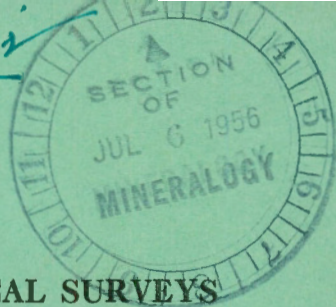


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CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

GEOLOGICAL SURVEY OF CANADA
BULLETIN 28

PELECYPODA OF THE OTTAWA FORMATION
OF THE OTTAWA-ST. LAWRENCE LOWLAND

BY

Alice E. Wilson



EDMOND CLOUTIER, C.M.G., O.A., D.S.P.
QUEEN'S PRINTER AND CONTROLLER OF STATIONERY
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PREFACE

This report is the sixth of a series of planned reference texts describing the palæontology of the Palæozoic strata of the Ottawa-St. Lawrence Lowland. The series has presented some of the results of studies of the fauna of the Ottawa formation, a thick, highly fossiliferous limestone formation of Middle Ordovician age, and has included Geological Survey Bulletins Nos. 4, 8, 9, 11, and 17, on Echinodermata, Brachiopoda, Trilobita, miscellaneous smaller groups, and Gastropoda respectively. It is intended that succeeding bulletins will deal first with other significant faunal classes of this formation, and later, as opportunity permits, with the fauna of other formations of this lowland area. Together these studies will represent the outcome of investigations commenced more than a century ago, and carried on intermittently during the past 30 years by Dr. Wilson. They are based upon fossil collections gathered and prepared by officers of the Geological Survey of Canada, and upon several loaned private collections.

Information on the geology and economic resources of the region is contained in Geological Survey Memoir 241, by Dr. Wilson, on the "Geology of the Ottawa-St. Lawrence Lowland". This report includes a selected bibliography on the geology and palæontology of this early Palæozoic basin.

GEORGE HANSON,
Director, Geological Survey of Canada

OTTAWA, February 10, 1954

PELECYPODA OF THE OTTAWA FORMATION OF THE OTTAWA-ST. LAWRENCE LOWLAND

INTRODUCTION

GENERAL STATEMENT

The Ottawa-St. Lawrence Lowland is the early Palæozoic basin drained by the Ottawa and St. Lawrence Rivers. It is bounded on the north and west by the Canadian Shield, on the south by the Adirondack Mountains, on the southwest by the Frontenac axis, which connects the Shield with the western Adirondacks, and on the east by the Beauharnois anticline, a lesser axis partly concealed by the earliest Palæozoic sediments and extending from St. Jerome, Quebec, to the eastern Adirondacks.

Within this basin the Precambrian floor is overlain by about 2,300 feet of Lower, Middle, and Upper Ordovician sediments. The Ottawa formation, of Black River-Trenton age, constitutes most of the Middle Ordovician rocks in the area but overlies about 160 feet of rocks of Chazy age. It is overlain by the black shales of Collingwood-Gloucester age. The formation has a thickness of 690 feet. It is composed mostly of thick beds of limestone, though some shale and sandstone is interbedded at the base. The lower beds, consisting of about 75 feet of limestone and dolomitic limestone interbedded at the base with some sandstone and shale, were originally considered to be of Chazy age, and were mapped as such. The remaining 615 feet of limestone were designated the Black River-Trenton group by early geologists. Both are included in the Ottawa formation because there is no evidence in the area of an interruption in the deposition of the sediments and no significant change in lithology, and because the fossils found in the lower beds show that they, too, are of Black River age. The more recent New York term 'Mohawkian' as originally employed did not include the lower beds.

The 690 feet of Black River-Trenton sediments have been split into seven divisions variously called 'members' or 'formations'. These several divisions are here considered to be beds of faunal associations. They are not sharply differentiated either in lithology, or, except in a very few cases, in the occurrence of fossils. A change in fauna would occur inevitably during the length of time required to deposit 690 feet of sediments, and such a change does occur, but it is gradual. Certain groupings of fossils can be recognized, but in successively younger beds first one and then another species or genus of each group gives place to other species or genera so that the grouping changes gradually with an overlapping of species and without a definite line of demarcation. These groupings of fossils are not faunal zones, because most of the species range irregularly through two or more groupings. For these reasons then the grouping of fossils within certain beds are faunal associations rather than faunal zones, or, rather than members or formations as previously defined. The original names of the so-called 'members' or 'formations', however, are retained here, in conjunction with the more elastic term 'beds', to designate the general level at which each fossil species occurs and to show its range.

The Ottawa formation carries the most prolific fauna of the Ordovician formations of the region. All the formation within the basin lies north of the International Boundary, and its best exposures are found in the vicinity of the city of Ottawa and below the city in the valley of the Ottawa River, from which its name is taken.

OCCURRENCE OF PELECYPODA

The Pelecypoda like the Gastropoda of the area are not so prolific in genera, species, or in the number of specimens as the Brachiopoda. Furthermore, these early Palæozoic forms are not so well preserved as younger Pelecypoda. The scarcity of interiors with their muscle scars and teeth means that, in some cases, even the generic identification cannot be as certain as that of most of the other phyla.

A number of the older collections are just labelled "Ottawa". The city of Ottawa as constituted in the days of the older collectors included exposures of Cobourg beds only. For this reason such specimens are designated as from the Cobourg beds unless the matrix definitely indicates another horizon—which is rarely the case.

The following tables analyse the main features of the range of the Pelecypoda of the area. As in previous studies by the author of the fauna in this region the width of the several columns of the tables is drawn to scale to indicate the relative thicknesses of the original 'members' or 'formations' as they have been variously described.

Table I is arranged biologically, based upon the type of tooth. It brings together all the species of the several genera, and indicates the range of each species. It shows that forms with Palæoconcha and Taxodonta teeth are more numerous in the lower beds, though not entirely limited to those beds.

Table II, arranged according to the first occurrence of each genus, shows that only one form, *Ctenodonta nasuta*, persists throughout. Only two species, *Cyrtodonta obtusa* and *Clionychia undata*, begin in the lower beds and definitely recur at the top. *Endodesma gesneri* and *Whiteavesia modioliformis* are somewhat doubtful because of the ambiguity of the locality label. This occurrence of species in the lower limestone and again in the upper limestone beds may have something to do with the similar environmental conditions. The situation appears to be different with respect to the few forms that range intermittently from the limestone of the lower beds into the shaly limestone of the Sherman Fall. They have shown that they could live in an environment producing either condition. The intermittence of their recorded occurrence is probably due to a failure in finding the forms.

Table III is a synopsis of Tables I and II, showing the number of species first appearing in each group of faunal beds, the number confined to the beds so far as known (the figures in parentheses), and the number and range of those that continue beyond the beds in which they first occur; for example, 44 species begin in Leray or Leray-Rockland beds; of these 36 are confined to those beds, none ceases in the Rockland or just above, 3 cease in the Hull or just above, 1 ceases in the Sherman Fall, and 4 occur in the Cobourg.

The table shows very clearly that pelecypods are much more numerous in the lower half of the formation than in the upper half.

TABLE I
Range of Pelecypoda in Order of Tooth Development

Species	Ottawa formation faunal beds						
	Pamella	Lowville	Leray	Rockland	Hull	Sherman Fall	Cobourg
PALAEOCONCHA							
<i>Orthodesma abveolatum</i> n.sp.							
<i>O. ? antiquum</i> Whiteaves.	?		X				
<i>O. ? subcarinatum</i> Ruedemann.	X					X	
<i>Cuneamya embrunensis</i> n.sp.		X					X
<i>C. sp.</i>							
<i>Saffordia intermedia</i> n.sp.	X		X				
<i>Psilocoencha</i> sp.							
TAXODONTA							
<i>Ctenodonta abrupta</i> Billings.				X		X	
<i>C. astariaeformis</i> Salter.				X		X	X
<i>C. compressa</i> Ulrich.			X				
<i>C. contracta</i> Salter.			X				
<i>C. gibberula</i> Salter.			X				
<i>C. hullensis</i> n.sp.				X		X	
<i>C. lenata</i> (Hall).			X			X	
<i>C. logani</i> Salter.			X			X	
<i>C. nasuta</i> Hall.	X		X		X	X	X
<i>C. nasuta robusta</i> Ulrich.			X		X	X	
<i>C. parvidens</i> Raymond.							
<i>C. stitcula</i> n.sp.	?					X	X
<i>Nuculites stitiformis</i> n.sp.						X	X

TABLE I—Cont.

Range of Pelecypoda in Order of Tooth Development—Cont.

Species	Ottawa formation faunal beds						
	Parnelia	Lowville	Leray	Rockland	Hull	Sherman Fall	Cobourg
<i>Cyrtodonta affinis</i> Ulrich		X					
<i>C. affinis minuta</i> n. var.			X	X			
<i>C. angusta</i> n. sp.			X	X			
<i>C. breviscula</i> Billings	X		X	X			
<i>C. canadensis</i> Billings		X	X	X		X	
<i>C. ? cornuallia</i> Wilson							
<i>C. glabella</i> (Ulrich)		X	X	X			
<i>C. gratlanensis</i> n. sp.		X	X	X			
<i>C. huronensis</i> Billings		X	X	X			
<i>C. kingstonensis</i> n. sp.	X						
<i>C. leucothea</i> Billings		X	X	X			
<i>C. mediocris</i> n. sp.		X	X	X			
<i>C. modesta</i> n. sp.		X	X	X			
<i>C. obtusa</i> Hall		X	X	X			X
<i>C. oviformis</i> Ulrich		X	X	X			
<i>C. ? planumbona</i> Wilson	X						
<i>C. rocklandensis</i> n. sp.			X				
<i>C. rugosa</i> Billings		X	X	X			
<i>C. simplex</i> n. sp.		X	X	X			
<i>C. spinifera</i> Billings			X	X			
<i>C. cf. subangulata</i> (Hall)		X	X	X			
<i>C. subcarinata</i> Billings		X	X	X			
<i>C. ? subquadrata</i> n. sp.		X	X	X		X	X
<i>Vanuxemia ampla</i> (Ulrich)							X
<i>V. canadensis</i> n. sp.						X	X
<i>V. gibbosa</i> Ulrich?		X	X	X			
<i>V. inconstans</i> Billings		X	X	X			

TABLE I—Contc.
 Range of Pelecypoda in Order of Tooth Development—Contc.

Species	Ottawa formation faunal beds						
	Parnella	Lowville	Leray	Rockland	Hull	Sherman Fall	Cobourg
<i>Modiolodon aylmerense</i> n.sp.	X						
<i>M. ? haesitans</i> n.sp.			X	X			
<i>Colpomya faba</i> (Emmons)			X	X			
<i>Whiteavestia ? angusta</i> n.sp.			X	X			
<i>W. ? compacta</i> n.sp.			X	X			
<i>W. ? modioliformis</i> (Meek and Worthen)			X	X		X	?
<i>Goniophora carinata</i> (Hall)			X	X			X
<i>G. ottawaensis</i> n.sp.			X	X			X
<i>Endodesma gesneri</i> (Billings)			X	X			X
<i>E. minusculum</i> n.sp.			X	X			X
<i>E. sindlari</i> n.sp.			X	X			X
<i>E. orthototum</i> (Meek and Worthen)			X	X			X
TEETH NOT KNOWN							
<i>Palaeosolen ? hullensis</i> n.sp.	X						

TABLE II
Range of Pelecypoda in Order of First Appearance

Species	Ottawa formation faunal beds						
	Parnella	Lowville	Leray	Rockland	Hull	Sherman Fall	Cobourg
<i>Orthodesma</i> ? <i>antiquum</i> Whiteaves.....	?						
<i>O.</i> ? <i>subcarinatum</i> Ruedemann.....							
<i>Psilocomcha</i> sp.....							
<i>Ctenodontia parvidens</i> Raymond.....	?						
<i>Ctenodontia</i> ? <i>planumbona</i> Wilson.....							
<i>Vanuzemia parvula</i> Whiteaves.....							
<i>V.</i> sp.....							
<i>Sowteria canadensis</i> (Raymond).....							
<i>Climychia</i> ? <i>gibbosa</i> Whiteaves.....							
<i>C.</i> ? <i>ottawaensis</i> Whiteaves.....							
<i>Modiolodon aylmerensis</i> n.sp.....							
<i>Palaeosolen</i> ? <i>hullensis</i> n.sp.....							
<i>Cyrtodontia kingstonensis</i> n.sp.....							
<i>M. odolopsis</i> ? <i>compacta</i> Wilson.....							
<i>Cyrtodontia breviscula</i> Billings.....							
<i>Vanuzemia steadensis</i> n.sp.....							
<i>Ctenodontia nasuta</i> Hall.....							
<i>Cyrtodontia affinis</i> Ulrich.....							
<i>C. subcarinata</i> Billings.....							
<i>Vanuzemia pudica</i> n.sp.....							
<i>Modiolopsis</i> cf. <i>maia</i> Billings.....							
<i>M. minuscula</i> n.sp.....							
<i>Cyrtodontia grantianensis</i> n.sp.....							
<i>C. huronensis</i> Billings.....							
<i>C. modesta</i> n.sp.....							
<i>C.</i> ? <i>subquadrata</i> n.sp.....							
<i>Whitella subcarinata</i> Ulrich.....							

TABLE II—Cont.
Range of Pelecypoda in Order of First Appearance—Cont.

Species	Ottawa formation faunal beds						
	Parnella	Lowville	Lery	Rockland	Hull	Sherman Fall	Cobourg
<i>Modiolopsis nepeanensis</i> n.sp.							
<i>Cyrtodonta rugosa</i> Billings							
<i>Vanuzemia rotundata</i> (Hall)							
<i>Cyrtodonta canadensis</i> Billings							
<i>Modiolopsis nazis</i> Billings							
<i>Cuneameya embrunensis</i> n.sp.							
<i>Cyrtodonta obtusa</i> Hall							
<i>Endodesma gesneri</i> (Billings)							
<i>Orthodesma abeolata</i> n.sp.							
<i>Saffordia intermedia</i> n.sp.							
<i>Ctenodonta compressa</i> Ulrich							
<i>Cyrtodonta glabella</i> (Ulrich)							
<i>C. mediocris</i> n.sp.							
<i>C. oviformis</i> Ulrich							
<i>C. rocklandensis</i> n.sp.							
<i>C. subangulata</i> (Hall)							
<i>Vanuzemia gibbosa</i> Ulrich?							
<i>V. inconstans</i> Billings							
<i>V. subrecla</i> Ulrich							
<i>Whitella scofieldi</i> Ulrich							
<i>W. subtruncata</i> (Hall)?							
<i>Ambonychia amygdalina</i> Hall							
<i>Modiolopsis</i> ? <i>dubia</i> n.sp.							
<i>M. rocklandia</i> n.sp.							
<i>Whiteavesia</i> ? <i>angusta</i> n.sp.							
<i>W.</i> ? <i>compacta</i> n. sp.							
<i>Endodesma sinclairi</i> n.sp.							

<i>E. orthotomum</i> (Meek and Worthen).....	_____
<i>Ctenodonta contracta</i> Salter.....	_____
<i>Cyrtodonta leucothea</i> Billings.....	_____
<i>C. simplex</i> n.sp.....	_____
<i>Vanuxemia cariadensis</i> n.sp.....	_____
<i>W. lutea</i> n.sp.....	_____
<i>Ctionychia undata</i> (Emmons).....	_____ ?
<i>Whitewesia modioliformis</i> (Meek and Worthen).....	_____
<i>Ctenodonta abrupta</i> Billings.....	_____
<i>C. gibberula</i> Salter.....	_____
<i>C. logani</i> Salter.....	_____
<i>Cyrtodonta affinis munita</i> n.var.....	_____
<i>C. angusta</i> n.sp.....	_____
<i>C. spinifera</i> Billings.....	_____
<i>Vanuxemia phaseola</i> n.sp.....	_____
<i>Conocardiium immaturum</i> Billings.....	_____
<i>C. paquettense</i> n.sp.....	_____
<i>Lyradesma acuminatum</i> Ulrich.....	_____
<i>Modiolodon</i> ? <i>haesitans</i> n.sp.....	_____
<i>Cobponya jaba</i> (Emmons).....	_____
<i>Goniophora carinata</i> (Hall).....	_____
<i>Ctenodonta lenata</i> (Hall).....	_____
<i>C. nasuta robusta</i> Ulrich.....	_____
<i>C. astariaeformis</i> Salter.....	_____
<i>Ctionychia subundata</i> Ulrich.....	_____
<i>Vanuxemia ampla</i> (Ulrich).....	_____
<i>Actinopterella</i> ? <i>tesseolata</i> n.sp.....	_____
<i>Ambonychia affinis</i> Ulrich.....	_____
<i>Ctenodonta hullensis</i> n.sp.....	_____
<i>C. silicula</i> n.sp.....	_____
<i>Nuculites stilesformis</i> n.sp.....	_____
<i>Cyrtodonta</i> ? <i>cornwallia</i> Wilson.....	_____
<i>Byssonychia vera</i> Ulrich.....	_____
<i>Modiolopsis nana</i> Ulrich.....	_____
<i>Endodesma minusculum</i> n.sp.....	_____
<i>Cuneameya</i> sp.....	_____
<i>Vanuxemia</i> cf. <i>obtusiformis</i> Ulrich.....	_____
<i>Ambonychia orbicularis</i> (Emmons).....	_____
<i>Modiolopsis meyeri</i> Billings.....	_____ ?
<i>Goniophora ottawaensis</i> n.sp.....	_____

TABLE III
Numerical Synopsis of Range of Species

Pamelia or Pamelia- Lowville	Lowville or Lowville- Leray	Leray or Leray- Rockland	Rockland or Rockland- Hull	Hull or Hull- Sherman Fall	Sherman Fall or Sherman Fall- Cobourg	Cobourg
17 (12)	2 18 (5)	2 9 44 (36)	— 1 —	— 2 3 3 (1)	— 1 1 1 7	1 — 4 1 — 5

FOSSIL LOCALITIES

1. Westport, Ontario
2. North side of Lake Clear, on a point about 3 miles from west end of the lake
3. Schoolhouse west from Westmeath towards Paquette Rapids, Ontario side
4. La Rhône snye, Ontario side of Paquette Rapids
5. Paquette Rapids, Allumette Island, Quebec (when unspecified it is assumed that the Quebec side of Paquette Rapids is meant)
6. Lot 25, con. V, Admaston tp., Ontario
7. Fourth Chûte of Bonnechère River, Ontario
8. Quarry near Cobden, Ontario
9. One mile south of Douglas, Ontario
10. East-west road on the township line 1½ miles east of White (Lake?), Ontario
11. Edge of hill above Sand Point, Ontario
12. Fitzroy Harbour, Ontario
13. South shore of Lake Deschênes, above MacLaren Landing, Ontario
14. Torbolton tp., west of MacLaren Landing, Ontario
15. West of MacLaren Landing, Ontario
16. On the right of the road, first terrace above farmhouse up from the dock, MacLaren Landing, Ontario
17. Top of terrace above MacLaren Landing, Ontario
18. Below terrace above MacLaren Landing, Ontario
19. Below farmhouse, MacLaren Landing, Ontario
20. MacLaren Landing, Ontario
21. Top of hillock, a little south of ridge and west of the road between Fitzroy Harbour and MacLaren Landing, east of Woodbridge road, Ontario
22. First corner east of Panmure, Ontario
23. Roadbed, near lot 14, cons. XI and XII, Ramsay tp., Lanark co., Ontario
24. Opposite old Sowter house, Aylmer, Quebec
25. Beyond Sowter house on road north from small park in Aylmer, Quebec
26. Just above small quarry near top of hill, Aylmer, Quebec
27. North of Aylmer, Quebec
28. Road about 1 mile north of Aylmer, Quebec
29. In field about 2 miles north of Aylmer, Quebec
30. Lot 18, ?, Aylmer road, Quebec
31. Val Tetreau, Quebec
32. Near shore, Val Tetreau, Quebec
33. Brook by Wright's old brickyard north of Val Tetreau, Quebec
34. Creek crossing road, west of Fairy Lake, north of Hull, Quebec
35. East side of Fairy Lake, Hull, Quebec
36. Behind schoolhouse on the road north from Fairy Lake, Hull, Quebec
37. Hull, Quebec
38. Above Chaudière Falls, Hull side?, Quebec
39. East of creek through Eddy's lumber yard, Hull, Quebec

40. La Petite Chaudière, Hull, Quebec
41. Back of axe factory, Brewery Creek, Hull, Quebec
42. Cliff behind Canada Match Factory, Hull, Quebec
43. Canadian Pacific Railway cutting south of Aylmer road, Hull, Quebec
44. Hull quarries, Hull, Quebec
45. Quarry in lower beds in southeast Hull, on Hull side of Brigham's Creek, Hull, Quebec
46. Philemon Island, Hull, Quebec
47. West end of lot K, con. A, R.F., Nepean tp., west of Ottawa, Ontario
48. Lot K, con. A, R.F., Nepean tp., west of Ottawa, Ontario
49. Con. A, R.F., Nepean tp., west of Ottawa, Ontario
50. Lot 13, con. XII, Goulbourn tp., Ontario
51. Lot 21, junction of Gore and lot 3, con. III, R.F., Gloucester tp., Ontario
52. Lot 2, con. III, R.F., Gloucester tp., Ontario
53. Lot 3, con. III, R.F., Gloucester tp., Ontario
54. Lot 4, con. IX, R.F., Gloucester tp., Ontario
55. Lots 3 and 4, con. III, R.F., Gloucester tp., Ontario
56. DeLury Farm, Ottawa, Ontario
57. Quarry on west side of Merivale road, Ottawa, Ontario
58. Foster quarry, Merivale road, Ottawa, Ontario
59. City View, Ottawa, Ontario
60. Fraser-Duntile quarry, Carling Avenue, Ottawa, Ontario
61. Hogsback, Ottawa, Ontario
62. East side of falls, Hogsback, Ottawa, Ontario
63. La Petite Chaudière, Ontario side
64. Westboro, Ottawa, Ontario
65. Mechanicsville, Ottawa, Ontario
66. West of Hintonburg drain, between Richmond road and Canadian Pacific Railway track, Ottawa, Ontario
67. Excavation, Clarendon Avenue, Ottawa, Ontario
68. Corner of Young Street and Fairmont Avenue, Ottawa, Ontario
69. Percy Street, the Glebe, Ottawa, Ontario
70. Corner of Percy Street and Fifth Avenue, Ottawa, Ontario
71. Booth Street, the Glebe, Ottawa, Ontario
72. Corner Lorne and Maple Avenues, Ottawa, Ontario
73. Junction of Sparks and Wellington Streets, Ottawa, Ontario
74. Excavation on Fourth Avenue, Ottawa, Ontario
75. Fifth Avenue, Ottawa, Ontario
76. Nepean Point, Ottawa, Ontario
77. Queen's wharf, Ottawa, Ontario
78. Ottawa, unspecified, Ontario
79. East side Governor Bay, Ottawa, Ontario
80. Governor Bay, Ottawa, Ontario
81. Near Beechwood, Ottawa, Ontario
82. Cliff facing swamp, Beechwood, Ottawa, Ontario
83. Rockcliffe Park, Ontario
84. In grounds of Research Council Laboratory, Skead road, Ottawa, Ontario
85. Skead road, about $\frac{1}{2}$ mile south of Ottawa River, Ontario
86. Sandstone layer, near base of Pamela, Skead road, Ottawa, Ontario
87. East edge of outcrop west of Green Creek, east of Ottawa, Ontario
88. West of Government Tank Proving ground, east of Ottawa, Ontario
89. Quarry $\frac{1}{2}$ mile southeast of Green Creek and Montreal road, east of Ottawa, Ontario
90. North and a little west of Orleans, Ontario
91. North of Orleans, Ontario
92. Near Daniston, Ontario
93. Corner of Montreal road and Navan road, Ontario
94. Quarry, 2 miles west of Cumberland, Ontario
95. Squiggley hill, west of Cumberland, Ontario
96. About lot 2, on road south from Cumberland, Ontario
97. Stewart quarry, Rockland, Ontario
98. Quarry, unspecified, Rockland, Ontario
99. Highway cutting east of Rockland, Ontario
100. North branch, Castor River, con. III, Russell tp., Ontario

101. Quarry west of first road west of boundary between Prescott and Russell counties, Ontario
102. Quarry south and west of Embrun, Ontario
103. Small quarry on west side of New York Central tracks about $\frac{1}{2}$ mile south of Embrun, Ontario
104. Small cut south of main pit in hill $\frac{3}{4}$ mile south of Embrun, Ontario
105. Four miles east of Embrun, Ontario, about 100 yards south of Castor River in the eastern quarry on the ridge
106. Ange gardien road, about 4 miles west of L'Orignal, Ontario
107. North and west of cheese factory, Ange gardien road, about 4 miles west of L'Orignal, Ontario
108. Jackson farm, near L'Orignal, Ontario
109. Old quarry near L'Orignal, Ontario
110. Quarry south of Montreal road, west of Alfred, Ontario
111. Old quarry north of Plantagenet, Ontario
112. One mile directly south from Treadwell, Ontario
113. Stepney hill, south of Hawkesbury, Ontario
114. Vankleek Hill, region unspecified
115. Lot 25, con. X, Cambridge tp., Ontario
116. Morrisburg region, unspecified
117. About 6 miles west of Lunenburg, con. V, Osnabruk tp., Ontario
118. Lots 25 and 26, con. V, Osnabruk tp., Ontario
119. Lot 26, con. V, Osnabruk tp., Ontario
120. Lot 13, con. VII, Finch tp., Ontario
121. Bed of Aux Raisin River, near Black River Station, Ontario
122. First road south of St. Andrews, Ontario
123. Farm near Bonville, Ontario
124. On right of way southwest of Skye, con. IX, Kenyon tp., Ontario
125. Monroe Mills, southeast of Apple Hill, Ontario
126. Alexandria dam, west of Alexandria, Ontario
127. Lot 9 or 10, con. VII, Kenyon tp., Ontario

DESCRIPTION OF SPECIES

A. *Palaeoconcha*

Genus, *Orthodesma* Hall and Whitfield

Genotype, *Orthodesma rectum* Hall and Whitfield

Shell thin, valves gaping at both ends; size, rather large, moderately convex; outline transversely elongate usually broadening somewhat posteriorly; anterior end contracted in front of the beak; hinge line straight; umbo prominent, wide, compressed, posterior to it a low ridge almost paralleling the hinge; a concave depression lying between the ridge and the hinge line and posterior to the beak; a broad indefinitely defined sinus extending from the umbo to the ventral margin; ligament internal and external; ornamented by more or less distinct concentric lines or wrinkles.

No teeth; anterior muscle scar large, well defined, ovate or nearly semicircular, the vertical diameter being the longer; posterior scar faint, elongate, ovate, nearly twice as large as the anterior one.

Orthodesma differs from *Modiolopsis* externally in its long straight hinge line almost subparallel to the ventral margin, its long contracted anterior projection, and in the ridge anterior to the umbo lying near the hinge line. It differs from that genus internally in its elongate, ovate muscle scars, and in its lack of teeth.

The genus differs from *Endodesma* in gaping at both ends, in the contracted anterior, in the ridge almost paralleling the hinge, and in its partly external ligament. Internally it differs in the large well-defined anterior muscle scar.

Orthodesma ? abscissum n.sp.

Plate I, figure 2

Small to moderate size, the holotype measuring approximately 25 mm. in length, 14 mm. and 7 mm. in height and thickness (one valve), respectively; outline elliptical except for the somewhat truncate anterior; beak small, incurved, situated in the anterior third of the shell; anterior margin truncate meeting the ventral margin at less than a right angle, posterior margin broken but rather narrowly curved, dorsal and ventral margins subparallel; umbonal region fairly prominent; sinus broad and shallow, the ridge on its dorsal side more narrowly rounded and more prominent than that anterior to the sinus; surface covered by fine striæ with a flat space between them and having a tendency to pile into wrinkles near the ventral and anterior margins.

Tooth not seen; anterior muscle scar showing on some specimens, sharply defined on the inner surface.

Orthodesma ? abscissum differs from other forms of the genus in its short, high outline and in the truncate anterior.

The specific name 'abscissum' refers to the truncate anterior.

Occurrence. Pamela beds, localities 14, 17, 20, 23, 26, 27, 53, 64, 85, 86, 88, 94, 100, 101.

Type. Holotype, G.S.C. No. 11552, Pamela beds, quarry to right of first road west of boundary between Russell and Prescott counties, south of the Montreal road, Ontario.

Orthodesma alveolatum n.sp.

Plate I, figure 6

Rather large, the holotype, the largest specimen present, measuring 45 mm., 19 mm., and 6 mm. in length (the posterior slightly broken), height and thickness (one valve), respectively, two other specimens being considerably smaller; outline transversely elongate; beak incurved, situated about one-third the length from the anterior end, directed almost at right angles to the hinge line; anterior contracted, the margin narrowly rounded, posterior margin broadly rounded, dorsal and ventral margins subparallel, the latter having a slight invagination; umbo broad and depressed, its convexity merging into the general convexity of the posterior part of the shell; anterior to the umbo a ridge extending to the anterior margin, sharply defined near the beak, still definite but decreasing towards the anterior extremity; the surface between the ridge and the dorsal margin concave, giving the upper part of the contracted anterior third of the shell a scoop-like appearance; hinge long and nearly straight; a broad indefinite sinus slightly affecting the ventral margin; ligament not present on the cast; surface smooth as far as can be seen, but probably ornamented by concentric lines.

Interior not seen.

