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CANADA
DEPARTMENT OF MINES AND TECHNICAL SURVEYS

GEOLOGICAL SURVEY OF CANADA
BULLETIN 17

GASTROPODA AND CONULARIDA OF THE
OTTAWA FORMATION OF THE OTTAWA-
ST. LAWRENCE LOWLAND

BY
Alice E. Wilson



Rice

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

This report is the fifth of a series of planned reference texts on the palæontology of the Palæozoic strata of the Ottawa-St. Lawrence Lowland. The series has consisted of studies of the fauna of the Ottawa formation, a thick, highly fossiliferous limestone formation, of late Middle Ordovician age, and has included Geological Survey Bulletins Nos. 4, 8, 9, and 11, on the Echinodermata, Brachiopoda, Trilobita, and miscellaneous smaller groups 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 the present author. 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 the same author, on the "Geology of the Ottawa-St. Lawrence Lowland". That report includes a bibliography on the geology and palæontology of this early Palæozoic basin.

GEORGE HANSON,

Chief Geologist, Geological Survey of Canada

OTTAWA, July 31, 1950

GASTROPODA AND CONULARIDA 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 Ottawa and St. Lawrence Rivers. It is bounded on the north by the Canadian Shield, on the west and 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 occurs at the top of the Middle Ordovician and is of Black River-Trenton age. It overlies deposits of Chazy age and underlies the shales of Collingwood-Gloucesterc age. The formation has a thickness of 690 feet. It is composed mainly 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 of interruption in the deposition of the sediments and no significant change in lithology, and because fossils found in the lower beds show that they, too, are of Black River age. The more recent New York term 'Mohawkian' cannot be applied here because it does 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 places, in the occurrence of fossils. A change in fauna would occur inevitably during the length of time required to deposit 690 feet of sediments, especially limestone, and such a change does occur, but it is gradual. Certain groupings of fossils can be recognized, but from the base to the top 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 or associations 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 Ottawa River, from which area its name is taken.

OCCURRENCE OF GASTROPODA

The Gastropoda are the third most important group of fossils found in the Ottawa formation. They are not as prolific in genera, in species, nor in number of specimens as the Brachiopoda. The number of genera almost equals that of the Trilobita, but they are more generalized and not as diagnostic. The specimens themselves are usually poorly preserved.

The following tables analyse three main features of the range of the Gastropoda. As in previous studies by the author of the fauna in this region, the widths of the columns of the tables are drawn to indicate the relative thicknesses of the original 'members' or 'formations' as they have been variously described.

Table I is arranged biologically. It brings together all the species of the several genera, indicates the range of each species, and illustrates that, in a few instances, a species occurring at a low horizon is replaced at a higher horizon by another species of the same genus, and that a few species occurring at a low horizon are recurrent at higher horizons but do not appear at intermediate levels.

Table II is arranged according to the first occurrence of each genus and species. It shows clearly that only a few forms have a long continuous range. Only two *Liospira*, of which one is doubtfully referred to *Pamelia* beds, occur throughout the Ottawa formation. In addition to the *Liospira* mentioned, species of *Sinuities* and *Hormotoma* range from Black River beds to the top of the formation. A few others, occurring in Lowville and Leray beds, are repeated higher in the section. The great bulk of gastropoda in this area, however, appear to have a comparatively short range.

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 those 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: 45 species begin in Leray or Leray-Rockland beds; of these, 30 are confined to those beds, 4 cease in the Rockland or just above, 3 cease in the Hull or just above, 1 persists in the Sherman Fall, and 7 occur in the Cobourg. Of the 10 beginning in the Leray and Rockland that appear in the Cobourg, 5 are recurrent, that is, they have not been found in the beds between these levels.

OCCURRENCE OF CONULARIDA

The Conularida are a small but interesting and rather bizarre faunal group. Their relationship to other groups has been in some doubt, and they are included here as a matter of convenience, without entering into their biological affinities.

Table IV, which gives the range of the few known Conularida from this region, clearly shows their lack of stratigraphic significance as regards the faunal beds of the Ottawa formation.

TABLE I
Range of Gastropoda in Biological Order

Species	Ottawa formation Faunal beds						
	Pamella	Lowville	Leray	Rockland	Hull	Sherman Fall	Cobourg
<i>Priscochiton canadensis</i> (Billings)							
<i>Archinacella clochensis</i> Foerste		X					
<i>A. eplamata</i> n.sp.	X	X					
<i>A. subrotunda</i> Ulrich and Scofield		X					X
<i>Macroscenella superba</i> (Billings)		X	X				
<i>Microplites obesus</i> n.sp.		X					
<i>M. oltavianus</i> n.sp.		X					
<i>Tryblidium erato</i> (Billings)		X					
<i>T.</i> ? sp.	X						
<i>Platyceras</i> ? <i>perplexa</i> n.sp.							X
<i>Cyrtolites</i> cf. <i>disjunctus</i> Ulrich and Scofield				X			
<i>C.</i> cf. <i>supplanus</i> Ulrich and Scofield			X				
<i>Sinuities bilobatus corrugatus</i> (Hall)				X	X	X	X
<i>S. cancellatus</i> (Hall)			X	X	X	X	X
<i>S. cancellatus angularis</i> n.var		X	X	X	X	X	X
<i>S. cancellatus tiratus</i> nom. nov.		X	X	X	X	X	X
<i>Bucania halli</i> Ulrich and Scofield		X					
<i>B. punctifrons</i> (Emmons)		X					
<i>Salpingostoma billingsi</i> n.sp.		X					
<i>S. expansum</i> (Hall) var.		X					
<i>Phragmotiles compressus</i> Conrad		X					
<i>Tetranota bidorsata</i> (Hall)		X	X	X	X		
<i>T. charon</i> (Billings)		X	X	X	X		
<i>T. seccarinata</i> Ulrich and Scofield		X	X	X	X	X	X
<i>Tropidodiscus</i> ? <i>argo</i> Billings		X	X	X	X		
<i>T.</i> ? <i>atiscutus</i> (Billings)		X	X	X	X		X

TABLE I—Cont.
 Range of *Gastropoda* in *Biological Order*—Cont.

Species	Ottawa formation Faunal beds						
	Pamella	Lowville	Leroy	Rockland	Hull	Sherman Fall	Cobourg
<i>Pterotheca expansa</i> (Emmons)		X	X	X			
<i>Lophospira angustina</i> n. var.			X	X			X
<i>L. helicteres</i> (Salter)		X	X	X		X	X
<i>L. medialis</i> Ulrich and Scofield		X	X	X		X	X
<i>L. milleri</i> (Miller)		X	X	X			
<i>L. peracuta</i> Ulrich and Scofield		X	X	X			
<i>L. perangulata</i> (Hall)	X	X	X	X			
<i>L. proerts</i> (Billings)		X	X	X			X
<i>L. saffordi</i> Ulrich and Scofield		X	X	X			
<i>L. serrulata</i> (Salter)		X	X	X	X		
<i>L. ventricosa</i> (Hall)		X	X	X	X	?	
<i>Hormotoma bellinecta</i> (Hall)		X	X	X	X	X	X
<i>H. gracilis</i> (Hall)		X	X	X	X	X	X
<i>H. cf. major</i> (Hall)		X	X	X	X	X	X
<i>H. salteri canadensis</i> Ulrich and Scofield		X	X	X	X	X	X
<i>H. salteri ottawensis</i> n. var.		X	X	X	X	X	X
<i>H. simplex</i> Wilson			X	X	X	X	X
<i>H. simplex paguettensis</i> n. var.			X	X	X	X	X
<i>H. tratonensis</i> (Hall)			X	X	X	X	X
<i>H. trenlonensis crassa</i> n. var.			X	X	X	X	X
<i>H. trenlonensis plana</i> n. var.			X	X	X	X	X
<i>Onospira alexandra</i> (Billings)			X	X	X	X	X
<i>Liospira americana</i> (Billings)			X	X	X	X	X
<i>L. micula</i> (Hall)	X	X	X	X	X	X	X
<i>L. prope</i> (Billings)		X	X	X	X	X	X
<i>L. vitruvia</i> (Billings)	?	X	X	X	X	X	X

TABLE I—Contc.
Range of Gastropoda in Biological Order—Contc.

Species	Ottawa formation Faunal beds						
	Parnelia	Lowville	Leray	Rockland	Hull	Sherman Fall	Cobourg
<i>H. rotunda</i> Ulrich and Scofield			X				
<i>H. undulata</i> Wilson			X				X
<i>Subulites acutus</i> Wilson			X				
<i>S. canadensis</i> Ulrich and Scofield	X	X	X		?		
<i>S. conradi</i> Ulrich and Scofield	X	X	X				
<i>S. gloucesterensis</i> n.sp.	X	X	X		X		
<i>S. regularis</i> Ulrich and Scofield	X	X	X		X		
<i>Cyrtospira</i> cf. <i>abbreviata</i> (Hall)			X		?		
<i>C. parvula</i> (Billings)		X	X				
<i>Lozonema murrayama</i> Salter		X	X				X
<i>L.</i> , ? sp.			X				
<i>Fusispira angusta</i> Ulrich and Scofield						X	
<i>F. elongata</i> Hall			X				X
<i>F. inflata nepeana</i> n.var.						X	
<i>F. nobilis</i> Ulrich and Scofield					X		X
<i>F. nobilis ingens</i> n.var.						X	X
<i>F. nobilis medialis</i> n.var.						X	X
<i>F. planulata</i> Ulrich and Scofield						X	X
<i>F. subbrevis obesa</i> n.var.						X	X
<i>F. subfusiformis</i> (Hall)						X	X
<i>F. subfusiformis germana</i> Wilson						X	X
<i>F. terebriformis</i> Hall					X		

TABLE II
Range of Gastropoda in Order of First Appearance

Species	Ottawa formation Faunal beds						
	Pamelia	Lowville	Leray	Rockland	Hull	Sherman Fall	Cobourg
<i>Tryblidium</i> sp.	—	—	—	—	—	—	—
<i>Eaphtisomina distincta</i> Wilson.	—	—	—	—	—	—	—
<i>Eolomaria larvata</i> (Salter)	—	—	—	—	—	—	—
<i>Lophospira perangulata</i> (Hall)	—	—	—	—	—	—	—
<i>Liospira micula</i> (Hall)	—	—	—	—	—	—	—
<i>Liospira vitruvia</i> (Billings)	—	—	—	—	—	—	—
<i>Trochomemella ? montreatensis</i> Okulitch.	—	—	—	—	—	—	—
<i>Archinacella clochensis</i> Foerste.	—	—	—	—	—	—	—
<i>A. explanata</i> n.sp.	—	—	—	—	—	—	—
<i>Micropileus ottawaensis</i> n.sp.	—	—	—	—	—	—	—
<i>Holopea injiformis</i> Wilson.	—	—	—	—	—	—	—
<i>Bucania halli</i> Ulrich and Scofield.	—	—	—	—	—	—	—
<i>Clathrospira subconica</i> (Hall)	—	—	—	—	—	—	—
<i>Subulites conradi</i> Ulrich and Scofield.	—	—	—	—	—	—	—
<i>Macrosenella superba</i> (Billings)	—	—	—	—	—	—	—
<i>Micropileus obesus</i> n.sp.	—	—	—	—	—	—	—
<i>Pterotheca expansa</i> (Emmons)	—	—	—	—	—	—	—
<i>Salpingostoma bilinguosi</i> n.sp.	—	—	—	—	—	—	—
<i>Lophospira peracuta</i> Ulrich and Scofield.	—	—	—	—	—	—	—
<i>Eolomaria dryope</i> (Billings)	—	—	—	—	—	—	—
<i>Straparollina circe</i> Billings	—	—	—	—	—	—	—
<i>Trochomemella ? arachne</i> (Billings)	—	—	—	—	—	—	—
<i>Holopea ottawaensis</i> n.sp.	—	—	—	—	—	—	—
<i>Lophospira serrulata</i> (Salter)	—	—	—	—	—	—	—
<i>Subulites canadensis</i> Ulrich and Scofield.	—	—	—	—	—	—	—
<i>S. regularis</i> Ulrich and Scofield.	—	—	—	—	—	—	—

TABLE II—Cont.

Range of Gastro-poda in Order of First Appearance—Cont.

Species	Ottawa formation Faunal beds						
	Pamela	Lowville	Leray	Rockland	Hull	Sherman Fall	Cobourg
<i>Cyclonema montrealense</i> Billings.....							
<i>Lophospira saffordi</i> Ulrich and Scofield.....							
<i>Salpingostoma expansum</i> (Hall) var.....							
<i>Lophospira milleri</i> (Miller).....							
<i>Lophospira medialis</i> Ulrich and Scofield.....							
<i>Tetranota scarinata</i> Ulrich and Scofield.....							
<i>Helicoloma planulata</i> Salter.....			?				
<i>Liospira progre</i> Billings.....							
<i>Sinuities cancellatus angularis</i> n. var.....							
<i>Homotoma bellicincta</i> (Hall).....							
<i>H. gracilis</i> (Hall).....							
<i>Sinuities cancellatus</i> (Hall).....							
<i>Cyrtolites</i> cf. <i>subplanus</i> Ulrich and Scofield.....							
<i>Subulites gloucesterensis</i> n. sp.....							
<i>Eunema erigone</i> Billings ?.....							
<i>Lophospira helictes</i> (Salter).....							
<i>Onospira alexandra</i> (Billings).....							
<i>Ecolanaria dryope plana</i> n. var.....							
<i>E. supracingulata</i> (Billings).....							
<i>Holopea pyrene</i> Billings.....							
<i>Loxonema murrayana</i> Salter.....							
<i>Phragmolites compressus</i> Conrad.....							
<i>Tetranota bidorsata</i> (Hall).....							
<i>Cyclonema hallianum</i> Salter.....							
<i>Trochonema umbilicatum</i> (Hall).....							
<i>T. umbilicatum canadense</i> Ulrich and Scofield.....							

TABLE II—*Conc.*
 Range of *Gastropoda* in Order of First Appearance—*Conc.*

Species	Ottawa formation Faunal beds						
	Pamella	Lowville	Leray	Rockland	Hull	Sherman Fall	Cobourg
<i>F. angusta</i> Ulrich and Scofield.....							
<i>Archinacella subrotunda</i> Ulrich and Scofield.....							
<i>Platyceras ? perplexa</i> n.sp.....							
<i>Tropidodiscus ? tisculus</i> (Billings).....							
<i>Lophospira angustina</i> n.var.....							
<i>Hormotoma</i> cf. <i>major</i> (Hall).....							
<i>H. salteri</i> <i>ottawaensis</i> n.var.....							
<i>Liospira americana</i> (Billings).....							
<i>Clathrospira conica</i> Ulrich and Scofield.....							
<i>Eccyliomphalus ottawaensis</i> (Billings).....							
<i>Trochonema fragile</i> Ulrich and Scofield.....							
<i>Holopea meata</i> n.sp.....							
<i>H. paludiniiformis</i> Hall.....							
<i>H. parvula</i> Ulrich and Scofield.....							
<i>H. undulata</i> Wilson.....							
<i>Loxonema ?</i> sp.....							
<i>Fusispira elongata</i> Hall.....							
<i>F. nobilis</i> <i>ingens</i> n.var.....							
<i>F. nobilis medialis</i> n.var.....							
<i>F. subbrevis</i> <i>obesa</i> n.var.....							
<i>F. subfusiformis</i> (Hall).....							
<i>F. subfusiformis germana</i> Wilson.....							

TABLE III

Numerical Synopsis of the 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
7 (1)	1 30 (4)	2 11 45 (30)	1 1 4 4 (1)	— 3 3 — 3 (2)	— 1 1 — — 5 (1)	2 11 7 3 1 4 23

FOSSIL LOCALITIES

1. Paquette Rapids, east end of Allumette Island, Ottawa River, Quebec
2. Paquette Rapids, unspecified
3. Eganville, north shore of Bonnechère River, below grist mill, Ontario
4. Quarry north of Bonnechère River, Ontario
5. Fourth Chôte of Bonnechère River, Ontario
6. Lake Clear, lowest beds exposed, Ontario
7. Loose, on hill south of Lake Clear, Ontario
8. Opeongo road, 1 mile west of Esmonde, Ontario
9. Lot 22, con. IV, Grattan tp., Ontario
10. Lot 2, con. IV, Grattan tp., Ontario
11. Paquette Rapids sink-hole, Westmeath tp., Ontario
12. Monroe quarry, lot 19, con. II, north of Westmeath, Ontario
13. Lot 20, con. III, Westmeath tp., Ontario
14. Quarry on hill, 1 mile south of Douglas, Ontario
15. Lot 25, con. V, Admaston, Ontario
16. Edge of hill above Sand Point, above Arnprior, Ontario
17. Lot 23, con. I, Torbolton tp., Ontario
18. Flat area, top of hill, Torbolton tp., west of MacLaren Landing, Ontario
19. Shore above MacLaren Landing, Ontario
20. MacLaren Landing, first terrace above farmhouse and to right of road, Torbolton tp., Ontario
21. MacLaren Landing, Ontario
22. Near Quyon, Quebec
23. Big quarry east of Pakenham, Ontario
24. Southwest corner of lot 20, con. V, Hull tp., $\frac{1}{4}$ mile north of Aylmer, Quebec
25. Top of hill, con. III, Hull tp., Quebec
26. North of Aylmer, Quebec
27. Opposite house on east side of road, The Gardens, east of Aylmer, Quebec
28. Near the old Sowter home, Aylmer, Quebec
29. Val Tetreau, Quebec
30. Val Tetreau, east of fault line (faulted block)
31. Above Chaudière, west of Hull, Quebec
32. Cache Bay, west of Hull, Quebec
33. "The Heap", Hull, Quebec
34. Canadian Pacific Railway cutting south of Aylmer road in Hull, Quebec
35. Near junction of former Aylmer and Hull electric lines, Hull, Quebec
36. Between the Canadian Pacific Railway tracks and the Armouries, Hull, Quebec
37. North of old axe factory near packing house, Hull, Quebec
38. Brewery Creek, Hull, Quebec
39. Wright's quarry, Hull, Quebec
40. Cement quarry, Hull, Quebec

41. Brigham's quarry, Hull, Quebec
42. Quarry south of Canadian Pacific Railway and north of Brigham Creek, Hull, Quebec
43. Behind old match factory, Eddy's lumber yard, Hull, Quebec
44. Waterworks excavation, Hull, Quebec
45. Bed of creek, Front street, Hull, Quebec
46. Hull, unspecified, Quebec
47. Next to last island, Lemieux Bay, Ottawa, Ontario
48. Lemieux Island, Ottawa, Ontario
49. East of powerhouse, Lemieux Island, Ontario
50. Lemieux Island—loose—Ottawa, Ontario
51. Philemon Island, Hull, Quebec
52. Small island at mouth of Hull slide, Hull, Quebec
53. Lot K, con. A, R.F., Nepean tp., Ontario
54. Lot 32, con. II, Nepean tp., Ontario
55. Lots G and H, con. III, Nepean tp., Ontario
56. City View, Ontario
57. Old quarry near post office, City View, Ontario
58. Base line, City View, Ontario
59. North of fault in quarry on Merivale road, 1½ miles south of Carling avenue, Ottawa, Ontario
60. Sandy layer, quarry on Merivale road, Ottawa, Ontario
61. Foster's quarry, Merivale road, Ottawa, Ontario
62. Merivale road, unspecified, Ottawa, Ontario
63. Rideau canal, loose but evidently not far from place, near Hogsback, Ottawa, Ontario
64. Hogsback above sandy layers, Ottawa, Ontario
65. Government quarry, Hogsback, Ottawa, Ontario
66. Top of cliff, Hogsback, Ottawa, Ontario
67. Quarry south of road, Hogsback, Ottawa, Ontario
68. Westboro, Ottawa, Ontario
69. Canadian Pacific Railway track east of Main street, Westboro, Ottawa, Ontario
70. Spencer street, west of Holland avenue, Ottawa, Ontario
71. Hintonburg, Ottawa, Ontario
72. Mechanicsville, Ottawa, Ontario
73. La petite Chaudière, Ottawa River, at Mechanicsville, Ottawa, Ontario
74. Booth mills, Ottawa, Ontario
75. Between Maple and Elm streets, Ottawa, Ontario
76. Corner of Primrose street and Lorne avenue, Ottawa, Ontario
77. Corner of Elm street and Lorne avenue, Ottawa, Ontario
78. Corner of Maple street and Lorne avenue, Ottawa, Ontario
79. Lorne avenue, Ottawa, Ontario
80. Corner Booth and Elm streets, Ottawa, Ontario
81. Corner of Wellington and Sparks streets, Ottawa, Ontario
82. Rochesterville, Ottawa, Ontario
83. Young street, east of Fairmont avenue, Ottawa, Ontario
84. Mount Sherwood, Ottawa, Ontario
85. Railway cutting, Bayswater avenue, Ottawa, Ontario
86. South end of LeBreton street, Ottawa, Ontario
87. South end of Booth (Division) street, Ottawa, Ontario
88. West side of Dow Lake, Ottawa, Ontario
89. Below Dow Lake, Ottawa, Ontario
90. Dow Lake, Ottawa, Ontario
91. Bronson avenue hill, Ottawa, Ontario
92. West end of Fifth avenue, Ottawa, Ontario
93. Corner of Fifth avenue and Percy street, Ottawa, Ontario
94. West end of Fourth avenue, Ottawa, Ontario
95. Percy street, Ottawa, Ontario
96. Corner Bay and McLeod streets, Ottawa, Ontario
97. Small island below Parliament Hill, Ottawa, Ontario

98. Base of Parliament Hill, Ottawa, Ontario
99. Lovers' Walk, Parliament Hill, Ottawa, Ontario
100. Parliament Hill, Ottawa, Ontario
101. Chateau Laurier excavation, Ottawa, Ontario
102. Nepean Point, Ottawa, Ontario
103. La Salle Academy excavation, Ottawa, Ontario
104. Lady Grey drive, Ottawa, Ontario
105. River end of Sussex street, Ottawa, Ontario
106. Steamboat landing, Sussex street, Ottawa, Ontario
107. Cliff between Rideau River and Earnscliffe, Ottawa, Ontario
108. Research Council Laboratories excavation, Sussex street, Ottawa, Ontario
109. Bureau of Statistics excavation, Ottawa, Ontario
110. New Edinburgh, Ottawa, Ontario
111. Crichton street excavation, New Edinburgh, Ottawa, Ontario
112. MacKay street, New Edinburgh, Ottawa, Ontario
113. Rideau Hall grounds, Rockcliffe Park, Ottawa, Ontario
114. Governor Bay, Rockcliffe Park, Ottawa, Ontario
115. Rockcliffe Park, Ottawa, Ontario
116. Quarry facing swamp near Beechwood cemetery, Ottawa, Ontario
117. Ottawa city, unspecified, Ontario
118. DeLury Farm, Ottawa district, Ontario
119. Ottawa district, unspecified, Ontario
120. Northwest of Leitrim, Ontario
121. Eastview cemetery, Ottawa, Ontario
122. Road east of Eastview cemetery, south of fault, Ottawa, Ontario
123. Road to Rockcliffe Airport from Montreal road, east of Ottawa, Ontario
124. Field, south of Walkley road and east of quarry, con. III, Gloucester tp., Ontario
125. Montreal road, unspecified, Ontario
126. Sandy layers, Skead road, east of Ottawa, Ontario
127. Quarry on Skead road, east of Ottawa, Ontario
128. Base of hill below Rothwell cottage, Skead road, east of Ottawa, Ontario
129. East of Skead road, unspecified, east of Ottawa, Ontario
130. First outcrop east of Skead road, east of Ottawa, Ontario
131. East end of bluff, 1 mile east of Skead road, east of Ottawa, Ontario
132. Quarry for Rideau canal, Dowler farm, Gloucester tp., Ontario
133. Lot 2, con. II, R.F., Gloucester tp., Ontario
134. Corner road at lots 2 and 3, con. III, Gloucester tp., Ontario
135. Lot 3, con. III, R.F., Gloucester tp., Ontario
136. Lot 4, con. III, R.F., Gloucester tp., Ontario
137. Lot 6, con. III, R.F., Gloucester tp., Ontario
138. Behind school north of Montreal road at Quarries, east of Ottawa, Ontario
139. Edge of bluff first outcrop west of Green Creek, east of Ottawa, Ontario
140. Quarry west of Government Tank Testing Grounds and east of Green Creek, east of Ottawa, Ontario
141. Top of escarpment south of Montreal road and east of R.C. Novitiate, east of Ottawa, Ontario
142. Quarry to right of road on first road west of boundary between Prescott and Russell counties, Ontario
143. Second quarry west of first road east of boundary between Prescott and Russell counties in Clarence tp., Ontario
144. North of Orleans, Ontario
145. End of outcrop, east of Orleans, Ontario
146. Near fault line, north of Orleans, Ontario
147. Near junction of Montreal and Navan roads, Ontario
148. West of Cumberland, Ontario
149. Quarry 2 miles west of Cumberland, Ontario
150. Front con., Cumberland tp., Ontario
151. Squigley Hill, Cumberland, Ontario

152. Lot 2, con. IV?, south of Cumberland, Ontario
153. West of Navan road, south of Cumberland, Ontario
154. North of Navan, $\frac{3}{4}$ mile north of road entering Navan road from west, Ontario
155. Navan road, unspecified, Ontario
156. Stewart quarry south of Rockland, Ontario
157. Montreal highway east of Rockland, Ontario
158. One mile south and 2 miles east of Clarence Creek, Ontario
159. Southwest of Wendover, Ontario
160. Southeast of Wendover, Ontario
161. South Nation River, $1\frac{1}{2}$ miles from mouth, Ontario
162. Con. II, N. Plantagenet, south from Wendover, Ontario
163. Jessop Rapids, South Nation River, Ontario
164. Lots 13 and 14, con. III, N. Plantagenet tp., Ontario
165. Lot 10, con. IV, N. Plantagenet, Ontario
166. Below the bridge, Plantagenet, Ontario
167. South of bridge, Plantagenet, Ontario
168. Lot 10, con. IV, N. Plantagenet, Ontario
169. Quarry directly west of Plantagenet, Ontario
170. One mile south of Treadwell, Ontario
171. Cumberland-Plantagenet area, unspecified, Ontario
172. Escarpment Sarsfield road, south of Cumberland, Ontario
173. Lot B, con. IV, Cumberland tp., Ontario
174. Sarsfield road, con. X, Clarence tp., Ontario
175. Lots 11 and 12, cons. IX and X, Clarence tp., Ontario
176. North branch of Castor River, Ontario
177. East end of Russell village, Ontario
178. East side of fault at Russell, Ontario
179. Small cut in quarry $\frac{3}{4}$ mile south of Embrun, Ontario
180. Little Castor River, east of Embrun, Ontario
181. Three-quarters mile south of Embrun, Ontario
182. Small quarry west side of New York Central tracks, $\frac{1}{2}$ mile south of river at Embrun, Ontario
183. Four miles east of Embrun, about 100 yards south of river, the eastern of the two quarries, Ontario
184. Quarry near road to South Indian, Ontario
185. Lavoie quarry, south from Bourget, Ontario
186. Lemieux bridge, Ontario
187. Quarry near Lemieux road, north of Casselman, Ontario
188. Casselman, Ontario
189. Lots 17-19, con. XVI, S. Plantagenet, Ontario
190. Loose on road between lots 13-15, cons. IX and X, Cambridge tp., Ontario
191. South of Chesterville, Ontario
192. Quarry $1\frac{1}{2}$ miles west of Finch, Ontario
193. Payne River, Finch, Ontario
194. Lot 24, con. IX, Finch tp., Ontario
195. Lots 25 and 26, con. V, Osnabruck tp., Ontario
196. Aux Raisin River, con. V, Osnabruck tp., Ontario
197. Lot 3, con. VI, Williamsburgh tp., Ontario
198. Morrisburg, unspecified, Ontario
199. One mile east of Bouckhill, Ontario
200. Near Curran, Ontario
201. Quarry in Pamela outcrop, con. IV, Alfred tp., Ontario
202. Con. V, Alfred tp., southeast of Alfred Centre, Ontario
203. Lalonde quarry south of Montreal highway and west of Alfred, Ontario
204. Quarry in Industrial School, Alfred, Ontario
205. L'ange gardien road, 4 miles west of L'Orignal, Ontario
206. South side of l'ange gardien road, 4 miles west of L'Orignal, Ontario
207. North of cheese factory, l'ange gardien road, 4 miles west of L'Orignal, Ontario
208. South from river road, west of L'Orignal, Ontario
209. L'Orignal, unspecified, Ontario
210. Longueuil tp., about 2 miles west of Cassburn, Ontario
211. Hawkesbury, Ontario
212. Grenville, Quebec
213. Stepney hill, south of Hawkesbury, Ontario
214. Quarry north of McAlpine, Ontario
215. McAlpine, Ontario

216. Vankleek Hill, Ontario
217. South of St. Isidore de Prescott, Ontario
218. Dunvegan, Ontario
219. East of Dunvegan, Ontario
220. Lots 10-12, con. VIII, Kenyon tp., Ontario
221. Lots 9 and 10, con. VII, Kenyon tp., Ontario
222. Lots 20 and 21, con. VII, Kenyon tp., Ontario
223. East side lot 23, con. VII, Roxborough tp., Ontario
224. Lots 24 and 25, con. VI, Roxborough tp., Ontario
225. Southwest of Greenfield, along edge of stream, Ontario
226. Dam, west of Alexandria, Ontario
227. Alexandria, Ontario
228. East half lot 35, con. IV, Roxborough tp., Ontario
229. East half lot 9, con. IV, Roxborough tp., Ontario
230. North half lot 3, con. IV, Roxborough tp., Ontario
231. West half lot 27, con. III, Roxborough tp., Ontario
232. Lot 35, con. III, Charlottenburgh tp., Ontario
233. West half lot 22, con. III, Roxborough tp., Ontario
234. Lot 16, con. III, Indian Lands, between Roxborough and Kenyon tps., Ontario
235. In railway cut, lots 14 and 15, con. III, Roxborough tp., Ontario
236. Lot 13, con. III, Roxborough tp., Ontario
237. Lots 10-12, con. III, Roxborough tp., Ontario
238. Cameron farm, southwest of Gravel Hill, Ontario
239. East of Gravel Hill, Ontario
240. Lot 15, con. II (in fence), Roxborough tp., Ontario
241. Lot 15, con. II, Roxborough tp., Ontario
242. West half lot 22, con. II, Roxborough tp., Ontario
243. North half lot 3, con. I, Roxborough tp., Ontario
244. Laflamme farm, near Strathmore, Ontario
245. Where stream crosses road, east of Strathmore, con. I, Roxborough tp., Ontario
246. Back of cheese factory, Strathmore, Ontario
247. Two miles southeast of Strathmore, Ontario
248. Lot 16, con. III, Indian Lands, between Roxborough and Kenyon tps., Ontario
249. Lot 33, con. III, Kenyon tp., Ontario
250. Lot 3, con. III, Kenyon tp., Ontario
251. South of road, lot 23, con. I, Kenyon tp., Ontario
252. East half of lot 23, con. I, Kenyon tp., Ontario
253. Monroe Mills, southeast of Apple Hill, Ontario
254. Lot 30, con. IX, Charlottenburgh tp., Ontario
255. Southeast of Apple Hill, Ontario
256. Lots 34 and 35, con. IX, Charlottenburgh tp., Ontario
257. Road intersection Indian Lands, and con. IX, Charlottenburgh tp., southeast of Strathmore, Ontario
258. Cons. VIII and IX, Charlottenburgh tp., Ontario
259. Road north from Sandfield, con. IX, Charlottenburgh tp., Ontario
260. East half lot 21, con. VIII, Cornwall tp., Ontario
261. Along river, lots 1-3, con. VIII, Cornwall tp., Ontario
262. Lot 1, con. VIII, Cornwall tp., Ontario
263. Bonville, Ontario
264. Quarry on McLaughlin farm, Bonville, Ontario
265. Black River station, Ontario
266. West of Lunenburg, Ontario
267. In river cut east of road and between Lunenburg and North Lunenburg, Ontario
268. East of Cornwall Centre, Ontario
269. North of Mille Roches, Ontario
270. Mille Roches quarries, Ontario
271. Lot 2, con. IV, Cornwall tp., Ontario
272. Ridge, con. IV, Cornwall tp., Ontario
273. Lot 26, con. III, Cornwall tp., Ontario
274. Lot 26, con. X, McNab tp., Ontario
275. Skead road, unspecified, east of Ottawa, Ontario
276. Old mill on South Nation River, 1½ miles from mouth
277. Quarry north of Plantagenet
278. Lot 12, con. IV, Cornwall tp., Ontario
279. Lot 23, con. VII, Roxborough tp., Ontario

DESCRIPTION OF SPECIES

In the present paper the orientation of the cap-shaped shells differs from that adopted by Shimer and Shrock in their 'Index Fossils of North America'. The living snail bears its shell on its back, and when it moves the apex is directed obliquely backward. *Carina*, a living form, closely allied to these *Patella*-like forms, has its tentacles and mouth on the larger end with the apex directed backwards. For these reasons the orientation here adopted is that the apex is nearer the posterior, usually tilted towards it, and the more open part away from the apex is considered the anterior.

Genus, *Priscochiton* DallGenotype, *Chiton canadensis* Billings

Small chiton, each plate with an acute posterior apex, and the interior excavated.

Only one species is known. Dall credits the genus to a manuscript of Billings, but Billings has not used it in his description of the species.

Priscochiton canadensis (Billings)

Plate I, figures 1-3

Chiton canadensis Billings, Geol. Surv., Canada, Pal. Foss., I, 1865, p. 394, figs. 37a-c.
Priscochiton canadensis (Billings), Dall, U.S. Nat. Mus. Proc. 4, 1881, p. 281.

Length 5 mm., height 4 mm.; anterior elevated and rounded, almost to a semicircle, the plane of which is at right angles to the sides; posterior very acute; the whole shell being half a short, broad cone, although one specimen is slightly compressed laterally; interior showing two minute concave plates attached to the posterior margin along one edge, free on the other edge, plates 2 mm. wide at the apex where they meet, tapering to nil within 3 mm. They may be part of a mechanism for attachment of the succeeding shell; a few concentric striæ visible on the exterior, paralleling the anterior margin.

Billings assumes that these two specimens, the only ones found, are posterior plates of a larger chiton, but the rounded anterior margin of both specimens, and the lack on that margin of any mechanism for attachment to a shell anterior to it, suggest rather that they represent the anterior shell of two complete individuals.

It is not possible to compare the species with any other because no other has been found.

Occurrence. Leray-Rockland beds, locality 1.

Type. Holotype, G.S.C. No. 1252; paratype, No. 1252a; Leray-Rockland beds, Allumette Island, Paquette Rapids, Ottawa River.

Genus, *Archinacella* Ulrich and ScofieldGenotype, *A. powersi* Ulrich and Scofield

Size variable; broader about the middle or in the posterior half; apex posterior to the centre, overhanging the posterior margin but not projecting beyond it, a broad convex curve from it to the anterior margin and slightly

concave outline to the posterior margin; muscle scar in form of a band, wide over the body of the shell but becoming narrow beneath the apex; aperture sub-elliptical; growth lines concentric.

The genus most resembles *Tryblidium* in the curves leading to the apex, but differs from that genus in that the apex stands high above, and in some species short of, the posterior margin, instead of curving down beyond it.

Archinacella clochensis Foerste

Plate I, figures 4-6

A. clochensis Foerste, Denison Univ. Sci. Lab. Bull. 17, 1914, p. 308, Pl. 2, figs. 5a and 5b.

Smaller than some species of the genus, holotype measuring 13 mm., 11 mm., and 4 mm. in length, width, and greatest height respectively; greatest width posterior to the centre; present specimen a little smaller but of the same proportions; apex extending to 1 or 1.5 mm., short of posterior margin; anterior part gently and evenly convex, posterior part concave; aperture suboval; anterior margin broadly curved, posterior margin more narrowly curved; a few fine concentric striæ preserved.

In his original description, Foerste states that the species differs from *A. orbiculata* Hall in having the apex less incurved, finer striations, and in lacking the set of coarser striations; but it is also evenly convex on the anterior part as compared with the subangular 'back' of *A. orbiculata*. The aperture is less circular than that of *A. subrotunda* Hall.

Occurrence. Lowville beds, locality 133.

Type. The holotype, which is refigured here, does not come from this locality; holotype, G.S.C. No. 8418; plesiotype, G.S.C. No. 9725; Lowville beds, lot 2, con. II, R.F., Gloucester tp., Ontario.

Archinacella explanata n.sp.

Plate I, figures 7, 8

Medium size, length, greatest width, and height of holotype 17 mm., 13 mm., and 4 mm., respectively; low and widespread in proportion to its height; apex overhanging but falling short of the posterior margin; profile slightly concave below the apex, very gently convex from the apex to the anterior margin and to the sides; aperture of somewhat ovoid outline, widest posterior to the middle, anterior more narrowly rounded; ornamentation, traces of concentric growth lines, and radial striæ discernible on the few specimens present, all of which are casts.

The species is very like *A. valida* Sardeson, but the form is more explanate, the apex is not so high and the aperture is not evenly elliptical as in that species. Compared with *A. clochensis* Foerste, the aperture is larger, the height is less, and the sides are less convex.

Occurrence. Lowville, locality 135.

Type. Holotype, G.S.C. No. 9726, Lowville beds, lot 3, con. III, R.F., Gloucester tp., Ontario.

Archinacella subrotunda Ulrich and Scofield

Plate I, figures 9, 10

A. subrotunda Ulrich and Scofield, Geol. Minnesota, Pal. 3, pt. 2, 1897, p. 834, Pl. 61, figs. 26, 27.

Shell thick, its exfoliation leaving a very narrow concave border equal to its thickness on the outer rim; outline almost circular; length 12 to 13 mm., width 11 to 12 mm., height approximately 5 mm.; concentric growth lines present; apex obtuse, not incurved, excentric, about one-quarter distant from the posterior end; from apex to posterior end, hardly concave; from apex to anterior, gently convex; greatest convexity just anterior to the apex; aperture very slightly arched; muscle scar circular. The only specimen found shows a low, faint, median ridge and one faint lateral ridge on the left side, both within the circular muscle scar. It is to be presumed that there was a right lateral ridge originally.

The species differs from *A. rotunda* Ulrich and Scofield in the more central position of the apex, and in the less concave profile from the apex to the posterior margin. It differs from *A. depressa* Ulrich and Scofield in its smaller size and the more central position of the apex; from *A. clochensis* Foerste and from *A. explanata* in its more rounded outline.

Occurrence. Cobourg beds, locality 80.

Type. Plesiotype, G.S.C. No. 9727, from Cobourg beds at the corner of Booth and Elm streets, Ottawa, Ontario.

Genus, *Macroscenella* gen. nov.Genotype, *Metoptoma superba* (Billings)

Small to large; patelliform, profile subconical; apex elevated, slightly excentric, in some species maintaining that characteristic throughout maturity, in other species developing a greater obesity between one end and the apex, so that the apex becomes directed towards the opposite end, but not incurved, an invagination present at the shorter end; aperture sub-elliptical or subcircular; muscle scars obscure; fine, concentric growth lines present, crossed by radial striæ.

The upright, elevated apex of *Macroscenella* distinguishes it at once from all the patelliform genera that have an apex curving towards the margin. It lacks the prominent rugose concentric undulations of *Palaeacmaea*, and the invagination, size, and thickness of shell differentiate it from the Cambrian genus *Scenella*.

The writer would include in *Macroscenella* such Ordovician forms as *Scenella radialis* Ulrich and Scofield, *Scenella beloitensis* Ulrich and Scofield, *Scenella obtusa* Sardeson, and *Scenella magnifica* Ulrich and Scofield.

The name is derived from *μακρός*—large, and *Scenella*.

Macroscenella superba (Billings)

Plate I, figures 19-21

Metoptomia superba Billings, Pal. Foss. 1, 1865, p. 172, fig. 155.*Scenella superba* (Billings), Ulrich and Scofield, Pal. Minnesota, 3, pt. 2, 1897, p. 838, Pl. 61, fig. 35.

Large for this type of gastropod, subcircular, 55 mm. in diameter, and 35 mm. in height; almost conical with slightly longer side gently convex and shorter one almost straight; apex much elevated and erect, somewhat excentric; aperture subcircular, with a slight invagination at the margin of the shorter side, from which, in the interior, an obscure fold extends obliquely upward to the faintly indicated muscle scar; one or two barely discernible concentric undulations about midway up the inner side of the shell limiting the upper end of the muscle scar, otherwise the interior appears to be smooth; ornamentation, reticulate network of concentric and radial intersecting striæ.

The great size of *Macroscenella superba* (Billings) distinguishes it from such small forms as *Scenella*. Of the larger forms, it is higher in proportion to its diameter and more convex than *M. radialis* Ulrich and Scofield or *M. obtusa* Sardeson (if the two be not the same species) and less triangular; not so high and more convex than *M. magnifica* Ulrich and Scofield.

The holotype is covered on the outside by secondary silica deposits except for one section; other specimens are casts only.

Occurrence. Lowville beds, locality 135; Lowville-Leray beds, localities 29, 31 or 73, 72; Leray-Rockland beds, localities 1, 72.

Type. Holotype, G.S.C. No. 1250a, from Leray-Rockland beds, Allumette Island, Paquette Rapids, Ottawa River.

Genus, *Micropileus* gen. nov.Genotype, *Micropileus obesus* n.sp.

Small patelliform shells with a high liberty cap profile; more or less ventricose; apex high, a little short of, or almost perpendicularly above, the posterior end; outline from apex to posterior margin slightly concave in young, in general straight or slightly convex; from apex to anterior margin very convex; aperture subelliptical, narrowing towards the posterior margin; muscle scars unknown; concentric striæ and/or undulations.

All patelliform shells show a great variation in the position of the apex. *Micropileus* might be considered a subgenus or species of *Helcionella* to which it is closely allied, but *Helcionella* has been limited to the Cambrian. *Archinacella* is more squat, with a much lower apex and a distinctly concave outline between the apex and the posterior margin. *Micropileus* differs from *Scenella* and *Palaeacmaea* in that its apex is posterior, not subcentral. The position of the apex is really transitional between the *Scenella* and the *Archinacella* and *Helcionella* types.

Several Ordovician forms, mostly defined as *Scenella*, appear to belong to this genus, but the illustrations are too poor to warrant listing them until they are better known.

The name *Micropileus* is derived from *μικρός*—little, and *πίλεος*—a soldier's helmet.

Micropileus obesus n.sp.

Plate I, figures 11, 12

Medium size, height 11 to 15 mm.; ventricose; aperture oval, posterior end narrowed gently by a regular curve in some specimens, by a slight constriction in others; long diameter of aperture 12 to 16 mm., short diameter 11 to 14 mm.; apex erect, high above or, in adult specimens, a little short of the narrower margin; profile from apex to posterior margin straight or slightly convex in adult specimens, or even very slightly concave in younger stages, from apex to anterior margin very convex in all stages; old specimens become more obese on all sides without increasing the aperture; ornamented by irregular undulations, apparently crossed by fine radial lines. All specimens are casts, and traces of ornamentation are few.

Micropileus obesus is larger than the other species to be described. It is probably the same species as Walcott's *Metoptoma billingsi*¹, but Walcott's illustrations are drawn and are somewhat contradictory. Figure 12 by its shading suggests the apex directed towards the narrow end, which corresponds with the present forms, but figure 12a shows the apex directed towards the broader end. If the former is the true situation the present species is not valid, but the drawings leave doubt.

Occurrence. Lowville beds, locality 135; Lowville-Leray beds, locality 29; Leray-Rockland beds, locality 2.

Type. Holotype, G.S.C. No. 9731, Lowville beds, lot 3, con. III, R.F., Gloucester tp., Ontario.

Micropileus ottawanus n.sp.

Plate I, figures 13, 14

Small, height 9.5 mm., somewhat compressed laterally; aperture oval, posterior end narrowed by the rather flat, converging sides, long diameter 14 mm., short diameter 10 mm.; apex erect; profile from apex to posterior margin straight for four-fifths of the distance from the margin, with a slight curve just at the apex, convex from apex to anterior margin; pronounced concentric undulations crossing the anterior body of the shell becoming almost obsolete on the flattened sides; faint indications of a few radial striæ present.

Micropileus ottawanus is considerably smaller and is more compressed laterally than *Micropileus obesus*, and has more definite undulations than any specimen seen of the latter species. It bears considerable resemblance to the Cambrian form *Helcionella rugosa*, but is larger, has a more erect beak, flatter sides, and fewer and larger undulations.

Occurrence. Lowville beds, locality 135.

Type. Holotype, G.S.C. No. 9728, Lowville beds, lot 3, con. III, R.F., Gloucester tp., Ontario.

¹ Walcott, C. D.: New York State, Cab. Nat. Hist., 35th Ann. Rept. 1884, pp. 212, Pl. 17, figs. 12, 12a.

Genus, *Tryblidium* LindströmGenotype, *T. reticulatum* Lindström

Patelliform shells with apex slightly elevated above and overhanging the posterior margin; aperture flat, ovoid in outline, narrower at the posterior end; muscle scars, when visible, in six pairs, arranged in a concentric ring; concentric growth lines or strong concentric lamellæ, in some species, accompanied by radiating striæ.

The genus differs from *Archinacella* in its narrow, almost acute posterior and in having six pairs of muscles instead of a continuous band.

Tryblidium erato (Billings)

Plate I, figures 17, 18

Meloptoma erato Billings, Geol. Surv., Canada, Pal. Foss. I, 1865, p. 39 (Adv. sheet 1862).