Orthodesma alveolatum differs from *Orthodesma canaliculum* Ulrich in having a proportionately longer anterior projection with a more pronounced concave area anterior to the beak. It differs from *Orthodesma nasutum* (Conrad) in these same features and in its greater height.

The specific name 'alveolatus' refers to the concave channel-like depression anterior to the beak.

Occurrence. Leray beds, locality 53.

Type. Holotype, G.S.C. No. 11545, Leray beds, lot 3, con. III, R.F., Gloucester tp., Ontario.

Orthodesma ? antiquum Whiteaves

Plate I, figure 4

Orthodesma antiquum Whiteaves, Ottawa Nat. 22, 1908, p. 111, Pl. 3, fig. 10.

Very much elongated, one specimen measuring 51 mm. in length, and 11.5 mm. in greatest height at 12 mm. from the posterior extremity; shell thin; posterior half a little higher than anterior half; anterior margin narrowly rounded, projecting one-eighth to one-tenth the whole length beyond the beak, posterior margin somewhat truncated above, curving more or less sharply into the ventral margin, the latter gently concave, dorsal margin straight or slightly arcuate, increasing a little in height posteriorly; hinge long, almost straight as far as can be seen; umbo not very prominent, but its convexity continuing as a subdued ridge to the posterior extremity dividing the shell into two areas; a low, broad, indefinite depression anterior to the umbonal ridge causing the slight flexure of the ventral margin; ornamented by fine concentric striae.

Interior not seen. Even the muscle scars are obliterated in the cast. All of which leaves a degree of doubt as to the generic designation. The outer form, however, is similar to that of other species of *Orthodesma*.

The species is longer and narrower than *Orthodesma rectum?* or any other described species of the genus.

Occurrence. Pamela beds?, locality 24.

Type. The holotype is missing. Plesiotype, G.S.C. No. 11532, Pamela beds, opposite the old Sowter home, Aylmer, Quebec.

The one specimen seen is made a plesiotype rather than a neotype because of its poor preservation. It is hoped that a better specimen may be found for a neotype.

Orthodesma decorosum n.sp.

Plate I, figure 3

Moderate size, holotype measuring 30 mm., 16 mm., and 6.5 mm. in length, height, and thickness (one valve), respectively; outline elliptical; beak, small, incurved, situated about one-fifth from the anterior; the anterior end rather short for the genus; anterior and posterior margins subequal, dorsal and ventral margins subparallel, dorsal one very gently arcuate; hinge long; umbo not very prominent, but a gently rounded convexity continuing from it almost to the posterior extremity; the surface from the rounded ridge sloping evenly to the dorsal margin; a shallow sinus extending from the umbonal region to the ventral margin; ornamentation fine, concentric lines.

Anterior muscle scar longer than wide, situated on the anterior projection, posterior scar not seen.

Orthodesma decorosum is longer and proportionately narrower than *Orthodesma abscissum* and the anterior is rounded not truncate and projects more than in that species. It is very similar to *Orthodesma minnesotense* but it is wider, the anterior projects less and the posterior extremity is more evenly rounded, curving gradually into both dorsal and ventral margins.

The specific name comes from decorosus meaning 'elegant'.

Occurrence. Pamela beds, localities 20, 23.

Type. Holotype, G.S.C. No. 11553, Pamela beds, about lot 14, on road between cons. XI and XII, Ramsay tp., Lanark co., Ontario.

Orthodesma? humile n.sp.

Plate I, figure 1

Small for the genus, holotype measuring 26 mm., 10 mm., and 9 mm., in length, height, and thickness (both valves), respectively; outline more or less oblong, broadening somewhat posteriorly; beak small, situated about one-sixth the length from the anterior; anterior margin slightly contracted, rounded on the lower half, posterior margin broadly rounded above but meeting the ventral margin at a right angle, dorsal and ventral margins subparallel; hinge short, projecting a little beyond the beak and meeting the anterior margin at an angle; umbo depressed, a low ridge extending from it to the angular intersection of the posterior and ventral margins, the greater part of the ridge lying nearer to the dorsal than to the ventral margin; surface between the ridge and the dorsal margin very gently concave, between the ridge and the ventral margin exhibiting a broad, indefinite flattening; surface showing traces of excentric striæ.

Small anterior muscle scars lying anterior to the beak, situated on the tip of the angle of the hinge and the anterior margin; no other character of the interior seen.

O.? humile differs from others of the genus in its small size and very narrow outline. The genus is questioned because the typical generic characteristics are all subdued in comparison with other species.

The name 'humile' refers to these mildly pronounced features.

Occurrence. Sherman Fall beds, locality 43.

Type. Holotype, G.S.C. No. 11554, Sherman Fall beds, Canadian Pacific Railway cutting, south of Aylmer road, Hull, Quebec.

Orthodesma ? subcarinatum Ruedemann

Plate I, figure 5

Medium size, average specimen measuring 29 mm. in length, 14 mm. at the greatest height, thickness of one valve approximately 6 mm., being slightly more ventricose in the posterior part; transversely elongate; beak low, incurved, about one-third to one-fourth the total length from the anterior; posterior margin broader than the anterior, gently convex and slightly oblique on the upper part, its line making less than a right angle with that of the ventral margin; anterior margin projecting forward,

round in the lower part, ventral margin gently invaginate; hinge long, almost straight, meeting the posterior margin with an obtuse angle; umbo low and broad, a low anterior ridge petering out, a sharply definite posterior ridge paralleling the hinge for a short distance thence continuing to the posterior extremity; a shallow sinus present beginning at the umbo and broadening until it occupies more than half the ventral margin; ligament, lunule, and escutcheon not seen; ornamented by concentric growth lines, as far as seen.

Interior not known, making generic identification doubtful. All specimens are casts, none showing the complete beak and upper part of the anterior. For these reasons the genus is queried.

In one specimen the ridge is so sharp that it suggests a *Goniophora* but the shape of the posterior is more like that of an *Orthodesma*, and the subparallel dorsal and ventral margins are more indicative of that genus.

Occurrence. Pamela beds, localities 24, 85. One form marked 'Ottawa', beds not known.

Type. Plesiotype, G.S.C. No. 11533, Pamela beds, Skead road east of Research Council Laboratories, Montreal road, east of Ottawa.

Genus, *Cuneamya* Hall and Whitfield

Genotype, *Cuneamya miamiensis* Hall and Whitfield

Moderate to large size; outline varying from subcircular to elongate rhomboid; beaks prominent, incurved, situated far forward but not quite terminal; anterior margin rounded, slightly projecting, posterior margin rather narrowly rounded, dorsal and ventral margins subparallel, the ventral usually having a faintly sinuous outline; umbo prominent, overhanging the hinge posterior to the beak, a ridge extending backward from it for nearly two-thirds the distance to the posterior extremity and lying nearer to the dorsal than to the ventral margin; the surface concave from the ridge to the hinge, flattening posteriorly, convex from the ridge to the ventral margin but developing a broad, shallow sinus before reaching the margin; hinge long and straight; a long escutcheon lying posterior to the beak and a lunule beneath the beak; surface ornamented by concentric lines.

Without teeth; muscle scars obscure, probably held together at the hinge by a ligament.

Cuneamya externally somewhat resembles *Grammysia* but the shell is commonly smaller, the sinus is shallower with less definite margins, and the folds on either side of the sinus are more evenly convex. Interiorly *Cuneamya* lacks the teeth of *Grammysia*.

Cuneamya embrunensis n.sp.

Plate I, figure 10

Rather small for the genus, 22 mm., 14 mm., and 7 mm., in length, height, and thickness (one valve), respectively; outline subovate, with valves markedly convex; beak prominent, incurved, situated close to the anterior; anterior margin concave beneath the beak, convex on its lower half towards the ventral part, posterior margin rather narrowly rounded, dorsal margin almost straight, ventral margin gently convex; umbo

prominent and broad, slightly flattened on top; the umbonal ridge on the dorsal side sharp anteriorly but decreasing posteriorly, forming the boundary of a concave area extending to the dorsal margin; the surface anterior to the beak bending at a sharp angle to the lunule area; a shallow rather narrow sinus lying entirely in the anterior half of the shell, beginning at the umbo but affecting the ventral margin but little; escutcheon not seen; lunule deep; surface crossed by coarse concentric undulations.

Interior not seen.

Cuneamya embrunensis differs from most species of the genus in its smaller size, greater thickness, narrowness of the sinus, and the situation of the latter in the anterior half of the shell.

Occurrence. Lowville beds, localities 29, 103; Sherman Fall beds, locality 41.

The occurrence of the form at such different elevations may be due to two causes. It is not common and may not have been found in the intervening beds, or it may be a question of ecology. The somewhat shaly beds of the Lowville and Sherman Fall are separated by the thick limestone of the Leray, Rockland, and Hull beds.

Type. Holotype in the private collection of G. W. Sinclair, Lowville beds, about $\frac{1}{2}$ mile south of the river at Embrun, Ontario, and west of the New York Central Railway track.

Cuneamya sp.

Plate I, figure 11

Moderate size, the posterior extremity somewhat broken but approximate width 26 mm., height and thickness (one valve) 13 mm. and 6 mm., respectively; outline almost oblong; beaks incurved, somewhat depressed, situated about one-fifth the whole width from the anterior; anterior margin rounded, projecting but little; posterior margin broken but quite narrowly rounded judging from the growth lines, dorsal and ventral margins almost parallel; umbo prominent but depressed on top, a narrow ridge extending backward from it for two-thirds the distance to the posterior extremity, prominent anteriorly and overhanging the dorsal margin; the surface from the ridge to the dorsal margin narrow and concave, from the ridge to the ventral margin wider and convex on the upper half, thence sloping steeply and exhibiting a broad, obscure sinus near the ventral margin; escutcheon and lunule not seen; ornamented by concentric growth lines.

Interior not seen.

The species is very close to the form illustrated by Ulrich as *Spheniolum parallelum*, but as the exact position of that form has not been defined the question is here left open. The only specimen found is not sufficiently perfect to be designated a holotype, but reference is made to it to complete the known pelecypods of the region.

Occurrence. Cobourg beds, locality 126.

Type. Figured specimen, G.S.C. No. 11555, Cobourg beds, Alexandria dam, Alexandria, Ontario.

Genus, *Saffordia* UlrichGenotype, *Saffordia ventralis* Ulrich

Shell varying considerably in size; suboval outline; very inequilateral; beak not large, situated near the anterior end, curving obliquely inward and forward; anterior margin concave above, rounded below, posterior margin somewhat oblique above but rounded below, dorsal margin gently arcuate, ventral margin broadly rounded; umbonal ridge moderate and distinguishable for only a short distance; surface slightly convex and sloping steeply to the dorsal margin, convex between the ridge and the ventral margin; hinge slightly arcuate, long, occupying most of the dorsal margin; lunule and escutcheon well defined; outer surface ornamented by concentric growth lines, subimbricating in some cases.

Hinge plate thin, arcuate; one cardinal and one lateral tooth on the left valve; resilifer present; anterior muscle scar distinct, subcircular in outline, lying beneath the lunule, posterior scar very faint; pallial line simple.

Internally *Saffordia* can be distinguished from *Cyrtodonta* by the teeth and the presence of the resilifer; externally, even in a cast, it can be distinguished by its arcuate hinge and by the anterior margin with its concave upper part.

Saffordia intermedia n.sp.

Plate I, figures 12, 13

Moderate size, greatest length, height, and thickness 38 mm., 30 mm., and 22 mm. (two valves), respectively; outline subovate; beak anteriorly situated but not quite terminal, broken in the only specimen at hand; anterior margin concave above convex below, posterior margin rounded, dorsal margin gently arcuate curving into the posterior margin, ventral margin broadly and evenly rounded; umbo moderately prominent with an obscure ridge which fades into the general convexity posteriorly; the surface evenly convex from the ridge to the ventral margin, less convex, sloping steeply to the hinge where it curves abruptly down to form the escutcheon; escutcheon long; lunule rather deeply concave; surface marked by relatively broad growth lines.

Hinge arcuate; teeth not seen; anterior muscle scar lying below the lunule, deeply excavated, posterior scar larger than the anterior and very faintly impressed; pallial line simple.

Saffordia intermedia is larger than *S. ventralis* and *S. modesta* and considerably smaller than *S. ulrichi*. In the only cast present the area between the obscure ridge and the hinge is less concave than in the other species described, but that may be partly due to a comparison of a cast with exteriors.

Occurrence. Leray beds, locality 53.

Type. Holotype, G.S.C. No. 11556, Leray beds, in the upper beds, lot 3, con. III, R.F., Gloucester tp., Ontario.

Genus, *Psiloconcha* UlrichGenotype, *Psiloconcha grandis* Ulrich

Shell very thin, medium to large size, length usually a little more than twice the width; compressed even in its thickest part; subelliptical outline, slightly gaping at both ends; beak, small, inconspicuous, situated about one-quarter to one-fifth from the anterior end; anterior and posterior margins subequal, rather narrowly rounded, dorsal and ventral margins subparallel, the latter slightly convex; hinge long posteriorly; umbo depressed; mesial sinus absent or shallow; ligament linear, internal; concentric growth lines the only ornamentation.

Teeth lacking; anterior muscle scar small, ovate, situated in front of the beak; posterior scar long, extending from the beak almost one-third the distance to the posterior extremity; pallial line simple, more deeply impressed in posterior half.

Psiloconcha differs from most other genera in its compressed umbones, and the length of its muscle scars, particularly that of the posterior scar.

Psiloconcha sp.

Plate I, figure 9

Cast only, when complete measuring approximately length 36 mm., height 18 mm., thickness of one valve 5 mm.; subelliptical outline; beak low, situated about one-quarter distance from the anterior; anterior margin slightly more broadly rounded than the posterior, ventral margin gently convex, dorsal margin practically straight for the length of the hinge thence curving towards the posterior end; hinge almost straight posteriorly, curving down somewhat anteriorly; no sinus visible in the cast; faint indications of concentric growth lines.

Interior not seen.

The form is very close to *Psiloconcha subovalis* Ulrich from the Lower Cincinnati beds, but it is too poor for specific identification. It is included here as the only record of the genus from the Ottawa formation, and from the eastern Ordovician.

Occurrence. Pamela beds, locality 85.

Type. Holotype, G.S.C. No. 11534, Pamela beds, Skead road, east of Ottawa.

B. TaxodontaGenus, *Ctenodonta* SalterGenotype, *Tellinomya nasuta* Hall

Size, small to medium; outline nearly equilateral, usually longer than high, anterior in most species more broadly rounded than posterior; beaks moderately prominent, slightly subcentral, directed forward or backward; hinge arcuate or in some forms almost angular beneath the beaks; ligament small, external, posterior; small lunule in some forms; surface smooth (?), ornamented with growth lines, or with tubercles following the growth lines.

Teeth taxodont, curved, arranged transversely, the largest being at the hinge extremities with the size decreasing as the beak is approached;

two adductor muscles bounded on the inner side by a low indefinite thickening that in some cases almost amounts to a low ridge, situated beneath the anterior and posterior extremities of the hinge; pallial line simple.

The position of the genus *Ctenodonta* has been in doubt for many years. Salter, the author of it, did not designate its family relationships. Ulrich¹, 1897, put it under the family Nuculidae, thereby uniting genera of very different characteristics. He attempted to overcome this difficulty by making five groups. He definitely states that *Ctenodonta* is a forerunner of *Nucula*. His Group III, which included *Ctenodonta albertina* (Pl. 42, fig. 80), would be transitional from this point of view. Hall's² *Nucula opima* (= *Nucula randalli*) of the Devonian would also stand here. From the present writer's point of view *Ctenodonta albertina* is not a true *Ctenodonta* because of the presence of a 'pit' or resilifer. Benschhausen³, 1895, created the family Ctenodontidae for the forms with taxodont teeth and an external ligament, thereby eliminating from Nuculitida all forms without an internal resilifer. Dall⁴ follows Benschhausen in his translation of Zittel's Textbook of Palæontology but he includes in it forms with an alivincular ligament. In descriptions of *Ctenodonta* neither he nor any other author mentions an alivincular ligament. In the present collections a number of specimens have ligaments preserved but, though short, all are of the parivincular type.

Williams and Breger⁵ erected a subgenus *Nuculoidea* embracing those forms that might be considered intermediate between *Ctenodonta* and *Nucula*, including *Ctenodonta albertina* of Ulrich's Group III. *Nuculoidea* has the resilifer of *Nucula* but lacks the crenulated edge on the inner margin of the shell. Isberg⁶ retains Ulrich's interpretation.

As yet no group has been described gradational between forms with the external ligament as in *Ctenodonta* and those with the internal resilifer as in *Nucula* and *Nuculoidea*. The present writer, then, feels that Ctenodontidae is a legitimate family, but lacking more information, the family is considered still to be in the superfamily Nuculacea.

With regard to orientation Ulrich, as mentioned above, definitely states that *Ctenodonta* is a forerunner of *Nucula*. In a footnote he explains that for the sake of uniformity he is considering the higher more broadly rounded end as the anterior—which, of course, is contrary to the orientation of *Nucula*.

Among the present species are some in which the ligament is on the more contracted end and some in which it is on the broader end. The beaks in some are directed towards the more rounded end in others towards the more contracted end. Two features, however, appear to be constant. The small, usually deeper muscle scar, when found, is on the more rounded end and the shallow sinus in every species is directed towards the more contracted end in which the lower part of the margin makes a sharper, in some cases almost angular, curve into the ventral margin. As this is

¹ Ulrich, E. O.: Geol. Minnesota, Pal. 3, pt. 2, 1897, p. 578.

² Hall, J.: Geol. New York, Fourth Dist., 1843, No. 3, p. 197, fig. 78.

³ Benschhausen, L.: Abhandl. der Königl. Preuss. geol. Landesanstalt, Neue Folge, 1895, Heft 17, p. 65.

⁴ Dall, W. H.: Zittel, Textbook of Palæontology, 1900 and 1913, p. 440.

⁵ Williams, H. S., and Breger, C.: U.S. Geol. Surv. Prof. Pap. 89, 1916, p. 173.

⁶ Isberg, O.: Studien über Lamellibranchiaten des Leptaenakalkes in Dalarna, 1934, p. 326.

suggestive of the position of the siphon, and as the two features seem to be constant in their relation to one another, the writer has considered the narrower more contracted end as the posterior, thereby agreeing with Ulrich's orientation of the type species, though not with his interpretation of the affinities of *Ctenodonta* with *Nucula*.

Adopting this orientation the *Ctenodontas* of the collection here studied divide themselves into two groups: I, those having a transverse outline and a produced and contracted posterior, with beaks practically at right angles to the hinge: (a) bearing a posterior ligament, *Ctenodonta nasuta*, *C. nasuta robusta*, *C. logani*, and perhaps *C. hullensis*; (b) with posterior ligament and anterior lunule, *Ctenodonta contracta* and *C. levata*; (c) ligament and lunule not seen, probably belong to (a) or (b), *Ctenodonta parvidens*; II, small nut-like shape, short truncated posterior, beaks distinctly directed backward: (a) posterior ligament, *Ctenodonta abrupta* and *C. silicula*; (b) no ligament seen but a slight flattening that might represent a posterior ligament, *Ctenodonta gibberula*, *C. astartaeformis*, and *C. compressa*.

Ctenodonta abrupta Billings

Plate II, figures 3-6

Ctenodonta abrupta Billings, Geol. Surv., Canada, Pal. Foss. I, 1865 (Adv. sheets 1862), p. 46, figs. 48a-c.

Small, holotype measuring 14.5 mm. in length, 11 mm. in height, and 9 mm. in thickness (both valves); subtriangular outline, ventricose; beak small, incurving, posterior to the middle, directed backward, anterior slightly longer than posterior part; posterior margin truncated above and narrowly rounded near the bottom, anterior margin less sharply rounded; umbo very convex curving abruptly to the hinge on both sides of the beak but more gradually to the other margins; a very shallow sinus present from the beaks to the ventral margin, its course very closely paralleling and near to the truncated posterior margin; ligament posterior, short and stout; surface ornamented by concentric lines as far as seen.

Hinge plate curved; taxodont teeth, more numerous in the anterior part of the hinge; muscle scars deeply impressed on the inner side where the thickening of the shell forms a low rounded elevation.

Ctenodonta abrupta differs from the other small forms of the genus in its outline and in the posterior position of the sinus almost paralleling the truncated posterior margin.

Occurrence. Leray-Rockland beds, localities 3, 5.

Type. Holotype, G.S.C. No. 1173b; paratype, G.S.C. No. 1173a; plesiotype, G.S.C. No. 11558; Leray-Rockland beds, Paquette Rapids, Allumette Island, Quebec.

Ctenodonta astartaeformis Salter

Plate II, figures 1, 2

Ctenodonta astartaeformis Salter, Geol. Surv., Canada, dec. 1, 1859, p. 39, Pl. 8, fig. 7.

Small, holotype measuring length 12.5 mm., greatest height 13 mm., thickness 4.5 mm. (one valve), respectively; outline roughly triangular; beak prominent, slightly incurved; anterior margin broadly rounded,

posterior concave, above, a characteristic accentuating the prominence of the beak, broadly rounded below, ventral margin convex; umbo convex, curved evenly to the anterior, more abruptly to the posterior margin; ligament not seen, but a small broad but indistinct escutcheon present under the posterior to the beak; surface with concentric growth lines, as far as seen.

Hinge plate shorter on the posterior side, broadest beneath the beak where it has an abrupt almost angular curve; teeth numerous, closely crowded, curved or bent at an angle directed towards the beak; anterior muscle scar narrow and deep, posterior scar larger and faint; pallial line not seen.

In shape *Ctenodonta astartaeformis* is most closely allied to *Ctenodonta gibberula* but differs externally in being smaller, in having a more prominent beak, a more compact posterior part, and in lacking the sinus. Internally it differs in the hinge plate which broadens beneath the beak and is shorter on the posterior, longer on the anterior side of the beak, exactly the reverse of the condition of these features in *Ctenodonta gibberula*.

Occurrence. Leray-Rockland beds, locality 5; Rockland beds, locality 109; Sherman Fall beds, locality 43; Cobourg beds, locality 114.

Type. Holotype, G.S.C. No. 1172c; paratypes, G.S.C. Nos. 1172, 1172a, 1172b; Leray-Rockland beds, Paquette Rapids, Allumette Island, Quebec.

Ctenodonta compressa Ulrich

Plate II, figure 15

Tellinomya compressa Ulrich, 19th Ann. Rept. Geol. Nat. Hist. Surv., Minnesota, 1892, p. 216, fig. 2.

Ctenodonta compressa Ulrich, Geol. Surv., Minnesota, Pal. 3, pt. 2, 1897, p. 600, Pl. 37, fig. 29 and Pl. 42, figs. 88-90.

Small, measuring 18 mm. from the beak to the posterior extremity, 16 mm. and 10 mm. in height and thickness (two valves), respectively; subtriangular in outline; beak small, compressed, acuminate, gently incurved, directed backward; margins flowing into one another and difficult to discriminate, anterior and ventral margins having a continuous convex curve to the beak, posterior margin broadly rounded giving way to a concave dorsal margin; umbo low, not distinguished from the general convexity but sloping abruptly to the anterior and dorsal margins and gradually to the posterior extremity; hinge bent with an acute angle at the beak; escutcheon and lunule obscurely defined; surface with very fine concentric growth lines not visible on the cast.

Internal characteristics not seen by the writer but according to the original description: hinge plate bent at an acute angle beneath the beak; teeth numerous, placed at right angles to the hinge plate, increasing in size away from the beaks and not crossing the full width of the plate but leaving a smooth area along the inner part; an obscure narrow depression lying beneath the beaks and between the right and left rows of teeth; muscle scars distinct, the posterior being bounded on the inner side by a slight elevation.

Ctenodonta compressa differs externally from *Ctenodonta astartaeformis* in its greater length from beak to posterior extremity. Internally it differs in the greater breadth of the smooth inner part of the hinge plate not covered by the teeth.

Occurrence. Leray beds, locality 31.

Type. Plesiotype, G.S.C. No. 11557, Leray beds, Val Tetreau, Quebec.

Ctenodonta contracta Salter

Plate II, figures 7-9

Ctenodonta contracta Salter, Geol. Surv., Canada, dec. 1, 1859, p. 37, Pl. 8, figs. 4, 5; Billings, Geol. Canada, 1863, p. 175, figs. 160a, 160b.

Small, average specimen seen 16 mm. in length, 11 mm. in height, 4.5 mm. in thickness (one valve); outline almost triangular; beak low, gently incurved, posterior to the middle, directed practically at right angles to the hinge; posterior margin sloping obliquely to a narrowly rounded, almost angular extremity, anterior margin more broadly rounded, ventral margin gently convex but interrupted by a flexure; umbo evenly convex, sloping rather abruptly to the anterior part of the hinge, more sharply to the posterior part forming an indistinct ridge near the beak; hinge curved; sinus from the umbo to the posterior half of the ventral margin; ligament short and stout, occupying a large escutcheon, lunule smaller than escutcheon, outlined by a flattened edge abutting on the convexity of the umbo; surface covered with concentric rows of tubercles, which are worn off most of the weathered specimens.

Hinge plate slightly wider on the posterior than on the anterior part, contracted under the beaks; teeth taxodont, gently curved, convex towards the beak where they are smaller and more crowded; muscle scars deep on the inner side, bounded by a low, indefinitely outlined, ridge-like swelling; pallial line not seen.

Ctenodonta contracta is most closely allied to *Ctenodonta gibberula* and the differences are cited under that species.

Occurrence. Leray beds, localities 6, 96; Leray-Rockland beds, localities 3, 5.

Type. Holotype, G.S.C. No. 1171b; paratypes, G.S.C. Nos. 1171c and 1171k; Leray-Rockland beds, Paquette Rapids, Quebec.

Ctenodonta gibberula Salter

Plate II, figures 16, 17

Ctenodonta gibberula Salter, Geol. Surv., Canada, dec. 1, 1859, p. 38, Pl. 8, fig. 6; Ulrich, Geol. Surv., Minnesota, Pal. 3, pt. 2, 1897, p. 587.

The forms in Salter's collection labelled as *Ctenodonta gibberula* are all triangular rather than trapezoidal as described. Apparently the specimens have been mixed with *Ctenodonta contracta* specimens. Salter's illustration, however, and Ulrich's reference to having had the Canadian specimens indicate that such specimens were found in this area. The following description then is compiled, not taken direct from the specimens.

Size small, 18 mm. and 14 mm., as shown in the illustration of the holotype, in length and height, the thickness not given by Salter (Ulrich's proportionate measurement does not state whether one or two valves are included); beak large, incurved, situated a little posterior to the middle, directed backward; posterior end obliquely truncate above, sharply rounded in the lower part; anterior end broadly rounded, ventral margin gently sinuate; umbo prominent; hinge curved, almost angular beneath the beak; sinus shallow, narrow, very close to the posterior end causing a distinct flexure in the ventral margin; ligament, escutcheon, and lunule not seen; ornamented by a few growth lines.

Hinge plate wider on the extremities, contracted beneath the beak, shorter on the anterior part; teeth larger towards the extremities; muscle scars deeply impressed; pallial line not seen.

Ctenodonta gibberula in proportions and outline is much closer to *Ctenodonta astartaeformis* than any other. The differences are cited in the description of that species. It differs from *Ctenodonta contracta* in its more compact outline and in its narrow posteriorly placed sinus.

Occurrence. Leray-Rockland beds, locality 5.

Type. Holotype missing, but from Leray-Rockland beds, Paquette Rapids, Allumette Island, Quebec.

Ctenodonta hullensis n.sp.

Plate II, figure 23

Large and compressed, the only specimen found measuring 44 mm., 32 mm., and 14 mm. in length, height, and thickness (two valves), respectively; almost equilateral in outline; beaks low and incurved; anterior and posterior almost equally produced and rounded, the extremities being about mid-height, dorsal margin practically straight, ventral margin broadly and evenly convex curving regularly to the anterior and posterior extremities; umbo low, not distinguishable from the general convexity, the surface on either side gently convex to the margins; hinge long and straight; ligament area long and wide for the thickness of the shell; lunule area short and indistinct; surface ornamented by concentric growth lines and low undulations.

Interior not seen.

Ctenodonta hullensis is most nearly allied to *Ctenodonta equilatera* in outline but it is much larger, and, of course, occurs in considerably older beds.

The only specimen found is a cast, with several small pieces of the outline missing, and a break in the original shell reflected in the cast. It is a poor specimen to be taken as a type, and is considered only as a 'figured specimen' pending the discovery of a better. It is given here to keep the record because it differs from any other in the area.

Occurrence. Sherman Fall beds, locality 43.

Type. Figured specimen G.S.C. No. 11559, Sherman Fall beds, Canadian Pacific Railway cutting south of Aylmer road, Hull, Quebec.

Ctenodonta levata (Hall)

Plate II, figures 10-13

Nucula levata Hall, Pal. New York, 1, 1847, p. 150, Pl. 34, figs. 1a-i.*Tellinomya levata* Hall, Can. Nat. Geol. 1, 1856, p. 395.*Ctenodonta levata* (Hall), Billings, Geol. Canada, 1863, p. 175, figs. 161a and b (erroneously printed 162a, b); Ruedemann, New York State Mus. Bull. 162, 1912, p. 100, Pl. 6, fig. 1.

Small, adult specimens averaging 10 mm., 12 mm., and 4 mm. in height, length, and thickness (one valve), respectively; subovate or subrhomboidal outline; beaks incurved, situated anterior to the middle of the hinge; anterior margin rounded below and slightly projecting above, meeting the hinge at an angle, though frequently broken at this subangular corner, posterior somewhat contracted with a consequent more narrowly rounded posterior margin; dorsal margin straight or gently curved, ventral margin broadly convex; umbo comparatively prominent and somewhat flattened on top, limited on either side by a small ridge at the junction with the shallow concavity extending thence to the dorsal and anterior margins; hinge slightly arcuate; small ligament and lunule; surface smooth as far as known.