Tryblidium erato (Billings), Whiteaves, Geol. Surv., Canada, Pal. Foss. 3, pt. 1, 1884, p. 31.

Largest specimen and Billings' type, 25 mm. in length and 16 mm. at its widest part, which is about central; sides broadly convex towards the rather narrow curve of the anterior end, and sloping into the almost acute posterior margin; upper surface gently convex from the apex to the anterior margin, the highest region a little anterior to the apex, and slightly concave from the apex to the posterior margin; a few muscle scars faintly visible indicating a narrower ring of muscles than is shown in the genotype; exterior ornamentation obliterated.

The form is larger than *T. modestum* Ulrich and Scofield and the posterior more acute.

Occurrence. Leray-Rockland beds, locality 1.

Type. Holotype, G.S.C. No. 1251, Leray-Rockland beds, Allumette Island, Paquette Rapids, Ottawa River.

Tryblidium sp.

Plate I, figures 15, 16

The specimens present are moulds only, and none is complete. They are too imperfect to establish a species, but the form is so rare, particularly in the lower beds, that its presence warrants mention.

Largest specimen 25 mm. from anterior margin to apex, and 14 mm. at its widest, from which it decreases gradually towards the apex; two other specimens shorter and proportionately somewhat wider; apex projecting approximately one-quarter of the total length beyond the posterior margin, and curving down to the plane of the aperture; sides very convex; aperture thickened; traces of concentric striæ visible, but their magnitude not discernible.

The form differs from the Trenton species *Proplina? unguiformis* (Ulrich and Scofield) in being larger and more convex, though narrower in proportion to its size, giving it a more attenuate appearance. It is closer

to the Richmond species *Tryblidium manitoulini* Foerste in size and projection of the apex, but it is narrower, and the downward curve of the apex almost reaches the plane of the aperture.

Occurrence. Pamelia beds, locality 126.

Type. Figured specimen, G.S.C. No. 9729, from Pamelia beds, in the sandy layers crossing Skead road, east of Ottawa, Ontario.

Genus, *Platyceras* Conrad

Genotype, *Pileopsis vetusta* Sowerby

Horn-shaped shells, with apex curved and twisted slightly to one side or with only a few initial whorls in contact; whorls rapidly enlarging, body whorl large and generally ventricose; aperture having an irregular outline depending upon the configuration of the object to which it is attached.

The genus has been subdivided into several subgenera because of the variability of the form. It is doubtful whether the Cambrian forms or the following Ordovician species can be correctly assigned to any of the subgenera described. For further remarks *See* the following species description.

Platyceras? perplexa n.sp.

Plate II, figures 1, 2

Small, length 21 mm., width 14 mm., height 10 mm.; ventricose; sides broadly convex, narrowing towards the anterior margin; apex hooked, slightly twisted to one side, overhanging but high above the posterior margin; space between the apex and the margin filled with matrix; evenness of the ventricose whorl disturbed by a narrow fold following the curved apex and broadening along the back but continuing to the slightly narrowed anterior margin.

The species is quite different from any other described Ordovician form.

The genus *Platyceras* has recently been excluded from beds below the Silurian, leaving no place for the few similar forms of Cambrian age, nor for any Ordovician forms such as the species here described. The present specimen is too poorly preserved to be the basis of the description of a new genus or subgenus, yet it is a type distinct from all others in these rocks. For these reasons it is cited as *Platyceras* with a query.

Occurrence. Cobourg beds, locality 226.

Type. Holotype, G.S.C. No. 9730, Cobourg beds, at the dam west of Alexandria, Ontario.

Genus, *Cyrtolites* Conrad

Small, thin-shelled; involute barely touching whorls, in some cases the last whorl being free; umbilicus open; aperture not expanded, and very slightly sinuate; no slit band; one dorsal carina and usually a carina bordering the umbilicus on either side, making the whorl subquadrate in section; ornamentation, fine growth lines directed obliquely forward crossed by very fine revolving lines, in many cases indistinct, but resulting in a reticulate surface when present.

Cyrtolites differs from *Sinuities* in the more gradual expansion of the whorls, in its less expanded aperture, in the oblique and revolving lines of ornamentation, and in the presence of carina and consequent subquadrate section of the whorl.

Cyrtolites cf. *disjunctus* Ulrich and Scofield

Plate II, figures 3, 4

Cyrtolites disjunctus Ulrich and Scofield, Pal. Minnesota 3, 1897, p. 864, Pl. 62, figs. 48, 49.

Loosely coiled, last whorl free; shell attaining 25 mm. in diameter; increase in height of whorl more rapid than that of width but whorl terminating in an almost circular aperture; strong dorsal carina, side carinae weak; ventral side exposed in the free part of the last whorl, showing a V-shaped groove; transverse ridges continuing from the dorsal carina to the V-shaped ventral groove; a few very fine revolving lines.

The species differs from all others of the genus in its free anterior coil.

The specimens at hand are too poorly preserved for certain identification, but they show the free final whorl. A copy of the type is here figured.

Occurrence. Rockland beds, localities 163, 207.

Cyrtolites cf. *subplanus* Ulrich and Scofield

Plate II, figures 5, 6

Cyrtolites subplanus Ulrich and Scofield, Pal. Minnesota 3, 1897, p. 846, Pl. 62, figs. 40-44.

Small; shell thin; whorls barely touching; umbilicus small; sharp dorsal carina and less sharp lateral carinae; ornamented in addition to the carinae by regular, fine, obliquely forward directed growth lines, with a few very faint revolving lines.

The form is represented by only one poorly preserved specimen, but it differs so from any others that it seems desirable to record it.

Occurrence. Leray beds, locality 62.

Type. Plesiotype, in the private collection of G. W. Sinclair.

Genus, *Sinuities* Koken

Genotype, *S. bilobatus* (Sowerby)

Medium size; involute, rapidly enlarging and embracing whorls, which are never wider than high; top of whorl generally rounded, a few specimens bearing on the outer whorl a faint low ridge-like constriction extending back a short distance from the sinus. As specimens are always casts, this feature may be more prominent on the outer shell. Neither slit nor slit band present; umbilicus closed; aperture large but not abruptly expanded, having a deep U-shaped sinus; parietal callosity present but not dense with faintly revolving striae; ornamentation consisting of fine growth lines intersected by delicate revolving lines, usually obscure.

Koken does not mention the presence of a ridge on the anterior of the dorsum, but it is shown in his illustration of *S. rugulosus* Koken. It is not shown in Sowerby's figure of *S. bilobatus*. Every gradation is found in the specimens of this region.

Knight¹ retains both *Sinuities* and *Protowartha*, but Shimer and Shrock² consider them to be synonymous. Knight states that the parietal region of *Sinuities* is unknown, which may be due to the fact that the holotype is a cast. Nevertheless, Koken's illustration³ of *Sinuities rugulosus* Koken shows the revolving striæ in the parietal region, a fact that argues for a parietal region similar to that of *Protowartha*. The differences, then, between *Sinuities* and *Protowartha* resolve themselves into one of size, width of profile of whorl, and relative height and width of the anterior whorl, differences in degree rather than in kind. For this reason the present author uses Koken's genus as the first described.

Sinuities is unlike *Bucania* in its closed umbilicus and more arched whorl profile.

Sinuities bilobatus corrugatus (Hall)

Plate II, figures 7-10

Bellerophon bilobatus corrugatus Hall, Pal. New York, 1, 1847, p. 185, Pl. 40, figs. 6a, b.

Medium size, greatest diameter 25 mm. in the largest specimens occurring in the higher beds, smaller in the lower beds, in which the variety is only sparsely represented; whorls rapidly enlarging, the final one retaining very little curvature; dorsum narrowly rounded; sides somewhat flattened; each whorl higher than wide; umbilicus hidden or very small; aperture gradually expanding, with some variation in the degree of expansion; sinus moderately deep; no carina; outer ornamentation obscure on the moulds, which constitute all the specimens found, but a few growth lines visible, and across the dorsum of the less curved anterior final whorl a series of corrugations which fade out on the sides.

Some variation in the expansion of the aperture is shown. Most specimens exhibit slightly expanding apertures with gentle forward lobes. One lot of three specimens having distinct corrugations shows a much wider aperture with larger lobes. The locality label of this lot is indistinct, but the lot is included here as a minor variation of the variety.

Many of the specimens are small, lacking the final whorl. They have, however, the narrow dorsum, flattened sides, and the height of the whorl greater than the width, in every way corresponding with the initial stages of *S. bilobatus corrugatus*. They are, therefore, included with this variety.

The variety is like the species in the flattened sides of the whorl, in the degree of invagination of the sinus, and, as compared with *S. cancellatus*, in the more narrowly rounded dorsum and the larger anterior lobes. It differs from the species in the dorsal corrugations of the last whorl.

Occurrence. Rockland beds, locality 151; Hull beds, localities 39, 40, 44, 46; Hull or Sherman Fall beds, locality 206; Sherman Fall beds, localities 34, 38; Cobourg beds, localities 93, 100, 114.

¹ Knight, J. Brookes: Geol. Soc. Amer. Spec. Pap. 32, 1941, pp. 279, 320.

² Shimer, H. W., and Schrock, R. R.: Index Foss. North Amer., 1944, p. 441.

³ Koken, E.: Acad. Imp. Sci. St. Petersburg, 5 ser., vol. 7, 1897, p. 117, fig. 4.

Types. Plesiotypes, G.S.C. No. 9733, Sherman Fall beds, from Canadian Pacific Railway cutting south of Aylmer road, Hull; G.S.C. No. 9734, Cobourg beds, Falls of ?.

Sinuities cancellatus (Hall)

Plate II, figures 11, 12

Bellerophon cancellatus Hall, Pal. N.Y. I, 1847, p. 184, Pl. 40, figs. 3a-d.

Protowartha cancellata (Hall), Ulrich and Scofield, Pal. Minnesota 3, pt. 2, 1897, p. 872, Pl. 63, figs. 1-14.

Small; 20 to 25 mm. in diameter, width of aperture 17 to 20 mm.; rapidly enlarging; involute, no slit band, but a shallow notch; rounded dorsally; umbilicus closed; aperture wider than high; surface not preserved on any of the specimens present, but described elsewhere as ornamented by very fine growth lines crossed by fine revolving lines; other characteristics as in the genus.

The species is characterized by being rounded dorsally and by the shallow rounded notch of the aperture, making the side lobes considerably less conspicuous than in the genotype *S. bilobatus* Sowerby.

Occurrence. Lowville-Leray, localities 135, 140, 156; Leray, localities 1, 24, 29, 61, 136, 148, 220, 221, 271; Rockland, localities 151, 163, 181, 207; Hull, localities 38, 44; Hull or Sherman Fall, locality 206; Sherman Fall, localities 34, 37, 43, 118, 180, 192, 265, 267; Cobourg, localities 6, 80, 87, 92, 94, 100, 106, 107, 110, 117, 121, 152, 168, 172, 204, 210, 219, 226, 237, 241, 242, 245, 246, 248, 256, 257, 258, 260, 261.

Type. Plesiotype, G.S.C. No. 1260, Leray-Rockland beds, Allumette Island, Paquette Rapids, Quebec.

Sinuities cancellatus angularis n.var.

Plate II, figure 13

Between the species *Sinuities cancellatus* and the variety *S. cancellatus liratus* is a group of forms that might conceivably be attached to either classification. Every intermediate stage is represented, as seen in the moulds, and it may be a mistake to consider the specimens as a different variety. But they are persistent. The new variety is more like the species in size, general proportions, umbilicus, and rate of increase in size of whorl. Species and both varieties here described, however, are alike in aperture and ornamentation, so far as known. *S. cancellatus angularis* differs from the species in its subangular dorsum, which presents an incipient ridge, extending a short distance posterior to the shallow notch of the aperture and gradually fading into the subangular dorsum. This character may be more pronounced on the outer shell, which would relate it more closely to *S. cancellatus liratus*.

This variety may be that designated by Ulrich and Scofield as *Bellerophon cancellatus trentonensis*, but the only definition given of the variety is that it has a more narrowly rounded dorsum, and that it occurs mostly in the higher beds; no mention is made of an incipient ridge, and *S. cancellatus angularis* occurs in the same localities and at the same horizons as the species.

Occurrence. Lowville beds, localities 62, 135, 140, 171; Leray beds, localities 24, 26, 29, 83; Leray-Rockland beds, localities 1, 136, 148; Rockland beds, localities 151, 163; Hull beds, localities 38, 46, 166; Sherman Fall beds, localities 8, 34, 37, 38, 43, 195; Cobourg beds, localities 74, 76, 80, 86, 92, 103, 106, 107, 112, 119, 180, 194, 204, 236, 246, 249, 252, 256, 258, 260, 261, 263.

Type. Holotype, G.S.C. No. 1700c, Cobourg beds? Ottawa. The aperture is broken, and is more expanding than the illustration suggests.

Sinuities cancellatus liratus nom. nov.

Plate II, figure 14

Bellerophon bilobatus acutus Hall, Pal. New York, I, 1847, p. 185, Pl. 40, figs. 4a-b, 5a-b.

This variety differs from the species in having a definite ridge on the dorsum, a more angular sinus, and in having fewer and more rapidly expanding whorls.

The name "*liratus*" refers to the ridge on the dorsum.

This is not a new species. It is the form named by Hall *Bellerophon bilobatus acutus*, later referred to as *Sinuities cancellatus acutus*. Sowerby described *Bellerophon acutus* and *Bellerophon bilobatus*, the latter being the genotype for *Sinuities*. Sowerby's *Bellerophon acutus* then would become *Sinuities acutus*, leading to confusion worse confounded with Hall's variety. *Sinuities acutus* or *S. cancellatus acutus* is here reserved for Sowerby's original *Bellerophon acutus* and Hall's *Bellerophon bilobatus acutus* is here changed to *Sinuities cancellatus liratus*.

Occurrence. Leray beds, locality 24; Sherman Fall beds, localities 37, 43; Cobourg beds, localities 51, 76, 80, 86, 100, 107, 119, 194.

Type. Plesiotype, G.S.C. No. 9732, Cobourg beds, Parliament Hill, Ottawa, Ontario.

Genus, *Bucania* Hall

Genotype, *Bellerophon sulcatinus* Emmons

Medium size; discoidal; three to four depressed whorls increasing gradually in size, with gently arched dorsum, subangular sides, and concave ventrally, being impressed on the preceding whorl; width of whorl greater than height; umbilicus open and rather deep, revealing the sides of all the volutions; aperture open widely but without a flare; shallow sinus culminating in a narrow slit that results in a selenizone; ornamentation of two kinds—round, irregular revolving lines, crossed obliquely by growth lines.

The genus is in many respects like *Salpingostoma*. Differences are cited under the latter genus.

Bucania halli Ulrich and Scofield

Plate II, figures 15, 16

Bucania halli Ulrich and Scofield, Pal. Minnesota, 3, pt. 2, 1897, p. 886, Pl. 66, figs. 4-8.

Shell diameter 30 to 40 mm.; three to four whorls, increasing gradually; dorsum, sides, venter, and umbilicus typical of the genus; aperture expanded but not flaring, height about one-half width; outer lip broadly sinuate; slit band and selenizone narrow, slightly elevated; ornamentation, revolving, wrinkled ribs, about 7 in 5 mm., increasing by bifurcation and implantation with expansion of the whorl, crossed by obliquely transverse striæ.

Bucania halli differs from the genotype *Bucania sulcatina* (Emmons) in being smaller and less globose, in having a proportionately smaller umbilicus, and in the less angular umbilicus margin.

Occurrence. Lowville beds, locality 135; Leray beds, localities 29, 156.

Type. Plesiotype, G.S.C. No. 9735, Lowville beds, lot 3, con. III, Gloucester tp., Ontario.

Bucania punctifrons (Emmons)

Plate II, figures 21-23

Bellerophon punctifrons Emmons, Geol. Rept. 2nd Dist. New York, 1842, p. 392.*Bucania punctifrons* (Emmons), Hall, Pal. New York, 1, 1847, p. 187, Pl. 40A, figs. 1a-e.

Shell, 20 to 25 mm. in diameter; three or four volutions; whorls having a rounded dorsum with subangular sides; umbilicus large, more than half the diameter of the shell; aperture a little wider than high, upper part of the whorl semicircular in section, lower part indented by the preceding whorl; slit band concave, bordered by a delicate line on each side; surface covered by a network pattern, the meshes regularly placed so that they appear as rows at right angles or oblique to the whorls, gradually swinging around to aline themselves with the growth lines at the aperture.

Bucania punctifrons (Emmons) differs from *Bucania halli* Ulrich and Scofield in its larger umbilicus, its typically more round dorsum, and in its ornamentation.

Several forms seem to depart from the norm of the species in having a depressed whorl and, consequently, a more angular umbilical margin. The network ornamentation is similar. The variation is represented in this collection by fragments only, not sufficient to ascribe it to a new variety with any certainty. If better specimens prove it to be a constant variation it should have a varietal name.

Occurrence. Rockland beds, localities 151, 156; Sherman Fall beds, localities 34, 192; Cobourg beds, localities 75, 87, 93, 188, 189, 204, 226, 233, 241, 247, 249, 260, 261.

Type. Plesiotypes, G.S.C. No. 9736, typical form; G.S.C. No. 9737, depressed dorsum; both from Sherman Fall beds, quarry 1½ miles west of Finch, Ontario.

Genus, *Salpingostoma* RoemerGenotype, *Bellerophon megalostoma* Eichwald

Rather large for the involute type of shell; numerous volutions, scarcely embracing; slit band closed in the mature part, open on the outer half of the last whorl, the opening not extending to the aperture; obscure dorsal keel present; aperture with wide, abrupt, trumpet-like expansion having a slightly sinuous outline at the margin, in line with the slit band; ornamented by revolving lines interrupted by oblique growth lines, which in the younger part accommodate themselves to the shape of the aperture, the intersection of the two sets of lines making a reticulate pattern.

The genus is very similar to *Tremanotus* from Silurian and Devonian formations in its wide and abrupt apertural expansion, but differs in that the expansion of the latter is periodic at frequent and regular intervals, and the slit band of that genus closes at intervals so that it bears a series of small, elongate perforations instead of the slit band of *Salpingostoma*.

Salpingostoma billingsi n.sp.

Plate III, figures 1-3

Medium size; holotype measuring 40 mm. from the tip of the apertural flare to the opposite side, as compared with 57 mm. in the succeeding species, but, apparently, having the same number of volutions; whorls rather tightly coiled; umbilicus deep, its width measuring 17 mm. as compared with 29 mm. in the succeeding species; aperture not quite so abruptly flaring as in some forms; notch very slight; ornamented by growth lines intersecting revolving lines, the latter being interrupted by the band thence passing outward and forward.

The species differs from both *S. buelli* (Whitfield) and *S. expansum* (Hall) in its smaller size, more rapidly increasing and more tightly coiled whorls, and in its less abrupt aperture.

Salpingostoma billingsi n.sp. is named after E. Billings, the first palæontologist of the Geological Survey of Canada.

Occurrence. Lowville beds, locality 135; Leray beds?, localities 29, 62, 150, 156; Leray-Rockland beds, localities 1, 270.

Type. Holotype, G.S.C. No. 1259, Leray beds, Front con., Cumberland tp., Ontario; paratype, G.S.C. No. 9738, Allumette Island, Ottawa River.

Salpingostoma expansum (Hall) var.

Plate III, figures 5-7

Involute; three or four whorls, enlarging rather rapidly, the last one elongate; whorl section subtriangular or elliptical, having the width twice the height, broadly rounded on top, with an obscure angulation at the keel, very slightly impressed ventrally, sides sharply rounded; aperture very abruptly expanded; faintly preserved ornamentation showing a reticulation of backward directed lines interrupted and disarranged by still more faint, obliquely forward directed lines, making a network of oblong meshes quite different from that of *S. billingsi*.

Descriptions and figures of *S. expansum* (Hall) are very poor, and there is no description or illustration of its ornamentation. If better specimens should show that the variety and species differ radically, the variety should have a specific name. At present all material is too poor to be certain. The variety is similar to the species in the angular margin of the umbilicus and in the slight straightening of the last whorl. It differs from the species in the abruptness of the apertural expansion, in which respect it is more like *S. buelli* (Whitfield). It differs from *S. sculptile* Ulrich and Scofield in this feature and in its less pronounced keel.

Occurrence. Lowville beds, locality 135; Leray-Rockland beds, localities 1, 29, 127, 150, 221; Cobourg beds, localities 77, 93, 257, 263.

Type. Plesiotypes, G.S.C. No. 1705, Leray-Rockland beds, Front con., Cumberland tp., Ontario, and G.S.C. No. 9739, Leray-Rockland beds, lot 3, con. III, R.F., Gloucester tp., Ontario.

Genus, *Phragmolites* Conrad

Genotype, *Phragmolites compressus* Conrad

Medium size; discoidal, involute, coiled symmetrically, volutions subcordate in section, the keel of each preceding volution being impressed in varying degree on the following whorl; widest in the middle or below it, with an abrupt inflexion at the umbilicus; gradually enlarging whorls; slit between two raised lines, which when filled form a prominent peripheral keel; wide umbilicus; aperture somewhat flaring, with fluted expansions that leave a zigzag ornamentation of coarsely wrinkled growth lines.

Phragmolites is readily distinguished from all smooth involute forms with a wide umbilicus. It differs from *Cyrtolites* in that it is not sharply angular on the edge of the umbilicus, enlarges less rapidly, is narrower in section, and has a very different ornamentation.

Phragmolites compressus Conrad

Plate II, figures 17, 18

Phragmolites compressus Conrad, 2nd Ann. Rept., New York Geol. Surv. 1838, p. 119.

Cyrtolites compressus (Conrad), Hall, Pal. New York 1, 1847, p. 188, Pl. 40A, figs. 2a-f.

Phragmolites compressus Conrad, Grabau and Shimer, North Amer. Index Fossils, 1, 1909, p. 617.

Discoidal; from 20 to 25 mm. in diameter, two and a half to three volutions, not contiguous; whorls gradually enlarging, rounded on the sides; sharply defined keel on the dorsum, about one-half of the keel of each coil impressed into the base of the succeeding coil; umbilicus a little less than half the total width, open to the nucleus, each volution distinctly separated from the next by the height of the unimpressed part of the keel; aperture probably expanded, with seven or more forward projecting folds on each side of the keel; aperture outline leaving its trace in a zigzag line which crosses the whorl at right angles to the axis of the coil on the upper surface, but becomes an irregular uneven line turned obliquely backward across the lower side of the whorl within the umbilicus; each projecting fold about 1 mm. in height, a little less in width, and the lines from 1 to 2 mm. distant at various stages of growth.

Hall states that the aperture is scarcely expanded, but neither the illustrations nor the specimens show an aperture preserved. But comparison with other species of the genus and the trace of the fluting certainly suggest a flare.

The original description of the species does not mention the oblique backward turn of the trace of the aperture, though some of the illustrations of *P. fimbriatus* show this feature. There, also, must be a close relationship to *P. obliquus* (Ulrich and Scofield), in which the course of the trace is oblique throughout.

P. compressus differs from *P. fimbriatus* (Ulrich and Scofield) in that the section of the whorl is wider than high.

Occurrence. Leray beds, localities 156, 211; Leray-Rockland beds, localities 1, 29, 136; Rockland beds, localities 17, 156.

Type. Plesiotype, G.S.C. No. 1257, Leray-Rockland beds, Allumette Island, Paquette Rapids, Ottawa River.

Genus, *Tetranota* Ulrich and Scofield

Genotype, *Bucania bidorsata* Hall

Medium size; shell thin; involute whorls compressed dorso-ventrally; width greater than height; umbilicus open, with a medium or large diameter and having a subangular margin; aperture moderately expanding, mainly in a lateral direction; inner lip without a callosity; sinus more or less deep, ending in a short slit; dorsal band wide and flat, with a ridge on either side; two other ridges present, one on either side of the broad, ridge-margined dorsal band and halfway between it and the margin of the umbilicus, making four ridges in all, hence the generic name; some species with additional ridges; covered with delicate growth lines, crossed at right angles or obliquely by minute ribs. The revolving ribs are almost indistinguishable in some specimens, particularly in moulds and near the aperture.

Tetranota is easily distinguished from *Bucania* where the surface is preserved. Moulds, which are more commonly found, differ in the broader, flatter dorsal band, lower whorl, and the outer pair of ridges when preserved.

Tetranota bidorsata (Hall)

Plate IV, figures 1, 2

Bucania bidorsata Hall, Pal. New York, 1, 1847, p. 186, Pl. 40, figs. 8a-9.

Tetranota bidorsata (Hall), Ulrich and Scofield, Pal. Minnesota, 3, pt. 2, 1897, p. 877, Pl. 65, figs. 10-18.

Medium size; subglobose; involute, having about three volutions; whorls enlarging gradually and expanding more abruptly near the aperture; whorl lightly straightened, low and wide; umbilicus comparatively wide; aperture sublunate, with a broad sinus ending in a short, broad slit producing a selenizone bordered by two ridges, the whole showing as a broad band in moulds; a second pair of revolving broad ridges near the edge of the umbilicus; fine transverse growth lines receding from the umbilicus and bending posteriorly, making a gentle curve on the dorsal band.

Occurrence. Leray beds, localities 24, 29, 61, 72, 209; Leray-Rockland beds, locality 151; Rockland beds, locality 156.

Type. Plesiotypes, G.S.C. Nos. 9740 and 9740a, Leray beds, Val Tetreau, Quebec.

Tetranota charon (Billings)

Plate IV, figures 3-6

Bellerophon charon Billings, Can. Nat. and Geol. 5, 1860, p. 169, figs. 14, 15.

Globose, greatest diameter 22 mm., width of whorl 19 mm., involute, each whorl embracing most of the preceding one; width of whorl section nearly twice that of its height; aperture very wide, expanding abruptly; sinus broken on all specimens, but apparently gently invaginated; umbilicus small and deep; dorsal ridge faint but present, disappearing near the aperture, showing more definitely on the oldest visible part of the whorl; ridges bordering the umbilicus rounded.

This species differs from *T. bidorsata* in the gradual elimination of the dorsal ridge and possibly in its abruptly expanding aperture. It is very similar to *T. obsoleta* Ulrich and Scofield. The only discernible difference might be the abruptly expanding aperture. No illustration or specimen of either *T. bidorsata* or of *T. obsoleta* shows the aperture. If better material should prove that the apertures of *T. obsoleta* and *T. charon* are similar, the names would be synonyms.

Occurrence. Leray-Rockland beds, localities 1, 136.

Type. Holotype, G.S.C. No. 1249b; paratypes, Nos. 1249a and 1249c; Leray-Rockland beds, Paquette Rapids, Ottawa River.

Tetranota sexcarinata Ulrich and Scofield

Plate IV, figures 10, 11

Tetranota sexcarinata Ulrich and Scofield, Pal. Minnesota, 3, pt. 2, 1897, p. 878, Pl. 65, figs. 3-9.

Large for the genus, 25 to 30 mm. in diameter; height to width as two to three, dorsal ridges continuing to the aperture; one extra pair of lateral ridges, making six in all; sinus of outer lip deep and wide; growth lines averaging about 1 mm. apart.

T. sexcarinata differs from *T. bidorsata* in its wider whorl, in having six instead of four revolving lines, in the wider and deeper sinus, and in the more widely spaced growth lines.

Occurrence. Lowville beds, locality 135; Leray? beds, localities 29, 63; Leray-Rockland beds, localities 1, 207; Rockland beds, locality 129; Sherman Fall beds, locality 114; Cobourg beds, localities 92, 204, 229, 239, 249, 259.

Type. Plesiotypes, G.S.C. Nos. 9741 and 9741a, Leray? beds, lot 3, con. III, R.F., Gloucester tp., Ontario.

Genus, *Tropidodiscus* (= *Oxydiscus* Koken)¹ Meek and Worthen

¹ For discussion of nomenclature, See Knight, Geol. Soc. Amer., Spec. Paper 32, 1941, pp. 360-361.

Genotype, *Bellerophon curvilineatus* Conrad

Coiled in one plane, each whorl embracing considerable of the preceding one; three or four volutions; periphery sharply keeled, with a V-shaped notch ending in a long slit; section of whorl subtriangular, sharply angular on top, greatest width at the edge of umbilicus where the base of the section is narrowly rounded making a re-entrant curve embracing a section of the preceding whorl; umbilicus open, varying in width depending upon the amount of the preceding whorl embraced, showing the spiral step-like edges of the whorls within the umbilicus; aperture subtriangular; growth lines obliquely forward from the keel to the umbilicus.

Tropidodiscus? *argo* (Billings)

Plate IV, figures 7-9

Bellerophon argo Billings, Can. Nat. Geol. 5, 1860, p. 167, figs. 12 and 13; Geol. Canada, 1863, p. 146, figs. 99a, b.

Size 18 to 35 mm. in diameter, 10 to 20 mm. in thickness; discoidal, embracing one-half to two-thirds of the preceding whorl; periphery sharp, but no distinct keel evident; notch, section of whorl, aperture, and ornamentation typical of the genus; sides of whorl sloping outward, with a gentle convexity to the region of greatest thickness just before the sharp curve into the umbilicus; umbilicus rather small, being one-fifth or less of the whole diameter; umbilical edge sharply rounded.

The species differs from *T.?* *cristatus* (Safford) in its more embracing whorls and smaller umbilicus; from *T.?* *disculus* (Billings) in its greater thickness and less acute periphery.

There is some doubt as to the genus of this group of Ordovician discoid forms. As seen from the discussion to which reference is made above, *Tropidodiscus* is primarily a Devonian form. Ordovician to Devonian is a long range for a genus, and yet the main difference seems to be a less pronounced keel in the Ordovician forms (many of the specimens are casts, in which a keel would not be very prominent), hardly basis enough for another genus.

Occurrence. Leray-Rockland beds, locality 1.

Type. Holotype, G.S.C. No. 1262a; paratype, No. 1262b; Leray-Rockland beds, Allumette Island, Paquette Rapids, Ottawa River.

Tropidodiscus? *disculus* (Billings)

Plate IV, figures 24, 25

Bellerophon disculus Billings, Can. Nat. and Geol. 5, 1860, p. 168, fig. 11.

Ozydiscus disculus (Billings), Ulrich and Scofield, Pal. Minnesota, 3, pt. 2, 1897, p. 852.

Shell thick, judging from the traces left; discoidal; largest specimen 35 mm. in diameter and 12 mm. in thickness near the aperture; involute, each whorl embracing about half of the preceding one; greatest width of whorl at the edge of the umbilicus; dorsum very acute; sides straight or even slightly concave on the outer half, becoming gently convex upon approaching the umbilicus; aperture almost an isosceles triangle, with a re-entrant at the base from the impression of the preceding whorl; umbilicus large, almost half the diameter of the shell; surface not seen, all specimens known are moulds.

T. disculus differs from *T. argo* in its acute dorsum and narrow whorl. The reason for the query is given under the description of the genus.

Occurrence. Cobourg beds, localities 51, 105, 188, 237, 256.

Type. Neotype, G.S.C. No. 9742, Cobourg beds, foot of Sussex street, Ottawa. Billings' type from Lake St. John has been lost, and the best available specimen is here designated the neotype.

Genus, *Pterotheca* Salter

Genotype, *Pterotheca transversa* (Portlock)

Large, widely expanding patelliform gastropods, subtriangular or oval in outline, broader than long; apex posteriorly placed, forming a hook-like projection incurred in the median plane; anterior margin wide and undulating, having a long narrow median sinus which becomes a ridge-like selenizone from the sinus to the hooked apex, symmetrically dividing the shell; interior shallow, covered by a flat triangular platform supported at the apex by a pair of short lamellæ.

The genus is much larger than any other gastropod of this type, and is distinguished from others by the strong median, ridge-like selenizone. It lacks the involute coil at the apex and the reflexed inner lip of *Carinaropsis*.

Pterotheca expansa (Emmons)

Plate II, figures 19, 20

Delthyris expansus Emmons, Geol. New York, 2, 1842, p. 397, fig. 2.

Pterotheca expansa (Emmons), Lesley, Geol. Surv., Pennsylvania, Rept. 4, 1889, p. 821, fig.

Large for the genus, the largest specimen seen measuring approximately 35 to 40 mm. from curved apex to anterior margin, and 62 mm. from side to side; very broad and subrhomboidal in outline; posterior outline convex, sides curving sharply into the anterior, which is gently convex and divided by the prominent but narrow sinus; surface bisected by the very prominent ridge-like selenizone, leaving a narrow depression immediately on either side of it adjoining a broad convexity in the lateral wings.

Interior with a triangular platform about twice as broad as long, the two sides making approximately a right angle at the apex; straight or gently convex on the anterior margin, and extending towards the anterior to beyond the middle of the shell, its lateral edges attached to the interior by a thickening of the shell, which leaves a low depression in moulds; growth lines fine, following the same pattern as the shell margin.

All known *Pterothecae* have been inadequately described and figured due to poor preservation. *Pterotheca expansa*, however, is more explanate than other forms. The sides of the platform make a greater angle than that of *Pterotheca transversa*. The sharp surface ridge seems narrower than that of *Pterotheca saffordi*, and the sides of the interior platform do not seem to be so close to the shell margin.

Occurrence. Lowville beds, locality 135; Leray beds, localities 56, 72, 73, 136; Leray-Rockland beds, locality 1.

Type. Plesiotypes, G.S.C. Nos. 1255 and 1255a; Leray-Rockland beds, Allumette Island, Paquette Rapids, Ottawa River.

Genus, *Lophospira* WhitfieldGenotype, *Lophospira milleri* (Miller)

Size variable; turbinate or with a moderately high spire; number of volutions variable; periphery angular; whorl strongly carinated; sutures well marked; umbilicus closed by the inner lip of the last whorl, but showing a minute axial perforation where broken; aperture somewhat prolonged at the lower end, bearing a notch that is progressively covered, resulting in a narrow band with successive striations concave to the anterior; ornamentation made up of several keels revolving around the whorl, crossed by growth lines that trend posteriorly towards the slit band, thence curving forward over the convex lower part of the whorl to turn backward again in the umbilical region.

Lophospira is distinguished from *Omospira* and *Hormotoma* by its carinæ. It is more robust than *Hormotoma* and usually more slender than *Omospira*.

Lophospira angustina n. var.

Plate III, figure 8

L. angustina minnesolensis Ulrich and Scofield, Pal. Minnesota, 3, pt. 2, 1897, p. 988, Pl. 71, figs. 3, 4.

Large, height 80 to 120 mm.; shell thick; apical angle 36 to 45 degrees; eight or nine whorls when complete, loosely coiled, upper surface gently convex, lower surface ventricose; obtuse carina below the middle, in casts presenting an angulation of the whorl outline, in the position of the band; aperture free except on the upper side, reflexed but not enclosing the umbilicus. The only forms seen are worn specimens or casts in which the carina and growth lines are indistinct or the latter are absent.

The authors describe this as a variety of *L. angustina*, a Beekmantown form from Newfoundland. Only a limited number of specimens have been seen, mostly casts. It is probable that complete specimens would show greater differences. The writer has seen only two fragments, one of which shows traces of growth lines considerably finer than those of *L. angustina*.

The form differs from all other *Lophospira* in its much larger size and in having more convex whorls. The variety differs from the species in having the band situated farther below the median line, the whorls are less convex, and the growth lines are finer. Casts might easily be confused with casts of *Hormotoma* cf. *major* but for the angulation at the band.

Occurrence. Cobourg beds, localities 220, 228.

Lophospira helicteres (Salter)

Plate V, figures 1-3

Murchisonia helicteres Salter, Geol. Surv., Canada, dec. 1, 1859, p. 21, Pl. 4, figs. 2-4.
Lophospira helicteres (Salter) Grabau and Shimer, N.A. Index Fossils, 1, 1909, p. 632, fig. 857.

Large for the genus, 55 to 60 mm. in length, and 25 to 35 mm. at greatest width; apical angle 45 to 65 degrees; whorls six to seven in number, contiguous in the younger part, becoming more and more loosely coiled, the last whorl entirely free and widely separated from the preceding one;

band wide, very distinct, borne upon the main peripheral carina, notch not very deep, but strongly marked by two marginal rims; aperture semicircular except for the angulation of the carinæ and an outer downward projection of the lower margin as indicated by some broken specimens; umbilicus with very convex sides, small in the older whorls becoming open in the last free whorl; four carinæ present, the broad peripheral band-bearing one being the most distinctive, two others equidistant one above and one below the peripheral band, the upper one being more distinct and situated about halfway between the band and the suture, the fourth less prominent carina situated at the suture being most evident at the upper edge of the last free whorl; spaces between all four carinæ concave, becoming very convex beneath the lowest carina and rounding into the umbilicus; growth lines coarse, many piled together, directed slightly backward between the two upper carina, thence sweeping more abruptly backward upon approaching the band, thence forward to the fourth and lowest carina, again curving backward to the umbilicus.

L. helicteres (Salter) is most closely allied to *L. serrulata* (Salter). The differences are enumerated under the description of that species.

Occurrence. Leray beds, locality 136; Leray-Rockland beds, locality 1.

Type. Cotypes, G.S.C. Nos. 1246a and 1246c, Leray-Rockland beds, Allumette Island, Paquette Rapids, Quebec.

Lophospira medialis Ulrich and Scofield

Plate IV, figure 12

Lophospira medialis Ulrich and Scofield, Pal. Minnesota, 3, pt. 2, 1897, p. 973, Pl. 73, figs. 23-29.

Spirally coiled; small; apical angle 58 to 70 degrees; six to seven volutions according to the original description, but four or five shown in the illustrations and in the specimens to hand; whorls contiguous, rapidly enlarging, upper slope almost flat, in some specimens convex near the suture and slightly concave near the periphery, generally rounded below; aperture almost circular, interrupted by the band; upper carina absent or represented by the inner convexity of the whorl, lower carina indistinct or absent; whorl flat or slightly concave between the position of the lower carina and the band, thence convex to umbilicus; umbilicus small; growth lines curved backward from the periphery, in some specimens piled in groups.

The species differs from *Lophospira perangulata* (Hall) in its more compact form, fewer whorls, and less pronounced angulation.

L. medialis does occur in the lower part of the section in the Leray and Rockland beds, but it is far more prolific in the Cobourg beds, that is, near the top of the section.

Occurrence. Lowville beds, locality 135; Leray-Rockland beds, localities 1, 22; Sherman Fall beds, localities 38, 180, 196, 266; Cobourg beds, localities 51, 80, 86, 210.

Type. Plesiotype, G.S.C. No. 9746, Leray-Rockland beds, Paquette Rapids, Ottawa River.

Lophospira milleri (Miller)

Plate V, figure 4

Murchisonia bicincta Hall, Pal. New York, 1, 1847, p. 177, Pl. 38, figs. 5a-f.

Murchisonia milleri Hall, Pal. N. America, 1889, p. 412.

Lophospira bicincta (Hall), Ulrich and Scofield, Pal. Minnesota, 3, pt. 2, 1897, p. 964, Pl. 72, figs. 1-5.

Lophospira milleri (Miller), Knight, Geol. Soc. Amer. Spec. Pap. 32, 1941, p. 179, Pl. 39, figs. 4a-b.

Medium size; moderately high spire with corresponding apical angle; strongly angulated periphery with a short, sharp notch successively filled by a selenizone between its two raised boundaries; five to six volutions; three carinæ, that at the periphery much sharper than the other two above and below it, each of which lies close to the adjacent suture, some specimens revealing a fourth carina at the lower edge of the axial perforation where the reflexed lip is broken off; whorl in section flat or slightly concave between the upper suture and carina, and between upper and lower carinæ and periphery, gently convex at the base; lower part of aperture somewhat drawn out, inner lip reflexed and eventually re-absorbed, because at the aperture it covers the small, lengthwise perforation which extends with a straight axis to the apex of the shell; growth lines rather coarse, directed slightly backward to the upper carina, more obliquely backward to the periphery, then almost vertical to the lower carina and more gently forward over the lower convexity, turning to vertical or even backward as it approaches the lower end of the axial perforation.

L. milleri is distinguished by the vertical direction of the striæ below the periphery, and differs from *L. perangulata* (Hall) in its larger size and consequent less sharp angulation, and in its more numerous carinæ; from *L. medialis* in its larger size and more gradually increasing whorl, hence its proportionately longer shell.

Although the form occurs in the upper part of the section it is more prolific in the lower beds.

Occurrence. Lowville beds, localities 135, 140, 159, 160; Leray beds, localities 56, 61, 73, 156; Leray-Rockland beds, localities 1, 10, 72; Sherman Fall beds, locality 38; Cobourg beds, localities 78, 80, 92, 94, 154, 204, 250.

Type. Plesiotype, G.S.C. No. 9743, Leray-Rockland beds, Paquette Rapids, Ottawa River.

Lophospira peracuta Ulrich and Scofield

Plate III, figure 4

L. peracuta Ulrich and Scofield, Pal. Minnesota, 3, 1897, p. 976, Pl. 73, figs. 15-17.

Rather large for the genus, higher than wide, height from 25 to 40 mm.; averaging five volutions, enlarging rapidly; periphery sharply angular; surface concave in profile above and gently convex below the periphery; peripheral carina the only one present; umbilicus small; aperture rounded, somewhat produced below; surface markings faint.

The single peripheral carina distinguishes *L. peracuta* from the large group of the genus that has three carina, and from the group that has a

peripheral carina and a second, not well defined, one on the lower part of the last whorl. From those with the single peripheral carina it differs in the concavity of the upper part of the whorl and the consequent sharper angle of the periphery.

The Canadian form is not common and it appears to be smaller, but otherwise agrees with the description.

Occurrence. Lowville beds, localities 127, 140; Leray-Rockland beds, localities 1, 3, 53.

Type. Plesiotype, G.S.C. No. 9744, Leray-Rockland beds, Allumette Island, Paquette Rapids, Ottawa River.

Lophospira perangulata (Hall)

Plate IV, figure 13

Murchisonia perangulata Hall, Pal. New York, 1, 1847, p. 41, Pl. 10, fig. 4.

Lophospira perangulata (Hall), Ulrich and Scofield, Pal. Minnesota, 3, pt. 2, 1897, p. 972, Pl. 73, figs. 1-7.

Very small; typical form measuring from 10 to 20 mm. in height, local form 6 to 8 mm.; fusiform; apical angle acute; five to six volutions when complete; notch deep; periphery sharply angular; whorl gently concave above to the suture, convex below, except the last whorl, which is more ventricose and is free in some specimens; umbilicus small; aperture subtriangular, slightly drawn out below; two sets of growth lines, several finer ones between two coarser, both curving backward towards the peripheral band.

Occurrence. Pamela beds, localities 20, 64, 127; Lowville beds, localities 21, 53, 59, 135, 140, 159; Leray beds, localities 22, 83, 156; Leray-Rockland beds, locality 1; Rockland beds, locality 156.

Type. Plesiotype, G.S.C. No. 9745, Leray-Rockland beds, Allumette Island, Paquette Rapids, Ottawa River.

Lophospira procris (Billings)

Plate V, figures 6, 7

Murchisonia procris Billings, Geol. Surv., Canada, Pal. Foss. 1, 1865 (Adv. sheet 1862), p. 34.

Hormotoma procris (Billings), Ulrich and Scofield, Pal. Minnesota, 3, pt. 2, 1897, p. 1014.

Small, short, about 23 mm. in length; apical angle approximately 50 degrees; five or six uniformly rounded, rapidly enlarging whorls; aperture oval in outline, slightly projecting, approximately 12 mm. in height and 9 mm. in width; band very narrow, filled with secondary silica, situated below the middle and almost covered by the succeeding whorl; a second indistinct carina midway between the band and the upper suture, faint indication of a third carina marking the base of the very small umbilicus; upper shoulder and the space between the two carina very gently convex, almost flat, lower part of the whorl quite convex; growth lines almost vertical from suture to umbilicus and slightly rugose.

The species differs from others in its rotund outline and in the direction of the growth lines.

Billings described the species as a *Murchisonia*. Ulrich and Scofield later placed it under *Hormoloma*. The holotype was never illustrated. A careful examination shows that what was called "a wide band" is the space between the carina and the true slit band. The latter is very narrow and mostly covered by secondary silica. The direction of the growth lines, passing over the upper carina and almost directly vertical down to the more prominent carina, shows that the upper carina is not the upper margin of a wide band. The growth lines are slightly rugose, but not so much so as seems at first sight. Secondary silica exaggerates every prominence, and adds some not originally present.

Occurrence. Leray-Rockland beds, locality 1.

Type. Holotype, G.S.C. No. 1241, Leray-Rockland beds, Allumette Island, Paquette Rapids, Ottawa River.

Lophospira saffordi Ulrich and Scofield

Plate V, figure 5

Lophospira saffordi Ulrich and Scofield, Pal. Minnesota, 3, pt. 2, 1897, p. 982, Pl. 73, figs. 49-51.

Height 23 to 33 mm.; whorls enlarging rapidly for the genus, the plesiotype, having six volutions, the two upper ones minute; length 17 mm. from apex to umbilicus where it is 18 mm. wide; apical angle 59 to 65 degrees; peripheral band very prominent, upper and lower carinæ distinct but not as prominent as the peripheral one; surface concave between the carinæ, but gently convex at the base; umbilicus very small; aperture subquadrate, inner lip broadly reflexed almost covering the umbilicus; growth lines uneven, directed backward towards the periphery.

L. saffordi differs from *L. milleri*, the genotype, in its smaller size, proportionately more rapidly enlarging whorls, less prominent upper and lower carinæ, and backward directed growth lines. It is very similar to *L. oweni* in size and shape but the upper and lower carinæ of that species are not so definite and it has a thickening at the edge of the umbilicus.