Hinge plate curved; teeth numerous and curved (the illustrated specimen does not show the full complement); only faint muscle scars discernible on the worn specimens.

As has been said by several authors, Hall's original material included more than one species, but Ulrich and Ruedemann, after examining the type material, concluded that the form with the slightly subangular anterior projection was intended to be the typical species. It is figured in the above reference by Ruedemann. The present specimens agree with Ruedemann's form. They vary considerably in size, and in many cases the anterior is broken, altering the outline of the shell.

Occurrence. Leray-Rockland beds, locality 5, Sherman Fall beds, localities 41, 43, 79.

Type. Plesiotypes, G.S.C. Nos. 11560 and 11560a, Leray-Rockland beds, Paquette Rapids, Ottawa River.

Ctenodonta logani Salter

Plate II, figures 24, 25

Tellinomya dubia Hall (not Pal. New York I, 1847, Pl. 34, fig. 1), Tenth Rept. New York State Mus. Cab. Nat. Hist., 1857, p. 183, figs. 4, 5.*Ctenodonta logani* Salter, Geol. Surv., Canada, dec. 1, 1859, p. 36, Pl. 8, figs. 3, 3a.

Medium size, holotype, though not the largest among the original specimens, measuring 29 mm. in length when complete, 21 mm. in height, 9 mm. in thickness (one valve); outline subovate; beak directed to the anterior, prominent, strongly incurved, placed a little anterior to the middle; anterior half of the shell very gibbous with the lower part of the margin broadly rounded; posterior half slightly less convex, having a more narrowly rounded margin; ventral margin almost straight with a gentle flexure in the posterior half; hinge slightly arcuate; umbo very convex, curving abruptly in the anterior and slightly less abruptly in the posterior part of the hinge; a broad shallow sinus from the hinge to the posterior half of the

ventral margin causing it to straighten somewhat; ligament external, extending almost to the posterior extremity of the hinge; ornamentation, growth lines only as far as known.

Hinge plate arcuate, slightly contracted beneath the beak; teeth curved, the convex edge towards the beak, about 9 along the posterior and 10 along the anterior part of the hinge plate, the central ones being the smallest; anterior muscle scar quite faint.

Ctenodonta logani differs from *Ctenodonta nasuta* in its gibbosity, and in its curved hinge plate and curved teeth, from *Ctenodonta gibberula* externally in being larger and internally in having the muscle scars much less deeply impressed.

Occurrence. Leray-Rockland beds, locality 5.

Type. Holotype, G.S.C. No. 1181; paratypes, Nos. 1181a-1181c; Leray-Rockland beds, Paquette Rapids, Allumette Island, Quebec.

Ctenodonta nasuta Hall

Plate II, figures 19, 20

Tellinomya nasuta Hall, Pal. New York 1, 1847, Pl. 34, figs. 3a-c; Tenth Rept. New York State Cab. Nat. Hist., 1857, p. 183, fig. 2; Billings, Can. Nat. I, 1857, p. 392, fig. 2.

Ctenodonta nasuta (Hall), Salter, Geol. Surv., Canada, dec. 1, 1859, p. 35, Pl. 8, figs. 1, 2.

Size small to medium, one large plesiotype measuring 40 mm. transversely, 20 mm. from beak to ventral margin, and 15 mm. in thickness including both valves; outline transversely elongate; beak small, not prominent, placed slightly anterior to the middle of the hinge, directed at right angles to it; dorsal margin nearly straight, ventral margin with a gentle flexure; anterior half gibbous, margin broadly rounded; posterior half produced, contracted, and tapering towards the more narrowly rounded anterior extremity; hinge long; almost straight, lying in a shallow groove; umbo moderately prominent, sloping more or less evenly to the anterior but on the posterior side having an obscure ridge near the dorsal margin, more abrupt near the beak, fading out towards the end of the hinge; ligament convex, external, lying in the hinge groove, extending about one-third the distance to the posterior extremity of the hinge; a broad, shallow sinus sloping from the beak to the ventral margin ending in the posterior half; surface, as far as seen, ornamented by obscure growth lines only.

Hinge plate moderately broad, upper margin nearly straight, lower margin contracted at the beak; teeth straight and vertical at the outer ends, but becoming oblique towards the beak with tops directed outward, from 10 to 12 on either side; muscle scars faint.

Ctenodonta nasuta is proportionately more transverse than most other species.

Occurrence. Pamela beds, locality 103; Lowville or Leray beds, localities 29, 33; Leray beds, localities 7, 54, 57, 60, 64, 87, 92, 97; Leray-Rockland beds, locality 89; Rockland beds, locality 22; Hull beds, localities 36, 39; Sherman Fall beds, localities 41, 43; Cobourg beds, localities 70, 76.

Type. Plesiotypes, G.S.C. Nos. 1182a and 1182b, Leray-Rockland beds, Paquette Rapids, Allumette Island, Quebec.

Ctenodonta nasuta robusta Ulrich

Plate II, figures 21, 22

Tellinomya nasuta Hall (pars), Can. Nat. Geol. I, No. 4, 1856, p. 392, figs. 1 and 3;
Tenth Rept. New York State Cab. Hist. 1857, p. 183, figs. 1 and 3.

Ctenodonta nasuta robusta Ulrich, Geol. Surv., Minnesota, Pal. 3, pt. 2, 1897, p. 585.

Large, robust for the species, illustrated form measuring 52 mm. and 30 mm. in length and height, respectively, thickness not shown; beak a little posterior to the middle of the hinge; anterior half larger and higher than in the species, and the posterior shorter and proportionately more narrowly contracted; hinge plate narrower and less constricted beneath the beak; muscle scars deeper than in the species.

Ulrich cites under this variety Hall's figures 1 and 3, in the above references. As the illustrations are drawn it might be thought that the differences were in part due to an artist's error, but Ulrich states that he had the specimens before him. The present writer has not seen the form.

Occurrence. Leray-Rockland beds, locality 5; Hull beds, locality 37; Hull or Sherman Fall beds, locality 56.

Ctenodonta parvidens Raymond

Plate II, figure 18

Ctenodonta parvidens Raymond, Amer. Jour. Sci. 4, ser. 20, 1905, p. 372; Whiteaves, Ottawa Nat. 22, 1908, p. 113, Pl. 3, fig. 16.

Medium size, plesiotype measuring length 22.5 mm., height 14 mm., thickness doubtful because of the crushed condition; outline transversely elongated; beak flattened, apparently directed forward; anterior margin in the mould, gently concave to the end of the hinge, though this may be partly due to crushing, broadly rounded below, posterior margin considerably longer than the anterior, obliquely truncated above and more narrowly rounded below than the anterior margin, ventral margin broadly convex; umbo broad, flattened, but apparently evenly convex; a broad, low, poorly defined depression extending from the umbo to the posterior half of the ventral margin; neither ligament, escutcheon, nor lunule seen; ornamented by fine concentric lines, as far as known.

Hinge plate evidently considerably curved; teeth of posterior part numerous, anterior teeth not seen; anterior muscle scar small, rather deeply impressed, posterior one only faintly seen.

Ctenodonta parvidens seems to lie between *Ctenodonta contracta* and *Ctenodonta logani* in shape and size. It differs radically from *Ctenodonta contracta* in ornamentation when preserved. It cannot be compared internally for lack of good material.

Occurrence. Pamela ? beds, locality 61. Neither the records nor the descriptions state from what part of Hogsback the specimens were obtained. The writer thinks these forms are from the Pamela beds that are exposed in this locality, and here as elsewhere have the dark shales that form the matrix of the specimens at hand.

Type. Plesiotype, G.S.C. No. 6805, Pamela ? beds, Hogsback, Ottawa. The holotype is in the Peabody Museum at Yale University.

Ctenodonta silicula n.sp.

Plate II, figure 14

Small, the largest specimen in the collection measuring 10.5 mm., 9 mm., and 5.5 mm. in length, height, and thickness (two valves), respectively; outline ovate; beak small, incurved, situated about one-third the length from the anterior; anterior margin rounded, posterior margin slightly narrower and more projecting than the anterior, dorsal margin almost straight, at the extremities curving gently into both the anterior and posterior margins, ventral margin evenly convex; umbo rather low and not clearly defined, the surface on either side continuing the convexity then curving rather abruptly down to the hinge anterior to the beak and less abruptly, even becoming flattened or concave, to the dorsal and the uppermost part of the posterior margin, elsewhere curving to the margins with an evenly decreasing convexity; hinge small, almost straight; ligamental area minute; surface ornamented by fine concentric lines as far as can be seen.

Interior not seen.

The species of the Middle Ordovician most nearly allied to *Ctenodonta silicula* are *Ctenodonta jerseyensis*, *Ctenodonta pulchella*, and *Ctenodonta levata*. But the present species lacks the sinus across the umbo of *Ctenodonta jerseyensis* although the general proportions and size are similar, and *Ctenodonta pulchella* according to the description is more equilateral. *Ctenodonta silicula* differs from *Ctenodonta levata* in the more rounded posterior and anterior margins and in the shorter hinge line. A number of authors already have noted that Hall included several small forms in his species. Ruedemann, though he gave no detailed description, had access to Hall's type, so it is here concluded that Ruedemann's illustration is a true representative of the species *Ctenodonta levata*.

Of the small forms in higher Ordovician strata *Ctenodonta silicula* differs from *Ctenodonta scofieldi* and from *Ctenodonta levata* in having a more broadly rounded posterior extremity, from *Ctenodonta fecunda* in having a less angular union of posterior and ventral margins. In outline it is most closely related to *Ctenodonta madisonensis* from Richmond beds.

The species name 'silicula' means a little pod and expresses the shape of the form.

Occurrence. Sherman Fall beds, localities 41, 80.

Type. Holotype, G.S.C. No. 11561, Sherman Fall beds, Governor Bay, Rockcliffe Park, Ontario.

Genus, *Nuculites* Conrad

Genotype, *Nuculites oblongatus* and *Nuculites coneiformis* Conrad

Small; elongate, ovate outline; beaks small, incurved and situated very far forward; anterior margin rounded, posterior margin generally truncated, in some cases so much so as to be pointed, dorsal and ventral margins gently curved with varying convexity; umbo subdued but surface posterior to it quite convex; hinge slightly curved, ligament external in a deep narrow groove; surface marked by concentric lines only.

Hinge plate narrow and gently curved; teeth in an uninterrupted arc extending from the anterior to the posterior muscle scar; anterior muscle scar deeply impressed and separated from the cavity of the shell by a partition which leaves an impression in the cast; posterior scar elongate; pallial line simple.

Nuculites differs from *Nucula* and *Nuculana* internally in lacking a resilifer and in the presence of the partition separating the anterior muscle from the cavity.

Nuculites stiliformis n.sp.

Plate I, figures 7, 8

Small, holotype measuring 15 mm., 7 mm., and 5.5 mm., in length, height, and thickness (two valves), respectively; torpedo-shaped outline with the greatest thickness at the umbones; beak low, incurved and situated approximately one-quarter distant from the anterior; anterior narrowly rounded; almost angular, posterior margin very obliquely truncated from the posterior of the hinge to the very acute extremity; dorsal margin slightly curved, ventral margin gently convex; umbo not prominent, a low ridge from it extending backward obliquely to the sharply pointed posterior extremity, its course nearer to the dorsal than to the ventral margin; the surface on either side of the ridge being convex both to the dorsal and to the ventral margins; hinge gently curved, about two-thirds the length of the whole shell; ligamental area long for the size of the form; surface of casts, the only type of specimens found, showing concentric growth lines.

Interior of hinge and teeth not seen; anterior scar large, deeply impressed as seen in the casts, separated from the cavity by a groove caused by the partition in the shell itself, the groove continuing from the base of the anterior of the hinge plate to the ventral margin, the latter being slightly indented; pallial line not seen.

Nuculites has not heretofore been found at such a low horizon. It differs from other species of the genus in the low obliquity of the posterior truncation resulting in the acute point of the posterior extremity, and in the length of the groove separating the anterior muscle from the cavity, which in most other species does not extend to the ventral margin.

The specific name 'stiliformis' refers to the stiletto-like posterior.

Occurrence. Sherman Fall beds, locality 43.

Type. Holotype, G.S.C. No. 11562, Sherman Fall beds, Canadian Pacific Railway cutting south of the Aylmer road, Hull, Quebec.

Genus, *Cyrtodonta* Billings

Genotype, *Cyrtodonta rugosa* Billings

Small to medium size; outline oblique, transversely subrhomboid or ovate to subcircular; posterior extremity larger than the anterior and broadly rounded; beak incurved and situated one-third to one-fifth the length of the hinge from the anterior end; umbo tumid; hinge gently curved; no lunule or escutcheon proper, but a narrow, undefined area between the beaks; ligament external and internal posteriorly; ornamentation, low undulations with superimposed growth lines.

Inner part of the hinge plate showing a low narrow ridge limiting the ligamental area, the ridge beginning above the cardinal teeth, crossing to the inner edge of the hinge plate, thence recrossing the plate to end just above the lateral teeth; cardinal teeth well developed, subequal, usually obliquely curved, in some instances nearly horizontal, two to four in each valve, situated in front of the beak; posterior lateral teeth slender, elongate, more or less curved, slightly oblique, two to three in each valve, situated at the posterior extremity of the hinge plate; muscle scars both ovate, the anterior one moderately impressed, the posterior larger but faint, each placed just below the corresponding set of teeth; pallial line simple.

For similarity and differences between *Cyrtodonta* and both *Vanuxemia* and *Whitella* see under description of those genera.

Cyrtodonta affinis Ulrich

Plate III, figure 7

Cyrtodonta affinis Ulrich, Geol. Surv., Minnesota, Pal. 3, pt. 2, 1897, p. 540, Pl. 39, figs. 20-23.

Small, plesiotype measuring 17 mm., 12 mm., and 9 mm. in length, height, and thickness (two valves), respectively; outline obliquely subovate; beak not prominent situated about one-third the total length from the anterior; posterior margin more broadly rounded than the anterior, dorsal margin almost straight near the beak, becoming slightly arcuate towards the posterior, ventral margin convex; umbo moderately prominent for the size of the shell, the surface from it very gently concave to the dorsal margin, decreasing but continuing convex to the posterior margin and almost flat to the antero-ventral margin; hinge short; surface ornamented by fine concentric lines.

Interior of present specimens not seen, but Ulrich's holotype has four short cardinal teeth, and four very slender lateral teeth in the right valve with very faint muscle scars.

The Ottawa form is slightly smaller than the type but the general proportions are similar.

It is considerably smaller than *Cyrtodonta angusta* and the sides are less parallel.

Occurrence. Lowville beds, localities 57, 97.

Type. Plesiotype in the private collection of G. W. Sinclair, Lowville beds, quarry west side of Merivale road, Ottawa, Ontario.

Cyrtodonta affinis minuta n.var.

Plate III, figure 6

Size very small, averaging 10 mm., 8.5 mm., and 6 mm. in greatest length, height, and thickness (two valves), respectively; oblique outline; beak rather prominent for the size of the shell, strongly incurved, situated about one-third distant from the anterior; anterior margin narrowly rounded and slightly projecting, posterior margin broadly rounded, dorsal margin straight to the juncture with the rounded posterior margin; ventral margin oblique and slightly convex; umbo rather prominent, melting into the gentle convexity posteriorly and ventrally, but reversing to very

slightly concave towards the anterior; hinge straight and long for the size of the variety; ligament and lunule not seen; surface having concentric growth lines scarcely visible on the casts present.

Interior not seen.

The variety resembles the species in general shape, and might be considered a young form but it is considerably smaller, proportionately a little thicker and intermediate forms have not been found. It resembles *Cyrtodonta parva* in its small size but the posterior extremity is much more rounded than in that species. The species is very similar to *Cyrtodonta leucothea*, but is somewhat larger, the ventral margin is more rounded and the convexity more evenly distributed.

Occurrence. Leray-Rockland beds, locality 5.

Type. Holotype, G.S.C. No. 11563; paratypes, G.S.C. No. 11563a, b; Leray-Rockland beds, Paquette Rapids, Ottawa River.

Cyrtodonta angusta n.sp.

Plate III, figures 1, 2

Moderate size, the greatest height 16 mm., greatest thickness 8 mm. (one valve), length unknown because of the broken posterior though probably about 28 mm., measured by completing the growth lines; outline long and comparatively narrow; beak moderately prominent, incurved, situated near the anterior; anterior margin rounded, projecting slightly, posterior margin broken but growth lines showing it to be less broadly rounded than most species of the genus, dorsal and ventral margins subparallel, the whole roughly outlining a parallelogram; umbo rounded, moderately prominent, the surface from it convex and sloping steeply to the dorsal margin but more gently to the ventral margin; ligament not preserved; surface ornamented by low, concentric undulations.

Hinge plate rather narrow, curved gently beneath the beak but rather sharply at the beginning of the lateral teeth; three or four cardinal teeth, two lateral teeth bifurcating making four teeth of varying lengths; anterior muscle scar round, not deeply impressed, lying in the anterior projection, posterior scar not seen; pallial line unknown.

Cyrtodonta angusta differs from other species in its narrowness and in having the dorsal and ventral margins subparallel.

Occurrence. Leray-Rockland beds, locality 5.

Type. Holotype, G.S.C. No. 11564; paratype, G.S.C. No. 11564a; Leray-Rockland beds, Paquette Rapids, Ottawa River.

Cyrtodonta breviscula Billings

Plate III, figures 4, 5

Cyrtodonta breviscula Billings, Can. Nat. Geol. 3, 1859, p. 446; Whiteaves, Ottawa Nat. 22, 1905, p. 107, Pl. 3, fig. 3.

Small, holotype measurements about average, 12 mm. in length, 9 mm. in width from the posterior end of the hinge to the opposite side, maximum thickness of one valve 4 mm.; subrhomboidal outline; anterior margin bluntly rounded, posterior margin more narrowly rounded; beak slightly overhanging the hinge, lying just above the anterior margin, in this

respect resembling the position of the beak of *Cyrtodonta grattanensis*; hinge long for the size of the species; umbo prominent, the convexity decreasing but continued in an oblique subangular ridge almost to the posterior extremity, and lying closer to the dorsal than to the ventral margin; ligament not seen; ornamentation, concentric growth lines.

Interior not seen, except for three long, very slender lateral teeth showing in a poorly preserved exfoliated specimen.

Cyrtodonta breviuscula belongs to the group of small *Cyrtodontas* being between *Cyrtodonta leucothea* and *Cyrtodonta obtusa* in size. It can be distinguished from the former by its larger size, by its subrhomboidal rather than alate outline, and by its subangular, umbonal ridge; from the latter by its smaller size and its subangular ridge. It resembles *Cyrtodonta subcarinata* in the possession of a subangular ridge, but differs greatly in size and in its subrhomboidal outline.

Occurrence. Pamelia beds, localities 18, 26, 33, 61, 85, 100, 101, 116; Leray beds, locality 1.

The type locality is given in Billings' original description. The formation is said to be Chazy. From the citation the place is probably the Skead road running north, just east of the Research Council Laboratories on the Montreal road. To the east of this road less than half a mile is an outcrop of Chazy sandstone. But crossing the road at slightly higher elevation and a little farther south is a low ridge of Pamelia beds, having exposures of Pamelia rocks on the road and on either side. At the base of the Pamelia is a lens of sandstone in which a number of fossils have been found. The matrix of the holotype of *Cyrtodonta breviuscula* is nearer that of the Pamelia than of the Chazy sandstone. Inasmuch as the species is found elsewhere in authentic Pamelia beds, and that nothing but vague markings have been found in the Chazy sandstone of the neighbourhood for many miles, it is assumed that the holotype came from the basal Pamelia beds 3 miles east of Ottawa.

Type. Holotype, G.S.C. No. 1051, Pamelia beds, 3 miles east of Ottawa and about $\frac{1}{2}$ mile south of the river.

Cyrtodonta canadensis Billings

Plate V, figures 15, 16

Cyrtodonta canadensis Billings (pars), Can. Nat. Geol. 3, 1858, p. 434, fig. 10 (non fig. 9, fig. 8 doubtful), p. 435, fig. 11; Geol. Surv., Canada, Rept. of Prog. 1857 (1858), p. 182, fig. 10 (non fig. 9, fig. 8 doubtful), p. 183, fig. 11; Geol. Surv., Canada, Geol. Canada, 1863, p. 148, fig. 106.

Rather large for the genus, the holotype measuring 58 mm. in length, 41 mm. in height (restoring the broken margin), and 16 mm. in thickness (one valve); subcircular in outline; anterior margin evenly rounded, projecting a little beyond the beak, posterior margin very broadly rounded almost semicircular; beak overhanging the hinge, situated behind the anterior margin about one-sixteenth the whole length; hinge moderately short, very gently curved; umbo broad, evenly rounded on top, sloping down steeply to the margins just posterior to the hinge but with a gradual decrease in convexity towards the posterior margin; ligament not seen; surface marked by obscure concentric lines of growth, and in some cases by ridges suggesting a temporary arrest in growth.

Three small cardinal teeth the central one of which is the largest and curved with its convex side towards the beak; outer tooth almost horizontal, beginning as a low ridge and ending abruptly as a tubercle; two posterior teeth long and slender, extending backward from the concave hinge plate; muscle scars and pallial line not seen.

Cyrtodonta canadensis differs from other species in its large size, more rounded umbones, and in lacking any tendency to form a ridge in any part of its length from beak to posterior margin. In some of these features it resembles *Cyrtodonta grandis*, but the latter is not so thick proportionately, and not so oblique.

Occurrence. Lowville beds, localities 85, 88, 97, 102, 103; Leray beds, localities 7, 65, 84, 93; Leray-Rockland beds, locality 5; Rockland beds, locality 84.

Type. Holotype, G.S.C. No. 1177; paratype, 1177a; Leray-Rockland beds, Paquette Rapids, Ottawa River.

Cyrtodonta ? cornwallia Wilson

Plate III, figure 3

Cyrtodonta ? cornwallia Wilson, Roy. Soc., Canada, 26, 1932, sec. 4, p. 401, Pl. 6, fig. 3.

Medium size, exact measurement not known, both specimens being broken; beak very close to anterior; anterior margin narrowly rounded, posterior margin broadly rounded, as far as can be seen; hinge line gently curved, particularly at the anterior end; umbo made more prominent by a ridge which crosses the valve obliquely, becoming somewhat flattened towards the posterior end, a shallow depression lying dorsal to it and slightly diverging towards the hinge posteriorly; ornamentation, low concentric undulations with occasional finer growth lines.

Interior not seen.

Because of their shape these two specimens are assigned to the genus *Cyrtodonta*, but the query is retained because no interior has been seen.

Cyrtodonta ? cornwallia, like *Cyrtodonta subcarinata* has an oblique ridge arising in the umbonal region, but it differs from that species and from any other described species in the dorsally placed shallow depression.

Occurrence. Sherman Fall beds, localities 117, 121.

Type. Holotype, G.S.C. No. 6661, Sherman Fall beds, con. V, Osnabrock tp., Ontario. Unfortunately the type is missing.

Cyrtodonta glabella (Ulrich)

Plate III, figures 12-14

Cypricardites glabella Ulrich, 19th Ann. Rept. Geol. Nat. Hist. Surv., Minnesota, 1892, p. 234, fig. 20.

Cyrtodonta glabella (Ulrich), Geol. Minnesota, Pal. 3, 1894, p. 543, Pl. 39, figs. 37-48.

Size medium to large, the largest specimen found here measuring 40 mm. and 36 mm. in length and height respectively, another specimen being considerably smaller; subquadrangular in outline; beak small, with a low, short depression on either side, slightly incurved, situated one-third from the anterior end of the hinge; anterior margin rather sharply defined,

posterior margin broadly rounded, ventral margin gently flattened; umbo convex but not as prominent as in many species of the genus, maintaining a diminishing convexity towards the posterior end but flattening towards the other margins; hinge straight and rather long; ligament not seen; surface covered by concentric growth lines.

Interior of hinge plate showing the narrow ridge limiting the ligamental area; at least two strong cardinal teeth, and two or three lateral teeth; anterior scar small, acuminate below, posterior scar, large, ovate, the long diameter vertical; anterior of pallial line a pustulose ridge.

Cyrtodonta glabella is considerably larger and proportionately less convex than *C. rotulata* or *C. tenella*, more quadrate than *C. cingulata* or *C. oviformis*. The anterior part of the hinge line is straighter than most comparable species.

Occurrence. Leray beds, locality 31.

Type. Plesiotype, G.S.C. No. 11535, Leray beds, Val Tetreau, Quebec.

Cyrtodonta grattanensis n.sp.

Plate III, figures 19, 20

Cyrtodonta canadensis Billings (pars), Can. Nat. Geol. 3, 1858, p. 434, fig. 9; Geol. Surv., Canada, Rept. of Prog. 1857 (1858), p. 182, fig. 9.

Holotype measuring 41 mm. in length, 31 mm. greatest height, and 22 mm. thickness (both valves); subrectangular outline interrupted by the wider posterior; anterior margin bluntly rounded, posterior margin broadly rounded; beak incurved, projecting slightly beyond the hinge, situated almost directly above the anterior margin; hinge line almost straight; umbo convex, the curve narrowing somewhat on the top but not forming a ridge; ligament not seen, but the convexity of the umbo reversing the curve, makes a small concavity between the valves within which the ligament probably rested; ornamentation, fine growth lines, gathering into wrinkles in the younger part of the shell.

Remnants of only two teeth present, long slender laterals; muscle scars and pallial line not seen.

The holotype of *Cyrtodonta grattanensis* was originally included with *Cyrtodonta canadensis*. The species is intermediate between *Cyrtodonta canadensis* and *Cyrtodonta subcarinata*. It differs from *Cyrtodonta canadensis* in its more oblong outline, and more narrowly convex umbo. It differs from *Cyrtodonta subcarinata* in being larger with a more broadly rounded posterior region and in having a less narrowly rounded umbo.

The name is taken from Grattan township, the locality from which the holotype came.

Occurrence. Lowville beds, localities 53, 57, 89, 103; Leray beds, localities 7, 31, 55.

Type. Holotype, G.S.C. No. 1179, Leray beds, Fourth Chôte of Bonnechère River, Grattan township, Ontario.

This specimen is twice illustrated by Billings from this locality. The specimen itself bore the label marked 'Pointe Claire'. It is assumed that Billings' listing is correct.

Cyrtodonta huronensis Billings

Plate III, figures 15, 16

Cyrtodonta huronensis Billings, Geol. Surv., Canada, Rept. of Prog. 1857 (1858), p. 180, figs. 3, 4; Can. Nat. Geol. 3, 1858, p. 432, figs. 3, 4.

Medium size for the genus, holotype measuring 34 mm., 21 mm., and 17 mm. in length, height, and thickness (one valve), respectively; outline obliquely rectangular; beak one-third to one-fourth the hinge length from the anterior; anterior margin narrowly rounded, posterior margin not greatly enlarging but broader, dorsal and ventral margins subparallel; umbo rounded, prominent but not ventricose; hinge medium length; surface everywhere convex; ligament depression long for the size of the shell; ornamentation consisting of rather fine concentric undulations.

Hinge plate straight for the most part, curving down at the anterior end; three short, slightly oblique cardinal teeth present, and three longer very obliquely placed posterior teeth; anterior muscle scar moderately deep, situated below and a little anterior to the cardinal teeth, posterior scar and pallial line not seen.

Cyrtodonta huronensis is a moderate, almost conventionalized *Cyrtodonta*. In size and outline it lies between *C. subcarinata* and *C. grattanensis*. It is wider than the former and the umbonal convexity is rounded not subcarinate. It is smaller and less robust than *C. grattanensis*. Its umbonal convexity curves more gradually, outlining the margins more sharply.

Occurrence. Lowville beds, locality 57; Leray beds, localities 40, 55, 87, 97.

Type. Cotypes, G.S.C. Nos. 1176 and 1176a, Leray beds, from an island off Point Palladeau, Lake Huron. The types, though not from this area, are illustrated here because they are better preserved than any of the present specimens.

Cyrtodonta kingstonensis n.sp.

Plate III, figure 11

Cyrtodonta sp. Wilson, Rept. Ont. Bur. of Mines, vol. 25, pt. 3, 1916, Pl. I, fig. 8.

Medium size, holotype measuring, length 25 mm., greatest height 15.5 mm., posterior to the middle, thickness of one valve 7 mm.; outline oval, anterior short and broadly rounded, posterior more narrowly rounded than is usual for the genus; beak above and a little behind the slightly protruding anterior; hinge line long; umbo prominent, with a very convex slope towards the ventral margin; ligament not seen; ornamentation fine, low, concentric growth lines.

Teeth not seen; anterior muscle scar small, broadly oval, lying below the beak and having its longer axis directed towards it; posterior scar, large, faint, rarely seen, situated just posterior to and below the hinge line; pallial sinus simple.

Cyrtodonta kingstonensis is shorter and proportionately wider than *Cyrtodonta subcarinata*, the umbo is more rounded and the slope downward from the umbo to the dorsal and ventral margins is more convex.

Occurrence. Pamelia beds, localities 17, 18, 20, 26, 27, 83, 89; Lowville beds, localities 52, 53.

Type. Holotype, G.S.C. No. 5392, Pamelia beds, Shannonville near Kingston, Ontario.

The specimen from the Kingston area is here chosen as the holotype because it is the first specimen illustrated, though not described, and it is the best preserved representative of the species, which is very prolific in the Ottawa-St. Lawrence area.

Cyrtodonta leucothea Billings

Plate III, figures 8-10

Cyrtodonta leucothea Billings, Geol. Surv., Canada, Pal. Foss. 1, 1865 (Adv. sheets, 1862), p. 46, fig. 49; Geol. Canada, 1863, p. 143, fig. 82.

Minute, holotype measuring 6.5 mm. in length, 6 mm. in height, and 4.5 mm. in thickness (both valves), a larger specimen measuring 9 mm., 8 mm., and 3 mm. in length, height, and thickness (one valve), respectively; alate, gibbous, with subquadrate outline; beak large for the size of the shell, overhanging the anterior third of the hinge; anterior and posterior margins narrowly curved, ventral and dorsal margins subparallel; hinge gently curved, almost straight, long, forming the widest part of the shell; umbo narrowly convex, the convex continuation to the posterior extremity lessening but almost forming a ridge, convexity persisting but decreasing towards the anterior margin, surface flattening towards the posterior part of the hinge; ligament probably long for the genus, judging by the length of the slightly concave area along the posterior part of the hinge; ornamentation not seen, all specimens being moulds.

Interiors not seen.

For comparison with *Cyrtodonta affinis minuta* see under that species. It differs from any other species of the genus in its minute size, in its wide hinge and alate outline.

Occurrence. Leray beds, locality 50; Leray-Rockland beds, locality 5.

Type. Holotype, G.S.C. No. 1188; paratype, No. 1188a, b; Leray-Rockland beds, Paquette Island, Ottawa River.

Cyrtodonta mediocris n.sp.

Plate IV, figure 11

Large, holotype measuring 49 mm., 32 mm., and 10 mm., in length, height, and thickness (one valve), respectively, the greatest height being about midlength; outline obliquely suboval, and the convexity for the size of the shell less than usual in the genus; beak not very prominent, incurved, and situated about one-third the hinge length from the anterior; anterior margin narrowly rounded, posterior margin broadly rounded, dorsal and ventral margins oblique and subparallel, the ventral margin being gently convex and the dorsal slightly convex posterior to the hinge; umbo moderately prominent, the convexity posterior to it broadly rounded and continuing to the posterior extremity, the surface on either side evenly convex to the dorsal and ventral margins except for a steeper slope just

posterior to the beak; hinge rather long, straight posterior to the beak and slightly curved anterior to it; surface marked by broad concentric growth lines.

Interior not seen.

Cyrtodonta mediocris is closely allied to *Cyrtodonta subovata* but is longer in proportion to its height and the dorsal and ventral margins are more nearly parallel. The general outline is suggestive of *Cyrtodonta huronensis* but *Cyrtodonta mediocris* is much larger and proportionately not so thick.

The specific name 'mediocris' designates a form that shows the characteristics of the genus but in which no particular feature is accented.

Occurrence. Leray beds, locality 65.

Type. Holotype in the private collection of G. W. Sinclair, Leray beds, Mechanicsville, Ottawa, Ontario.

Cyrtodonta modesta n.sp.

Plate III, figure 18

Size medium for the genus, holotype measuring 37 mm., 26 mm., and 10 mm. in length, width, and thickness (one valve), respectively; outline subovate; beak slightly overhanging, situated about two-fifths the hinge length from the anterior; anterior margin rounded, moderately narrow, posterior margin considerably broader than the anterior, dorsal and ventral margins gently convex, subparallel; umbo prominent, the convexity continuing but gradually diminishing towards the posterior extremity, dividing the shell almost equally, the slope on either side the convexity very gently convex, almost flat; hinge slightly curved; ligamental area not seen.

Interior not seen.

Unfortunately the only specimens present are moulds.

Cyrtodonta modesta is a form of moderate size and moderate convexity for the genus. Compared with *C. huronensis* the beak is farther from the anterior, hence the umbonal convexity makes the dorsal and ventral slopes more nearly equal. It is less robust than *C. grattanensis*.

Occurrence. Lowville beds, locality 53; Leray beds, localities 31, 81.

Type. Holotype and paratype, G.S.C. Nos. 1183a and 1183b respectively, Leray beds, La petite Chaudière, Ontario side.

Cyrtodonta obtusa Hall

Plate V, figures 13, 14

Ambonychia obtusa Hall, Pal. New York, I, 1847, p. 167, Pl. 36, figs. 8a, 8b.

Cyrtodonta obtusa Hall, Billings, Can. Nat. Geol. 3, 1858, p. 436, figs. 13, 14; Geol. Surv., Canada, Rept. of Prog. 1857 (1858), p. 184, figs. 13, 14; Geol. Canada, 1863, p. 147, figs. 101a, 101b.

Medium size, largest specimen measuring 28 mm. in length, 23 mm. in width, and 9.5 mm. in height; short, wide, and gibbous, obliquely ovate; anterior extremity small and round; posterior extremity large and broadly rounded; beak close to the anterior margin, slightly incurved; hinge gently curved, wide for the size of the shell; umbo short and rounded, the convexity

gradually decreasing towards the posterior extremity, curving abruptly to the anterior, but somewhat flattening out towards the posterior part of the hinge line; ligament not seen; only ornamentation visible on the moulds being a few wrinkles towards the ventral margin.

Hinge plate of the right valve crossed by a low ridge beginning above the inner, more medianly placed cardinal tooth, crossing to the inner side of the hinge plate, thence recrossing and ending on the upper, outer edge just above the lateral teeth; hinge plate of the left valve not seen, but probably having a groove in the corresponding position; four cardinal teeth, in some cases the one nearest the beak bifurcating to make the fourth; three long, slender lateral teeth, slightly oblique to the hinge; anterior muscle scar large and deeply impressed, lying obliquely beneath the cardinal teeth; part only of the posterior scar seen, faintly impressed, lying beneath the lateral teeth.

Cyrtodonta obtusa is closest to *Cyrtodonta spinifera*, and a comparison of the two species is given under the latter form.

Occurrence. Lowville beds, localities 31, 53; Leray beds, localities 40, 55; Leray-Rockland beds, localities 5, 7; Cobourg beds, localities 69, 76, 126. The few forms found in the Cobourg beds are smaller and if better preserved might be considered a variety.

Type. Plesiotypes, G.S.C. Nos. 1187b and 1187e, Leray-Rockland beds, Paquette Rapids, Allumette Island, Quebec.

Cyrtodonta oviformis Ulrich

Plate III, figure 17

Cyrtodonta oviformis Ulrich, Geol. Surv., Minnesota, Pal. 3, pt. 2, 1897, p. 544, Pl. 39, fig. 46; Pl. 40, fig. 1.

Shell medium size, moderately convex, one specimen measuring 40 mm., 33 mm., and 23 mm. in length, width, and thickness (two valves), respectively; oblique outline, broad, oval, somewhat flattened at the hinge line; beak small, slightly incurved, situated about one-quarter to one-fifth the length from the anterior; anterior margin rounded, posterior margin broadly rounded, dorsal and ventral margins gently convex and subparallel beyond the hinge; umbo not very prominent, the surface gently convex to the ventral margin and flattened or even slightly concave to the dorsal margin; hinge wide and slightly curved; ligamental area partly in the interior, well developed; surface showing concentric growth lines.

Several small, unequal, cardinal teeth, more or less vertical, originating at the small ridge delimiting the inner part of the ligamental area; two or three posterior lateral teeth, the median tooth, when present being considerably larger than the others; anterior muscle scar distinct, elongate, situated immediately below the cardinal teeth, posterior scar faint; pallial line not seen.

Cyrtodonta oviformis is distinguished externally from *Cyrtodonta canadensis* by its short, wide proportions, low umbo and long hinge. Internally it differs in the form of the cardinal teeth. The genus is more oblique than *Cyrtodonta glabella*, and the cardinal teeth differ.

Occurrence. Leray beds, locality 40.

Type. Plesiotype, G.S.C. No. 11536, Leray beds, La petite Chaudière, Quebec.

Cyrtodonta ? planumbona Wilson

Plate IV, figures 14, 15

Cyrtodonta ? planumbona Wilson, Geol. Surv., Canada, Bull. 33, 1921, p. 52, Pl. 4, figs. 1, 2.

Medium size, holotype measuring, length 28 mm., greatest width anterior to the middle 16 mm., thickness of one valve 5 mm.; outline ovate, anterior a little more narrowly rounded than posterior, ventral margin gently convex; beak low, lying in the anterior quarter; umbo low and evenly convex; ligament not seen; ornamented with concentric growth lines.

Teeth not seen; anteriorly muscle scar fairly prominent, particularly on the inner side; posterior scar apparently the larger but very faintly impressed; pallial line simple.

The muscle scar, the position of the beak, and the gently convex ventral margin are characteristic of *Cyrtodonta*, but the genus is queried because in no specimen at hand can the teeth be seen.

Occurrence. Pamelia beds, localities 15, 17, 20. It must be remembered here that the Pamelia beds were considered to be of Chazy age by the early geologist.

Type. Holotype, G.S.C. No. 6223; paratype, G.S.C. No. 6223a; Pamelia beds, MacLaren Landing, Ottawa.

Cyrtodonta ? pudica n.sp.

Plate V, figure 12

Small, holotype measuring 18 mm., 14 mm., and 9 mm., in length, height, and thickness (two valves), respectively; outline very oblique; beak small, incurved, situated about one-quarter the whole length from the anterior; anterior margin narrowly rounded, posterior margin broad and truncated, dorsal margin straight, ventral margin very oblique but gently convex; umbo low and evenly convex; anterior to the umbo a slight concavity elsewhere gently convex surface; hinge straight and long for the size of the shell; surface markings obliterated from the cast.

Interior not seen.

The specimen is not well preserved but its shape differs from any other and it is included to complete the record. The comparatively low beak and umbo and the hinge line seem to relate it to *Cyrtodonta* rather than to *Vanuxemia*. It differs from *Cyrtodonta affinis* in its more oblique outline, and in its broad and truncate posterior.

The specific name 'pudica' means modest.

Occurrence. Lowville, locality 57.

Type. Holotype in the private collection of G. W. Sinclair, from Lowville beds, in quarry west of Merivale road, Ottawa, Ontario.

Cyrtodonta rocklandensis n.sp.

Plate IV, figure 7

Small, the holotype measuring 12 mm., 8.5 mm., and 4 mm. in length, height, and thickness (one valve), respectively; almost oval in outline; beak incurved, one-third distant from the anterior; posterior margin

broadly rounded, anterior more narrowly rounded, and ventral margin almost straight; umbo prominent, subangular on the dorsal side; a narrow round ridge extending posteriorly from the umbo almost to the posterior margin, its convexity gradually decreasing, its course nearer the dorsal than the ventral margin, the surface on either side to the margins gently convex almost flat; hinge line short, gently curved; lunule and escutcheon not seen; surface showing concentric lines.

Interior not exposed except for the ends of two, relatively long, lateral teeth; muscle scars not seen.

Cyrtodonta rocklandensis is nearest to *Cyrtodonta affinis fillimorensis* in outline but it is smaller, and in it the anterior part is more produced and narrower.

Occurrence. Leray beds, locality 98.

Type. Holotype, G.S.C. No. 11537; paratype, G.S.C. No. 11537a; Leray beds, 10 feet above the base at Rockland, Ontario.

Cyrtodonta rugosa Billings

Plate IV, figures 5, 6

Cyrtodonta rugosa Billings, Can. Nat. Geol. 3, 1858, p. 432, figs. 1, 2; Geol. Surv., Canada, Rept. of Prog. 1857 (1858), p. 179, figs. 1, 2; Geol. Canada, 1863, p. 148, figs. 104a, 104b.

Small, holotype measuring 17.5 mm. in length, 14.5 mm. in height, 5 mm. in thickness (one valve); very gibbous with subquadrate outline; beak small, slightly overhanging, situated in line with the anterior margin and its convexity more or less entering into the anterior outline; anterior and posterior margins broadly rounded, subequal, the posterior being a little the larger, ventral margin gently convex and subparallel to the dorsal margin; hinge gently curved in the posterior, the degree of curve increasing in the anterior half; umbo convex; the convexity decreasing gradually towards the posterior end, curving down abruptly towards the anterior margin, and a little less abruptly towards the dorsal margin; beneath the umbo a broad, shallow, indistinct depression or flatness trending towards the anterior part of the ventral margin, but not affecting the marginal outline in the one complete specimen at hand; ligament very small judging from the shortness of the more or less concave space beneath the beak; ornamentation consisting of concentric growth lines, some more heavily accented than others.

Hinge plate gently curved, the right valve showing the characteristic slender ridge crossing from the top of the cardinal teeth to the inner edge of the hinge plate thence obliquely across the plate ending above the lateral teeth, left valve showing a corresponding groove; four minute cardinal teeth seen in one right valve, sharply curved; three slender, lateral teeth; anterior muscle scar deeply impressed, large for the size of the shell, slightly elongate, lying beneath the cardinal teeth; posterior scar seen in part only; pallial line not seen.

Cyrtodonta rugosa is closest to *Cyrtodonta breviuscula* in size and outline. It can be distinguished from that species by its larger size, the lack of the umbonal ridge, and by its indistinct depression.

Occurrence. Lowville beds, locality 53; Leray-Rockland beds, localities 5, 7, 40.

Type. Holotype, G.S.C. No. 1186; paratypes, Nos. 1186a and 1186b; Leray-Rockland beds, Paquette Rapids, Allumette Island, Quebec.

Cyrtodonta simplex n.sp.

Plate IV, figures 12, 13

Moderate size, averaging 25 mm., 19 mm., and 7 mm. in length, height, and thickness (one valve), respectively; having an almost oval outline but being a little narrower at the anterior end; beak not prominent, incurved; anterior margin somewhat narrowly rounded and projecting slightly, posterior margin much more broadly rounded, dorsal margin gently concave near the beak reversing to gently convex posterior to the hinge, ventral margin very little convex; umbo low, rounded, the convexity continuing diagonally across the shell towards the lower part of the posterior extremity, the surface being convex on the antero-ventral side and very gently concave on the dorsal side; hinge comparatively short, slightly curved; ligament and lunule not seen; ornamented with concentric growth lines.

Hinge plate narrow; two long, lateral teeth and three cardinal teeth, the latter being curved with their convexity towards the beak and placed obliquely upon the hinge plate; pallial line simple.

Cyrtodonta simplex is closest to *Cyrtodonta modesta* but it is consistently smaller, the umbo is less pronounced and the hinge is relatively shorter.

The name 'simplex' refers to the simple form of the shell.

Occurrence. Leray beds, locality 98; Leray-Rockland beds, locality 5.

Type. Holotype, G.S.C. No. 11565; paratype, G.S.C. No. 11565a; Leray-Rockland beds, Paquette Rapids, Ottawa River.

Cyrtodonta spinifera Billings

Plate IV, figures 2-4

Cyrtodonta spinifera Billings, Can. Nat. Geol. 3, 1858, p. 435, fig. 12; Geol. Surv., Canada, Rept. of Prog. 1857 (1858), p. 183, fig. 12.

Medium size, largest specimen measuring length and height 24 mm., thickness 7.5 mm. (one valve); subcircular outline, broken by the hinge; beak slightly overhanging, in the anterior fourth of the hinge line, not quite so acute as in Billings' original illustration; anterior and posterior margins broadly curved; umbo evenly rounded, the convexity gradually decreasing towards the ventral margin, surface sloping abruptly to the anterior margin and somewhat flattened towards the posterior part of the hinge; ligament not seen but its position indicated by a small, short concavity along the hinge line just posterior to, and extending a very little anterior to, the beak; ornamentation spectacular in well-preserved mature forms, consisting of stout tubercles irregularly placed in concentric rows and in some cases on the ventral half of the shell, in other cases in rows near the hinge.

Hinge plate of the right valve, as in *Cyrtodonta obtusa*, crossed by a low, slender ridge beginning above the inner, more medianly placed cardinal tooth crossing to the inner side of the hinge plate, thence recrossing and ending on the upper, outer edge, just above the lateral teeth; hinge plate of left valve not seen, but probably having a corresponding groove; four cardinal teeth gently curved; three long, slender lateral teeth, slightly oblique to the hinge; anterior muscle scar moderately impressed, lying just beneath the cardinal teeth, posterior scar large, elongate, its longer axis paralleling the lateral teeth, below which it is situated.

Cyrtodonta spinifera differs from *Cyrtodonta obtusa* externally in its more subcircular outline, and in being ornamented with tubercles. It differs internally, in the specimens seen, in having a less deeply impressed anterior muscle scar, and in that its longer hinge plate is longer in proportion to the whole length.

Occurrence. Leray-Rockland beds, locality 5.

Type. Holotype, G.S.C. No. 1185b; paratypes, G.S.C. Nos. 1185a and 1185c; Leray-Rockland beds, Paquette Rapids, Allumette Island, Quebec.

Cyrtodonta cf. subangulata (Hall)

Plate IV, figure 10

Edmondia ? subangulata Hall, Pal. New York 1, 1847, p. 156, Pl. 35, figs. 2a, b.

Cyrtodonta subangulata (Hall), Billings, Geol. Surv., Canada, Rept. of Prog. 1857 (1858), p. 185.

Size large, Hall's illustrated type measuring 54 mm. and 32 mm. in length and height, respectively, the present illustrated plesiotype a little shorter and wider, measuring 52 mm., 35 mm., and 18 mm. in length, height, and thickness (one valve); outline oblique; beak obtuse, situated a little anterior to the middle of the hinge line; anterior margin rather sharply rounded, posterior margin making a broad curve, ventral and dorsal margins gently convex; umbo very prominent, especially near the anterior end, the strong convexity decreasing but continuing to the posterior extremity, dorsal surface sloping steeply but gently convex, ventral surface considerably broader, convex to the margin; hinge short in proportion to the rest of the shell; ligamental depression deep; the whole ornamented by broad, low, concentric undulations, most evident near the posterior.

Hinge plate not seen; anterior muscle scar large, deeply impressed, situated at the anterior margin under the beak; posterior scar not seen, evidently very faint; pallial line simple.

Compared with *Cyrtodonta canadensis*, *C. subangulata* is longer, and has a much narrower and more prominent umbo with a tendency towards angularity upon the dorsal side of the prolonged convexity. Externally it is difficult to distinguish some of the specimens from *Whitella*, but the line of greatest convexity recedes from the dorsal margin more than in *Whitella* and the surface between that convexity and the dorsal valve is gently convex rather than concave as is usual in *Whitella*. There is no difficulty in separating the genera when the hinge plate can be seen.

Occurrence. Leray beds, localities 40, 55.

Type. Pleisotype, G.S.C. No. 11566, Leray beds, La petite Chaudière.

Cyrtodonta subcarinata Billings

Plate IV, figures 8, 9

Cyrtodonta subcarinata Billings, Can. Nat. Geol. 3, 1858, p. 433, figs. 5, 6; Geol. Surv., Canada, Rept. of Prog. 1857 (1858), p. 181, figs. 5, 6; Geol. Canada, 1863, p. 148, fig. 105.

Medium size, holotype measuring 30 mm. in length, 17 mm. in height, 15 mm. in thickness (two valves), respectively; some specimens larger; obliquely sub-oval; beak small, incurved, about two-fifths of the hinge line from the anterior; anterior and posterior extremities narrowly rounded, the posterior being the broader; ventral and dorsal margins gently convex, almost subparallel; umbo prominent, angular, the angular convexity continuing obliquely half-way from the umbo thence gradually rounding to the posterior extremity, convexity flattening out on both ventral and dorsal sides of the angular umbonal ridge; ornamentation very faint, concentric growth lines.

Interior not seen.

Cyrtodonta subcarinata is distinguished from any other species of the genus by its long, narrow outline, by its obliquity, and by the angular umbonal ridge. The form is much more prolific in the Lowville beds of the area than in the Leray beds. Many of the specimens of the Ottawa-St. Lawrence Lowland area are considerably larger than the holotype. Others are considerably smaller, as well as those of the same size. It may be that there is more than one variety present. A few specimens show the anterior scar but none has exhibited the teeth in a collection of more than a hundred. So, for the present all are included under the species because: there are forms intermediate in size; they have the same general outline; and they have the same proportions.

Occurrence. Lowville beds, localities 10, 12, 21, 29, 40, 49, 55, 57-59, 63, 66-68, 82, 98, 103, 104.

Type. Holotype, G.S.C. No. 1184, Leray beds, Pointe Claire, Quebec.

Cyrtodonta ? subquadrata n.sp.

Plate IV, figure 1

Small, averaging 19 mm., 14 mm., and 7 mm. in length, height, and thickness (one valve), respectively; obtusely subquadrate; beak incurved, situated in the anterior third of the hinge; anterior margin narrowly rounded, posterior margin broadly rounded, dorsal margin decidedly convex, ventral margin gently convex; umbo almost angular, very prominent, the convexity continuing to the posterior extremity though decreasing in angularity and height, the slope gently concave to the dorsal margin and gently convex to the ventral margin; surface marked by concentric growth lines.

Interior not seen except for the fragment of the posterior muscle scar that is nearer the end of the hinge than usual.

This lack of knowledge of the teeth and muscle arrangement leaves some doubt as to the genus, but the hinge and broadening posterior are characteristic of the genus *Cyrtodonta*.

Cyrtodonta ? *subquadrata* is less circular than *C. rotulata*, smaller and more subquadrate than *C. obtusa*, and longer and more subquadrate than *C. obesa*. It is, perhaps, more closely allied to *C. affinis* in outline, but it is considerably more obese than that species.

The name 'subquadrata' refers to the outline of the shell.

Occurrence. Lowville beds, locality 53; Leray beds, locality 54.

Type. Holotype, G.S.C. No. 11567, Lowville beds, lot 3, con. III, R.F., Gloucester tp., Ontario; paratype, G.S.C. No. 11568, Leray beds, lot 4, con. III, R.F., Gloucester tp., Ontario.

Genus, *Vanuxemia* Billings

Genotype, *Vanuxemia inconstans* Billings

Shell ventricose, in most cases fairly large; outline ovate to sub-circular; anterior end usually acute, posterior end broadly rounded; beak well forward and generally strongly incurved; umbo prominent; hinge short and strong, curved in some cases, particularly at the anterior end; ligament area elongate; ornamentation, concentric lines or undulations.

Two to four cardinal teeth present as in *Cyrtodonta*, frequently striated transversely; anterior muscle scar sharply defined and situated on a lobe-like prolongation of the hinge plate; posterior scar indistinct; casts showing a prominent internal, scarp-like ridge present, crossing from the umbo to the ventral margin and meeting the latter short of the posterior extremity, the surface on the dorsal side being flush with the top of the ridge and the antero-ventral area at a lower level flush with the base of the ridge; pallial line simple.

Vanuxemia differs from *Cyrtodonta* externally in its more acuminate anterior. Small rotund forms of the two genera are easily confused but in *Vanuxemia* there is a flattening of the antero-ventral slope. In *Cyrtodonta* this tendency is on the dorsal side. Internally the two genera are similar in the variability of the number of teeth, but differ in the wide hinge line, which in *Vanuxemia* bears the anterior muscle scar, and in the internal scarp-like ridge, which is absent from *Cyrtodonta*.

Vanuxemia ampla (Ulrich)

Plate VI, figure 11

Cyrtodonta ampla Ulrich, Geol. Surv., Minnesota, Pal. 3, pt. 2, 1897, Pl. 39, fig. 34.

Large, the plesiotype measuring 56 mm., 41 mm., and 16 mm. in length (slightly broken), height, and thickness (one valve), respectively; outline obliquely ovate; beak small, incurved and close to the anterior; anterior margin slightly projecting and narrowly rounded; posterior margin broadly rounded, dorsal margin straight in the anterior half, gently convex in the posterior half, ventral margin definitely convex; umbo prominent, the greatest convexity being about one-third the length of the shell from the anterior, decreasing gradually towards the posterior extremity, the surface sloping abruptly to the antero-dorsal margin and less abruptly to the antero-ventral margin; the cast showing the ridge characteristic of the genus, and extending backwards from the back to the mid-ventral margin, the upper edge of the ridge level with the antero-dorsal surface, the lower

edge, some 5 mm. below, extending to the antero-ventral surface; the space, as usual in the genus, being filled with secondary calcite concealing the existence of the ridge when the outer surface is present; hinge of moderate length for the size of the shell; ligamental area long and narrow; surface of the cast preserving traces of concentric growth lines and low undulations.

Interior showing only a trace of the anterior muscle through the secondary calcite.

Vanuxemia ampla is larger than *Vanuxemia canadensis*, and the anterior is broader.

Ulrich, in the reference given above, places the form in the genus *Cyrtodonta*. None of the specimens found shows the tooth structure, but the internal ridge, which Ulrich, too, mentions and which shows in the present specimens, places the form in the genus *Vanuxemia*.

Occurrence. Hull beds, locality 35.

Type. Plesiotype, in the private collection of G. W. Sinclair, Hull beds, east side of Fairy Lake, Hull, Quebec.

Vanuxemia canadensis n.sp.

Plate VI, figures 7-10

Medium to large size, the largest specimen present measuring 42 mm. from beak to posterior extremity and 32 mm. and 28 mm. in greatest height and thickness (two valves), respectively; outline acuminate ovate; beak sharp, incurved, terminally situated; anterior margin narrow but having a slight projection, posterior margin broadly rounded, dorsal margin straight for a short distance thence rounding into the posterior curve, ventral margin oblique and gently convex; umbo sharply prominent in casts crossed by a scarp-like ridge extending from beak to the ventral margin short of the posterior extremity, its course continuing nearer to the ventral than to the dorsal margin, at a lower level a flattened or concave area, often filled with crystalline calcite in the cast, curving abruptly to the antero-ventral margin; hinge short and approximately straight; outer surface not known.

Teeth not seen; anterior muscle prominent, situated on the projection beneath the beak, posterior muscle large and faint; pallial line simple.

Vanuxemia canadensis is most closely related to *Vanuxemia obtusifrons* but it is more ventricose, longer and proportionately more slender with a more prominent scarp-like ridge in the cast.

Occurrence. Leray beds, localities 31, 57, 65; Hull beds, localities 35, 45, 109; Hull or Sherman Fall beds, locality 107.

Type. Holotype, G.S.C. No. 11569; paratypes, G.S.C. No. 11569a; from Hull or Sherman Fall beds, along the Ange gardien road about 4 miles west of L'Orignal, and G.S.C. No. 11570, from Jackson quarry near L'Orignal, Ontario.

Vanuxemia gibbosa Ulrich ?

Plate VI, figure 6

Vanuxemia gibbosa Ulrich, Geol. Minnesota, Pal. 3, pt. 2, 1897, p. 559.

Moderate size, the greatest length, height, and thickness of the figured specimen measuring 30 mm., 28 mm., and 23 mm. (two valves), respectively; ventricose; outline subquadrate; beak not very prominent, incurved; anterior margin rounded, projecting a little, posterior margin broadly rounded, almost semicircular, dorsal margin straight near the beak then gently convex rounding into the posterior margin, ventral margin convex; umbo prominent but not showing the ridge in this specimen, the convexity continuing to the posterior margin; surface flat or slightly concave from the umbo to the dorsal margin, towards the ventral margin inconspicuously concave near the beak but convex elsewhere; hinge rather short, straight posteriorly, gently deflected anteriorly; ligament area barely visible in the cast; outer surface with broad, low, concentric undulations, any other ornamentation lost in the cast.

Interior not seen.

Ulrich states *Vanuxemia gibbosa* "differs from the present species (*Vanuxemia hayiana*) in being more gibbous, in having a larger umbo, almost terminal beaks, and more obtuse anterior side". Ulrich never illustrated or formally described the species. The only reference is the comparison with *Vanuxemia hayiana*. For that reason the identification is queried, but the form corresponds with his diagnosis.

Occurrence. Leray beds, locality 32.

Type. Plesiotype, G.S.C. No. 11571, Leray beds, near the shore, Val Tetreau, Quebec.

Vanuxemia inconstans Billings

Plate VI, figures 3-5

Vanuxemia inconstans Billings, Geol. Surv., Canada, Rept. of Prog. 1857 (1858), p. 186, figs. 15, 16; Can. Nat. Geol. 3, 1858, p. 438, figs. 15, 16.

Shell thick; comparatively large, one specimen if completed measuring 35 mm. in length, 25 mm. in height, and 7 mm. in thickness (one valve); ovate outline; beak terminal, curved inward, and directed forward; dorsal margin gently convex, anterior margin slightly protruding above the muscle scar, posterior margin broadly rounded; umbo moderately prominent, curving gradually into the margins; hinge curved; ligamental area a shallow narrow groove posterior to the beak, the anterior and posterior part meeting at an angle; surface ornamented with concentric lines more pronounced in the later growth.

The thickened anterior part of the shell functioning as a hinge plate; three cardinal teeth, obliquely placed and gently curved, two long lateral teeth, striated on the inner side as exhibited in one specimen from which the outer lateral tooth is broken away, a rather unusual revelation; anterior muscle scar deeply excavated from the thickened anterior edge of the shell, lying just beneath and slightly posterior to the cardinal teeth, in some specimens making a protuberance on the anterior margin; posterior scar larger, not so deeply excavated and situated beneath the lateral teeth.

Vanuxemia inconstans is the genotype and comparison with other species is made under the description of each form.

Occurrence. Leray beds, localities 7, 19, 31, 40, 55, 108.

Type. Cotypes, G.S.C. Nos. 1174 and 1174c, Leray-Rockland beds, Fourth Chûte Bonnechère River, Renfrew county, Ontario.

Specimen No. 1174c was found in the old collections with some other material from St. Joseph Island, Lake Huron. It is evidently one of Billings two cotypes, which he states come from the Fourth Chûte of the Bonnechère. The other cotype is missing unless it is a drawing restored from 1174, here illustrated.