Although the species occurs in the lower part of the section it is more prolific in the upper beds.

Occurrence. Lowville beds, locality 135; Leray-Rockland beds, locality 1; Cobourg beds, localities 92, 93, 99, 207.

Type. Plesiotype, G.S.C. No. 9747, Leray-Rockland beds, Allumette Island, Paquette Rapids, Ottawa River.

Lophospira serrulata (Salter)

Plate V, figures 8, 9

Murchisonia serrulata Salter, Geol. Surv., Canada, dec. 1, 1859, p. 20, Pl. 4, fig. 1.

Lophospira serrulata (Salter), Ulrich and Scofield, Pal. Minnesota, 3, pt. 2, 1897, p. 968, Pl. 72, figs. 51-55; Pl. 73, fig. 57.

Height 20 to 25 mm., width 10 to 15 mm., spire moderately produced with an apical angle of 56 to 62 degrees; five to six whorls, closely coiled in young stage, becoming loosely coiled, with the last whorl free; band very narrow, situated on the prominent flange-like peripheral carina; umbilicus

rather large with convex sides; four carinæ in all, the main peripheral carina bearing the band, one above it near the suture, one equally distant below the periphery, and a fourth marking the umbilicus margin; all carinæ sharply defined and having a serrate edge; aperture deeply notched, subcircular except for the interruptions of the angular carinæ; growth lines slightly backward from the suture, thence forward to first carina, thence sweeping backward to the periphery, thence directed forward again to the third carina, where it makes a rectangular turn and more gently backwards to the fourth carina and the umbilicus margin, thence pursuing a directly vertical course.

L. serrulata (Salter) is similar to *L. helicteres* (Salter) in many respects, and one is apparently derived from the other or from a common ancestor. It differs, however, in being much smaller when completely grown, in having a much narrower band, in having the last whorl less flamboyantly free, and in having one carina above the periphery with two beneath, the lowest one delimiting the umbilicus, as compared with the position of the carinæ of *L. helicteres* (Salter), which has two above the periphery and a faint one below it, with a very convex margin of the umbilicus.

Occurrence. Lowville beds, locality 135; Leray-Rockland beds, locality 1; Hull beds, localities 40, 41.

Type. Holotype, G.S.C. No. 1245, Leray-Rockland beds, Paquette Rapids, Ottawa River.

Lophospira ventricosa (Hall)

Plate IV, figures 22, 23

Murchisonia ventricosa Hall, Pal. New York, 1, 1847, p. 41, Pl. 10, fig. 3; Emmons, Amer. Pal. 1, pt. 2, 1855, p. 162.

Lophospira ventricosa (Hall), Bassler, U.S. Nat. Mus. Bull. 92, 1915, p. 766.

Large, one specimen measuring 50 mm. from apex to umbilicus; about five rapidly enlarging volutions, each whorl ventricose, the last one being very rotund; carina of periphery much more pronounced than the one above it or below it; the lower carina on each whorl not always enveloped by the succeeding whorl; aperture slightly oblique, nearly twice as long as high; growth lines coarse, directed backward towards the periphery.

The species can readily be distinguished from any other by its ventricose whorls.

Hall's illustration is very inadequate. He cites the species from the 'higher part of the rock, where it passes into the Trenton limestone', from Tribes Hill, but Emmons cites it from the 'Birdseye and Black River'. The Ottawa specimens have been identified by Billings, who no doubt was familiar with Hall's species. With this weight of evidence it is assumed that the specimens belong to Hall's species; if not, it is different from any other described and should be considered a new species.

Occurrence. Leray-Rockland beds, locality 1; Hull beds, localities 40, 41; Sherman Fall beds?, localities 69, 114.

Type. Plesiotypes, G.S.C. Nos. 1253 and 1253a, Leray-Rockland beds, Allumette Island, Paquette Rapids, Ottawa River.

Genus, *Hormotoma* SalterGenotype, *Murchisonia gracilis* Hall

Turreted with numerous rounded whorls; apical angle acute; no slit, but a broad, deep notch, medially or submedially situated, resulting in a faint peripheral band, generally obscure, flat or slightly concave; whorl section almost round; sutures fairly deep; umbilicus covered; when complete, aperture longer than wide, slightly produced below; growth lines obliquely backward, directed towards the peripheral band both from above and from below.

Hormotoma is closely allied to *Coelidium*, but it is not so long, has fewer whorls, lacks the umbilicus when covered by reflex lip, and has more, more-rounded whorls.

A comparison of the outlines of the several species of *Hormotoma* here described is shown in figures 1 and 2.

Hormotoma bellicincta (Hall)

Plate IV, figure 16

Murchisonia bellicincta Hall, Pal. New York 1, 1847, p. 179, Pl. 39, figs. 1a-d (not 1c).

Hormotoma bellicincta (Hall), Ulrich and Scofield, Pal. Minnesota, 3, pt. 2, 1897, p. 1017, Pl. 70, figs. 15-17.

Short and broad for the genus; height averaging 25 to 30 mm.; apical angle 38 to 50 degrees; volutions rounded, having a tendency to be flattened on top, closely coiled, width and height of whorl subequal, four to six present, the small upper ones usually broken off; no slit, but a deep notch; band broad, situated at or just above the middle; small umbilicus when the reflex lip is broken away; aperture rounded except for a small lower extension; growth lines swinging backward to the band both above and below it. *H. bellicincta* is much smaller than the complete forms of either *H. trentonensis* or *H. trentonensis crassa*, but it can be distinguished from the broken tips of either by its shorter, more compact whorls, which in the casts examined number about four in 16 mm., as compared with three in the same length of *H. trentonensis*.

Occurrence. Lowville beds, localities 61, 62; Leray beds, localities 12, 15, 61, 202, 209, 273; Leray-Rockland beds, localities 1, 14, 197; Rockland beds, localities 18, 156; Hull beds, localities 39, 40; Sherman Fall beds, localities 33, 37, 114, 118, 167, 174, 180, 192; Cobourg beds, localities 74, 80, 87, 92-94, 100, 112, 119, 154, 172, 189, 190, 204, 210, 215, 224, 235, 249, 256, 264.

Type. Plesiotypes, G.S.C. No. 1243, Leray-Rockland beds, Allumette Island, Paquette Rapids, Ottawa River, and G.S.C. Nos. 6664 and 1678b, Cobourg beds, lot 21, con. VIII, Cornwall tp., Ontario, and from an unspecified locality at Ottawa, respectively.

Hormotoma gracilis (Hall)

Plate IV, figure 15

Murchisonia gracilis Hall, Pal. New York, 1, 1847, p. 181, Pl. 39, figs. 4a-c; p. 303, Pl. 83, figs. 1a-b.

Hormotoma gracilis (Hall), Ulrich and Scofield, Pal. Minnesota, 3, pt. 2, 1897, p. 1015, Pl. 70, figs. 18-21; Knight, Geol. Soc. Amer., Spec. Paper 32, 1941, p. 152, Pl. 45, figs. 2a-c.

Small, slender, with bead-like whorls, about fourteen in 30 mm.; 15 to 30 mm. in height; apical angle 18 degrees; deep V-shaped notch; slightly angular at the band; sutures deep; base rounded; umbilicus minute, but covered by the parietal lip; aperture round; ornamentation typical of the genus.

The species is most closely allied to *H. salteri canadensis* Ulrich and Scofield from which it differs in being smaller, more slender, with a smaller apical angle, less rapidly enlarging and more bead-like whorls. Where only a few of the larger whorls are preserved it is difficult to separate them.

Occurrence. Lowville beds, localities 21, 61, 65, 140, 143, 145, 156; Leray beds, localities 5, 9, 12, 15, 16, 22, 29, 58, 72, 156, 197, 202, 270, 272-274; Leray-Rockland beds, localities 1, 144; Hull beds, localities 40, 46, 166; Sherman Fall beds, localities 37, 118, 180, 195; Cobourg beds, localities 51, 74, 78, 87, 117, 164, 185, 222, 234, 236, 256, 260.

Type. Plesiotype, G.S.C. No. 1228y, Leray-Rockland beds, Allumette Island, Paquette Rapids, Ottawa River.

Hormotoma cf. *H. major* (Hall)

Plate VII, figures 13, 14

Murchisonia major Hall, Geol. Lake Superior Land Dist. 2, 1851, p. 209, Pl. 26, figs. 1a-c.

Hormotoma ? *major* (Hall), Ulrich and Scofield, Pal. Minnesota, 3, pt. 2, 1897, p. 1018, Pl. 71, figs. 5-7.

Large, 80 to 150 mm. in length; apical angle 30 to 37 degrees; eight or nine whorls when complete, which is rare; whorls rapidly enlarging, the upper ones well rounded externally, the lower ones a little more attenuated, slightly flattened on the upper half; shell apparently thick because the casts are very loosely coiled, especially so in the last two whorls; notch broad and rather shallow; aperture angular above, and but little produced below; band and growth lines not preserved.

The species differs from others of the genus in its large size, very loosely coiled whorls, and shallow notch. A few very poorly preserved specimens that occur in the Ottawa-St. Lawrence region are referred to the species, which is everywhere poorly represented.

Occurrence. Cobourg beds, localities 76, 82, 87, 184, 214.

Type. Plesiotype, G.S.C. No. 9748, Cobourg beds, north of Casselman in quarry near Lemieux road.

Hormotoma salteri canadensis Ulrich and Scofield

Plate IV, figure 14

Murchisonia (Hormotoma) gracilis Salter, Geol. Surv., Canada, Can. Org. Rem., dec. 1, 1859, p. 22, Pl. 5, fig. 1; Billings, Geol. Surv., Canada, Geol. Canada, 1863, p. 183, fig. 178.

Hormotoma salteri canadensis Ulrich and Scofield, Pal. Minnesota, 3, pt. 2, 1897, p. 1016, Pl. 70, figs. 44-51.

Small, fine, turreted; height 25 to 40 mm.; apical angle 24 to 25 degrees; whorls small, gradually increasing in size, about ten or eleven in complete specimens, with a slight tendency to angularity in the profile of the lower whorls; band broad, about one-fourth the width of the whorl, medially placed, or a little below the middle line, umbilicus small when lip is broken; aperture round, with its inner lip reflexed; growth lines directed backward to the band both above and below it.

This species and the next are most closely allied to *H. gracilis* (Hall). For differences, *See* under description of that species. This species is not so common as *H. gracilis* at any level, but like that species it is more common in the lower beds.

Occurrence. Leray beds, localities 5, 14, 61, 156, 270; Leray-Rockland beds, locality 1; Sherman Fall beds, localities 34, 37, 180; Cobourg beds, localities 47, 51, 74, 86, 117, 188.

Type. Paratype, G.S.C. No. 1228b, Leray-Rockland beds, Allumette Island, Ottawa River. This is the original specimen of Salter's illustration.

Hormotoma salteri ottawaensis n.var.

Plate VI, figures 3, 4

Long and slender; no specimen complete, longest one present 61 mm.; apical angle 24 or 25 degrees; ten or eleven whorls when complete, very gradually enlarging, slightly angular on the side, well rounded below and flat or very gently convex above; deep notch; band comparatively wide, about mid-height on the whorl, producing a subangular outline of the outer wall of the whorl; umbilicus, when exposed by fracture, comparatively large for the genus; aperture not seen; growth lines extending sharply backward to the band both above and below it.

H. salteri ottawaensis has the same apical angle as *H. salteri canadensis* and the same tendency to slight angularity of the whorl at the band, but differs in its larger size and more rapidly enlarging whorls.

Occurrence. Cobourg beds, localities 98, 117.

Type. Holotype, G.S.C. No. 1678g; paratype, G.S.C. No. 9749; Cobourg beds, from an unspecified locality at Ottawa, and from the base of Parliament Hill, Ottawa.

Hormotoma simplex Wilson

Plate IV, figures 17-19

H. simplex Wilson, Roy. Soc., Canada, 26, 1932, sec. 4, Pl. VI, figs. 6 and 7.

Medium size, no specimen complete, largest specimen seen 45 mm. in length; apical angle approximately 28 to 30 degrees; whorls rounded on the exterior, gradually increasing in size, there being six, with possibly a seventh

or eighth at the apex, in the 45 mm., having an oval section almost twice as high as wide; band apparently at the middle or just above it; umbilicus medium for the size of the shell in the casts, which are all that have been seen; aperture and growth lines unknown.

This neat shell lies between *H. salteri canadensis* and *H. trentonensis*. It is longer than the former, with more rapidly enlarging whorls, and smaller than the latter, with less rapidly enlarging whorls, resulting in fewer and more whorls respectively when measured a fixed distance from either end.

Several specimens at hand are much better preserved than the original holotype and paratype.

Occurrence. Sherman Fall beds, localities 37, 180; Cobourg beds, localities 86, 87, 92, 100, 110, 117, 194, 200, 215, 234, 249, 254.

Type. Holotype, G.S.C. No. 6665; paratype, G.S.C. No. 6666; Cobourg beds, boundary between con. 9, Cornwall tp., and con. 9, Charlottenburgh tp., and lot 22, con. III, Roxborough tp. respectively; plesiotype (and better specimen), G.S.C. No. 9750, west end of Fifth avenue, Ottawa, Ontario.

Hormotoma simplex paquettensis n.var.

Plate IV, figures 20, 21

No complete specimen found, but longest known 42 mm., lacking the lower whorls; apical angle 25 to 28 degrees; whorls well rounded and enlarging rapidly more in width than in height so that seven and a half whorls occur in the 42 mm.; height of whorl in section only slightly greater than its width; sutures deep; umbilicus minute where the broken whorl reveals it; aperture, band, and growth lines not seen. Most specimens are covered with secondary silica.

There are some differences between the specimens from the lower and higher levels. The forms from the Cobourg beds are similar in size, aperture outline, and number of whorls, but the whorls have a tendency to be less round, are more flattened above the widest part, below the middle, and the increase in the size of the last whorl is somewhat accelerated.

The variety differs from the species in the deeper sutures, more rounded whorls, and in the proportionately shorter vertical axis of the whorls, there being six whorls in 20 mm. from the apex in *H. simplex paquettensis* as compared with four and one-third whorls in 20 mm. from the apex in *H. simplex*.

Occurrence. Leray-Rockland beds, locality 1; Sherman Fall beds, locality 34; Cobourg beds, localities 87, 117.

Type. Holotype, G.S.C. No. 1221b; paratype, G.S.C. No. 1221; Leray-Rockland beds, Allumette Island, Paquette Rapids, Ottawa River.

Hormotoma trentonensis (Hall)

Plate VI, figures 1, 2

Murchisonia bellicincta Hall (part), Pal. New York, 1, 1847, Pl. 39, fig. 1e (not 1a-d).*Hormotoma trentonensis* (Hall), Ulrich and Scofield, Pal. Minnesota, 3, pt. 2, 1897, p. 1018 (not figured).

Larger than most species of the genus, averaging about 80 to 85 mm. in length when complete; apical angle 28 to 30 degrees; eight or nine volutions in 75 to 85 mm., uniformly rounded on the exterior; sutures deep; umbilicus small when lip is broken; aperture higher than wide, produced and slightly reflexed at the base; band medially placed. No specimen that preserves the outer aperture has been seen, but judging by growth lines the species has a deep, wide notch, with growth lines directed backward from above and below.

Apart from its varieties, *H. trentonensis* is closest to *H. major*. The complete shell, which is rarely found, can be distinguished by the deeper sutures and by the more rounded whorl, particularly on the upper surface where *H. major* has a slightly flattened outline. Casts can be distinguished by the more rounded, more closely coiled whorls, and by the smaller umbilicus.

It is with hesitation that the writer suggests a change in the usage of this well-known name. But Ulrich and Scofield, in separating the two forms illustrated by Hall as *Murchisonia bellicincta*, state that "The course adopted having necessitated a new name for the larger form (Hall's figure 1e) we propose to call it *trentonensis*, since the species is one of the most characteristic fossils of the Trenton group" (op. cit., p. 1018), adding that it is rare in Minnesota but common in the Trenton limestone of Canada and New York. The authors have previously described the species based upon the Minnesota form, which the present writer thinks is not the New York and Canadian Trenton form, as it differs in size, in apical angle, and in less rapidly increasing size of whorls. The Minnesota figures show six volutions in 55 mm., measuring the complete form. Hall's figure shows six in 72 mm. lacking the largest whorl, which would increase the difference in proportion. The name, then, is here restricted to the New York form that has also been found, though not commonly, in the Ottawa-St. Lawrence region. The common form in this area is the following variety that has always been lumped with *H. trentonensis* here restricted.

Occurrence. Sherman Fall beds, locality 267; Cobourg beds, localities 51, 86, 92, 121, 165, 204, 250.

Type. Plesiotype, G.S.C. No. 9751, Cobourg beds, west end of Fifth avenue, Ottawa, Ontario.

Hormotoma trentonensis crassa n.var.

Plate VI, figures 5-7

Murchisonia bellicincta Hall, Billings, Geol. Surv., Canada, Geol. Canada, 1863, p. 183, fig. 177.*Hormotoma* cf. *trentonensis* (Hall), Wilson, Roy. Soc., Canada, 25, 1932, sec. 4, p. 402, Pl. 6, fig. 5.

Large; no complete specimen found, but apparently averaging 70 to 85 mm. in length; apical angle 38 to 40 degrees; seven or eight volutions, rounded on the exterior, rapidly enlarging, rate of enlargement accelerated

in the last two whorls; umbilicus small when the lip is removed; notch deep and wide; band moderately wide, situated with its lower margin on the median line; aperture oval, longer than wide, slightly reflexed on the lip; growth lines directed backward both above and below the band.

This variety is so named on account of its rapidly enlarging, robust whorls. It is the form that has usually been identified as *H. trentonensis*, but it differs from the species in the rapidly enlarging whorls and the consequent greater apical angle. It differs from the Minnesota species in its size, robustness, and apical angle. These species can be distinguished by placing them side by side with one suture of each in line at a level where the whorls are equal in size. The sutures of the specimens compared will be farther and farther apart above and below the common line.

Occurrence. Leray beds, localities 12, 13, 15, 202; Leray-Rockland beds, localities 1, 11, 144; Rockland beds, localities 156, 181; Hull beds, localities 37, 40, 41; Sherman Fall beds, localities 33, 180; Cobourg beds, localities 30, 48, 50, 80, 86, 87, 90, 92, 94, 100, 104, 106, 108, 110, 113, 117, 122, 125, 130, 152, 154, 164, 165, 168, 186, 188, 189, 203, 204, 210, 215, 217, 219, 222, 223, 225, 229, 233, 235-237, 239, 243, 244, 249, 252, 253, 257, 258, 260, 261, 264, 279.

Type. Holotype, G.S.C. No. 9752, Cobourg beds, west end of Fifth avenue, Ottawa, Ontario; paratype, G.S.C. No. 9753, Leray-Rockland beds, Allumette Island, Paquette Rapids, Quebec.

Hormotoma trentonensis plana n.var.

Plate VIII, figures 1-4

Hormotoma cf. trentonensis (Hall), Wilson, Roy. Soc., Canada, 25, 1932, sec. 4, Pl. 6, fig. 4.

Large, 70 to 90 mm. or more in height; apical angle about 30 degrees; eight or nine whorls, rapidly but evenly enlarging, the last having a tendency to detach itself; lower part of the whorl rounded, the upper part more or less flattened; shell thick; sutures not deep in a specimen showing the outer shell but more so in casts appearing loosely coiled; notch not very deep; band above the middle; umbilicus not seen in complete shell but in casts larger than in the species, possibly due to the thickness of the shell; aperture not perfect but, apparently, width and length subequal; growth lines coarse for the genus, directed gently backward towards the band.

The variety is like the species in the regularity, but not in the rate of increase of the whorls and in its more shallow suture, features that in many instances make it difficult to distinguish in casts, but it differs in the flattening of the upper part of the whorl and in the more loosely coiled whorls. It is similar to the variety *H. trentonensis crassa* in general size, but lacks the accelerated increase of the last whorls, and also differs in the more flattened upper surface, and in its coarser growth lines. In the nature of its suture line it approaches *H. major* Ulrich and Scofield, but the specimens found are smaller, though they might be larger if complete, but the whorls of *H. major* are more widely separated, due partly to their being more loosely coiled and partly to the greater thickness of the shell.

The varietal name is given because of the flatter upper surface, a characteristic that in many cases is the only way of distinguishing between fragmentary pieces of species and variety, the apical angle being practically the same.

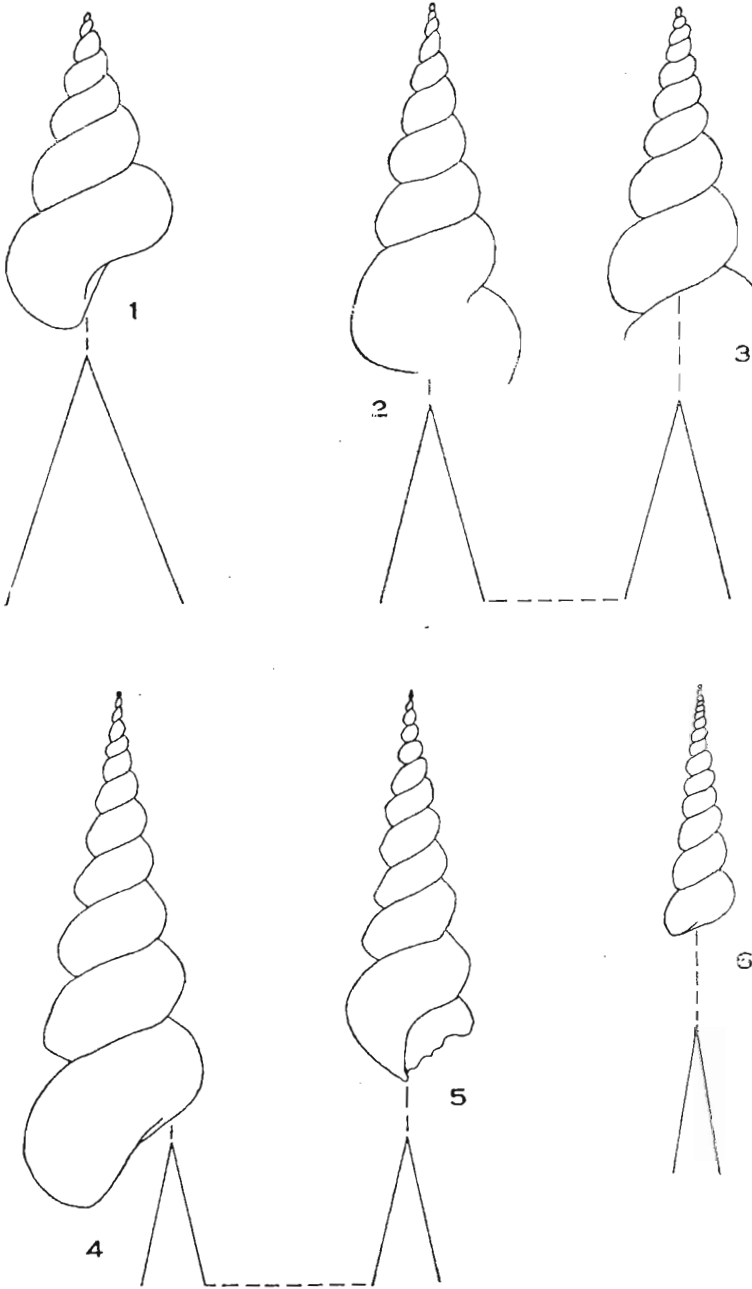


Figure 1. *Hormoloma* species. Comparison of apical angle and increase in size of whorl. 1, *H. bellicincta*; 2, *H. simplex*; 3, *H. simplex paquellensis*; 4, *H. salleri ottawaensis*; 5, *H. salleri canadensis*; 6, *H. gracilis*. (Natural size.)

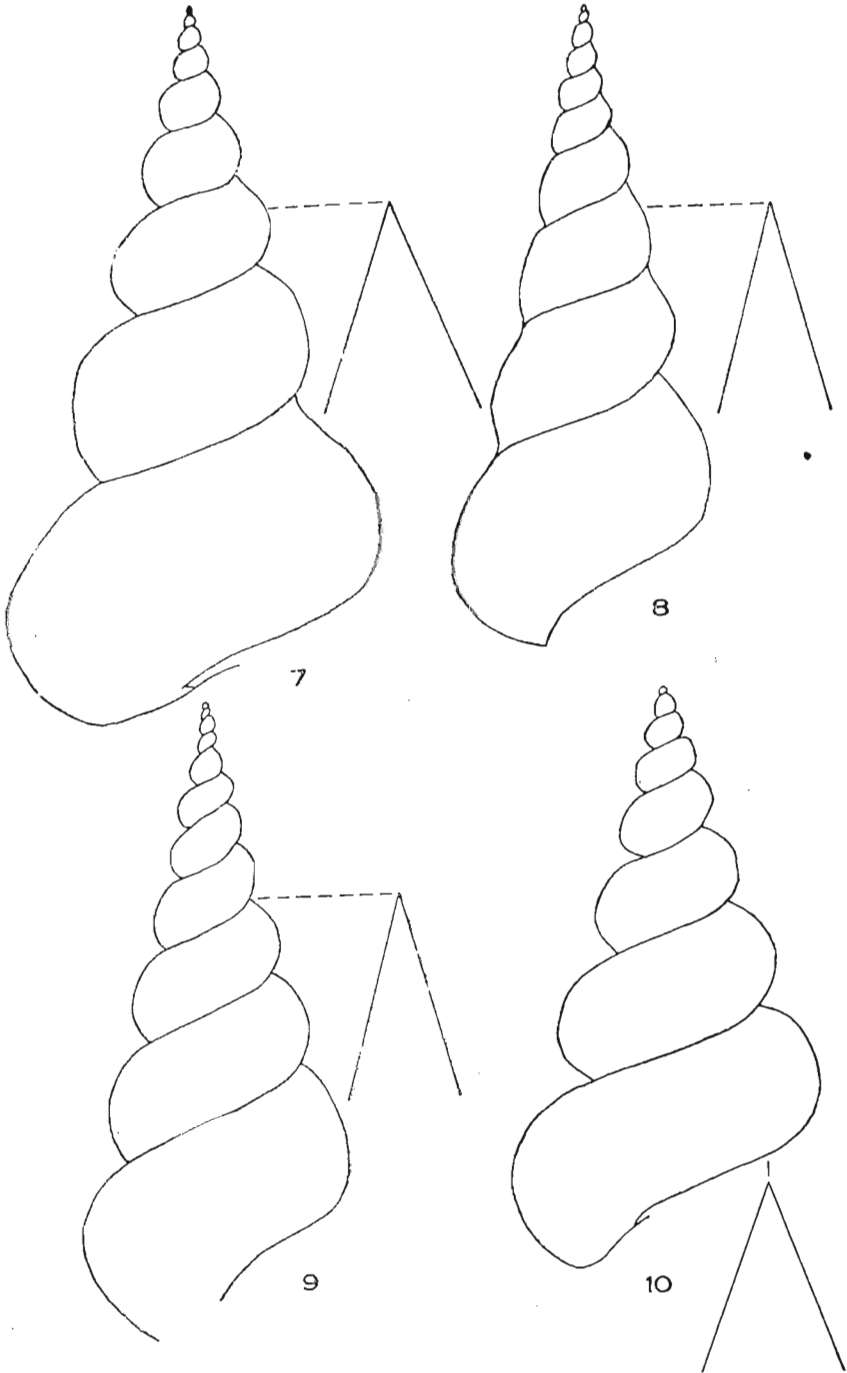


Figure 2. *Hormotoma* species. Comparison of apical angle and increase in size of whorl. 7, *H. major*; 8, *H. trentonensis plana*; 9, *H. trentonensis*; 10, *H. trentonensis crassa*. (Natural size.)

Occurrence. Sherman Fall beds, localities 37, 174, 180; Cobourg beds, localities 91, 99, 111, 117, 154, 155, 188, 228, 239, 249.

Type. Holotype, G.S.C. No. 9754, Cobourg beds, an unspecified locality at Ottawa, Ontario; paratypes, G.S.C. Nos. 9755 and 6663, Cobourg beds, Navan road about 4,130 feet north of first east-west road north of Navan, and Gravel Hill, respectively.

Genus, *Omospira* Ulrich and Scofield

Genotype, *Omospira laticincta* Ulrich and Scofield

Known species rather large and robust; turreted; seven or nine volutions, slightly flattened and obliquely sloped on top, ventricose below; band broad lying entirely upon the upper surface, its lower edge accentuated and coinciding with the subangular periphery of the whorl; sutures deep; umbilicus small and covered; aperture slightly higher than wide, subquadrate or subtriangular in outline, its lip reflexed and covering the umbilicus; surface markings directed gently backward from the sutures, making a broad curve on the band, thence forward over the ventricose lower part of the whorl.

The genus can be readily distinguished from *Lophospira* and *Hormotoma* in the position and width of the band, the position of which even in casts is usually evident upon the flattened shoulder.

Omospira alexandra (Billings)

Plate IX, figures 16-19

Murchisonia ventricosa Salter (not Hall, 1847), Geol. Surv., Canada, Can. Org. Rem dec. 1, 1859, p. 23, Pl. 5, figs. 2, 2a, 3.

Murchisonia alexandra Billings, Geol. Surv., Canada, Pal. Foss. I, 1865, p. 172.

Omospira alexandra (Billings), Ulrich and Scofield, Pal. Minnesota 3, pt. 2, 1897, p. 946, Pl. 70, figs. 2, 2a.

Large robust form when mature, largest specimen found being 95 mm. in length, and 51 mm. in width at the broadest part of the last whorl; apical angle 45 to 50 degrees; seven to nine whorls, flat or gently convex above and comprising about one-third or less of the whorl surface, very ventricose below; band broad, occupying quite half of the upper surface, the lower limit more strongly carinated than the upper and lying upon the periphery of the whorl; lines of growth curved backward from the suture to the band, the curve becoming more accentuated upon approaching the band, making a reverse curve within the band, thence forward with a gentle curve over the ventricose lower part of the whorl.

Two specimens from Cobourg beds seem to belong to this species, but they are too fragmentary for absolute certainty. They are mentioned here because of the probability that they represent another example of a recurrence in Cobourg beds of forms found in Leray beds.

Only one other species of this genus has been described, *O. laticincta* Ulrich and Scofield, and it can be distinguished from *O. alexandra* by its smaller apical angle.

Occurrence. Leray beds, locality 72; Leray-Rockland beds, localities 1, 199.

Type. Holotype, G.S.C. No. 1242; paratypes, G.S.C. Nos. 1242b and 1242g; Leray-Rockland beds, Allumette Island, Paquette Rapids, Quebec.

Genus, *Liospira* Ulrich and Scofield

Genotype, *Pleurotomaria micula* Hall

Small or medium size; lenticular outline; low spire; volutions few, subrhomboidal in section, gently convex to slightly concave on top, gently convex below; periphery subangular, with a slit band which extends farther on the upper side than on the lower, showing only faintly on most specimens; umbilicus rounded or in some cases angular at the edge, partly or wholly filled with a callus from the inner part of the thickened lip; aperture deeply notched, wider than high, with all angles rounded; growth lines fine, curving back to the periphery from above and below it.

Liospira is readily distinguished from the more turbinate forms. The slope of the upper surface from the apex to the periphery is gentle and uninterrupted as compared with the raised band and turreted surface of *Eotomaria*; the whorls are more rapidly enlarging than in *Eotomaria*, the final whorl is less bulky in proportion to its breadth, and the aperture is wider in proportion to its height.

Casts of *Liospira* resemble casts of *Raphistoma* and *Raphistomina*. Most of the species of the two latter genera have greater height than *Liospira* and the lower part of the whorl descends more abruptly from the periphery giving the two genera a more robust appearance. *Raphistoma* has a slightly flatter whorl, a difference not always evident in a cast, but the raised line on the upper surface formed by the piled up strata is usually reflected in the cast. The sharply angular periphery of *Raphistomina* projects over the succeeding whorl. The casts of the genus can be distinguished thus if adequately preserved. If the initial whorls are worn or lacking, the almost vertical outer margin of the whorl, approximately at right angles to the upper surface, marks *Raphistomina*.

A comparison of the outlines of the several species of *Liospira* here described is shown in Figure 3.

Liospira americana (Billings)

Plate IX, figure 9

Pleurotomaria americana Billings, Can. Nat. Geol. 5, 1860, p. 164, fig. 7.

Liospira americana (Billings), Ulrich and Scofield, Pal. Minnesota, 3, pt. 2, 1897, p. 996; Ruedemann, New York State Mus. Bull. 49, 1901, p. 31, Pl. 2, fig. 7.

Diameter 30 to 50 mm.; lenticular outline; depressed spire with somewhat rounded apex; whorls rapidly enlarging, numbering about four, each whorl flat on top becoming concave in the last volution, underside moderately convex; margins rather more sharply angular than in other species; suture lines faint; umbilicus penetrating to the apex, a little less than a third of the diameter of the last whorl, its inner sides rounded, and in most

specimens filled with matrix; aperture transversely subrhomboidal, its width greater than its height; lower lip normally rounded, not projecting as in *L. vitruvia*; growth lines not seen.

In specimens showing the outer shell it is not difficult to distinguish the three species *L. americana*, *L. progne*, and *L. vitruvia*. The last differs from the other two in having a prolongation of the lower lip, and in the step-like walls of the umbilicus.

L. americana and *L. progne* differ in their proportions. The whorl of *L. americana* increases more rapidly in size, a feature that is retained in casts, the lower bulk of its whorl is only a little greater than the upper, and the rather large umbilicus with rounded margins is filled with matrix in most specimens. *L. progne*, on the other hand, is smaller, its whorls increase in size more gradually, the lower bulk of the whorl is nearly double that of the upper part, and its umbilicus is almost covered by the last whorl.

L. americana and *L. vitruvia* can be distinguished by the rapidly enlarging whorls, and by the rounded, matrix-filled umbilicus of the former, as compared with the more gradually enlarging whorls and angular step-like umbilical sides of the latter.

Occurrence. Cobourg beds, localities 80, 95, 154, 210, 230, 237, 264.

Type. Plesiotype, G.S.C. No. 9756, Cobourg beds, Percy street, Ottawa, Ontario.

Billings' type specimen is unrecognizable or lost. His original description lists several localities. All the specimens from the Ottawa-St. Lawrence Lowland are casts, none of them complete. The selection of a neotype, therefore, has been deferred until better material is available from one of the localities cited by him. The specimen here illustrated, combined with a drawing (Figure 3), shows the characteristics of the species.

Liospira micula (Hall)

Plate IX, figures 1, 2

Pleurotomaria micula Hall, Geol. Report Wisconsin, 1882, p. 55, fig. 1.

Liospira micula (Hall), Ulrich and Scofield, Pal. Minnesota, 3, pt. 2, 1897, p. 994, Pl. 68, figs. 24-29.

Small, averaging 11 or 12 mm., rarely reaching 16 mm.; discoidal; very low spire with almost continuous slope from apex to periphery; shell thin; three or four volutions enlarging more rapidly in a lateral than in a vertical direction; upper part of whorl flat, lower part gently convex; narrow slit with convex filling; umbilicus filled with reflexed lip, but showing very small perforation in moulds; suture shallow; aperture obliquely subrhomboidal, very much wider than high, lower part gently convex; growth lines arched slightly forward at the suture, but dragged obliquely backward to the periphery thence strongly convex below.

L. micula is smaller than the other forms of *Liospira*; it lacks the tongue-like, forward projection of the lower part of the aperture of *L. vitruvia*, and is much smaller than *L. americana*.

The possibility of *L. micula* being the young of *L. progne* has been considered. In a few cases one or two forms have been found that might be intermediate, but they are not common. Because all specimens seen

are moulds the only criteria for distinguishing the two species are the apparently persistent small size of *L. micula* and the tendency for the whorl to enlarge more gradually than that of *L. progne*, both of which characteristics may be stages only. Until better specimens are available, however, the two forms are retained as separate species.

Occurrence. Pamelia beds, locality 183; Lowville beds, localities 57, 135, 275; Leray beds, localities 15, 123, 141, 170, 181, 202, 270; Leray-Rockland beds, localities 1, 23, 144; Rockland beds, locality 156; Sherman Fall beds, localities 34, 37, 38, 114, 167, 192; Cobourg beds, localities 7, 47, 80, 86, 109, 110, 117, 164, 194, 204, 207, 221, 260, 264.

Type. Plesiotype, G.S.C. No. 9757, Cobourg beds, lots 9 and 10, con. VII, Kenyon tp., Ontario.

Liospira progne (Billings)

Plate IX, figures 3-6

Pleurotomaria progne Billings, Can. Nat. Geol. 5, 1860, p. 163, fig. 6.

Liospira progne (Billings), Ulrich and Scofield, Pal. Minnesota, 3, pt. 2, 1897, p. 996, Pl. 68, figs. 38-44.

Diameter 25 to 35 mm.; height about one-half width; lenticular outline; four to four and a half volutions; upper surface of whorl flat or slightly concave, forming an almost uniform slope from apex to margin, underside depressed convex but convexity increasing more rapidly near the aperture, the maximum lower part being almost double the height of the spire; suture lines extremely faint; umbilicus closed by the reflexed lip but showing a small perforation in casts; aperture transversely oval, width nearly twice the height.

The form can readily be distinguished from *L. vitruvia* by the lack of the forward projection of the underpart of the lip. For discussion regarding its relationship to *L. micula* See under the description of that species, and for differences from *L. americana* See under description of that species.

Occurrence. Lowville beds, localities 135, 156; Leray-Rockland beds, locality 15; Rockland beds, locality 73; Sherman Fall beds, locality 267; Cobourg beds, localities 47, 49, 105, 115, 229, 239, 258.

Type. Holotype, G.S.C. No. 1688a, Cobourg beds, from an unspecified locality at Ottawa; plesiotype, G.S.C. 9758, Sherman Fall beds, in brook between Lunenburg and North Lunenburg.

Liospira vitruvia (Billings)

Plate IX, figures 7, 8

Pleurotomaria vitruvia Billings, Geol. Surv., Canada, Pal. Foss. 1, 1865, p. 171.

Liospira vitruvia (Billings), Ulrich and Scofield, Pal. Minnesota, 3, pt. 2, 1897, p. 995, Pl. 69, figs. 3-8.

Medium size for the genus, averaging 25 mm. in diameter; height about one-half the width; outline lenticular; spire depressed; three or four volutions; whorls fairly rapidly enlarging, nearly flat above, the outer one in some specimens being concave, gently convex below, gradually increasing in convexity to the edge of the umbilicus; periphery angular, with a faint

band and deep notch; no carina; umbilicus open, in casts usually free of matrix, occupying one-quarter to one-third width of specimen, with angular margins and flat sides abruptly descending like indistinct steps; aperture below the periphery projecting forward with a narrowly rounded margin and an inner edge approaching vertical, forming a sigmoid curve, the upper edge of which is convex, the lower edge concave; growth lines with a backward swing from the suture line to the periphery, thence forward to follow the prolongation of the lip, curving back again to the umbilicus.

Liospira vitruvia differs from other species in the forward prolongation of the lower lip, but unfortunately that feature is rarely preserved. It can be distinguished, however, from any other in this area, by the step-like sides of the umbilicus, some part of which is exposed in most specimens, even in casts.

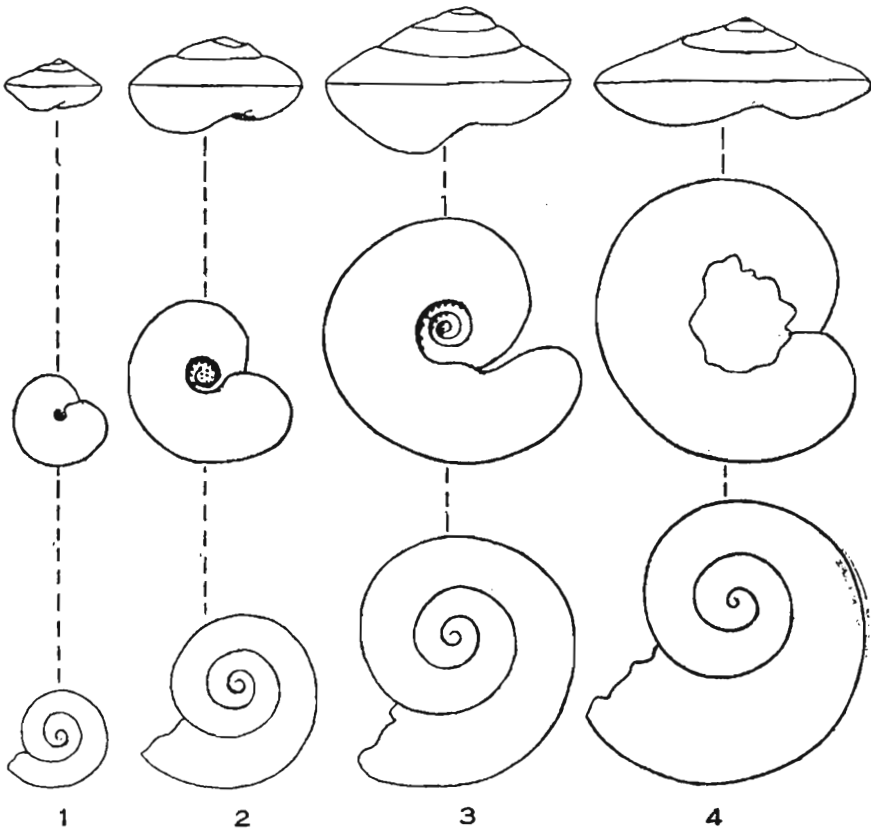


Figure 3. *Liospira* species. Comparison of profile, umbilicus, and increase in size of whorl. 1, *L. micula*; 2, *L. progne*; 3, *L. vitruvia*; 4, *L. americana*. (Natural size.)

Occurrence. Pamelia beds, locality 61?; Lowville beds, locality 135; Leray beds, localities 15, 72, 73, 129, 136, 139, 156, 270, 275; Leray-Rockland beds, localities 1, 29, 114; Rockland beds, localities 144, 146; Hull

beds, localities 40, 45, 125; Sherman Fall beds, localities 34, 37, 158, 193, 267; Cobourg beds, localities 48, 78, 80, 81, 92, 96, 100, 102, 106, 108, 110, 173, 189, 204, 210, 214, 220, 226, 236, 237, 241, 244.

Type. Plesiotypes, G.S.C. Nos. 9759 and 9759a, Leray-Rockland beds, Paquette Rapids, Ottawa River.

As in the case of some others of Billings' species of *Liospira*, the type is missing. Forms showing the step-like sides of the umbilicus are fairly common but none shows more than an indication of the prolongation of the lower part of the aperture. Choosing of the neotype, therefore, is left until such be found.

Genus, *Eotomaria* Ulrich and Scofield

Genotype, *Eotomaria canalifera* Ulrich and Scofield

Medium size, lenticular outline; depressed conical but slightly turreted spire; three or four volutions; periphery angular; shallow notch, its course defined by a band on the upper edge of the periphery; upper surface of whorl concave or convexo-concave, lower surface convex curving into a small open umbilicus; sutures usually clearly defined; aperture obliquely rhomboidal, the notch forming the upper and outer angle; ornamentation consisting of fine growth lines curving backward at the periphery both on the upper and lower surfaces of the whorl, but usually having a longer forward curve on the lower two-thirds of the whorl.

The genus differs from *Raphistomina* in its more turbinate spire and in having the band on the upper surface of the whorl. The differences from *Liospira* are given under that genus.

A comparison of the outlines of the several species of *Eotomaria* here described is shown in Figure 4.

Eotomaria dryope (Billings)

Plate IX, figures 10-12

Pleurotomaria dryope Billings, Geol. Surv., Canada, Pal. Foss. 1, 1865, p. 170, fig. 154.

Shell medium size, greatest width of holotype 23 mm., greatest height from apex to centre of umbilicus 12 mm., from apex to base of aperture 19 mm.; shell turbinate, each whorl raised slightly above the succeeding one; apical angle approximately 100 degrees; three or four volutions; upper surface of whorl concave near the margin, becoming somewhat convex near the suture, lower surface gently convex, but becoming rapidly deeper near the aperture; umbilicus having an angular margin, measuring one-third the diameter in the last whorl but diminishing rapidly to a small perforation that extends to the apex; aperture subcircular or subrhomboidal, due to the angulation at the notch; growth lines fine and coarse curving back from the suture to the margin, slightly forward below the periphery thence almost straight or very gently backward to the umbilicus, perpendicular in the umbilicus.

E. dryope differs from *E. larvata* in its larger size, higher spire, more rapidly increasing whorls, and especially in that the growth lines beneath the periphery project very little towards the aperture.

Occurrence. Lowville beds, locality 135; Leray beds, locality 9; Leray-Rockland beds, locality 1.

Type. Holotype, G.S.C. No. 1224; paratype, G.S.C. No. 1224a; both from Leray-Rockland beds at Paquette Rapids on Ottawa River.

Eotomaria dryope plana n.var.

Plate IX, figures 13-15

Medium size, averaging diameter 25 mm., height 10 mm. from the umbilicus; spire depressed; apical angle 130 to 135 degrees; four to four and a half volutions; upper part of whorl flat or concave, lower part having a slight constriction below the band, then gently convex, rounding into the umbilicus; periphery carrying the lower edge of the band, the upper edge of which lies upon the upper surface; sutures not deeply indented; umbilicus about one-fifth the diameter, a little more definitely defined near the aperture; aperture destroyed, but the growth lines show a more prominent forward projection of the lower part of the whorl than in *E. dryope*, but less pronounced than in *E. supracingulata*; growth lines with a convex swing forward, thence curving back to the band, below which they swing sharply forward, thence again backward to the umbilicus.