Vanuxemia cf. obtusifrons Ulrich

Plate VI, figures 12-15

Cypricardites obtusifrons Ulrich, 19th Ann. Rept. Geol. and Nat. Hist. Surv., Minnesota 1892, p. 233, figs. 18 and 19.

Vanuxemia obtusifrons Ulrich, Geol. Surv., Minnesota, Pal. 3, pt. 2, 1897, p. 554, Pl. 38, figs. 15-19.

Large, the illustrated specimen measuring 43 mm. and 30 mm. in its greatest length and height respectively; rather ventricose, outline subovate and very oblique; beak subterminal, incurved, prominent, particularly in casts; anterior margin short and obtusely rounded, posterior margin broadly rounded, dorsal margin straight or slightly concave before rounding into the posterior curve, ventral margin gently convex; umbo prominent, narrowing towards the beak, broadening posteriorly into the general convexity, the latter situated a little nearer to the dorsal than to the ventral margin, the surface between it and the dorsal margin slightly concave, and convex towards the ventral margin; ligament not seen; surface covered with irregular undulations and growth lines.

Three cardinal teeth curved, and placed obliquely beneath the beak; anterior muscle scar large, excavated from the hinge, posterior scar large, ovate, faintly impressed; pallial line simple.

Vanuxemia obtusifrons is longer in proportion to its width than *Vanuxemia suberecta* and has a shorter hinge line than *Vanuxemia sardesoni*. It is perhaps most closely allied to *Vanuxemia umbonata* but the anterior of the hinge of that species projects more, and internally the cardinal teeth of *Vanuxemia umbonata* are larger and not so oblique.

Ulrich's type comes from an horizon more nearly corresponding to Leray than to Cobourg beds, but it has been noted several times that certain forms of the Leray are repeated in the Cobourg beds.

Occurrence. Cobourg beds, localities 71, 96.

Vanuxemia parvula Whiteaves

Plate V, figure 4

Vanuxemia parvula Whiteaves, Ottawa Nat. 22, 1908, p. 111, Pl. 3, figs. 11, 12.

Small, one cotype measuring 12 mm. in length and 10 mm. in height; subtriangular in outline; beak acuminate, projecting beyond the hinge, directed slightly to the anterior; posterior and anterior margins both truncated, the anterior being a little the shorter and more broadly rounded,

both rounding into the gently convex ventral margin with a narrow curve, almost angular at the posterior extremity; umbo moderately prominent, curving somewhat abruptly to the anterior and posterior margins, but flattening towards the ventral margin; hinge apparently slightly curved; ligament area shallow as far as seen; surface ornamented by rather fine concentric lines as revealed in the casts.

Hinge and teeth not seen; anterior muscle scar small, almost circular, very prominent, evidence of a deep excavation, situated a little short of the middle of the anterior margin; posterior scar larger, not so prominent, oval, placed near the posterior extremity; pallial line not seen.

Vanuxemia parvula differs from *Vanuxemia inconstans* in being much smaller and in its transverse and triangular outline. In size it is very similar to *Vanuxemia rotundata* Hall but can be readily distinguished by its triangular outline and less gibbous umbo.

Occurrence. Pamelia beds, localities 57, 61, 85.

Type. Cotypes, G.S.C. Nos. 6804 and 6804a, Pamelia beds, east side of falls, Hogsback, Ottawa, Ontario.

Vanuxemia phaseola n.sp.

Plate VI, figures 1, 2

Comparatively large, averaging 39 mm., 24 mm., and 13 mm. in length, height, and thickness (one valve); outline bean-shaped, the total anterior and the posterior extremities being subequal; anterior margin rounded, projecting very little, posterior margin rather narrowly rounded, dorsal margin gently convex, ventral margin considerably more convex, resulting in the bean-shaped outline; umbo low, rounded, the continuing convexity lying nearer the dorsal margin, becoming flatter about one-third the distance from the posterior extremity; surface flattened, almost concave towards the dorsal margin but evenly convex towards the ventral margin; hinge very short, almost straight; ligament not seen; surface ornamented by concentric growth lines.

Hinge plate narrow beneath the beak, becoming wider anteriorly; three fine cardinal teeth, obliquely placed; anterior muscle scar excavated from the wider part of the hinge plate immediately anterior to the cardinal teeth; posterior scar and pallial line not seen.

Vanuxemia phaseola is closest to *Vanuxemia inconstans* but is considerably longer from the beak to the posterior extremity, the anterior projection is less pronounced, the beak is less conspicuous, and the posterior extremity is narrower.

The name 'phaseola' refers to the bean-shaped outline.

Occurrence. Leray-Rockland beds, locality 5.

Type. Holotype, G.S.C. No. 11572; paratype, G.S.C. No. 11572a, Leray-Rockland beds, Paquette Rapids, Ottawa River.

Vanuxemia rotundata (Hall)

Plate V, figure 7

Cypricardites rotundata Hall, Rept. Supt. Geol. Surv., Wisconsin, 1861, p. 29; Geol. Rept. Wisconsin 1, 1862, p. 38, fig. 7, p. 437.

Vanuxemia rotundata (Hall), Ulrich, Geol. Minnesota, Pal. 3, pt. 2, 1897, p. 552, Pl. 38, figs. 8-14.

Small to medium size, an average specimen measuring 21 mm., 19 mm., and 8 mm. in length, height, and thickness (one valve), respectively; almost circular outline broken by the anterior; beak incurving, quite short; anterior margin flush with the beak or projecting beyond it, more obtuse than is usual in the genus, posterior, dorsal, and ventral margins very convex; umbo broadly and evenly convex, the slope to the anterior part of the dorsal margin a little steeper than that to the anterior and ventral margins; hinge short; lunule and ligament not seen but the steeper dorsal side curves in as though for a narrow ligamental area; surface, known from casts only, showing a few, hardly distinguishable, low concentric undulations.

Teeth not seen; a few specimens showing the anterior scar, posterior scar when visible large and faint; pallial line not seen.

Vanuxemia rotundata is close to *V. dixonensis* but differs in being proportionately shorter and more nearly circular.

Occurrence. Lowville beds, locality 53; Leray beds, localities 2, 5, 31, 55, 88, 92; Leray-Rockland beds, locality 5.

Type. Plesiotype, G.S.C. No. 11573, Leray beds, quarry southeast of Green Creek and Montreal road, east of Ottawa, Ontario.

Vanuxemia skeadensis n.sp.

Plate V, figures 2, 3

Medium size for the genus, holotype, a cast, measuring approximately 18 mm. in length, 16 mm. in height, and 7 mm. in thickness (one valve); shell thick, outline ovate; beak terminal slightly incurved, projecting beyond the hinge line; anterior and posterior margins broadly rounded, the posterior extremity more narrowly curved into the gently convex ventral margin; umbo moderately prominent but in the cast having a flattened area or ribbon-like depression, the dorsal side of which is the higher, forming a subdued ridge almost to the posterior extremity; hinge curved, formed by the thickening of the anterior of the shell, and on the outer side of the cast showing as a flange for a short distance on both sides of the beak; surface ornamented with fine concentric lines.

Anterior teeth not seen, three lateral teeth present, the outer one very short; anterior muscle scar small, circular, not so prominent as in some species, posterior scar longer, more faintly impressed. A fragment of another specimen, broken in the cleaning, showed the three lateral teeth more clearly than does the holotype.

Vanuxemia skeadensis is intermediate between *Vanuxemia inconstans* and *Vanuxemia parvula* but can be readily distinguished from them. It is approximately the size of *Vanuxemia media* Ulrich but differs in not being

so convex, in having a shallow umbonal sulcus in the moulds, and in its less rounded outline. *Vanuxemia dixonensis* has the umbonal sulcus but is much larger and more gibbous.

The species is named from the Skead road, a country road lying just outside the present limits of the city of Ottawa. The road cut through a section where the basal sandy Pamela beds were first seen above the Chazy sandstone.

The local term 'skeadensis' refers to the road at the edge of which the specimens were found.

Occurrence. Pamela beds, localities 57, 84; Leray beds, locality 53.

Type. Holotype, G.S.C. No. 11574; paratype, G.S.C. No. 11574a; Pamela beds, hillside in grounds of National Research Council Laboratory, north of the Montreal road and west of Skead road.

The holotype shows the muscle scars and lateral teeth but the anterior margin is broken and distorted. The paratype gives a more correct outline of the anterior margin, though in it the posterior margin is broken.

Vanuxemia suberecta Ulrich

Plate V, figures 8, 9

Cypricardites rotundata (pars) Whitfield, Rept. Geol. Surv., Wisconsin 4, 1874, p. 208, Pl. 5, fig. 11.

Vanuxemia suberecta Ulrich, Geol. Minnesota, Pal. 3, pt. 2, 1897, p. 553, Pl. 38, figs. 20-22.

Medium size, the illustrated plesiotype, which is average, measuring 30 mm., 28 mm., and 14 mm. in length, height, and thickness (one valve), respectively; outline subcircular; beak not greatly incurved about one-fifth length from the anterior; all margins convex except beneath the beak; umbo prominent, the greatest convexity about two-fifths distance from the beak, the slope from the umbo to the anterior part of the dorsal margin steep, the anterior and ventral side less steep, eventually flattening to form a narrow band along the ventral margin from the anterior muscle scar to the posterior extremity, in some specimens an additional more or less flattened area or sinus from the beak backward, compressing the anterior part of the umbo; hinge not seen, apparently short; lunule and ligament not seen; surface showing traces of concentric lines in the casts, the only specimens seen.

Three or four oblique cardinal teeth and three lateral teeth, not seen in the casts; anterior muscle scar oval and deep; posterior scar and pallial line not seen.

Vanuxemia suberecta differs from *Vanuxemia rotundata* externally in being larger as a rule, in its less pronounced beak, and in the narrower anterior portion of the umbo.

Occurrence. Leray beds, localities 53, 54, 88.

Type. Plesiotype, G.S.C. No. 11575, Leray beds, lot 3, con. III, R.F., Gloucester tp., Ontario.

Vanuxemia tutrix n.sp.

Plate V, figures 5, 6

Medium size, averaging 32 mm., 24 mm., and 20 mm., in length, height, and thickness (both valves), respectively; outline oblique; beak prominent, incurved, almost terminally situated; anterior margin moderately rounded; posterior margin very broadly rounded, dorsal margin straight near the beak, rounded posteriorly, ventral margin gently convex; umbo very prominent over the beak; the interior scar-like ridge characteristic of the genus quite pronounced in some specimens, less so in others; hinge moderately short; ligamental area narrow; outer surface, as reflected in casts, crossed by low concentric lines.

Hinge straight posterior to the beak, short and slightly curved in front of it; teeth not seen; anterior muscle scar small, distinctly impressed, lying below and slightly anterior to the beak; posterior scar and pallial line not seen.

Vanuxemia tutrix differs from most species of the genus in its more quadrate form. *Vanuxemia gibbosa* is even more quadrate but in it the convexity of the valves persists almost to the posterior extremity rather than decreasing gradually. *Vanuxemia tutrix* is larger and longer than *Vanuxemia decipiens*, and the posterior part is more extended than that of *Vanuxemia niota*. Many specimens of both *Vanuxemia tutrix* and *Vanuxemia canadensis*, in a marked degree, exhibit the scarp-like ridge that is characteristic of the genus and is not evident on the exterior of the shell. In most specimens found of both species calcite crystals build up the lower level to the top of the ridge thus making an even curve over the ridge on the outer surface.

The specific name 'tutrix' (female guardian or protectress) refers to the 'Ange gardien' road.

Occurrence. Leray beds, localities 38, 54, 109; Hull beds, localities 35, 36, 45; Hull or Sherman Fall beds, locality 106.

Type. Holotype, G.S.C. No. 11576, Hull or Sherman Fall beds, Ange gardien road about 4 miles west of L'Original, Ontario; paratype, G.S.C. No. 11576a, from above locality.

Vanuxemia ? sp.

Plate V, figure 1

Allodesma ? *umbonatum* Wilson, Geol. Surv., Canada, Bull. 33, 1921, p. 54, Pl. 4, fig. 4.

Shell small, exact size not known, all specimens being broken; acuminate anterior, posterior not preserved; beak sharp, anteriorly situated, projecting beyond the hinge and very little incurved, as far as can be seen; umbo quite prominent, the diminishing convexity continuing to the broken posterior, slope steep both to the ventral and to the dorsal margins; umbonal ridge prominent but rounded, bifurcating at its highest elevation, the secondary ridge being less distinct and lying upon the ventral side of the umbo; low concentric undulations on the ventral side of the two ridges, and indistinct radial ridges on the dorsal side.

Fragment of what may be one crushed cardinal tooth beneath the beak, no other tooth preserved; anterior muscle scar prominent, bounded on the inner side by a deep groove indicative of a strengthening wall, posterior scar not seen.

The position of this species is still in doubt. It is not an *Allodesma* as at first suggested because of the terminal beak. The ornamentation is more like some species of *Palaeosolen*, but again the terminal beak distinguishes it from that genus. For the present it is put in the genus *Vanuxemia* because of the beak and anterior muscle scar. The query is retained because of the ornamentation, and the lack of a diagnostic interior.

Occurrence. Pamelia beds, locality 16. This form also belongs to those Pamelia beds at first considered to be of Chazy age.

Type. Holotype and paratype, G.S.C. Nos. 6225 and 6225a, respectively, Pamelia beds, first terrace above farmhouse to right of road up from the dock at MacLaren Landing, Ontario.

Genus, *Whitella* Ulrich

Genotype, *Whitella obliquata* Ulrich

Small to large; subovate or subquadrangular in outline; beak strongly incurved, situated a little anterior to the middle of the hinge; anterior margin rounded, posterior margin narrowing from the greatest width at the posterior end of the hinge, dorsal and ventral margins gently convex in outline; umbo very prominent, its convexity continuing subparallel and close to the dorsal margin; the shell surface concave between the umbonal ridge and the dorsal margin but convex to ventral margin; hinge short, gently curved; lunule and escutcheon short, the lunule hardly found in some species; ligament probably both external and internal where its inner edge is supported by an internal ridge, ligamental area striated longitudinally; surface ornamented by concentric undulations with superimposed finer growth lines.

From two to five anterior teeth, no posterior ones; anterior and posterior muscle scars simple, the latter very faint; pallial line simple, situated near the margin.

Compared with *Cyrtodonta*, externally *Whitella* has a shorter hinge line, more definite escutcheon, usually more prominent umbones and the posterior end narrows from the region of greatest width to the extremity, whereas in *Cyrtodonta* it becomes more broadly rounded. The umbonal convexity of *Whitella* is subparallel to the dorsal margin, in *Cyrtodonta* it retreats from it. Internally *Whitella* is similar to *Cyrtodonta* in having a small ridge on the hinge plate outlining the inner edge of the ligamental area, but differs in that its ligamental area is striate longitudinally and it lacks the posterior teeth present in *Cyrtodonta*.

Whitella scofieldi Ulrich

Plate VII, figures 5-7

Whitella scofieldi Ulrich, Geol. Surv., Minnesota, Pal. 3, pt. 2, 1897, p. 571, Pl. 41, figs. 17-21.

Shell medium to large size, ventricose, greatest height at the posterior end of the hinge, largest specimen to hand measuring 56 mm., 38 mm., and 35 mm. in length, height, and thickness (both valves), respectively; out-

line oblique; beak incurving, slightly anterior to the middle of the hinge; anterior and posterior extremities rather narrowly rounded, dorsal and ventral margins gently convex; umbo very prominent, relatively narrow anteriorly, the convexity continuing to the posterior extremity; surface from the oblique convexity sloping steeply to the anterior margin, becoming slightly concave, but gently convex on the broader side towards the ventral margin; hinge short for the size of the shell; escutcheon high and narrow, striate; ornamentation, concentric undulations with superimposed finer growth lines.

Interior supports of the ligament appearing as a double ridge; two cardinal teeth, elongate, slightly curved, almost horizontal; anterior muscle scar large, situated within the curve of the anterior extremity, posterior scar not seen; pallial line obscure.

Whitella scofieldi is longer in proportion to its height than most species of the genus and its umbones are very prominent in the anterior end.

Some of the specimens assigned to this species are crushed and split along the dorsal margin. The sharp angle between the posterior of the hinge and the dorsal margin is worn off. Nevertheless, other proportions being correct they are considered *W. scofieldi*.

Occurrence. Leray beds, localities 53, 65.

Type. Plesiotypes, G.S.C. Nos. 11538 and 11538a, Leray beds, lot 3, con. III, R.F., Gloucester tp., Ontario.

Whitella subcarinata Ulrich

Plate VII, figures 3, 4

Whitella subcarinata Ulrich, Geol. Minnesota, Pal. 3, pt. 2, 1897, p. 572, Pl. 41, figs. 22, 23.

Small, 24 mm., 19 mm., and 15.5 mm. in length, height, and thickness (two valves), respectively, greatest height being close to the hinge giving an aspect of hunched shoulders; outline roughly triangular with one side interrupted by the overhanging umbo; beak incurved, the tips reversed towards the posterior of the hinge, situated very close to the anterior; anterior margin projecting very slightly, posterior margin decreasing rapidly from the area of greatest height ending in a narrow curve, dorsal margin and to a greater degree the ventral margin convex near the hinge, thence gently convex to the posterior extremity; umbo prominent, subangular, the angularity continuing for two-thirds the distance to the posterior extremity then gradually dissolving into a low convexity, which continues to the end; surface concave, almost trough-like to the dorsal margin and gently convex the longer side to the ventral margin; hinge short, slightly curved; ligamental area very short extending very little beyond the overshadowing beak in either direction; surface of the cast exhibiting a few concentric lines.

Interior not seen.

Whitella subcarinata differs from *W. ventricosa* in its smaller size, in its reversed beaks, and in the sharpness of its umbonal ridge. It is larger than *W. truncata* and the anterior part of the hinge is not so extended.

The plesiotype exactly corresponds to the illustration of Ulrich's holotype, but the measurements are slightly larger than those given in the text.

Occurrence. Lowville beds, locality 57; Leray beds, localities 31, 54.

Type. Plesiotype, G.S.C. No. 11539, Leray beds, lot 4, con. III, R. F., Gloucester tp., Ontario.

Whitella subtruncata (Hall) ?

Plate VII, figures 1, 2

Edmondia subtruncata Hall, Pal. New York 1, 1847, p. 156, Pl. 35, figs. 3a-b (non 3c).

Whitella subtruncata (Hall), Bassler, U.S. Nat. Mus. Bull. 92, pt. 2, 1915, p. 1326.

Longer and narrower than some species, the longest specimen present measuring 62 mm. and 46 mm. in length and thickness (one valve), respectively; exact height not known, every specimen being incomplete; a long oval outline; beak incurved, very close to the anterior; anterior margin short and narrowly rounded, posterior margin drawn out and narrowing to semi-acuteness, dorsal and ventral margins gently convex; umbo prominent and angular, the angularity continuing to the posterior margin but becoming progressively less sharp; the surface between the ridge narrow and concave to the dorsal margin, wide and convex to the ventral margin; hinge short; escutcheon long and narrow, surface marked by concentric growth lines.

The shape of the interior of the hinge plate showing in one specimen only and that with markings obliterated, otherwise not seen.

Hall's figures are very poor, and his illustrations quite evidently represent at least two species. Some of them have a broadly rounded posterior, in others the shell narrows posteriorly from the region of greatest width. The present specimens have the narrowing posterior characteristic of *Whitella*. All shells present are casts, none is complete, and none shows teeth or muscles, leaving an element of doubt and limiting the description of a form that is fairly common but always broken.

Occurrence. Leray beds, localities 9, 31, 40, 54, 60, 65.

Type. Plesiotypes, G.S.C. No. 11540, Leray beds, lot 3, con. III, R.F., Gloucester tp., Ontario, and G.S.C. No. 11541, Duntile quarry, south of Carling Avenue, Ottawa, respectively.

Genus, *Sowteria* Whiteaves

Genotype, *Sowteria canadensis* (Raymond)

Small, convex and in some cases tumid; shell thick; outline quadrate or subtrapezoidal, a little longer than high; anterior margin almost at right angles to the direction of the ventral margin, making a gentle sigmoid curve slightly concave above and convex below; posterior margin oblique, joining the ventral margin with a sharp curve, the latter margin gently rounded; beak rather prominent, projecting slightly above the hinge, directed forward; umbo prominent, the convexity decreasing but continuing obliquely to the posterior extremity, somewhat flattened on both sides; hinge apparently curved; surface of casts with concentric undulations.

Cardinal teeth, if any, not seen; long posterior lateral teeth present; anterior muscle scar between the beak and the junction of the anterior and ventral margins, posterior scar large and faint.

Sowteria is much smaller than *Whitella*, more quadrate in outline. *Whitella* lacks the posterior lateral teeth. *Cyrtodonta* has lateral teeth but differs in shape, size, and external ornamentation.

Sowteria canadensis (Raymond)

Plate I, figures 14-16

Whitella canadensis Raymond, Amer. Jour. Sci., 4 ser. 20, 1905, p. 373.

Sowteria canadensis (Raymond), Whiteaves, Ottawa Nat. 22, 1908, p. 112, Pl. 3, figs. 13-15.

Small to medium size, an average specimen measuring 19 mm. in length, 16 mm. in height, and 13 mm. in thickness (both valves); quadrate to subtrapezoidal outline; beak forming one angle of the outline, projecting slightly above and beyond the hinge thence curving down; umbo a little flattened in the casts, prominent, the decreasing convexity continuing to the posterior extremity, a slight flattening of the convexity on the ventral side, curving more abruptly on the dorsal side; hinge line short, gently curved; ligament, escutcheon, and lunule not seen; a few low concentric undulations on the casts but finer concentric lines visible on small fragments of the outer surface.

Cardinal teeth, if any, not seen; four long lateral teeth of varying length; anterior muscle scar large for the size of the shell, deeply impressed, situated midway between the beak and the junction of the anterior and ventral margins; posterior scar larger and very faint; pallial line not seen.

The specimens seen are all casts except that small fragments of the outer surface are preserved in a few, showing the finer concentric lines. A few are less gibbous than most, the curve to the margin is more flattened, and, as a rule, these specimens are a little larger. It may be that they should be considered as a variety but because the difference is slight and the specimens are poorly preserved, they are retained in the species for the present.

Raymond did not illustrate his *Whitella canadensis*, though he states that it came from Aylmer. Whiteaves specimens are missing and his illustrations are drawings, considerably idealized to judge from specimens to hand. He, too, specifies the locality as Aylmer. Whiteaves, however, in changing the genus gives it the name *Sowteria*. In front of the old home of the late Mr. Sowter, a local collector of Aylmer, is an outcrop of sandstone, originally designated as of Chazy age, but now known to be a sandstone layer in the basal Pamela beds. A little south of the above outcrop is a sandstone of undoubted Chazy age. The matrix of one specimen might indicate the Chazy sandstone, but all other specimens from the localities listed are certainly from Pamela beds. For these reasons it is thought that the types may have come from Pamela beds.

Occurrence. Pamela beds, localities 24, 33, 57, 85, 101.

Type. Plesiotypes, G.S.C. Nos. 11542, 11542a, Pamela beds, Skead road, east of the National Research Council Laboratories on the Montreal road and half-way to the river; and G.S.C. No. 11603, the Merivale road, west of Ottawa, respectively.

C. Schizodonta

Genus, *Actinopterella* Williams

Genotype, *Pterinea radialis* Clarke (pars)

Medium to large size; oblique pteroid outline with both anterior and posterior wings; the left valve slightly more convex than the right; beak small, incurved, slightly overhanging the hinge; hinge of moderate length; umbo evenly convex, the convexity in both valves gradually decreasing to flatness in the wings; ligament well developed, striate; ornamentation fine or strong radial striæ superimposed upon growth lines.

Three or four cardinal teeth, the latter close to the ligament; anterior muscle scar small and deep, situated on the anterior wing; posterior scar large and obscure.

Actinopterella differs from *Actinopteria* and *Pterinea* in having both valves convex.

Actinopterella ? tessellata n.sp.

Plate VII, figures 8-11

Large, averaging 52 mm., 42 mm., and 18 mm. in length, greatest height, and thickness (two valves), respectively; outline ovate, equivalent and almost equilateral with subequal anterior and posterior wings; beak small, narrow, sharply pointed when preserved complete, and slightly elevated above the hinge line; hinge line averaging 29 mm. in length but rarely complete; ligament not seen; a fine tessellate ornamentation superimposed upon concentric growth lines apparently best developed on the central part of the posterior half, when worn, only the concentric lines preserved.

Teeth not seen; anterior muscle scar medium for the size of the shell, deeply impressed, oval shape, situated in the anterior wing with its long axis almost parallel to the hinge; posterior scar not seen.

Actinopterella ? tessellata differs from the genotype in being large, in being more nearly equilateral, and in the tessellated ornamentation. It is very close to *Actinopterella subelliptica* in shape, and worn specimens were first assigned to that species but the tessellated ornamentation is distinct when preserved, and it lacks the radial striæ other than the fine, broken lines of the tessellate pattern.

The genus is queried, because the typical forms have strong radial striæ.

Occurrence. Hull beds, locality 109; Hull or Sherman Fall beds, locality 105; Sherman Fall beds, localities 117-119; Cobourg beds, locality 124.

Type. Holotype, G.S.C. No. 1659a; paratypes, G.S.C. Nos. 1659, 1659b, lot 26, con. V, Osnabruck tp., and G.S.C. No. 11578, in bed of Aux Raisins River near Black River Station; all from Sherman Fall beds; and G.S.C. No. 11604, Hull or Sherman Fall beds, Ange gardien road, about 4 miles west of L'Original, Ontario.

Genus, *Ambonychia* HallGenotype, *Ambonychia bellistriata* Hall

Medium or large; very inequilateral; beak terminal or nearly so, no anterior wing but some wing extension posteriorly; valves tightly closed, anterior margin receding, posterior margin broadly rounded, dorsal margin curved convexly beyond the hinge line, ventral margin convex; ventricose, with prominent umbo; hinge short; ligament external; surface with fine radiating lines crossed by obscure undulations, only the latter showing in casts, which is the condition of most specimens.

Two small cardinal teeth, no lateral teeth; a small lobe-like cavity present lying beneath the beak and separated from the main umbonal cavity by a thin partition.

The genus is most closely allied to *Byssonychia* from which it differs externally in its sharper beak, in the lack of a byssal opening, and in the weaker radial striæ. Internally it differs in having the small anterior cavity and in the lack of lateral teeth. *Ambonychia* differs from *Ambonychinia* externally in its longer, less triangular outline and internally in the presence of the two cardinal teeth.

Ambonychia affinis Ulrich

Plate VIII, figure 11

Ambonychia affinis Ulrich, Geol. Surv., Minnesota, Pal. 3, pt. 2, 1897, p. 492, Pl. 35, figs. 5-7.

Moderate size, the only specimen found measuring 34 mm. from the beak to posterior extremity and 27 mm. in greatest height; outline oblique, acuminate anteriorly, ovate posteriorly; beak terminal, narrow, projecting; anterior margin oblique, posterior margin broadly rounded, dorsal margin straight for the length of the hinge and then convex to the posterior; ventral margin oblique from the anterior and then convex; umbo narrow, moderately prominent for the genus, the convexity lessening posteriorly, surface curving steeply to the anterior margin, more gradually towards the dorsal side, ultimately becoming concave; hinge short, ligamental area shallow; surface covered with fine radiating striæ.

Hinge plate narrow; two oblique cardinal teeth, no lateral teeth.

Only a part of the anterior muscle is visible on the specimen to hand, and the striæ are a little finer than cited in the Minnesota form, but this may be because the striæ are preserved only under the curve of the umbo. They may become broader posteriorly.

Ambonychia affinis differs from *Ambonychia planistriata* in that the umbo is less tumid and the general convexity is less, the outline is more rounded, the hinge is shorter, and the radiating striæ are a little coarser.

Occurrence. Hull beds, locality 109; Cobourg beds, localities 70, 72.

Type. Plesiotype, G.S.C. No. 11579, Cobourg beds, corner of Fifth Avenue and Percy Street, Ottawa, Ontario.

Ambonychia amygdalina Hall

Plate VIII, figures 13, 14

Ambonychia amygdalina Hall, Pal. New York, 1, 1847, p. 165, Pl. 36, figs. 6a-c.

Large, ventricose; obliquely ovate or subelliptical; beaks terminal, turned very slightly forward; anterior margin almost concave with a little hollow beneath the beak, posterior margin broadly rounded, dorsal margin convex beyond the hinge line, ventral margin oblique and convex; umbo, narrow, prominent, the slope towards the dorsal margin almost flat but gently convex towards the ventral margin, the convexity increasing for about two-fifths the length from the beak and then decreasing towards the posterior extremity, but throughout lying nearer to the ventral than to the dorsal margin; hinge straight, in length more than one-half that of the whole; ligamental area shallow; no lunule seen in the hollow beneath the beak; surface of the moulds, the only specimens seen, not showing any radial striæ, but a few concentric undulations present.

Interior not seen.

Ambonychia amygdalina differs from *A. orbicularis* in its longer, narrower outline. *A. bellistriata* has a very slight projection beyond the beak, and *A. planistriata* has stronger undulations which begin just below the beak. *A. affinis* is smaller and rounder.

Occurrence. Leray beds, localities 31, 40, 53; Hull beds, localities 36, 122; Hull or Sherman Fall beds, localities 43, 44; Cobourg beds, locality 73.

Type. Plesiotype, G.S.C. No. 11580, Leray beds, La petite Chaudière, Val Tetreau, Quebec.

Ambonychia orbicularis (Emmons)

Plate VIII, figure 12

Pterinea orbicularis Emmons, Nat. Hist. New York, Geol. 2, 1842, pp. 368-9, fig. 3.*Ambonychia orbicularis* (Emmons), Hall, Pal. New York 1, 1847, p. 164, Pl. 36, figs. 5a-d.

Generally large; outline sub-rhomboid or orbicular, having some wing extension posteriorly; beak terminal projecting beyond the hinge; anterior margin receding, posterior margin broadly rounded, dorsal margin straight along the hinge thence curving into the posterior, ventral margin oblique at the anterior, thence curving into the posterior; umbo broadly rounded but contracting towards the beak, the convexity continuing to the posterior extremity, ventricose throughout, but the surface somewhat flattened towards the dorsal and ventral margins; hinge straight, more than half the length of the whole shell; ligamental area shallow; surface ornamented with radiating crossed by concentric striæ gathered into undulations, only the latter seen in the casts at hand.

The two specimens found are somewhat smaller than the types illustrated but no measurements are given and the figures of the types are drawn not photographed, otherwise the specimens correspond.

Ambonychia orbicularis is wider in proportion to its length than *Ambonychia amygdalina* and more ventricose, less oblique in outline, and the beak is not so prominently projecting.

Occurrence. Cobourg beds, locality 123.

Type. Plesiotype, G.S.C. No. 11581, Cobourg beds, excavation for 401 Fourth Avenue, Ottawa, Ontario.

Genus, *Byssonychia* Ulrich

Genotype, *Ambonychia radiata* Hall

Generally large and ventricose; outline oblique, inequilateral with short wing posterior to the beak; beak acute, nearly or quite terminal; anterior margin oblique, a byssal opening in the upper half, posterior margin broad and rounded, dorsal margin short, ventral margin very convex; umbo moderately prominent, hinge short; ligament external; surface covered with strong radiating striæ with a few less prominent concentric growth lines.

Hinge plate containing several small cardinal teeth and two or three slender, lateral teeth; posterior scar large; pallial line simple.

Byssonychia differs from *Ambonychia* externally in its more erect form, the presence of the byssal opening, and in the strength of the radiating striæ. Internally it differs in having lateral teeth and in lacking the partition between the anterior muscle and the cavity.

Byssonychia vera Ulrich

Plate VIII, figure 1

Byssonychia vera Ulrich, Geol. Surv., Ohio, 7, 1893, p. 629, figs. a-c; Foerste, Jour., Cincinnati Soc. Nat. Hist. 21, 1914, p. 134, Pl. 1, fig. 15.

Rather small for the genus; winged and subtriangular in outline; beak tumid, sharply pointed, overhanging and terminal; anterior margin oblique, posterior margin broadly rounded, dorsal margin straight, ventral margin oblique and convexity of its outline increasing posteriorly; umbo sharp near the beak but its convexity decreasing rapidly, the surface sloping abruptly into the dorsal margin, more gradually to the ventral margin, finally becoming almost flat or even concave; hinge rather long for the size of the shell; ligament not seen; surface covered by approximately fifty low, radiating striæ, the striæ being broader than the space between.

Interior not well preserved, a posterior scar and simple pallial line generally visible.

Byssonychia vera is readily distinguished from *Byssonychia byrnesi* by its narrower striæ, from *Byssonychia intermedia* by its larger size and coarser striæ.

Occurrence. Sherman Fall beds, locality 43.

Type. Plesiotype, G.S.C. No. 11582, Sherman Fall beds, C.P.R. cutting south of Aylmer road, Hull, Quebec.

Genus, *Clionychia* Ulrich

Genotype, *Ambonychia lamellosa* Hall

Size variable from small to medium; equivalved, almost equilateral; beak small, a little incurved, terminal; anterior margin sharply pointed, no byssal opening, posterior margin broadly rounded; hinge straight, proportionately rather long; umbo prominent, the convexity decreasing but

maintained to the posterior extremity, surface curving abruptly to the ventral margin, more gradually towards the hinge; margins tightly closed; ligament internal; ornamentation undulations or growth lines only.

No cardinal or lateral teeth; anterior having a thickened hinge producing an impression in the cast; anterior muscle near the beak; posterior muscle scar large, bilobed, the lower lobe being the larger, situated in the posterior third.

The genus is very similar to *Ambonychia* in outline and in the bilobation of the posterior scar. It differs, however, internally in the lack of teeth and externally in lacking the small cavity anterior to the beak and the radial striæ.

Clionychia ? gibbosa Whiteaves

Plate IX, figures 2, 3

Clionychia gibbosa Whiteaves, Ottawa Nat. 22, 1908, p. 109, Pl. 3, figs. 5 and 6.

Shell medium size, the largest illustrated specimen measuring 24 mm. in length, 16 mm. in height, taken from the illustration only; outline sub-pentagonal or subovate, very tumid; beak rather acute, terminal, projecting beyond the hinge and slightly incurved; anterior margin obliquely truncated, posterior margin slightly less truncated, both curving into the narrowly rounded posterior extremity; umbo broad, very tumid, with steep sides curving down to the almost parallel margins and its convexity continuing to the posterior extremity; a few concentric lines seen.

Interiors not seen.

Clionychia ? gibbosa, as described, differs from *Clionychia ottawaensis* in having a less acuminate and shorter beak, in its greater size, and outstanding gibbosity.

The form is still assigned to the genus *Clionychia* with a query because of the poor preservation and the lack of any specimen showing the characteristic bilobed muscle scar.

The writer has not seen the types which are missing, though there are a number of poorly preserved specimens in the collections that might be broken members of the species.

Occurrence. Pamela beds ?, locality 61.

As mentioned elsewhere the forms from Hogsback, particularly those from the east side of the falls, are probably from Pamela beds.

Type. Holotype and paratype missing, Pamela beds ?, Hogsback, south of Ottawa, Ontario.

Clionychia ? ottawaensis Whiteaves

Plate IX, figure 1

Clionychia ottawaensis Whiteaves, Ottawa Nat. 22, 1908, p. 108, Pl. 3, fig. 4.

Shell small, the illustration of the holotype about average, measuring 19 mm. in length and 12 mm. in greatest height; outline oblique and acuminately suboval; beak small, slightly overhanging; anterior margin very small, acutely rounded, posterior margin subalate; hinge long and straight; umbo convex, the convexity gradually decreasing but continuing

to the posterior extremity, curving abruptly to the ventral margin but slightly flattening in its descent to the hinge; ornamentation concentric growth lines only on the casts.

Interior not seen.

Clionychia ? ottawaensis is most closely related to *Clionychia subundata* Ulrich, but it is smaller and more convex.

The genus is here queried because no interior has been seen, either by the author of the species or by the present writer. The identification is based upon external features.

Occurrence. Pamelia beds, localities 15, 17, 61, 101.

Type. Unfortunately the holotype is missing, nor have Whiteaves' seven other original specimens been found. None of the specimens at hand are sufficiently complete to be named as neotypes. The holotype came from Pamelia beds at Hogsback, southwest of Ottawa, Ontario.

These beds were originally classed as of Chazy age "immediately underlying the Birds-eye limestone at this locality". It has since been found that in the Ottawa area there are some 70 to 75 feet of basal Black River beds, the Pamelia, between the Lowville and the Chazy beds.

Clionychia subundata Ulrich

Plate IX, figure 4

Clionychia subundata Ulrich, Geol. Surv., Ohio, 7, 1893, p. 651, figure.

Shell small for the genus, length of the holotype as illustrated 25 mm. from beak to posterior extremity and 15 mm. in greatest width; outline narrow and very oblique; beak terminal, moderately prominent, very little incurved; anterior margin oblique, posterior margin rounded, dorsal margin straight, ventral margin gently convex; umbo low, not differentiated from the general convexity, the latter continuing to the posterior extremity, its course lying nearer to the ventral than to the dorsal edge; surface from the greatest convexity flattened or gently concave to the dorsal margin but convex and sloping steeply to the antero-ventral margin; ornamented by fine growth lines gathered into closely spaced undulations.

Interior not known.

Clionychia subundata is very similar to *Clionychia undata* but is smaller and the undulations are lower and closer together.

Occurrence. Leray-Rockland beds, localities 5, 94, 96; Sherman Fall beds, locality 121; Cobourg beds, locality 124.

Type. Plesiotype, G.S.C. No. 11584, Leray-Rockland beds, Paquette Rapids, Ottawa River.

Clionychia undata (Emmons)

Plate IX, figures 5, 6

Pterinea undata Emmons, Geol. Rept. New York, 2, 1842, p. 395, fig. 1.

Ambonychia undata (Emmons) Hall, Pal. New York, 1, 1847, p. 165, Pl. 36, figs. 7a-b.

Clionychia undata (Emmons), Ulrich, Geol. Minnesota, Pal. 3, pt. 2, 1897, p. 497, Pl. 35, figs. 21, 22.

Shell medium size to large, one specimen measuring 35 mm. and 15 mm. in height and thickness (one valve), posterior broken and length not known; outline triangular, or subquadrate; beak prominent, acute, slightly

incurved, almost terminal; anterior margin oblique receding from the beak, posterior margin broadly rounded, dorsal margin convex beyond the hinge line, ventral margin gently convex, the slope to the anterior margin abrupt and convex; umbo rounded, its greatest prominence about one-third the distance from the beak, the convexity decreasing posteriorly but throughout lying nearer to the ventral than to the dorsal margin; the surface from the umbo to the anterior margin almost vertical near the beak, but becoming convex as the umbonal convexity lessens posteriorly, surface from the umbo to the dorsal margin with a concave slope, which flattens out anteriorly and posteriorly, giving the dorsal side a somewhat winged effect; hinge long, straight, projecting very slightly beyond the beak in well-preserved specimens; ligament and lunule not seen; surface covered with broad undulations, which begin at the beak.

Interior with a narrow hinge plate and a lunule-like impression beneath the beak; anterior muscle scar moderately large, situated beneath the beak at the anterior of the hinge, posterior scar not seen.

Clionychia undata in general shape is near *C. lamellosa*, but can be distinguished by its undulations.

Occurrence. Leray beds, localities 53, 112; Leray-Rockland beds, locality 5; Rockland beds, locality 113; Cobourg beds, locality 69.

Type. Plesiotype, G.S.C. No. 11583, Leray beds, lot 3, con. III, R.F., Gloucester tp., Ontario (upper beds).

Genus, *Conocardium* Brown

Genotype, *Conocardium hibernicus* Sowerby

Size variable; form cylindrical to abruptly truncate, the proportion of height to length also variable, the length in most specimens being considerably greater than the height; beak strongly incurved, directed slightly towards the posterior, the relative situation varying with the prolongation of either the anterior or posterior; anterior margin more or less produced and gaping ventrally, posterior margin truncate, with a knob or tubercle, and in some forms with the ventral part produced into a scoop-like process which is usually broken away, dorsal margin straight or slightly deflected at the anterior, ventral margin rounded anteriorly and in some species changing abruptly; hinge long, following the dorsal margin; umbo prominent, some species having a definite ridge dividing the anterior and posterior part of the shell; ligament external; no lunule or escutcheon; ornamented by both concentric and strong radial striæ, the latter crenulating the ventral margin and curving into the prolongation of both anterior and posterior when present.

An obscure cardinal tubercle and a single lateral tooth present; both anterior and posterior muscle scars are evident.

Conocardium is distinguished from other genera in the decided difference between the shape of the anterior and posterior parts of the shell.

Conocardium immaturum Billings

Plate VIII, figure 5

Conocardium immaturum Billings, Geol. Canada, 1863, p. 143, fig. 83; Geol. Surv., Canada, Pal. Foss. 1, 1865, p. 41, fig. 43.

Very minute, lectotype measuring 7 mm. and 5.5 mm. in length and height respectively; more or less triangular in outline; beak incurved, directed slightly towards the posterior; anterior end broken but apparently only a little produced; posterior margin truncated, thin, about mid-height sharply projecting into a tubular process, dorsal margin probably nearly straight, a little deflected anteriorly and posteriorly, broken between the beak and the extremity, ventral margin rather sharply rounded anteriorly but abruptly altered posteriorly in passing into the prolonged extremity; umbo rather prominent, rounded; hinge not preserved but probably approximating the course of the dorsal margin; ligament not seen; ornamented by fine concentric lines and strong radial striæ on the umbo and the part of the anterior that is preserved, obliterated posteriorly by silica, but crenulating the ventral margin.

Interior not seen.

Occurrence. Leray-Rockland beds, locality 5.

Type. Lectotype, G.S.C. No. 1180a, Leray-Rockland beds, Paquette Rapids, Ottawa.

Two highly silicified specimens were with Billings types. One is evidently a small brachiopod, which, without the posterior projection, looks very similar to the *Conocardium* in outline. If the other is the type the drawing is reversed and is a little idealized. In the specimen no distinct ridge is visible between the central and anterior regions. The present writer, having respect for Billings customary careful observation, prefers to call it a lectotype.

Conocardium paquettense n.sp.

Plate VIII, figure 6

Small, the only specimen present broken at both anterior and posterior wings but height measuring 18 mm.; anterior extended and posterior flat; beak incurved, directed somewhat to the posterior; anterior and posterior margins sharply divided by a strong curved rib, dorsal margin straight, ventral margin convex on the anterior part thence abruptly turning at an angle of less than 90 degrees, continuing towards the hinge to the broken base of the apparently small posterior projection; umbo very prominent, crossed by the rib mentioned above; surface marked by strong radiating lines, between them fine growth lines slightly convex towards the hinge.

Interior not seen.

Conocardium paquettense is considerably larger than *Conocardium immaturum* and *Conocardium antiquatum*, the other species of the Ordovician. The species is distinguished from others of the genus by the unusually backward curve of the rib described above, which divides the anterior from the posterior part of the shell with the consequent acuteness of the angle on the ventral margin.

Occurrence. Leray-Rockland beds, locality 5.

Type. Holotype, G.S.C. No. 11585, Leray-Rockland beds, Paquette Rapids, Ottawa River, Quebec.

Genus, *Lyrodesma* ConradGenotype, *Lyrodesma planum* Conrad

Small to moderate size; ovate to subquadrate outline; beak small, incurved, situated anterior to the middle; anterior margin rounded, posterior acute to truncate, dorsal margin oblique to the acute posterior or meeting the truncated posterior at an angle, ventral margin broadly rounded; umbo low and even, rounding into the anterior margin without interruption but on the dorsal side bounded by a ridge outlining a flat or concave slope extending almost or quite to the posterior extremity, in the latter case producing the truncate posterior margin; hinge short and curved; radial striæ from the beak to the posterior extremity within the concave dorsal area, concentric striæ elsewhere.

Hinge plate triangular, bearing upon it six to eight radiating teeth, the whole producing a definite depression upon the dorsal edge of the cast of an interior; muscle scars rather faintly impressed, the posterior ones being the larger, two pairs of small pedal muscle scars present, the anterior pair situated immediately above the anterior scars and the posterior pair just behind the teeth; pallial line with a slight invagination posteriorly.

Lyrodesma acuminatum Ulrich

Plate IX, figures 18, 19

Lyrodesma acuminatum Ulrich, Geol. Surv., Minnesota, Pal. 3, pt. 2, 1897, p. 609, Pl. 42, figs. 1-5.

Moderate size, average specimen measuring 18 mm., 12 mm., and 5 mm. in length, height, and thickness (one valve); almost triangular in outline; beak small, incurved, not very prominent, situated about one-third distance from the anterior; anterior margin rounded, posterior margin acute or very acutely rounded, dorsal margin curved beneath the beak becoming straight posteriorly, ventral margin gently convex; umbo low, rounded, curving rather steeply into the hinge on the anterior, but bounded by a sharp ridge posteriorly; a concave triangular area lying between the umbonal ridge and the margin posterior to the beak ending acutely at the posterior extremity; hinge arcuate; surface radially striate in the concave area bordering the umbonal ridge, concentrically striate elsewhere.

Six radiating teeth placed upon a concave plate beneath the beak, the anterior teeth considerably shorter than the posterior; vertical carinæ on each side of each tooth and on the inner side of the shell bordering the concave plate; muscle scars represented by two small pits excavated in the thickened margin of the plate beyond and slightly below the teeth; a faint anterior muscle scar lying below the hinge plate; posterior muscle scar and pallial line not seen.

Lyrodesma acuminatum differs from most other species of the genus in being wider and in the acute posterior extremity. The specimens at hand do show some variation, some but not all of them being a little more rounded than the type specimen as illustrated.

Occurrence. Leray-Rockland beds, localities 4, 5.

Type. Plesiotypes, G.S.C. Nos. 1163a and 1163f, Leray-Rockland beds, Paquette Rapids, Allumette Island, Quebec.

D. *Dysodonta*

Genus, *Modiolopsis* Hall

Genotype, *Cypricardites ovatus* (Conrad)

Shell thin, usually with a dark epidermis; outline very inequilateral, subovate, broader posteriorly; moderately ventricose and tightly closed; beak small, situated in the anterior third; hinge gently arcuate; umbo small and low projecting slightly beyond the hinge; a low depression lying inconspicuously below or posterior to the umbo becoming broader ventrally and making a definite sinus in the outline of the ventral margin; ligament external, in a very narrow area; ornamentation concentric growth lines, which are more strongly defined and more regular in the posterior half.

A single obscure undefined cardinal tooth and socket present in each valve; anterior adductor scar deeply impressed, sharply defined on the inner edge, situated beneath the umbo; posterior scar large, only faintly impressed, situated in the posterior third of the shell; pallial line simple.

For differences from *Whiteavesia* see under that genus.

Modiolopsis differs from *Modiolesma* in the presence of the oblique depression which alters the ventral margin, in its more prominent umbo, in the position of the beaks, and in the posterior position of the stronger growth lines. It differs from *Modiomorpha* in lacking well-defined teeth.

Modiolopsis compacta Wilson

Plate IX, figure 15

Modiolopsis compacta Wilson, Geol. Surv., Canada, Bull. 33, 1921, p. 53, Pl. 4, fig. 3.

Size rather variable, average length 20 mm., height 12 mm., thickness 4 mm. (one valve) as given in the original description but a large number of smaller forms have been found since; very inequilateral, the anterior being short and narrowly rounded just beneath the beak, the posterior longer and more broadly rounded; beak small, incurved, placed about one-quarter of the length from the anterior end; hinge gently curved; umbonal region prominent but somewhat flattened on top; sinus very shallow, beginning with a narrow flattening on the umbo, widening towards the ventral margin though affecting it only slightly; surface apparently covered by fine striæ.

The obscure modiopsian type of tooth not seen on any specimen; anterior muscle scar sharply defined on the inner side, fading out towards the margin of the shell but occupying most of the anterior projection beyond the beak, posterior scar faint, rarely preserved.

The varying sizes of *Modiolopsis compacta* can be graded into three groups, those below 13 mm. in length, those between 14 and 16 mm., and those above 17 mm. The intermediate and larger groups are slightly higher in proportion to their length, but it is thought that a larger collection would probably eliminate the different groupings. For this reason the smallest forms are considered to be young forms rather than a variety.

Small specimens of *Modiolopsis compacta* are very similar to *Modiolopsis nana* Ulrich, but the posterior of the latter is more broadly rounded. The larger forms differ from *Modiolopsis similis* Ulrich in having

a narrower anterior margin and in being less robust on the whole. There is little doubt that they are all closely related, and it is possible that the Michigan species, which occur in younger Ordovician beds, are derived from the older form that in the Ottawa-St. Lawrence region does not persist to the higher beds. It is difficult to compare drawings, but in outline *Modiolopsis compacta* seems to be close to *Modiolopsis parva* Ulrich from the Cincinnati beds. It differs in that the oblique convex continuation of the umbo appears to be nearer the dorsal margin than it is in *Modiolopsis parva* as illustrated.

The writer is inclined to think that the specimens identified by Whiteaves as *Modiolopsis fabaeformis* Raymond (Ottawa Field Nat. 22, Pl. 3, fig. 7) may belong to this species. Whiteaves specimens are missing so that it is not possible to compare them. In addition it must be remembered that the Pamela beds of eastern Ontario were originally thought to be of Chazy not of Black River-Trenton age.

Occurrence. Pamela beds, localities 13, 20, 30, 62, 83, 99; Lowville beds, localities 28, 52.

Type. Holotype, G.S.C. No. 6224, Pamela beds, west of MacLaren Landing, 30 miles west of Ottawa, Ontario.

Modiolopsis ? dubia n.sp.

Plate IX, figure 14

Medium size, holotype measuring 23 mm., 16 mm., and 6.5 mm. in length, height, and thickness (one valve), respectively; outline subquadrate; beak small, incurved, situated about one-quarter the total length from the anterior margin; anterior margin rather sharply rounded, posterior margin broadly rounded, dorsal and ventral margins subparallel, but the latter having a slight invagination; umbo raised but somewhat flattened on top, umbonal ridge ending on the ventral margin rather than as usual at the posterior extremity; the slope from the ridge to the dorsal margin being gently concave; hinge broken anteriorly but extending about two-thirds the posterior length from the beak; a broad, low but distinct sinus extending from the umbonal region, gradually widening until it occupies more than half the ventral margin; lunule and escutcheon area not preserved; surface worn off.

Interior not known.

Modiolopsis ? dubia differs from *Modiolopsis ? compacta* in its more quadrate form, more broadly rounded posterior margin, and deeper sinus. It more closely resembles *Modiolopsis oweni* in outline, but differs from that species, as illustrated, in that the umbonal ridge melts into the ventral margin a little anterior to the posterior extremity.

The genus *Modiolopsis* is queried because of the imperfectness of the only specimen found, yet it differs from other described species and, therefore, is included. The shape of the anterior margin suggests a slight bend, which would eliminate the genus *Orthodesma*. The umbonal region is considerably less robust than that of *Cuneamya* and it lacks the radial striæ and consequent spines of *Rhytimya*.

Occurrence. Leray beds, locality 54.

Type. Holotype, G.S.C. No. 11543, Leray beds, lot 4, con. III, R.F., Gloucester tp., Ontario.

Modiolopsis fabaeformis Raymond

Modiolopsis fabaeformis Raymond, Amer. Jour. Sci., 4th ser., XX, 1905, p. 374.

Modiolopsis fabaeformis Raymond, Whiteaves, Ottawa Nat. 22, 1908, p. 110, Pl. 3, figs. 7-8.

This form has been omitted for several reasons. Whiteaves' plesio-types are missing and his illustrations show one form with a blunt anterior, and two forms having a somewhat projecting anterior.

In addition, there is doubt as to the beds from which the specimens came. The fossil-bearing horizon of the Hogsback area belongs to the Pamela beds of Black River age. And, although true Chazy sandstones occur in the area, it must also be remembered that the Pamela was originally classed as of Chazy age.

Modiolopsis cf. *maia* Billings

Plate IX, figure 8

Modiolopsis maia Billings, Geol. Surv., Canada, Pal. Foss. 1, 1865 (Adv. sheets 1862), p. 44, figs. 4a and 4b.

Small specimen figured here measuring 12 mm., 8.5 mm., and 6 mm. in length, height, and thickness (two valves), respectively; outline oval; beak small, incurved, situated far forward, approximately one-fifth the total length from the anterior; anterior margin more narrowly rounded than the posterior, dorsal margin gently convex posterior to the hinge, ventral margin straight or showing a slight invagination; umbo rather prominent, the ridge posterior to it continuing to the lower posterior extremity with decreasing convexity, its course in general lying nearer to the dorsal margin than to the ventral; surface gently concave from the ridge to the anterior of the dorsal margin, more gibbous but flattened or showing a broad shallow sinus from the ridge to the ventral margin; ligamental area very narrow and short; surface of the cast revealing only a few coarse concentric growth lines.

Interior showing only the anterior muscle scar.

Modiolopsis maia differs from *Modiolopsis nais* in the more rectangular posterior margin, in being less gibbous, in its narrower ligamental area, and in its less robust appearance. It is considerably higher and less robust than *Modiolopsis minusculus* and has a more prominent umbo.

The present specific identification is queried because the holotype as illustrated has a more angular posterior extremity, but Billings' illustration does not agree with the proportionate measurements of the text. The holotype itself is missing.

Occurrence. Lowville beds, locality 98.

Type. Figured specimen in the private collection of G. W. Sinclair, Lowville beds, Stewart quarry, Rockland, Ontario.

Modiolopsis meyeri Billings

Plate IX, figure 16

Modiolopsis meyeri Billings, Geol. Surv., Canada, Pal. Foss. 1, 1865 (Adv. sheets 1862), p. 42, fig. 44.

Unfortunately Billings' type is missing. The original description is as follows: "Transversely sub-ovate, alated posteriorly, rather strongly ventricose. The umbones are a little flattened and the beaks strongly

incurved. From the umbones a strong oblique gibbosity extends diagonally downwards and backwards, becoming obsolete near the lower posterior angle. The hinge line is straight and about half the whole transverse length of the shell. The posterior half of the dorsal margin is elevated into a rather prominent rounded alation, thence descending with a uniform gentle curve to the posterior extremity, which is narrowly rounded and confined to the lower half of the shell. Ventral margin gently convex; anterior extremity small, about one-seventh the whole transverse length.

"The length from posterior to anterior extremity is about 2 inches; from greatest elevation of dorsal margin in the posterior half to ventral margin 1 inch; from umbones to ventral margin $\frac{3}{4}$ of an inch.

"Differs from *M. modiolaris* in its greater gibbosity, and from *M. gesneri* in the convex ventral margin, and absence of a byssal sinus.

"*Locality and Formation*—City of Ottawa, Trenton limestone."

Billings' description and illustration are somewhat contradictory. One of the characteristics of *Modiolopsis* is the invagination of the ventral margin, and it is evident in the illustration. This characteristic is not mentioned in the description, and later he states that it differs from *M. gesneri* in the convex ventral margin.

The form is cited and illustrated here because it has been found in the area, and with the expectation that it will be found again, when a more exact description can be given.

Modiolopsis minuscula n.sp.

Plate IX, figure 10

Minute, holotype measuring 11 mm., 5 mm., and 5 mm. in length, height, and thickness (two valves), respectively, a few specimens being slightly larger and others slightly smaller; outline a long, narrow oval; beak small, a little incurved, situated far forward; anterior and posterior margins rounded, the anterior being the narrower, dorsal and ventral margins subparallel, the ventral one having a gentle invagination; umbo prominent for the size of the shell, depressed a little on top, rather broad for the size of the specimens; the ridge posterior to the umbo quite prominent in the anterior part but decreasing posteriorly; a shallow oblique sinus extending from the umbo to the ventral margin; hinge short and almost straight; surface as reflected in the casts, having a few undulations.

Interior not seen except for a part of the anterior muscle.

Modiolopsis minuscula is nearest to *Modiolopsis maia* but it is longer and narrower, and the posterior is not truncated as shown in the illustration of *Modiolopsis maia*.

Occurrence. Lowville beds, localities 53, 98.

Type. Holotype, in private collection of G. W. Sinclair, from Lowville beds, Stewart quarry, Rockland, Ontario.

Modiolopsis nais Billings

Plate IX, figures 11-13

Modiolopsis nais Billings, Geol. Surv., Canada, Pal. Foss. 1, 1865 (Adv. sheet 1862), p. 45, fig. 47.

Small, holotype measuring 13 mm. in length, 7.5 mm. in height, and 7 mm. in thickness (both valves); transversely elongate; beak small, incurved, situated from the anterior about one-quarter the total length; anterior and posterior margins slightly gaping, possibly due to preservation, both margins rounded, the posterior being slightly the broader of the two, dorsal and ventral margins subparallel; umbo small, slightly flattened on top, bounded by a minute ridge sloping towards the top of the anterior margin, and a more pronounced, oblique ridge that gradually blends into the general convexity just short of the posterior extremity; hinge short, straight or gently curved; a broad indistinct sinus extending from the flattened umbo to the ventral margin; ligamental area, if present, very small; surface showing rather large but low concentric ridges, which in better preserved specimens may have finer growth lines superimposed. All specimens known are casts.

Interior not known except for two poorly preserved impressions of the anterior scar in one specimen.

The genus cannot be established unquestionably because of the lack of an adequate interior, but the flattened umbo with the indistinct sinus continuing to the ventral margin distinguish it from *Cyrtodonta*, to which genus it might otherwise be thought to belong.

Occurrence. Lowville beds, localities 27, 50, 52, 53, 103; Leray beds, localities 1, 47, 48, 54; Leray-Rockland beds, locality 5; Hull or Sherman Fall beds, locality 43.

Type. Holotype, G.S.C. No. 1165, Leray-Rockland beds, Paquette Rapids, Allumette island, Quebec. The posterior extremity is more broadly rounded than is shown by the rather worn holotype (See Pl. IX, figs. 12, 13); plesiotype, G.S.C. No. 11544, Leray beds, just above small quarry near top of hill north of Aylmer, Quebec.

Modiolopsis nana Ulrich

Plate IX, figure 9

Modiolopsis nana Ulrich, Geol. Surv., Minnesota, Pal. 3, pt. 2, 1897, p. 507, Pl. 36, fig. 7.

Small, the plesiotype measuring 20 mm., 10.5 mm., and 4.5 mm. in length, greatest height, and thickness (one valve), respectively; outline oblique and elongate; beak low, gently incurved; anterior margin slender and projecting, posterior margin more broadly rounded, dorsal margin becoming more convex about midway, ventral margin rounded posteriorly but gently sinuate for the greater part; umbo low, the greatest height being posterior to it; sinus broad and shallow; hinge slightly curved; surface ornamented by strong concentric lines as shown in the casts.

Anterior scar large, striated, situated upon the anterior projection.