The variety differs from the species and from other species in its flatter spire, the more concave upper surface and the more gentle convexity of the lower part of the whorl. In size it more nearly approaches *E. dryope*, and worn moulds can be distinguished with difficulty. The forward projection of the growth lines of the lower part of the whorl is intermediate between the slight convexity of those of *E. dryope* and the sharp convexity of those of *E. supracingulata*.

Occurrence. Leray beds, localities 9, 136; Leray-Rockland beds, localities 1, 213.

Type. Holotype, G.S.C. No. 9760, Leray-Rockland beds, Paquette Rapids, Ottawa River.

Eotomaria larvata (Salter)

Plate IX, figures 20-25

Helicotoma larvata Salter, Geol. Surv., Canada, Can. Org. Rem., dec. 1, 1859, p. 15, Pl. 2, figs. 11-14.

Liospira larvata (Salter) Ulrich and Scofield, Pal. Minnesota, 3, pt. 2, 1897, p. 994.

Eotomaria rotunda Wilson, Geol. Surv., Canada, Bull. 33, 1921, p. 55, fig. 6A, Pl. 4, figs. 5-7.

Small, largest found 20 mm. in diameter, 9 mm. in height measured from the centre of umbilicus but 15 mm. measured from lowest edge of aperture, average specimen 17 mm., 9 mm., and 12 mm., respectively; gently turreted; apical angle about 105 degrees; three to four volutions; whorl gently concave above becoming almost imperceptibly convex near the upper suture, convex below the periphery; periphery definitely outlined by the narrow band which slopes upward and inward, representing the course of the notch; umbilicus occupying a third or more of the base of the last whorl, decreasing suddenly to a seventh or eighth on the next whorl,

marked by an angular ridge from which it slopes at right angles leaving a perforation to the apex; aperture subrhomboidal, the upper part angular on the upper, outer edge in the position of the band, and on the lower, outer side by the sharply forward projection of the lower part of the whorl; growth lines not preserved on the upper surface, on the lower surface turned forward from the band, narrowly rounded thence sharply backward to the umbilicus ridge thence abruptly perpendicular making a right angle.

Eotomaria larvata differs from all other species found in the region in its smaller size, in the pronounced forward projection of the lower lip as evidenced by the growth lines. It bears a relationship to *E. supracingulata*, but can be distinguished by its size and more gently turreted spire. It differs from *E. dryope* in size and in the projection of the underlip of the aperture, and from *E. dryope plana* in size and in its proportionately higher spire.

Salter's specimens, with one exception, are partly or completely covered by an organic growth which obliterates the band and obscures the turreted spire, thereby accounting for his reference of the species to *Helicotoma* and Ulrich's later designation as *Liospira?* with a query.

A re-study of a group of specimens of *E. rotunda* Wilson shows that they belong to the same species. Salter's name, then, has precedence. At the time of publication of this species it was not known that the Pamelia beds, in which the specimens were found, were basal Black River, not Chazy as designated on early reconnaissance maps.

Occurrence. Pamelia beds, localities 21, 142, 182?; Lowville beds, localities 15, 71, 135, 140, 275; Leray beds, locality 73; Leray-Rockland beds, locality 1.

Type. Holotype, G.S.C. No. 1211; paratypes, G.S.C. Nos. 1211a-i; Leray-Rockland beds, Paquette Rapids, Ottawa River; plesiotype, G.S.C. No. 6226, Pamelia beds, MacLaren Landing, Ottawa River.

Eotomaria supracingulata (Billings)

Plate VIII, figures 5-7

Pleurotomaria supracingulata Billings, Geol. Surv., Canada, Rept. of Prog. 1857, p. 302; Geol. Canada, 1863, p. 181, fig. 175.

Eotomaria supracingulata (Billings), Ulrich and Scofield, Pal. Minnesota, 3, pt. 2, 1897, p. 1004.

Rather large for the genus, the type specimen 31 mm. in diameter, and 20 mm. in height measuring from umbilicus to apex, the last whorl broken so that the overall size would be greater; upper part of conical profile greater than the lower; apical angle varying from about 105 to 110 degrees; four to four and a half volutions; whorls gradually enlarging; upper surface of whorl gently convex in the outer shell but in moulds slightly concave near the periphery, lower surface convex, becoming somewhat flattened as it nears the umbilicus; periphery moderately sharp, the lower surface almost at right angles to the upper; band narrow, entirely on the upper surface of the whorl; sutures deep; umbilicus broad, an indefinite low ridge marking its border in specimens showing the outer surface, not visible in moulds; aperture subtriangular, outer lip not shown, but the course of the growth lines suggests that the lower part projects forward

abruptly; ornamentation, growth lines only, in some specimens in wrinkles with smaller ones between, oriented backward from the suture to the band, thence forward on the upper part of the lower whorl, thence abruptly backward, curving to a course almost at right angles down the inner wall of the umbilicus.

E. supracingulata is larger than either *E. larvata* or *E. dryope* and has a wider umbilicus that does not narrow so rapidly; the band is on top of the whorl rather than sloping inward. The species resembles *E. larvata* in the forward projection of the lower lip.

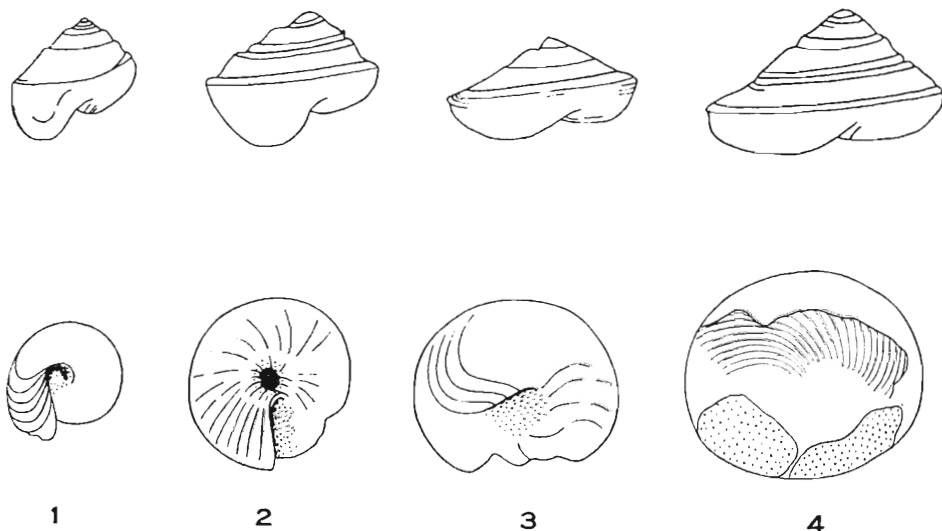


Figure 4. *Eotomaria* species. Comparison of profile, umbilicus, and direction of growth lines. 1, *E. larvata*; 2, *E. dryope*; 3, *E. dryope plana*; 4, *E. supracingulata*. (Natural size.)

Occurrence. Leray beds, localities 73, 136; Leray-Rockland beds, localities 1, 151.

Type. Holotype, G.S.C. No. 1686; paratype, No. 1686a, not from this region, but from St. Joseph Island, Lake Huron.

Genus, *Clathrospira* Ulrich and Scofield

Genotype, *Pleurotomaria subconica* Hall

Varying in size, height and width subequal; subconical spire and gently convex base; apical angle sharp; periphery angular; deep notch and short slit forming a vertical concave band just at the lower angle of the upper slope of the whorl; profile above slightly convex or very gently convex, becoming almost flat sloping upward towards the preceding smaller whorl, below gently convex, in some cases interrupted by a carina; sutures shallow, hardly visible on a cast but defined by the vertical attitude of the band of the preceding whorl; umbilicus very small for the size of the shell; aperture following growth lines; growth lines obliquely backward, but in some cases

maintaining a gentle forward convex curve, interrupted by the band, below the band having a strong forward curve, thence obliquely backward to the umbilicus.

Clathrospira differs from *Eotomaria* in its subconical form, in the flat surface of the upper part of the whorl, and in the position of the band placed vertically upon the periphery, not upon the upper rounded surface.

Clathrospira conica Ulrich and Scofield

Plate VII, figures 1, 2

Clathrospira conica Ulrich and Scofield, Pal. Minnesota, 3, 1897, p. 1008, Pl. 70, figs. 1-4.

Small, 20 to 25 mm. in width and approximately 16 mm. in height; conical apical angle 60 to 65 degrees; three to four volutions; whorls gradually enlarging, flat or concave above, gently convex below; periphery very acute; band narrow, situated upright upon the periphery; notch short; umbilicus small; one carina on the lower side of the whorl; sutures shallow; aperture angular at the suture and at the periphery, with slight angulation at the carina, the base somewhat prolonged; growth lines, obliquely backward from the suture but maintaining a gentle forward convexity, forward below the band and then almost straight.

C. conica differs from *C. subconica* in its smaller size, in the more gradually enlarging whorls in the concave rather than flat upper surface of the whorl, and in the presence of a carina on the lower convexity.

All of the specimens found were moulds, though one of them has traces of growth lines preserved.

It is to be noted that *C. conica* occurs in Cobourg beds and *C. subconica* in Lowville or Leray beds.

Occurrence. Cobourg beds, localities 78, 86, 168.

Type. Plesiotype, G.S.C. No. 9761, Cobourg beds, corner Maple and Lorne avenues, Ottawa.

Clathrospira subconica (Hall)

Plate VII, figure 3

Pleurotomaria subconica Hall, Pal. New York, 1, 1847, p. 174, Pl. 37, figs. 8a-e.

Clathrospira subconica (Hall), Ulrich and Scofield, Pal. Minnesota, 3, pt. 2, 1897, p. 1006, Pl. 69, figs. 47-50; Pl. 70, figs. 5, 6; Knight, Geol. Soc. Amer., Spec. Pap. 32, 1941, p. 78, Pl. 34, figs. 4a-b.

Comparatively large; largest specimen in collections approximately 50 mm. in height; subconical in profile; apical angle 72 to 80 degrees; about four volutions; whorls gently convex immediately beneath the suture of the preceding whorl, becoming gently concave at the periphery, again gently convex below the periphery; periphery sharp; band wide, situated vertically upon the edge of the periphery; notch short; umbilicus small; no carina; sutures shallow; aperture angular at the last suture and at the band, with slightly forward convexity above and below the band, curving backward in the lower part, and with a definite prolongation at the lower edge;

growth lines comparatively coarse, obliquely backward on the upper side of the whorl, but maintaining a very slight forward convexity interrupted by the band, from which they curve convexly forward, thence very obliquely backward to the umbilicus.

The species differs from *C. conica* Ulrich and Scofield in its much larger size, and in lacking the carina on the lower surface; from *C. convexa*, in size and in the straight rather than convex profile of the upper part of the whorl.

Occurrence. Lowville beds, localities 61, 135; Leray beds, localities 72, 73, 116, 124, 136, 140.

Type. Plesiotype, G.S.C. No. 9762, Leray beds, La petite Chaudière, Ottawa River just above the city.

Genus, *Ectomaria* Koken

Genotype, *Ectomaria nieszkowski* (Fr. Schmidt)

High-spired, slender outline; apical angle very acute; many slowly enlarging whorls; peripheral band vertical, defined by two carinæ, one above and one below; a V-shaped notch on the outer lip but within the peripheral band; one or two other carinæ present; umbilicus minute or closed; growth lines only known in part, directed backward above and below the peripheral band and following the V-shaped notch within it.

The genus resembles the smaller types of *Hormotoma* in its size, many small volutions, and acute apical angle, but it can be readily distinguished by the sharp carinæ. It can be differentiated from *Eunema* by its V-shaped notch and surrounding growth lines, and by the slowly enlarging whorls with no tendency to free themselves.

Ectomaria pagoda (Salter)

Plate VII, figure 4

Eunema ? pagoda Salter, Geol. Surv., Canada, Can. Org. Rem., dec. 1, 1859, p. 30, Pl. 6, fig. 5.

Solenospira pagoda (Salter), Ulrich and Scofield, Pal. Minnesota, 3, pt. 2, 1897, p. 1022, Pl. 70, figs. 56-60.

Ectomaria pagoda (Salter), Donald, Quart. Journ. Geol. Soc. London, 55, 1899, p. 253.

Small and slender, longest specimen seen, 30 mm., its greatest width 8 mm., having ten volutions in that length but lacking both apex and base; apical angle 10 to 14 degrees; whorl flat above and below peripheral band, concave within it; band wide, bearing the V-shaped notch and bounded by two stout carinæ above and below; four carinæ in all—one near the suture, the two delimiting the band, and one below; umbilicus very minute or closed; aperture subquadrate, slightly produced below; growth lines not visible on any of the silicified Canadian specimens except where they cross the carinæ on the margins of the peripheral band, but described from the Minnesota specimens as directed strongly backward from both above and

below towards the peripheral band. None of the specimens seen shows the V-shaped notch, but growth lines on some specimens have indicated its presence.

The species is the only one found in the area. It differs from the Chazy form *Ectomaria prisca* in having an extra carina near the suture.

Occurrence. Leray-Rockland beds, locality 1.

Type. Holotype, G.S.C. No. 1203c; paratypes, Nos. 1203a, b, e-g; Leray-Rockland beds, Paquette Rapids, Ottawa River.

Genus, *Straparollina* Billings

Genotype, *Straparollina pelagica* Billings

Small, trochiform; apical angle rounded or usually greater than a right angle; five or six gradually enlarging whorls, almost circular in section, and not embracing the preceding ones to any extent; periphery rounded; umbilicus very small, defined by a very slight ridge; sutures moderately deep; aperture round or slightly longer than wide; ornamentation, consisting of growth lines and a few undulations across the whorls in some species.

Straparollina differs from *Straparollus* in its smaller size, its narrow umbilicus with the limiting ridge as compared with the wide umbilicus without a ridge of *Straparollus*, and the round whorl without the tendency to angulation.

Straparollina asperostriata Billings

Plate VII, figures 10-12

Straparollus asperostriatus Billings, Can. Nat. Geol. 5, 1860, p. 162; Geol. Surv., Canada, Geol. Canada, 1863, p. 144, fig. 84.

Straparollina asperostriatus Billings, Geol. Surv., Canada, Pal. Foss. 1, 1865, p. 223.

Shell small, height 6 mm., width 10 mm., depressed; apical angle greater than 90 degrees; about four volutions, each whorl rising almost its entire height above the succeeding one; whorl section approximately circular; periphery rounded; no band or notch visible; umbilicus a small perforation, but defined on the last whorl by a very low but rather sharp ridge, which at the aperture extends to the middle of the lower part of the whorl; sutures deep; aperture rounded on the upper and outer edges, but with a slight angulation marking the position of the ridge outlining the umbilicus and another slight angulation on the lower inside of the whorl where it curves gently downward; ornamented by sharply elevated growth lines that cross the periphery with a slight convex curve towards the umbilicus, thence gently backward to the umbilical ridge, thence straight up the sides of the perforation.

S. asperostriata is smaller and less turbinate than either of the succeeding forms, and differs in the sharpness of the growth lines.

Occurrence. Leray-Rockland beds, locality 1.

Type. Cotypes, G.S.C. Nos. 1201 and 1201a, Leray-Rockland beds, Paquette Rapids, Ottawa River.

Straparollina circe Billings

Plate VII, figures 5-7

Straparollus circe Billings, Can. Nat. Geol. 5, 1860, p. 161, figs. 1-3; Geol. Surv., Canada, Pal. Foss. 1, 1865, p. 223.

Small, width of the largest specimen 18 mm., height 10 mm., depressed; apical angle greater than a right angle; four or five volutions, whorls round in section, the last whorl having a tendency to free itself; periphery rounded; umbilicus open, occupying about one-third the width of the whole, bounded by a faint ridge that shows clearly in the smaller, younger specimens, but tends to be obliterated on the last whorl of the larger forms, the rounded inner margin of each whorl visible in the umbilicus; sutures deep; aperture slightly higher than wide, with an angle at the suture line; growth lines fine, directed slightly forward over the top and underside of the whorl, in general transverse to the axis of coil.

Straparollina circe differs from *Straparollina asperostriata* in size, in the tendency of the last whorl to free itself, in the finer less prominent growth lines, and in the position of the ridge bounding the umbilicus.

Occurrence. Lowville beds, locality 135; Leray-Rockland beds, locality 1.

Type. Holotype, G.S.C. No. 1200, Leray-Rockland beds, Paquette Rapids, Ottawa River.

Straparollina eurydice Billings

Plate VII, figures 8, 9

Straparollus eurydice Billings, Can. Nat. Geol. 5, 1860, p. 162, figs. 4, 5; Geol. Surv., Canada, Geol. Canada, 1863, p. 444, figs. 86a, b.

Straparollina eurydice Billings, Geol. Surv., Canada, Pal. Foss. 1, 1865, p. 223.

Small, height 15 mm., width 14 mm.; bluntly conical; apex rounded, apical angle approximately 60 degrees; four to five volutions; whorls ventricose, round in section, each only slightly embracing the preceding one; periphery rounded; umbilicus small and deep, about one-third the width, bounded by an obtuse ridge; sutures deep; aperture round; lines of growth crossing the whorl in a slightly oblique backward direction, and a few shallow undulations present on the upper surface of the whorl.

Straparollina eurydice is more turbinata than either of the other species; the umbilicus is small as in *S. asperostriata*, but the umbilical ridge and growth lines are less pronounced; the undulations are a distinctive feature. It is readily distinguished from *S. circe* by the less open umbilicus.

Occurrence. Leray-Rockland beds, locality 1.

Type. Holotype, G.S.C. No. 1199; paratype, No. 1199f; Leray-Rockland beds, Allumette Island, Paquette Rapids, Ottawa River.

Genus, *Machurites* LesueurGenotype, *Machurites magnus* Lesueur

Shell large, some specimens attaining a width of 200 mm.; discoidal; whorl rapidly increasing in size, flat on one side exposing all the whorls without involution, convex on the other side, each whorl embracing part or the whole of the preceding one, leaving an umbilical perforation; periphery

usually acutely rounded; sutures moderately deep on the flat side; umbilicus on the convex side deep, with walls sloping in some species, almost vertical in others, outlined by a more or less acutely rounded margin, which some authorities consider to be the notch; aperture subrhomboidal; growth lines coarse with finer lines between, slightly concave towards the anterior on the flat side, almost at right angles to the axis of the whorl on the convex side, crossed on the convex side by revolving lines which become finer toward the umbilicus; operculum very thick, elevated at one end forming a triangular shaped cap, convex and marked by concentric striæ on the outer surface, concave on the inner side to which is attached a long process roughened at the free end, evidently for muscle attachment, a second muscle attachment visible upon some opercula.

This genus has been variously considered as having a right-hand or left-hand coil. Advocates of the right-hand coil orient the shell with the flat side down. Advocates of the left-hand coil consider the flat side to be the spire and orient it with that side up. Left-hand coils are not common, but genera do exist in which the sinistral direction of the coil is beyond dispute. Some modern gastropods when using the foot carry the shell obliquely.

Maclurites is clearly distinguished from other genera by its flat coil on one side and convex involute coil on the other side, whether the direction of coiling be considered sinistral or dextral.

Maclurites has been variously called *Maclurite* (the original form) and *Maclurea*. Brookes Knight (op. cit.) considers *Maclurite* was a typographical error for *Maclurites*. Emmons introduced the form *Maclurea*.

Whiteaves differentiated another genus *Maclurina* by a scar in the operculum, which he considered to replace the process for muscle attachment. Actually the state of preservation of the type operculum would not preclude its being a scar of the broken end of the process. There is no other generic distinction in the specimens themselves.

Maclurites logani (Salter)

Plate X, figures 1-6

Maclurea logani Salter, Rept. 21st Meeting Brit. Assoc. Adv. Sci., Notes and Abstracts, 1852, p. 63; Geol. Surv., Canada, dec. 1, 1859, p. 7, Pl. 1, figs. 1-6.

Maclurites logani (Salter), Bassler, U.S. Nat. Mus. Bull. 92, p. 779; Knight, Geol. Soc. Amer., Spec. Paper 32, p. 184.

Medium size for the genus on the average, but some specimens attaining 100 to 110 mm. in width and approximately 45 mm. in height; discoidal; five or six rapidly enlarging whorls when complete, flat on one side, very convex on the other; periphery almost a right angle; umbilicus defined by an obscure ridge, considered as the notch-keel by the advocates of right-hand coiling, sloping with a gentle convexity to a deep umbilical perforation which extends almost to the other side, each whorl embracing the preceding one but the ridge bounding the umbilicus making it appear that the umbilicus is greatly enlarged in the last whorl; sutures moderately deep; aperture subrhomboidal; growth lines with a gentle concave outline towards the anterior, thence almost at right angles to the whorl axis just beyond the margin, thence very slightly backward over the umbilical

boundary ridge and traversing the sides of the perforation; convex side of the whorl with revolving striæ near the margin but becoming finer and then disappearing towards the umbilicus.

The species differs from *M. manitobensis*, *M. magnus*, and *M. bigsbyi* in the small size of the perforation, and from most others in the less acute umbilical margin. It differs from *M. altus* in the more round, less steep sides of the convex side.

Occurrence. Leray-Rockland beds, localities 1, 5, 7, 131, 136, 140, 141, 170, 275, 276; Rockland beds, localities 156, 277.

Type. Cotypes, G.S.C. Nos. 1263d, g; plesiotype, G.S.C. No. 9763; Leray-Rockland beds, Allumette Island, Paquette Rapids, Ottawa River.

Genus, *Eccyliomphalus* Portlock

Genotype, *Eccyliomphalus bucklandi* Portlock

Medium size; discoidal form; spire depressed, each whorl rising above the preceding one; three or four volutions, just contiguous, with a tendency for the last whorl to free itself in some species; whorl flat or concave on top, sloping inward, convex below; periphery angular; a V-shaped notch outlined by a strong carina on the upper and outer surface of the whorl; umbilicus open, bounded by a contraction in the convexity of the lower surface; aperture subtriangular; ornamentation by growth lines and transverse liræ in some cases.

The genus is distinguished from *Helicotoma* by its sunken spire.

Ulrich and Scofield¹ separate *Eccyliomphalus* and *Eccyliopectus* on the sharpness of the keel. Knight² continued to regard them as separate for some time, but later Knight and Bridges³ considered them to be synonyms.

Eccyliomphalus ottawaensis (Billings)

Plate XI, figures 20-23

Ophileta ottawaensis Billings, Can. Nat. Geol. 5, 1860, p. 166, figs. 9-10.

Eccyliopectus ottawaensis (Billings), Ulrich and Scofield, Pal. Minnesota, 3, pt. 2, 1947, p. 937.

Shell 30 to 35 mm. in width; greatest height 11 mm.; spire depressed below the rim; four or five volutions without any marked tendency in the last whorl to free itself; whorls concave on top, convex below; periphery sharp; notch outlined by a thin carina, its full height not known because it is broken from the only specimen preserving any exterior; umbilicus open, defined by a narrowing of the convexity of the lower part of the whorl, a part of every whorl visible; sutures well defined; ornamentation consisting of fine growth lines obliquely backward but maintaining a forward convexity in their course on the upper surface, the lower surface not seen.