Modiolopsis nana is most closely allied to *Modiolopsis arguta* but differs in being less convex, the umbo is less sharply convex, and the concentric lines are coarser.

Occurrence. Sherman Fall beds, locality 43.

Type. Plesiotype, G.S.C. No. 11586, Sherman Fall beds, Canadian Pacific Railway cutting, south of Aylmer road, Hull, Quebec.

Modiolopsis rocklandia n.sp.

Plate IX, figure 17

Medium size, holotype measuring 36 mm., 21 mm., and 8 mm. in length, height (slightly broken), and thickness (one valve), respectively; outline elongate, oblique and almost arcuate; beak small, incurved, almost but not quite terminal; anterior end very short and contracted, the margin being narrowly rounded, posterior margin broadly rounded, dorsal margin gently convex, ventral margin concave in the anterior half, convex in the posterior half; umbo not prominent, the general convexity extending over the posterior half of the shell but the surface becoming slightly concave on the anterior dorsal slope and having a very shallow, poorly defined sinus on the antero-ventral side, the invagination of the ventral margin being much more accentuated than the sinus itself; hinge long and gently arcuate; ligamental area very narrow; surface of the cast showing a few indistinct growth lines.

Interior not seen.

The form is very close to *Modiolopsis arguta* but is considerably larger, the hinge line is slightly curved, and the posterior is more rounded, less truncate. It is larger and on the whole less arcuate than *Modiolopsis concava* Ulrich.

The cast is poor for a type but the outline is clear and it differs from any other.

The specific name 'rocklandia' is taken from Rockland where the specimen was found.

Occurrence. Leray beds, locality 98.

Type. Holotype, in the private collection of G. W. Sinclair, from Leray beds, Stewart quarry, Rockland, Ontario.

Genus, *Modiolodon* Ulrich

Genotype, *Modiolodon oviformis* Ulrich

Shell small to medium size, ovate outline; beak near the anterior end, low, very little overhanging or slightly erect; anterior and posterior margins broadly rounded, the posterior being considerably the broader; hinge broad and strong; umbo not very prominent but not depressed, with or without a low mesial sinus; ornamentation concentric growth lines.

Hinge plate broad both anterior and posterior to the beak; one to three cardinal teeth, no lateral teeth; anterior muscle scar deeply impressed, especially on the inner margin, posterior scar oval, larger than the anterior and not so deeply impressed.

The author of the genus compares it to *Modiolopsis* and to *Ischyrodonta*. It differs from the former in the presence of cardinal teeth, and from the latter in possessing a heavy cardinal tooth in the left valve and in the lack of the small elevated point interpreted as the point of attachment of the pedal muscle.

Modiolodon aylmerense n.sp.

Plate V, figure 11

This description is based upon the only specimen seen, a cast of a left valve lacking the posterior extremity.

Comparatively large, length not known because of broken posterior, height 34 mm., thickness approximately 6 mm.; outline broadly elliptical; beak very close to the anterior margin, low, probably slightly erect; anterior margin broadly rounded, posterior margin broken, dorsal and ventral margins gently convex; umbo low, the convexity continuing as a low, rounded ridge paralleling the dorsal margin and descending steeply to the marginal flange mentioned below, gradually flattening towards the ventral margin; hinge broad, forming a flat area beneath the beak continuing as a broad flat flange around both the ventral and dorsal margins, its posterior development not known; outer ornamentation not known but on the cast three or four large low undulations or rounded ridges radiating from the umbo to the margins, the shortest one ending in the flat flange on the ventral margin, the longest one cut off by the break at the posterior extremity, but slightly curved convex to the dorsal margin, faint traces of growth lines imposed on the surface.

One small cardinal tooth and traces of another present on left valve, but evidently at least two on the right valve, the posterior one being unusually large judging from the socket of the cast on the left valve; anterior muscle scar unusually deep, especially on the inner side, more or less circular; posterior scar more than twice the size, more definite than is usual in a great many of these pelecypods, deeper on the inner side, extending to the edge of the ridge nearest to the dorsal side, situated fairly far back at the beginning of the curve to the posterior end.

Modiolodon aylmerense differs from *Modiolodon oviformis* in the more broadly rounded anterior, in the presence of a strong cardinal tooth in the right valve, and from any other described species in the radial undulations.

Occurrence. Pamelia beds, locality 25.

Type. Holotype, G.S.C. No. 11588, Pamelia beds, road north from small park in Aylmer, beyond Sowter house.

Modiolodon ? haesitans n.sp.

Plate V, figure 10

Medium size for the genus, the holotype measuring 29 mm., 20 mm., and 11 mm. in length, height, and thickness (both valves), respectively; obliquely oval with the greatest width about the middle of the shell; beak small, gently incurving, situated about the middle of the hinge line; anterior margin narrow, slightly projecting with a minor constriction just posterior to it, posterior margin a little more broadly rounded, ventral and dorsal margins gently convex, the dorsal one less so than the ventral; umbo not very prominent, the continuing ridge gradually lost in the general convexity about midway to the posterior extremity; hinge line short; surface not preserved.

The interior showing only the rather clearly defined anterior muscle scar with the slight constriction behind it.

The species is very similar to *Modiolodon ? gibbus* Ulrich, but its height is less in proportion to its length, and it is a little smaller.

The genus is queried because of the lack of the essential part of the interior.

The specific name 'haesitans' refers to its doubtful classification.

Occurrence. Leray or Rockland beds, locality 115.

Type. Holotype, G.S.C. No. 11546, Leray or Rockland beds, Van-
kleek Hill, Ontario.

Genus, *Colpomya* Ulrich

Genotype, *Colpomya constricta* Ulrich

Size rather variable, from the small form of *Colpomya faba pusilla* to the much larger form *Colpomya constricta*; outline obliquely oblong though somewhat wider posteriorly; beak not large, incurved, situated a little anterior to the middle; anterior margin rounded, posterior margin a little more broadly rounded but longer, dorsal margin straight, ventral margin having a distinct invagination; the convex, prominent umbo divided by a mesial sulcus, the latter causing the invagination of the ventral margin; hinge long and straight, heavy anterior to, and thin posterior to, the beak; surface ornamented by more or less strong concentric growth lines and undulations.

On the right valve a strong tooth-like process matched by a corresponding depression in the left valve, also on the left valve beneath the depression a projecting process fitting into the socket formed by one side of the process of the right valve and curling under it; anterior muscle scar large, deep, and sharply defined on the inner edge with a smaller scar just behind it, posterior scar subcircular, large, less impressed than the anterior; pallial line simple.

Externally *Colpomya* suggests *Modiolopsis* but differs from it in its strong umbonal region and the relative narrowness and depth of the sulcus. Internally the hinge plate and processes are completely different.

Colpomya faba (Emmons)

Plate IX, figure 7

Nuculites faba Emmons, Nat. Hist. New York, Geol. 2, 1842, p. 385, fig. 2.

Modiolopsis faba (Emmons) Hall, Pal. New York 1, 1847, p. 158, Pl. 35, figs. 6a-d.

Colpomya faba (Emmons), Bassler, U.S. Nat. Mus. Bull. 92, p. 257.

Very small, the largest specimen illustrated (in a drawing) measuring 15 mm. and 7 mm. in greatest length and greatest height, respectively, specimens at hand considerably smaller, the largest measuring 6 mm., 4 mm., and 3.5 mm. in length, height, and thickness (two valves), respectively; subelliptical in outline; beak incurved, about two-fifths distant from the anterior; anterior and posterior margins sub-equal, dorsal margin straight, ventral margin sinuate; umbo prominent, a narrow and comparatively deep sulcus extending from the beak to the sinuate ventral margin, shallow over the umbo but deeper and slightly wider towards the margin, the anterior lobe formed by the sulcus being smaller than the posterior; hinge long and straight; surface crossed by prominent concentric lines.

Interior not seen.

Colpomya faba is much smaller than *Colpomya constricta*. In the description of *Colpomya faba pusilla* it is stated that the variety has a more oblique ventral margin and, therefore, the posterior lobe is considerably deeper than the anterior as compared with the proportions of the species.

Occurrence. Leray-Rockland beds, locality 5.

Type. Plesiotype, G.S.C. No. 1166, Leray-Rockland beds, Paquette Rapids, Allumette Island, Quebec.

Genus, *Whiteavesia* Ulrich

Genotype, *Modiolopsis cincinnatiensis* Hall and Whitfield

Size varying from small to large; outline ovate, oblique, somewhat elongate, highest at the hinge or slightly posterior to it, narrowing posteriorly, moderately convex; beak rather prominent, incurved, situated anterior to the middle of the hinge; anterior margin produced a little and narrowing, posterior margin narrow, sharply rounded, dorsal and ventral margins gently convex; umbo prominent, in some species subangular; surface marked by an oblique, narrow, and in some cases subangular convexity nearer to the dorsal than to the ventral margin, extending from the umbo to the posterior extremity, and decreasing in height; slope from the greatest convexity slightly concave to the dorsal margin, flat or gently convex to the ventral margin; a small, narrow, external ligament present; ornamented by concentric growth lines, and in some species by fine radiating lines beneath the outer shell.

Hinge plate narrow beneath the beak, widened slightly on either side, without teeth; both anterior and posterior muscle scars rather faintly impressed; pallial line simple.

Whiteavesia differs from *Modiolopsis*, the nearest genus, in its proportional shorter hinge, in its flat or convex, never sinuate, ventral slope, in the gently convex rather than sinuate ventral margin, in the lack of the obscure cardinal tooth, and in having a less pronounced anterior muscle scar.

The genus was originally described under the name *Actinomya*, but was changed to *Whiteavesia* when it was found that the former name was preoccupied.

Whiteavesia ? *angusta* n.sp.

Plate VIII, figure 2

Size, rather small, holotype measuring 23 mm., 13 mm., and 4.5 mm. in length, height, and thickness (one valve), respectively; outline narrowly oval, very oblique, highest at the hinge line, moderately ventricose; beak small, incurved, situated slightly anterior to the middle of the hinge line; anterior margin narrowly rounded, dorsal and ventral margins gently convex but converging towards the narrowly rounded posterior extremity; dorsal slope gently concave, ventral slope convex; umbo moderately prominent; a broadly rounded ridge placed nearer to the dorsal than to the

ventral margin and extending backward from the umbo, its distinctness gradually submerged into the general convexity; hinge line short; ligament not seen; a few concentric growth lines visible.

Interior not known, leaving the genus in some doubt.

Whiteavesia ? *angusta* differs from the following species, *Whiteavesia* ? *compacta*, in its more elongate outline, its greater obliquity, its proportionally narrower posterior extremity, the position of greatest height at the hinge line rather than posterior to it, its more rounded umbo and ridge, and in the lack of the rugose concentric ornamentation as far as can be seen from the rather worn specimen.

Occurrence. Leray beds, locality 47.

Type. Holotype, G.S.C. No. 11547, Leray beds, lot K, con. A, R.F., Nepean tp., Ontario.

Whiteavesia ? *compacta* n.sp.

Plate VIII, figure 3

Small for the genus, the holotype measuring 20 mm., 11.5 mm., and 5 mm. in its greatest length, height, and thickness (one valve), respectively; beak small, incurved, situated very little anterior to the middle of the hinge line; anterior margin slightly produced, narrowly rounded, almost angular, posterior margin more broadly rounded but still subangular on the lower part, dorsal margin definitely convex, ventral margin only gently convex; dorsal slope concave, ventral slope very slightly convex, almost flat; umbo prominent, subangular, with a backward extending, subangular ridge the convexity of which decreases rapidly, being almost absorbed in the general convexity at the posterior extremity; hinge line comparatively short; ligament not seen; ornamented by concentric growth lines combined into rugose irregular bundles on the anterior ventral slope, becoming less conspicuous after the abrupt turn to the concave dorsal slope.

Interior not seen, leaving the genus a bit doubtful.

For comparison with *Whiteavesia* ? *angusta* see under the description of that species. *Whiteavesia* ? *compacta* differs from *Whiteavesia subcarinata* in being less oblique, in being longer in proportion to its height, and in having a more rugose ornamentation though apparently lacking the radiating striæ.

Imperfect specimens of *Whiteavesia compacta* might be confused with imperfect specimens of *Modiolopsis* ? *compacta*. In *Whiteavesia compacta* the ridge is directed to the lower posterior angle, in *Modiolopsis compacta* it is directed to the middle of the posterior. In *W. compacta* the surface from the ridge to the ventral margin is convex, in *M. compacta* a low indefinite sinus crosses the surface obliquely and the outline of *Modiolopsis compacta* is longer and narrower than that of *W. compacta*.

Occurrence. Leray ? beds, locality 40.

Type. Holotype, G.S.C. No. 11548, Leray ? beds, La petite Chaudière, Ottawa or Hull. The matrix apparently comes from the Leray beds, but the position is queried because the La petite Chaudière section ranges from Pamela to Rockland beds and is exposed on both the Ottawa and Hull sides of Ottawa River.

Whiteavesia modioliformis (Meek and Worthen)

Plate VIII, figure 4

Modiolopsis modioliformis Meek and Worthen, Geol. Surv., Illinois, 3, 1868, p. 294, Pl. 1, figs. 7b and 8.

Actinomya (Whiteavesia) modioliformis (Meek and Worthen) Ulrich, Geol. Surv., Minnesota, Pal. 3, pt. 2, 1897, pp. 515, 628, Pl. 36, figs. 19 and 20.

Large or medium size, the holotype, as illustrated, measuring 54 mm., 25 mm., and 10 mm. in length, height, and thickness (one valve), respectively; obliquely ovate, widest about the middle, strongly convex; beak rather prominent, incurved, situated about the middle of the hinge line; anterior and posterior margins rather sharply rounded, the anterior protruding somewhat, dorsal and ventral margins gently convex, converging posteriorly; umbo prominent, a rather prominent subangular ridge posterior to it continuing back almost to the posterior extremity though becoming more rounded and decreasing in height; hinge nearly straight, rather short, rounding into the convex dorsal margin but meeting the anterior margin with a sharper curve; ligament, escutcheon, and lunule not seen; surface ornamented with fine concentric lines, which gather in wrinkles.

Interior not seen.

Whiteavesia modioliformis is one of the larger forms of the genus. It resembles the genotype *Whiteavesia cincinnatiensis* in its general size and shape, in its subangular umbo, and in the narrow curve of the posterior extremity, but it lacks the radiating striæ, as far as seen, and the ventral margin is more convex. It differs from *Whiteavesia chamblensis* in its more sharply rounded anterior and posterior margins and its more pronounced umbonal ridge. Compared with *Whiteavesia kentonensis* and *Whiteavesia oblonga* its posterior extremity is more narrowly rounded, though the anterior margin is very similar.

The specimen illustrated is minus the tip of the beak, which makes it appear less sharply angular. It is, also, broken at the posterior end but the wrinkles show the narrow rounding of the extremity.

Occurrence. Leray beds ?, locality 65; Sherman Fall beds, locality 118; Cobourg ? beds, locality 78.

Type. Plesiotype, G.S.C. No. 11549, Sherman Fall beds, lots 25 and 26, con. III, Osnabruck tp., Ontario.

Genus, *Goniophora* PhillipsGenotype, *Goniophora cymbiformis* Sowerby

Size small to large; outline subrhomboidal to trapezoidal; beak small, closely incurved, situated about one-third or less from the anterior of the shell; anterior margin short and rounded, posterior margin obliquely truncate, dorsal margin straight, ventral margin oblique, almost straight, some species having a slight invagination; umbo prominent and continued as a strong angular ridge to the posterior extremity, ridge bordered on the antero-ventral side by a poorly defined sulcus; hinge long and straight; surface marked by more or less irregular concentric lines.

Hinge in the right valve bearing a strong, oblique tooth, a corresponding cavity in the left valve; anterior muscle subcircular situated within the anterior projection; posterior muscle large, faintly impressed, situated beneath and near the posterior end of the hinge; pallial line simple.

Internally the genus is similar to *Modiomorpha* but externally it is very different.

The forms with radiating striæ formerly included in this genus have been removed to *Cosmogoniophora* McLearn.

Goniophora carinata (Hall)

Plate IX, figure 20

Modiolopsis carinatus Hall, Pal. New York 1, 1847, p. 160, Pl. 35, figs. 11a-c.

Goniophora carinata (Hall), Ulrich, Geol. Surv. Minnesota, Pal. 3, pt. 2, 1897, p. 504.

Shell very small, the only specimen to hand measuring 8 mm., 4 mm., and 3 mm. in length, height, and thickness (two valves), respectively; subovate in outline; beak small, incurved; anterior margin narrowly rounded, posterior margin slightly truncate and acute at the extremity, dorsal margin straight, ventral margin almost straight though oriented obliquely; umbo prominent, crossed by a sharp ridge extending from beak to the acute posterior extremity; surface gently concave from the ridge to the dorsal margin, and on the antero-ventral side bearing a broad shallow sinus; the whole ornamented by concentric growth lines.

Interior not seen.

Goniophora carinata differs from other members of the genus in its very small size. It is most closely related to *Goniophora dubia* from the Silurian of Ohio, but differs in the more narrowly rounded anterior margin and in the acute posterior extremity. The author of *Goniophora dubia* cites these characteristics in young specimens of the species and it may be that the latter is derived from *Goniophora carinata*.

Occurrence. Leray-Rockland beds, locality 5.

Type. Plesiotype, G.S.C. No. 1167, Leray-Rockland beds, Paquette Rapids, Allumette Island, Quebec.

Goniophora ottawaensis n.sp.

Plate IX, figures 21, 22

Small, holotype measuring 20 mm., 9 mm., and 10.5 mm. in greatest length, height, and thickness (two valves), respectively, the widest and thickest part being just posterior to the end of the hinge, another specimen present larger but distorted by crushing; outline long and slender, irregularly ovate; beak incurved, situated very close to the anterior, somewhat depressed on the anterior half; anterior margin very small and rounded, hardly projecting beyond the beak, posterior margin truncate but with a slight convexity, the posterior extremity being acute, dorsal margin straight near the beak but becoming gently convex, ventral margin almost straight; umbo prominent, overhanging near the beak, capped by a sharp ridge extending to the posterior extremity; surface concave from the ridge to the dorsal margin but sloping abruptly, gently convex or almost flat in the

more gradual slope to the ventral margin, possibly exhibiting a broad, indefinite sinus on the outer shell; hinge rather short; a few very fine concentric growth lines visible, directed practically at right angles to the length in the concave dorsal region.

Interior not seen except for the muscle scar on the rounded projecting part of the anterior.

The outline of *Goniophora ottawaensis* resembles a *Nuculites* but the sharp ridge extending to the posterior extremity distinguishes the genus. It is very similar to *Goniophora carinata* but is much larger. The posterior is more oblique than that of *Goniophora dubia*.

Occurrence. Cobourg beds, localities 75, 110.

Type. Holotype, G.S.C. No. 11589, Cobourg beds, Fifth Avenue, Ottawa, Ontario.

Genus, *Endodesma* Ulrich

Genotype, *Endodesma cuneatum* Ulrich

Shell thin; medium size to large; elongate; dorsal and ventral margins subparallel; generally ventricose; beak one-third to one-quarter distant from the anterior end; hinge line gently curved beneath the beak; umbo compressed, projecting beyond the hinge in the anterior part; a broad mesial depression crossing the anterior half from the umbo to the ventral margin, in which it produces an invagination; an internal ligament present, attached to a ridge in each valve, the shell above it being slightly flattened or curved inward along the hinge but without forming a true escutcheon; an obscure depression anterior to the beak; concentric growth lines the only ornamentation.

Teeth absent as far as known; muscle scars and pallial line so faint as to be indefinite.

Endodesma differs from *Modiolopsis* externally in its proportionately larger anterior, in the subparallel dorsal and ventral margins, and in the deeper mesial depression usually situated in the anterior half. Internally it differs in the lack of teeth and the faintness of the muscle scars.

The differences between *Endodesma* and *Orthodesma* are given under the description of the latter species.

Endodesma gesneri (Billings)

Plate VIII, figure 10

Modiolopsis gesneri Billings, Geol. Surv., Canada, Pal. Foss. 1, 1865 (Adv. sheets 1862), p. 43, figs. 45a, 45b; Ulrich, Geol. Minn., Pal. 3, pt. 2, 1897, p. 528, Pl. 37, figs. 3, 4.

Large, holotype measuring approximately 70 mm. (posterior extremity lacking), 27 mm. in its greatest height, posterior to the middle, greatest thickness of the two valves 22.5 mm.; transversely elongate, slightly arcuate and ventricose, particularly just posterior to the middle; beak small and incurved, situated from the anterior about one-sixth to one-seventh the transverse length; hinge gently arched posteriorly, almost parallel to the ventral margin, more definitely curved in the short anterior part, the anterior of the hinge meeting the anterior margin in an angle of about 120 degrees; umbo somewhat flattened, usually having an obscure depres-

sion anterior to the beak, slightly accentuated in the holotype by a minor distortion; a wide shallow mesial depression mostly lying in the anterior half and causing an invagination in the ventral margin; ornamentation concentric striæ and ridges of variable sizes.

Interior not seen.

The holotype is more arcuate, narrower, and more sharply rounded at the posterior than is shown in the original illustration. The second figure, 45b, is larger than the holotype but is proportionately more correct.

Endodesma gesneri differs from *Endodesma orthonotum* in its sub-angular anterior, and slightly more curved anterior margin. It differs from *Endodesma cuneatum* in its larger size and proportionately greater ratio of length to height, and the narrowly rounded anterior is placed lower in relation to the beak. Small specimens are often difficult to separate, but the proportionate length to height can usually be obtained from growth lines if specimens are incomplete. It differs from *Endodesma trentonensis* in its longer and narrower form, and in having the dorsal and ventral margins more nearly parallel.

Occurrence. Lowville-Leray beds, locality 55; Leray beds, localities 8, 40, 51, 54, 60; Leray ? beds, locality 38; Cobourg ? beds, locality 78.

Type. Holotype, G.S.C. No. 1665; paratype, G.S.C. No. 1665a; Cobourg beds ?, Ottawa, Ontario.

Endodesma minusculum n.sp.

Plate VIII, figure 7

Very small for the genus, holotype measuring 17 mm., 7.5 mm., and 3 mm. in length, greatest height, and thickness (one valve), respectively; outline very long and narrow; beak small, incurved; anterior margin narrow and projecting, rounded below and slightly broken at the rather angular tip, posterior margin more broadly rounded and also slightly broken, dorsal and ventral margins subparallel, a broad but not deep invagination constituting more than half the ventral margin; umbo low and broad, depressed on top, the thickest part of the shell posterior to it, the highest part of the shell situated about one-third the length from the posterior extremity; a broad shallow sinus present extending from the umbo and widening to the invagination of the ventral margin; the ridge on the anterior of the sinus low and rounded, that on the dorso-posterior side higher, more sharply defined and extending to the lower part of the posterior extremity; hinge comparatively long and very gently curved; surface covered by growth lines gathered into low undulations.

An obscure anterior muscle scar discernible.

Endodesma minusculum differs from other forms of the genus in its very small size and in its proportionately shorter hinge.

The trivial name *minusculum* refers to its small size.

Occurrence. Sherman Fall beds, locality 41.

Type. Holotype, G.S.C. No. 11590, Sherman Fall beds, Brewery Creek, Hull, Quebec.

Endodesma orthonotum (Meek and Worthen)

Plate VIII, figure 9

Modiolopsis orthonota Meek and Worthen, Geol. Surv., Illinois, 3, 1868, p. 295, Pl. 1, fig. 7a.

Endodesma orthonotum (Meek and Worthen) Ulrich, Geol. Surv., Minnesota, Pal. 3, pt. 2, 1897, p. 527, Pl. 37, figs. 1 and 2.

Large, the specimen illustrated here measuring 70 mm., 29 mm., and 27 mm. in length (not quite complete), height, and thickness (two valves), respectively; outline very elongate; beak small, depressed, strongly incurved, situated about one-sixth the total length from the anterior; anterior margin extended and both anterior and posterior margins narrowly rounded, dorsal and ventral margins subparallel, the ventral margin with a gentle convexity on the posterior half and a slight invagination on the anterior half; umbo depressed; a broad, shallow sinus extending from the umbo to the anterior half of the ventral margin somewhat constricting the anterior fifth of the shell; the low, broad ridge on the posterior of the sinus giving rise to the greatest convexity of the shell at midlength; hinge long and slightly curved anterior to the beak; a low flat area posterior to the hinge defining the position of the internal ligament, and a rather large, obscure depression anterior to the beak; surface ornamented by fine growth lines, somewhat fasciculate, surmounting broad, low undulations.

Interior not seen.

Ulrich makes the low undulations of *Endodesma undosum* one of the specific features, but the present specimen, though broken, has the proportions of *Endodesma orthonotum* and the present writer suggests that the recognition of the undulations depends upon the state of preservation on any or all species of the genus.

Occurrence. Leray beds, locality 65.

Type. Plesiotype in the private collection of G. W. Sinclair, from Leray beds at Mechanicsville, Ottawa, Ontario.

Endodesma sinclairi n.sp.

Plate VIII, figure 8

Moderately large for the genus, the type, with a slightly broken posterior extremity, measuring 20 mm. and 13 mm. in height and thickness (two valves), respectively, and approximately 47 mm. in length; outline a long oval; beak incurved, situated about one-fifth or one-sixth the length from the anterior; anterior margin rounded, posterior margin slightly higher, rounded above and below but becoming more acutely rounded at the posterior extremity, judging from the direction of the growth lines, dorsal and ventral margins long and approximately parallel; umbo depressed; a low, indefinite ridge extending backward from the umbo to the posterior, decreasing in convexity and its course lying nearer to the dorsal than to the ventral margin; surface from the ridge sloping steeply to the dorsal margin just behind the beak but becoming slightly concave posteriorly; a broad rather shallow sinus lying between the ridge and an anterior swelling beneath the beak; ligamental area long and narrow, lunule short; surface crossed by concentric growth lines making a narrow curve over the ridge.

Interior not seen except for a slight contraction beneath the beaks.

Endodesma sinclairi is very similar to *Endodesma orthonotum* but is smaller, the sinus is not so deep, and the course of the concentric striae shows a narrower posterior extremity.

The only specimen seen is poorly preserved but is included here to make the pelecypods of the region as complete as possible.

Occurrence. Leray beds, locality 65.

Type. Holotype, G.S.C. No. 11591, Leray beds, Mechanicsville, Ottawa, Ontario.

Teeth not Known

Genus, *Palaeosolen* Hall ?

Genotype, *Palaeosolen siliquoides* Hall

Transversely elongate, length more than four times the height; beak low, situated near the anterior; anterior margin more or less straight above, rounded in the lower part, posterior margin abruptly truncated and gaping, ventral and dorsal margins subparallel, almost straight, outline of the ventral margin very gently convex; umbo not very prominent; umbonal slope marked by an oblique ridge extending to or almost to the posterior extremity; surface on the ventral side of the umbonal ridge having growth lines, in some cases superimposed upon broad indefinite undulations; dorsal side of umbonal ridge marked by two or three radial undulations.

Interior not known.

Palaeosolen differs externally from other genera with subparallel dorsal and ventral margins in its definite umbonal ridge dividing two types of ornamentation. Internally it lacks the ridge separating the anterior muscle from the body of the shell.

Palaeosolen ? hullensis n.sp.

Plate IX, figures 23-25

Medium size, transversely elongate; beak low, situated near the anterior end; anterior margin straight for a short distance, rounded in the lower part, posterior margin gaping, truncated above, subangular at the extremity, ventral margin gently convex; hinge with the dorsal margin and the ventral margin subparallel; umbo not very prominent; post-umbonal ridge extending from the umbo to the posterior extremity and dividing the valve into two distinct parts; sinus, ligament, and lunule not seen; two to four broad, concentric undulations with finer superimposed growth lines visible on the edge of one specimen marking the ventral side of the umbonal ridge; dorsal side of the ridge marked by at least one broad radial ridge, as seen in moulds.

Interior not seen.

The species is assigned to *Palaeosolen* with a query because of the lack of a knowledge of the interior. The genus itself has never been clearly defined. *Palaeosolen ? hullensis* is closer to *Palaeosolen antigonishensis* and *Palaeosolen amii* from the Silurian beds of Arisaig than to the

genotype. It differs, however, in its more sharply defined umbonal ridge, in the more pronounced concentric undulation, and in having only one radial undulation on the dorsal side of the umbonal ridge.

The writer feels the specimens are rather poor for a description of a new species but they have a very distinctive ornamentation and can hardly be omitted from a complete paper on known pelecypods of the area.

Occurrence. Pamelaia beds, locality 34.

Type. Holotype, G.S.C. No. 11550, basal sandy Pamelaia beds, creek crossing road west of Fairy Lake, Hull, Quebec; paratype, G.S.C. No. 11551, same locality and same beds but loose.

PLATE I¹

- Figure 1. *Orthodesma ? humile* n.sp. Holotype, G.S.C. No. 11554. (Page 15.)
- Figure 2. *Orthodesma ? abscissum* n.sp. Holotype, G.S.C. No. 1152. (Page 13.)
- Figure 3. *Orthodesma decorosum* n.sp. Showing the anterior muscle scar. Holotype, G.S.C. No. 11553. (Page 14.)
- Figure 4. *Orthodesma ? antiquum* Whiteaves. Showing its elongated outline. Plesio-type, G.S.C. No. 11532. (Page 14.)
- Figure 5. *Orthodesma ? subcarinatum* Ruedemann. The ridge is more evident on the lower specimen. Plesiotype, G.S.C. No. 11533. (Page 15.)
- Figure 6. *Orthodesma alveolatum* n.sp. Showing the scoop-like anterior. Holotype, G.S.C. No. 11545. (Page 13.)
- Figures 7, 8. *Nuculites stiliformis* n.sp. 7, left valve showing groove caused by the partition in the interior of the anterior part; 8, view from the dorsal side. Holotype, G.S.C. No. 11562. (Page 29.)
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¹All figures Plates I-IX natural size, except where otherwise stated.

Where the figure is enlarged the vertical line at the side represents the true measurement from the point indicated on the figure to a point on the margin directly above it.

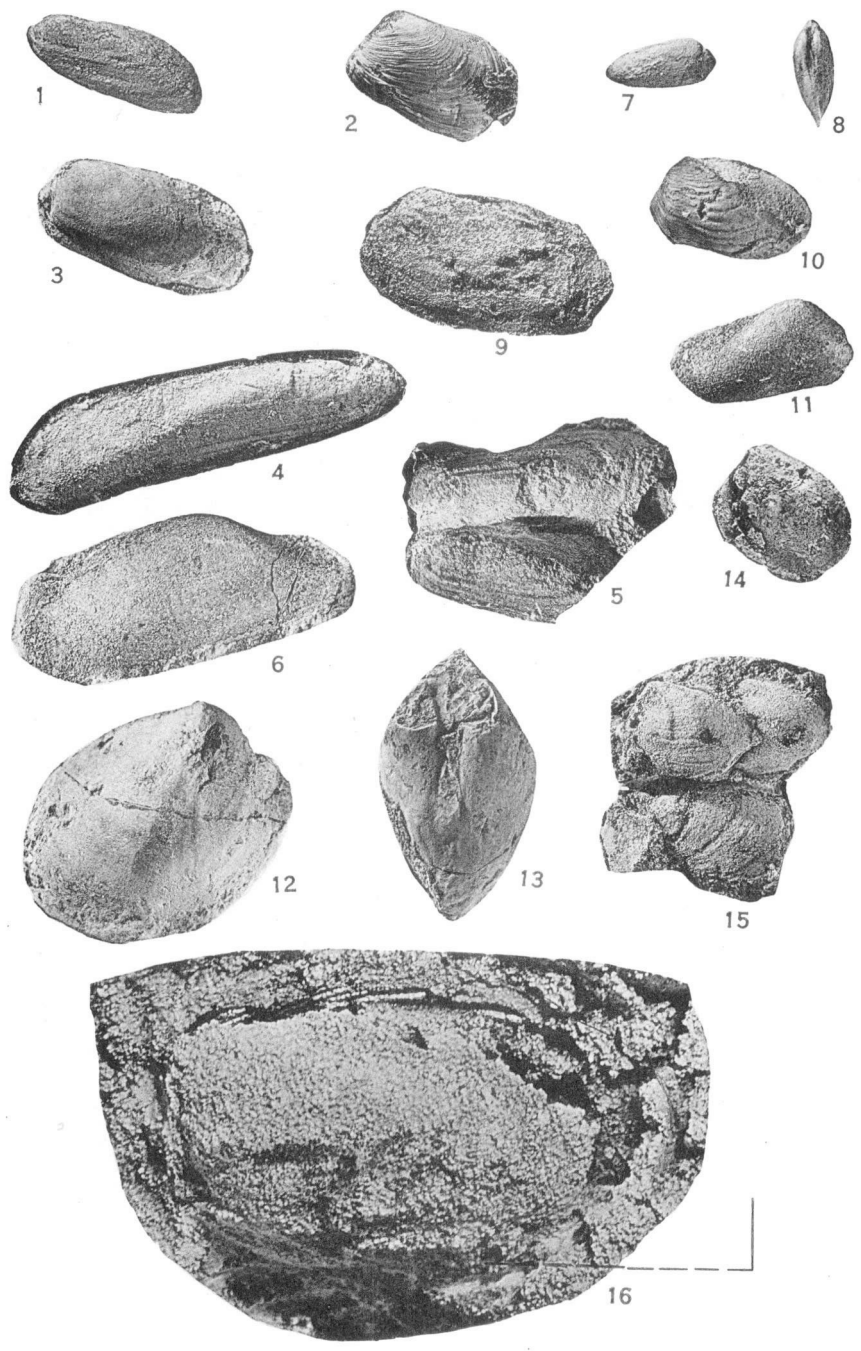


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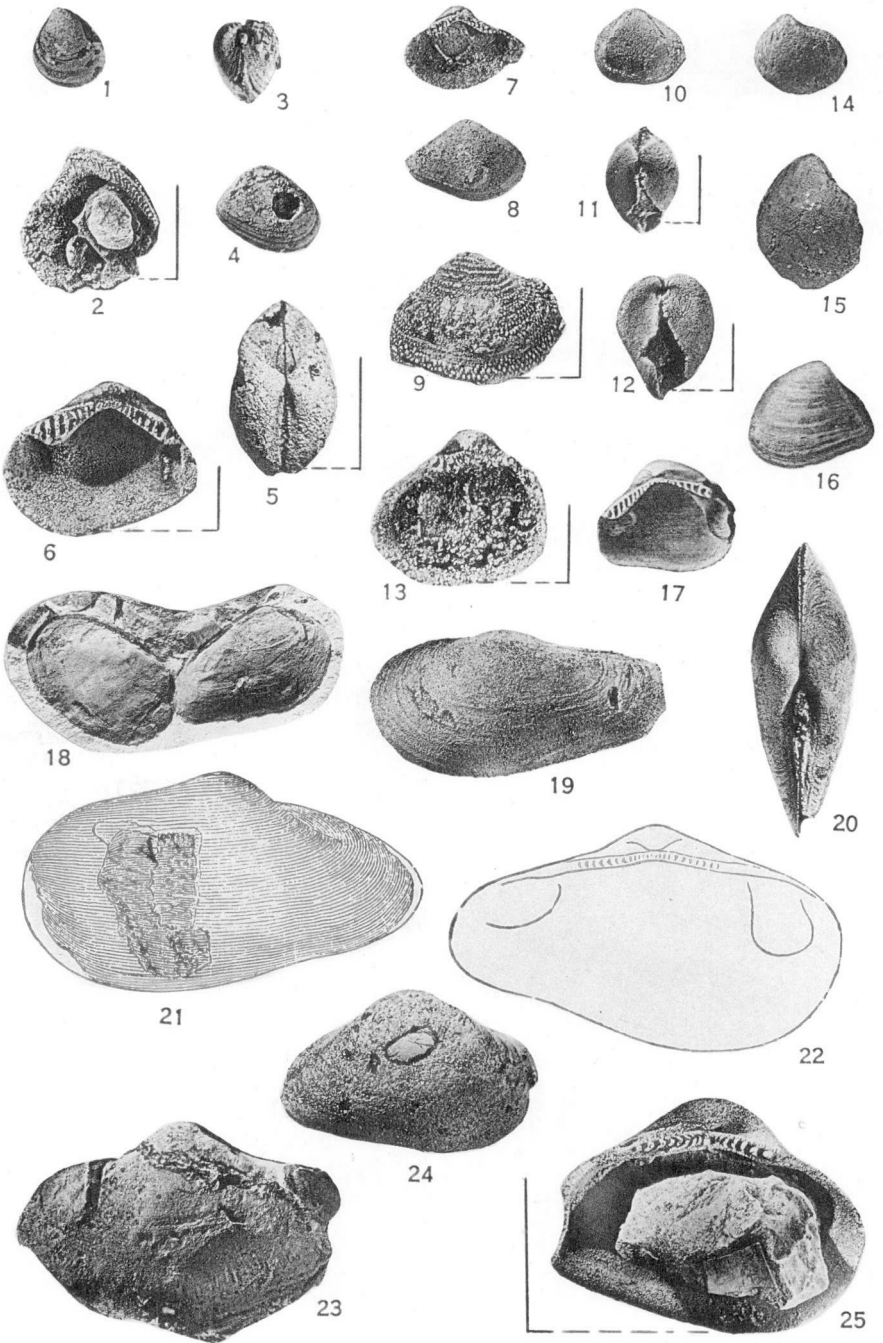
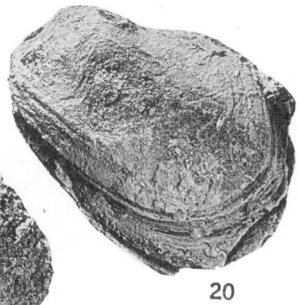
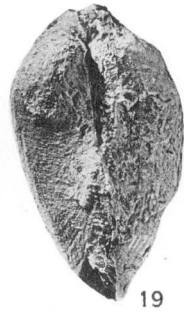
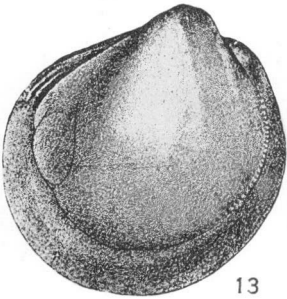
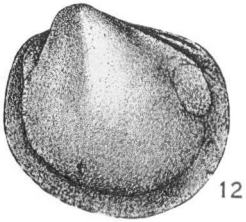
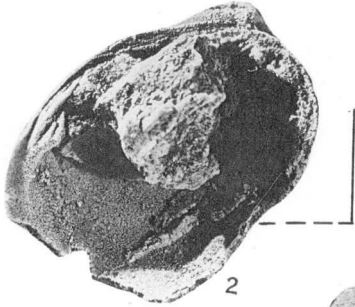


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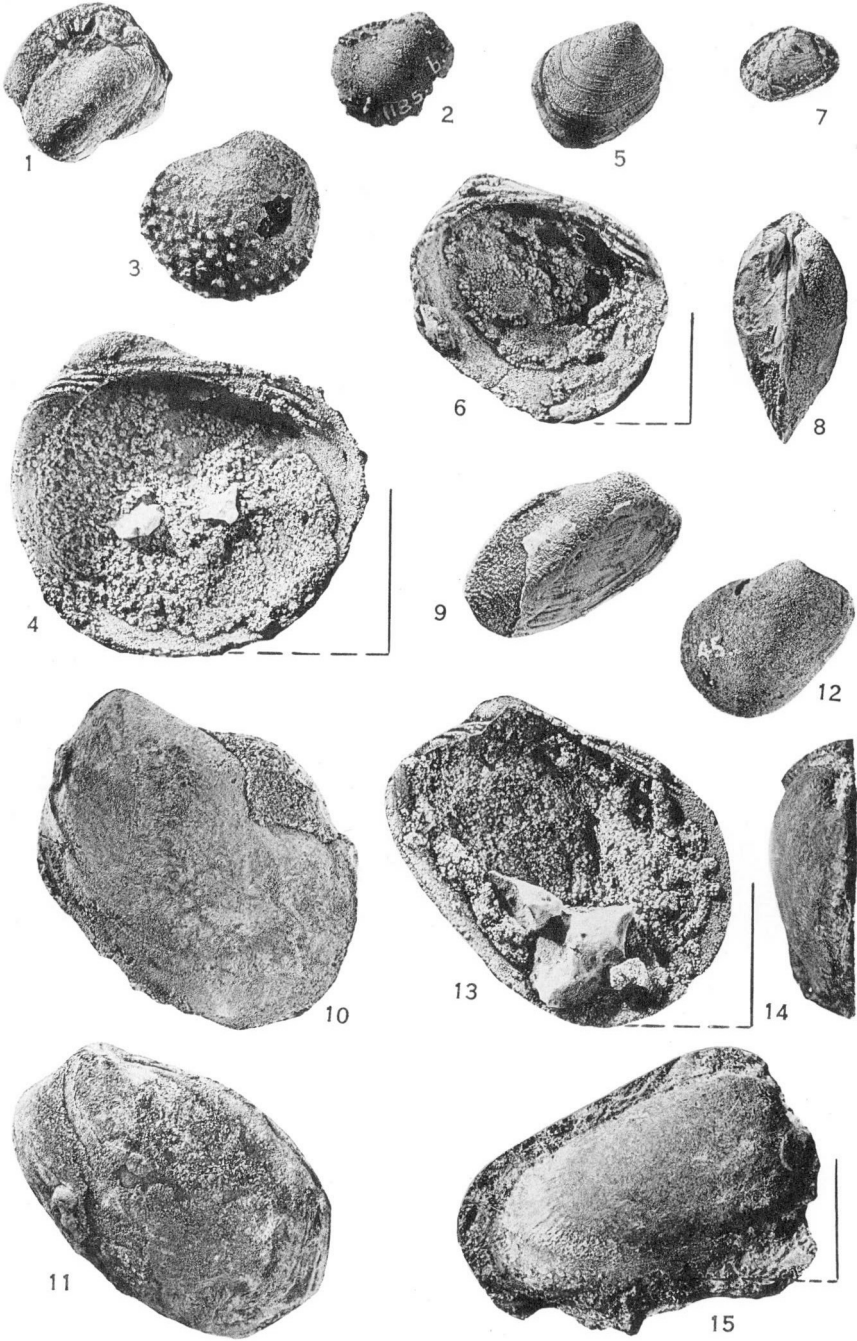


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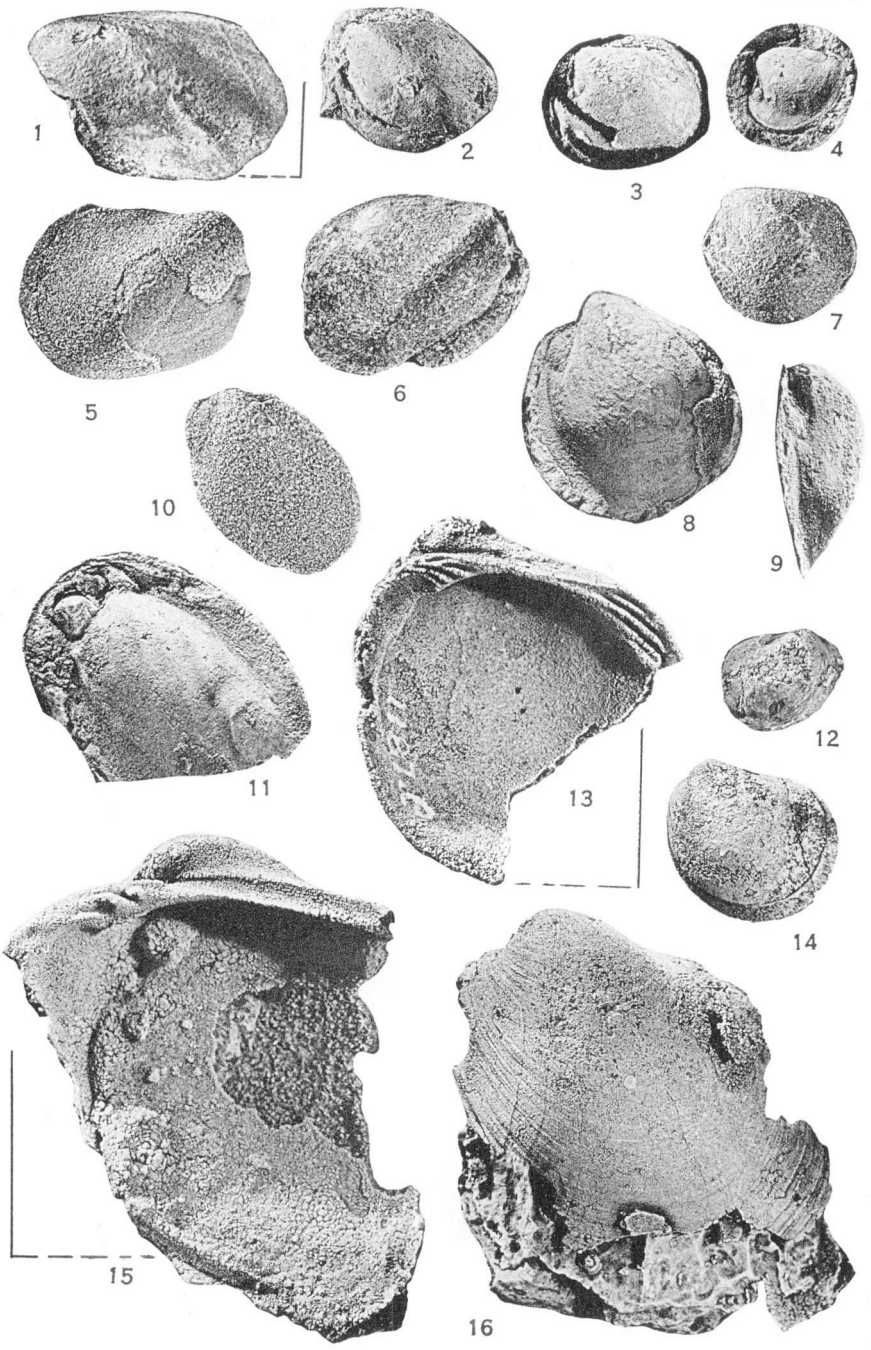


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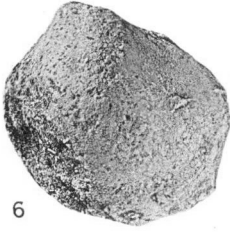
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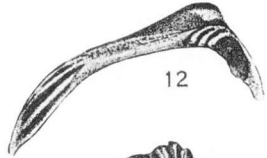
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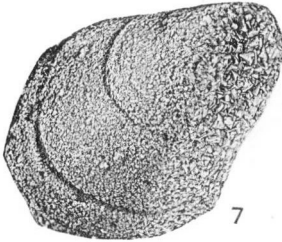
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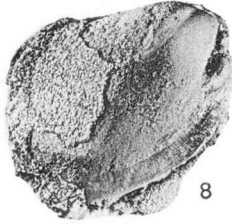
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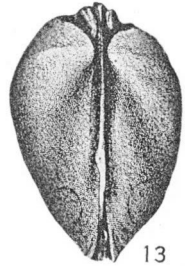
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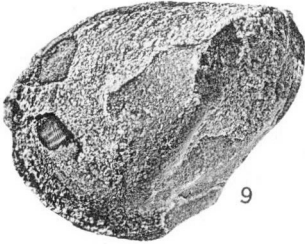
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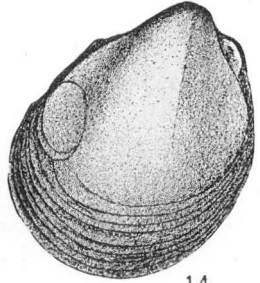
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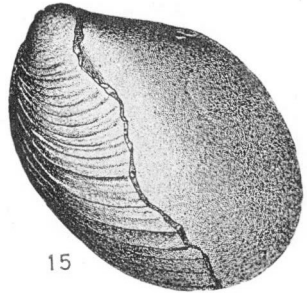
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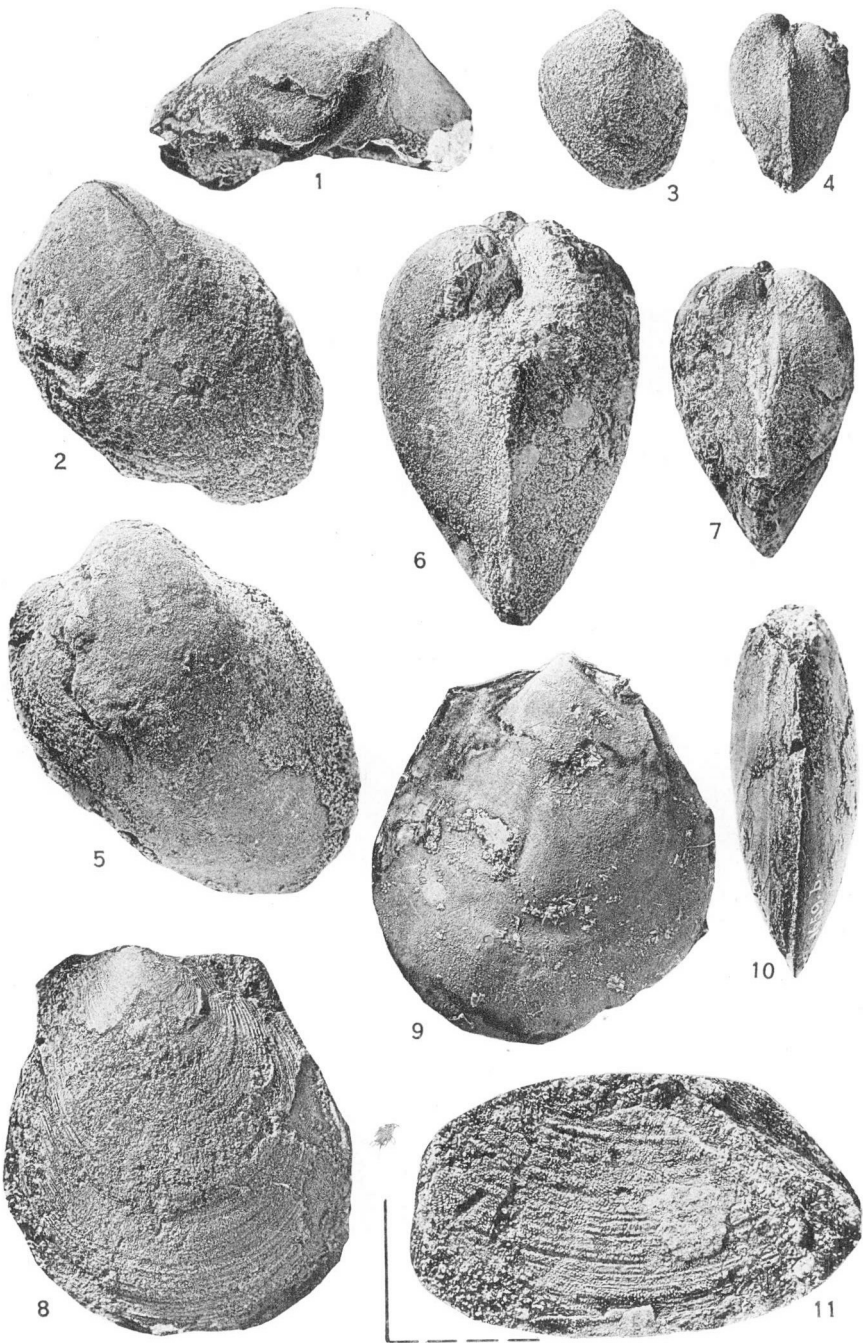
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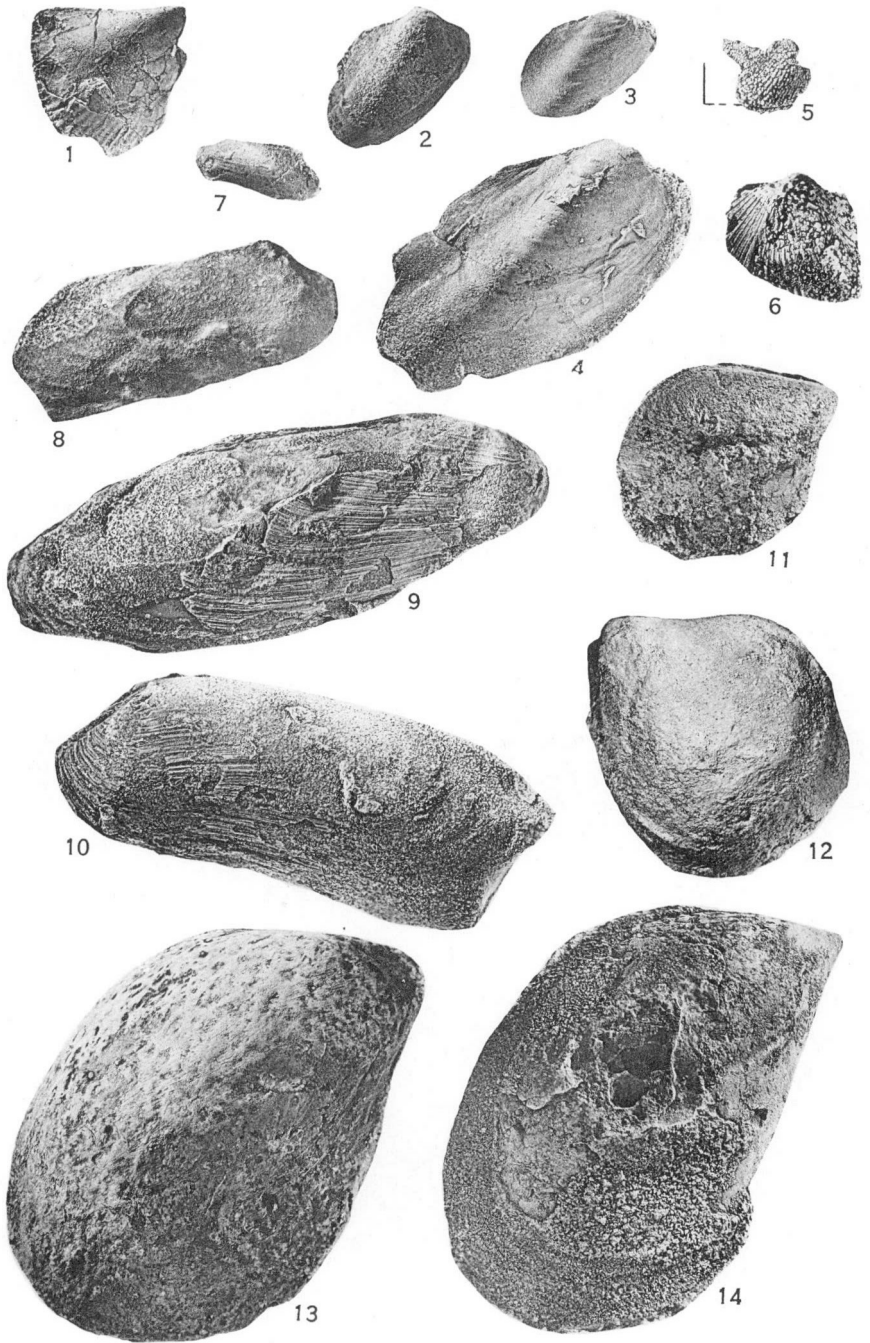
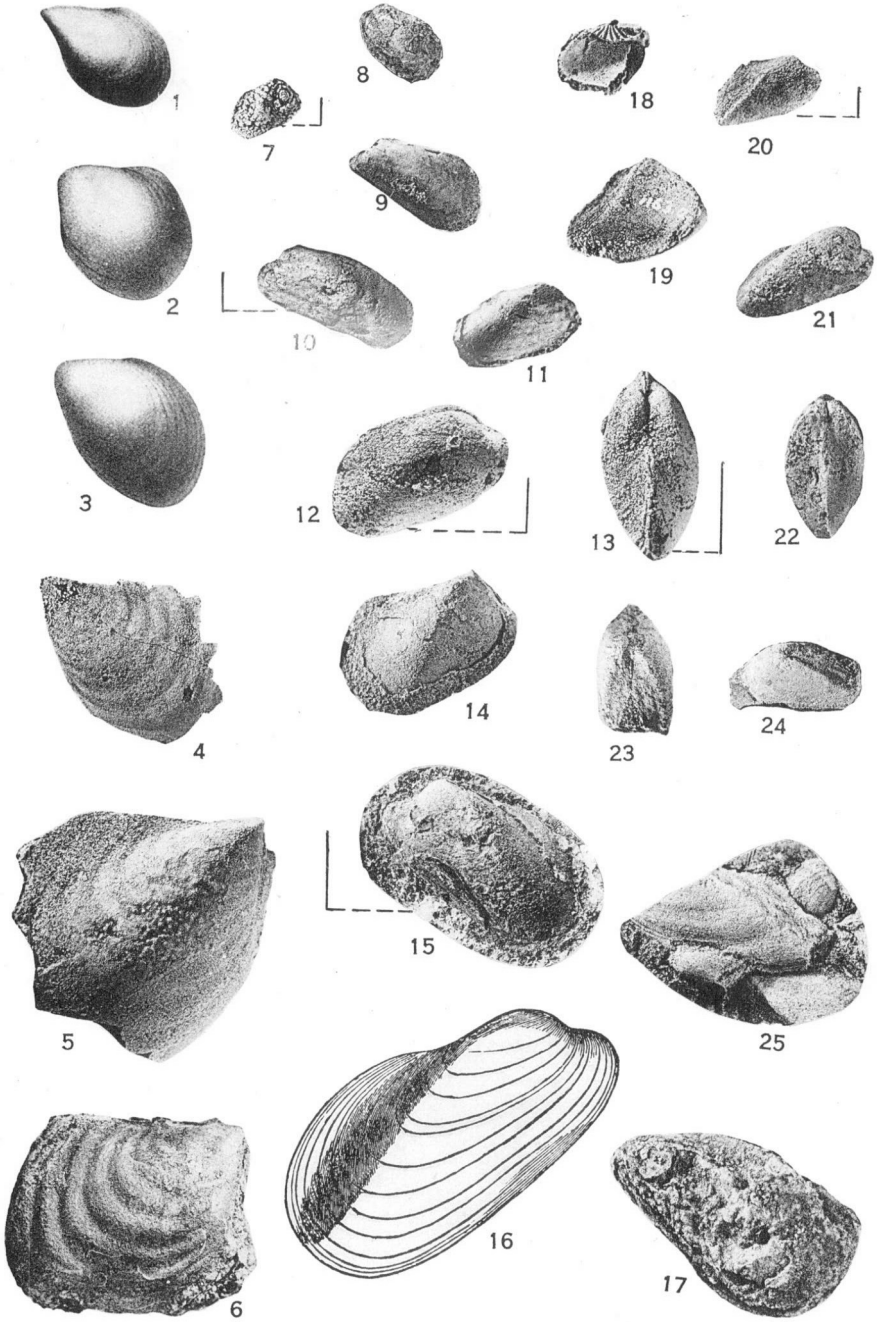


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