Eccyliomphalus ottawaensis differs from *E. beloitensis* Ulrich and Scofield in its smaller size and in having less height. It is very similar to *E. owenanus* (Meek and Worthen) in proportion. The illustrations of that

¹ Ulrich and Scofield: Pal. Minnesota, 3, 1897, pp. 935-937.

² Knight: Geol. Soc. Amer., Spec. Pap. 32, 1941, pp. 106-107.

³ Knight and Bridges: Index Fossils of North America, 1947, p. 467.

species show a very high carina. If such existed on *E. ottawaensis* it has been broken from all known specimens, not a surprising result of such a delicate feature. If any specimen should be found with such a high carina the two would be synonymous, and in that case Billings' name would have priority.

Occurrence. Cobourg beds, localities 80, 87, 106, 117, 188, 194, 234, 237, 258.

Type. Holotype, G.S.C. No. 1698, Cobourg beds, from an unspecified locality at Ottawa; plesiotypes, G.S.C. Nos. 9764 and 9765, from cons. VIII and IX, Indian Lands, Roxborough tp., and steamboat landing, foot of Sussex street, Ottawa, respectively.

Genus, *Helicotoma* Salter

Genotype, *Helicotoma planulata* Salter

Medium size; somewhat discoidal, but widest halfway below the angular periphery; low spire; three to five whorls, upper surface between the suture and periphery sloping inward and slightly downward or gently concave, often carrying a shallow trough just within the periphery, sides almost straight or gently concave for half their height, becoming ventricose on the lower half; periphery sharp; a deep notch on the upper edge of the periphery making a prominent band surmounting the straight sides of the upper half of the whorl; each whorl enveloping the lower convex half of the preceding whorl leaving exposed the upper straight-sided half surmounted by the prominent band, the whole resembling a miniature battlement wall; sutures strongly marked; umbilicus open, in some cases bounded by a more or less pronounced carina, and increasing rapidly in width at the last whorl; aperture having width and height subequal, kettle-shaped, widest in the lower half with the flat top margined by the elevation of the notch; the lower surface and inner side broadly convex; growth lines straight across the top, rounding backward to the interrupting band, thence downward with an oblique forward curve and rounding on the lower ventricose part of the whorl, thence backward obliquely to the umbilicus; the lower part of the whorl bearing, in addition, revolving lines of more or less prominence.

Helicotoma in some respects is midway between *Liospira* and *Eotomaria*. The likeness to *Liospira* is more evident in small specimens. It differs, however, in its turreted upper surface, in the section of the whorl with its flat top, its prominently elevated band, in the straight part of the outer side, and wall-like parapet of each whorl as compared with the sub-rhomboidal section wider than high of *Liospira*.

Helicotoma is like *Eotomaria* in having a supra-peripheral band, but differs in being discoidal rather than turbinate in its flat inward-sloping upper surface, the straight vertical surface of the upper part of the outer side of the whorl rising above the succeeding whorl, and the kettle-shaped section of the whorl.

The species differs from *Eccyliomphalus* in having a turreted instead of a sunken spire.

Helicotoma planulata Salter

Plate XI, figures 8-14

Helicotoma planulata Salter, Geol. Surv., Canada, Can. Org. Rem., dec. 1, 1859, p. 14, Pl. 2, figs. 5-7; Ulrich and Scofield, Pal. Minnesota, 3, 1897, p. 1033, Pl. 74, figs. 16-17; Knight, Geol. Soc. Amer., Spec. Paper. 32, p. 144, Pl. 75, figs. 2a-2c.

Large for the genus, measuring 30 mm. in diameter including the lip projection, and 15 mm. in height; more or less discoidal; spire very low; four to five volutions, rapidly increasing in width, less rapidly in height; upper surface almost flat, sloped inward and slightly downward, sides slightly concave on the upper half, becoming ventricose on the lower half, curving broadly into the umbilicus; the greatest width at this lower ventricose part; periphery sharp; a deep notch at the outer, upper angle of the whorl becoming a filled-in convex carina which rises above the edge of the upper surface parapet-like surmounting the straight part of the outer edge of the whorl, the two together more than compensating for the slight downward slope of the upper surface of the succeeding whorl; umbilicus deep, open, about one-third the whole width, each whorl within distinctly separated from the preceding one because of the curve of the whorl section; aperture typical, with a tongue-like projection of the lower outer part; growth lines gently convex forward near the suture, the lower limb curving obliquely backward to the band, thence gently forward on the upper concave part of the outer side, increasingly forward with a sigmoid curve strongly convex on the lower part of the whorl, becoming concave and curving into the umbilicus where it is at right angles to the axis of the whorl; the whole crossed by revolving lines over the convex lower part of the whorl.

Helicotoma planulata is much larger than *H. declivis*, and has a more convex outer whorl with the band nearer the outer edge of the whorl. It lacks the granules of *H. granosa* and has a more projecting lip. It lacks the ridge on the lower surface of *H. subquadrata*, with the consequent difference in the shape of the whorl section. Small forms are very similar to *H. tennesseensis*. The umbilicus is smaller and the sides of the whorls lower than those of *H. umbilicata*. It is smaller than *H. verticalis* and the section more kettle-shaped.

Occurrence. Lowville beds, localities 61, 135, 140, 182; Leray beds, localities 15, 53, 72, 73, 136; Leray-Rockland beds, locality 1; Sherman Fall beds, locality 180; Cobourg beds, localities 48, 49.

Type. Holotype, G.S.C. No. 1210; paratypes, Nos. 1210e, 1210g, and 1210h; Leray-Rockland beds, Allumette Island, Paquette Rapids, Ottawa River.

Helicotoma planulata muricata Salter

Plate XI, figures 6, 7

Helicotoma planulata muricata Salter, Geol. Surv., Canada, Can. Org. Rem., dec. 1, p. 14, Pl. 2, fig. 8.

Size, shape, and aperture similar to the species; periphery and carina more pronounced; ornamentation peculiar to the variety, a row of rugose striae extending inward from the peripheral band across the flat upper surface of the whorl for one-third the distance, on the upper concave or

straight part of the side of the whorl a row of small knobs, and a row of smaller irregular knobs upon the upper three revolving lines of the whorl, the whole resulting in a much more highly ornamented form than the species.

Salter refers to the possibility of this rugose ornamentation being an extraneous growth, and it may be. One argument against such a conclusion is its regularity, peculiar for such a growth, and it is curious that such extraneous matter would not be found on more specimens. The form is cited here as Salter suggested until the question can be settled by more material.

Salter's holotype has not been found, but there is one specimen answering to his description.

Occurrence. Leray-Rockland beds, locality 1.

Type. Holotype not recognized; plesiotype, G.S.C. No. 9766, Leray-Rockland beds, Paquette Rapids, Ottawa River.

Helicotoma spinosa Salter

Plate XI, figures 1-5

Helicotoma ? spinosa Salter, Geol. Surv., Canada, Can. Org. Rem., dec. 1, 1859, p. 15, Pl. 2, figs. 9, 10.

Small; largest specimen 14 mm. in width and 7 mm. in height; low turbinate outline; apical angle about 135 degrees; three or four whorls rising above one another, enlarging gradually, upper surface flat, sides slightly concave above but becoming convex below with a gentle flattening on the base; periphery sharply defined; band upon the upper edge of the periphery; umbilicus open but very small and deep, bounded by the sharp curve from the basal convexity into the umbilicus, one specimen showing a slight groove at the angle of the umbilicus but other specimens lacking it; sutures definite; aperture subtriangular, its lower outer edge projecting tongue-like; growth lines destroyed on the upper surface, having a strong forward convexity below the band on the outer side of the whorl, thence obliquely backward with a backward convexity within the perforation of the umbilicus, the upper surface and sides covered with larger spines or tubercles than below.

Salter stated that the spinose feature may be extraneous. It can be seen in some specimens, small and fine and in general following the growth lines on the underside of the whorl. If extraneous, there is some reason for its growth being confined to these small specimens with the small umbilicus. An examination of many small specimens of *H. planulata* of the same size and from the same beds at the same horizon failed to reveal signs of such a growth.

Helicotoma spinosa differs also from *Helicotoma planulata*, in its smaller size, the more gradual enlarging of the whorl, the small, deep umbilicus, the direction of growth lines within the umbilicus, and the apparent lack of revolving growth lines.

Occurrence. Leray-Rockland beds, locality 1.

Type. Holotype, G.S.C. No. 1209; paratype, No. 1209a; plesiotype, No. 9767; Leray-Rockland beds, Paquette Rapids, Ottawa River.

Genus, *Raphistomina* Ulrich and ScofieldGenotype, *Raphistoma lapicidum* Salter

Moderate size, lenticular outline; low spire; about four volutions, gradually increasing in size; each whorl subrhomboidal; upper surface gently convex, in some cases becoming concave near the periphery; lower surface convex; periphery sharply angular; carina on the periphery formed by an abrupt, narrow, beak-like projection that slightly overlaps the succeeding suture; no notch; umbilicus about one-quarter the width, its margin rounded or slightly angular; sutures not deeply impressed; growth lines on the upper surface directed gently forward on the inner part, then backward towards the sharply defined periphery, below which the gentle concavity is continued, slightly backward to the umbilicus, making an almost imperceptible sigmoid curve on the lower part of the whorl with the concave limb near the periphery.

Raphistomina differs from *Raphistoma* in having a more elevated spire, in lacking the revolving raised line crossing the growth lines on the upper surface, in the beak-like forward projection of the peripheral carina, as compared with the slight notch of *Raphistoma*, in having the peripheral half of the growth lines on the lower surface gently concave, with a consequent more or less corresponding upper and lower outline of the aperture as compared with the forward projection of the lower lip of *Raphistoma*.

Raphistomina aperta (Salter)

Plate XII, figures 1-3

Raphistoma apertum Salter, Geol. Surv., Canada, Can. Org. Rem., dec. 1, 1859, Pl. 2, figs. 4a, b.

Moderately small, Salter's holotype measuring 12 mm. in width and 6.5 mm. in height, the largest specimen found measuring 25 mm. in width and 12 mm. in height; discoidal, more gibbous below than above; about four volutions, the upper part of the whorl decidedly convex near the suture and correspondingly concave near the periphery, lower surface ventricose, with sides approximately at a right angle to the slope of the upper surface; periphery sharply outlined by a carina; umbilicus open, bounded by a contraction in the convexity of the lower part of the whorl, almost resulting in a ridge; sutures slightly impressed; aperture nearly square, the deepest part of the lip being directly below the convex half of the upper surface of the whorl; growth lines typical, obliquely backwards on the upper surface with a slight forward convexity near the suture, and almost straight across the lower part of the whorl, thence into the umbilicus.

R. aperta differs from *R. lapicida* in having a more ventricose lower part of the whorl, the whorl having its greatest height beneath the inner convex part of the upper half of the whorl, which results in a proportionately larger umbilicus and a more nearly square section of the whorl.

Small specimens of *R. aperta* are very similar to small specimens of *R. distincta*, but in mature forms of the latter the lower ventricose part of the whorl becomes somewhat flattened, altering the ridge-like boundary of the umbilicus, and its whorls enlarge more rapidly in width.

Salter's figured specimen, the holotype, has been lost, but the companion specimens with the same Geological Survey number are at hand. Two forms are present among them, several of which correspond to his meagre description except that they are somewhat larger than the holotype, the illustration of which is drawn, not photographed. The other form is described below, and the differences between it and *R. aperta* are noted there.

Occurrence. Leray-Rockland beds, locality 1.

Type. Lectotype, G.S.C. No. 1213; plesiotype, No. 1213f; Leray-Rockland beds, Paquette Rapids, Ottawa River.

Raphistomina aperta ampla n.var.

Plate XII, figures 4-6

Raphistoma apertum Salter (pars), Geol. Surv., Canada, Can. Org. Rem., dec. 1, 1859, p. 12.

Large for the genus, the largest specimen seen measuring 40 mm. in width and 16 mm. in height; discoidal, with thickness greater below the periphery than above; about four whorls, rapidly enlarging, the upper surface like that of the species, gently convex near the suture and concave near the periphery, the lower surface gently convex in the first immature whorls, becoming almost ventricose on the latter half of the last whorl; whorl section subrhomboidal, the greatest thickness of the outer whorl about the middle of the base of the section; periphery sharply defined by the carina; sutures lightly impressed; umbilicus open wide, a small part of each whorl being visible; aperture of all specimens broken; growth lines typical, obliquely backward on the upper surface with a very gentle forward convexity near the suture, gently forward on the lower surface rounding into the umbilicus at right angles to the axis of the whorl.

The variety differs from the species in its larger size, its more rapidly enlarging whorls, and in the change in convexity of the lower surface of the whorl from gently convex in the immature part to ventricose in the mature part of the whorl as compared with the species, which is ventricose in the immature whorl and maintains that characteristic throughout, the region of greatest thickness outlining the umbilicus more definitely in the species.

The fact that the species and variety differ in the immature part weighs against designation of the new form as a variety instead of a new species, but the variety has been so designated for the present because it gains something of the ventricose lower part of the whorl in its mature state, it has the open umbilicus, and more identifiable specimens from more localities are needed to establish a species.

Occurrence. Leray-Rockland beds, locality 1.

Type. Holotype, G.S.C. No. 9768a; paratype, No. 9768; Leray-Rockland beds, Paquette Rapids, Ottawa River.

Raphistomina distincta (Wilson)

Plate XII, figures 21-24

Raphistoma distinctum Wilson, Geol. Surv., Canada, Bull. 33, 1921, p. 56, Pl. 4, figs. 8-11.

Comparatively small; width, height, and height of spire of an average specimen about 18 mm., 11 mm., and 3 mm., respectively; depressed turbinate outline; three or three and a half volutions; whorls flat or very slightly convex above, steeply convex, somewhat flattened on the base; periphery forming almost a right angle with the upper surface; sutures defined clearly but not deep; umbilicus open, about one-third the total width, having an angular margin and steep sides; aperture subrhomboidal; growth lines, so far as can be seen, typical on top of the whorl, bending forward and crossing the steep, lower side obliquely, with a slight forward convexity, mounting into a ridge that delimits the umbilicus into which they disappear at right angles to the plane of the axis of the whorl.

Specimens from the Lowville beds have a tendency to be larger, one such specimen measuring 25 mm. in width, but no other difference has been noted.

R. distincta is closely allied to *R. aperta* (Salter). Young specimens are very similar. Mature specimens differ in that in *R. distincta* the whorls increase more rapidly in size, it has a flatter, upper surface with steeper sides, the curve of the lower convexity is somewhat flattened on the base; the backward turn of the growth lines towards the periphery is more accentuated on the upper and lower surfaces of the whorl, and the ridge bounding the umbilicus seems to be more prominent in well preserved specimens.

Occurrence. Pamela beds, localities 19, 21, 26-28, 54, 60, 66, 68-71, 126-128, 132, 142, 149, 157, 176-178, 191, 198, 201, 208, 212; Pamela-Lowville beds, localities 25, 211; Lowville beds, localities 61, 133, 135, 140, 181, 182.

Type. Cotypes, G.S.C. Nos. 6227 and 6227a, Pamela beds, MacLaren Landing, Ontario; plesiotype, No. 9769, Pamela beds, Dowler farm quarry for Rideau canal.

Raphistomina lapicida (Salter)

Plate XII, figures 7-11

Raphistoma lapicidum Salter, Geol. Surv., Canada, Can. Org. Rem., dec. 1, 1859, p. 12, Pl. 2, figs. 1-3.*Raphistomina lapicida* (Salter) Ulrich and Scofield, Pal. Minnesota, 3, pt. 2, 1897, p. 934, figs. 5a-c, p. 942; Pl. 68, figs. 18-20.

Medium size, width averaging 25 mm., height about half the width or a little more; more or less discoidal outline, nearly equal convexity above and below periphery; about four volutions; upper side of whorl gently convex near the suture becoming gently concave near the periphery, evenly and broadly convex below; periphery sharply defined; peripheral carina sharp, accentuated by the slight concavity on the outer upper edge of the whorl, barely rising above the succeeding whorl; umbilicus open but small, with its edge abruptly rounded but not angular; sutures shallow, suture and carina hardly interrupting the profile of the gentle convexity of the upper

part of each specimen; aperture wider than high, oval except for the angularity at the periphery; growth lines with a very gentle sigmoid curve directed backward to the periphery, below almost straight, having a very slight forward direction as they enter the umbilicus where they continue gently forward.

For differences between *Raphistomina aperta* and *Raphistomina lapicida* See under description of the former species.

Occurrence. Leray-Rockland beds, locality 1.

Type. Holotype?, G.S.C. No. 1212a; paratype, No. 1212; Leray-Rockland beds, Paquette Rapids, Allumette Island, Quebec.

Genus, *Trochonema* Salter

Genotype, *Pleurotomaria umbilicata* Hall

Medium to large; turbinate spire varying in height; four to eight volutions, strongly angular to ventricose, usually bearing four rather prominent ridges, the two centre ridges separated by a broad, flat or concave band forming the periphery with its plane either parallel to the axis of the specimen or slightly inclined toward the apex; a flat concave slope above the peripheral band interrupted by a third ridge just short of the suture, a convex or flat area below the peripheral band interrupted by a fourth ridge, which forms the angular margin of the umbilicus; smaller ridges in some cases on the lower half; broad notch at the upper angle of the peripheral band; sutures deep; umbilicus open, large at the last whorl and occupying about one-third the whole width; aperture somewhat oblique, usually inclined with the upper part towards the axis, and the plane transverse to the whorl axis also inclined, having the base of the aperture posterior to the summit as in the lines of growth; inner lip varying in thickness, not reflexed; lines of growth passing obliquely backwards on the upper part of the whorl, straight or slightly forward on the peripheral band, thence obliquely backwards to the umbilicus and within it.

Trochonema differs from *Eunema*, the most nearly related genus, in being shorter and wider, in having a wider umbilicus, in having the lower whorl proportionately less convex, and in having a wider aperture, which is less oblique and inclined with the upper part towards the axis as compared with *Eunema* with the lower part of its aperture towards the axis.

Trochonema fragile Ulrich and Scofield

Plate XIII, figures 1, 2

Trochonema fragile Ulrich and Scofield, Geol. Minnesota 3, pt. 2, 1897, Pl. 77, figs. 13-16.

Small, averaging 15 mm. at the largest diameter; trochiform; apical angle approximately 90 degrees; about four volutions; peripheral band narrow; four sharp carinæ present—one near the upper suture, one each at the upper and lower edge of the peripheral band, and one on the underside, the whorl being concave between them in the moulds, which are all that have been found; umbilicus large for the size of the shell, sharply defined by the lowest carina on the last whorl; aperture and growth lines not seen, but judging by the sharpness of all the carinæ the circular outline of the aperture would be considerably modified.

The species differs from *Trochonema umbilicatum* in the more gradual enlargement of the whorls and hence is smaller when measured from a corresponding volution. It is smaller and broader in proportion to its height than *Trochonema umbilicatum canadense* and has the upper carina nearer to the upper suture than in either *T. umbilicatum* or *T. umbilicatum canadense*.

Occurrence. Cobourg beds, localities 88, 189, 254, 260, 264.

Trochonema umbilicatum (Hall)

Plate XIII, figures 3-6

Pleurotomaria umbilicata Hall, Pal. New York, 1, 1847, p. 43, Pl. 10, figs. 9a-b; p. 175, Pl. 38, figs. 1a-g.

Trochonema umbilicatum (Hall), Billings in Hind's Narr. Can. Red River Expl. Exped. pt. 2, Assiniboine and Saskatchewan Exped. of 1858, 1860, p. 287; Ulrich and Scofield, Pal. Minnesota, 3, pt. 2, 1897, p. 1047, Pl. 77, figs. 1-3.

Rather large, 30 to 40 mm. in width, 25 to 30 mm. in height; turbinate spire not very high; four to five volutions, the last whorl with a tendency to be partly free; periphery a wide band, angular above and below; four or five revolving carinæ, one on the upper shoulder, two bounding the peripheral band, a fourth not so prominent on the underside, in some cases an obscure fifth within the umbilicus; space between the carina flat or gently concave on the upper part and sides, slightly convex below; sutures deep; umbilicus open, deep, about one-third the width, except at the last whorl where it broadens; aperture almost circular in outline but broken by the angular carinæ, oblique to the axis of the specimen, the upper part inclined toward the axis, also oblique to the axis of the last whorl, the upper part being anterior to the lower part; growth lines slightly backward from the suture to the upper carina, obliquely backward to the second carina, almost vertical but with a slight backward swing over the peripheral band, thence very obliquely backward to the umbilicus.

There is some disagreement about the direction of the growth lines. The specimens at hand are worn casts not showing outer ornamentation so that the writer is dependent upon other illustrations and descriptions. Some refer to the growth lines as directed continuously backward though with varying obliquity, others suggest a forward turn over the peripheral band and just below it. Specimens of the following variety show the direction of the growth lines and the aperture, neither of which is in any part directed forward.

The differences between *T. umbilicatum* (Hall) and *T. umbilicatum canadense* Ulrich and Scofield are given under the description of that variety.

Occurrence. Leray beds, localities 9, 16, 61, 86, 135, 136, 140, 182; Leray-Rockland beds, locality 1; Rockland beds, locality 156; Cobourg beds, localities 48, 74, 78, 86-88, 90, 92-95, 100, 101, 110, 113, 117, 120, 122, 152, 154, 162, 164, 168, 169, 172, 184, 188-190, 200, 203, 204, 215, 219, 220, 222-224, 233, 235, 236, 249, 252, 257, 260, 261, 264.

Type. Plesiotype, G.S.C. No. 9770, Cobourg beds, west half lot 22, con. III, Roxborough tp., Ontario.

Trochonema umbilicatum canadense Ulrich and Scofield

Plate XIII, figures 7, 8

Trochonema umbilicatum (Hall), Salter, Geol. Surv., Canada, Can. Org. Rem., dec. 1, 1859, p. 27, Pl. 6, fig. 3.*Trochonema umbilicatum canadense* Ulrich and Scofield, Pal. Minnesota, 3, 1897, p. 1047, Pl. 77, figs. 4-6; Wilson, Roy. Soc., Canada, Trans. 3rd ser. 32, 1938, sec. 4, Pl. 3, fig. 6.

Moderate size, average width of an adult 27 mm., average height 15 to 18 mm. from spire to umbilicus, 26 to 27 mm. from spire to lower part of aperture; apical angle about 79 degrees; four to five volutions, the height of the whorls being greater than the width, the anterior end of the last whorl having a tendency to detach itself; the broad, peripheral band between the two median carinæ in some instances slightly inclined towards the axis at the base; four carinæ as in the species, definitely concave between the carinæ including the peripheral band; notch present as in the species; umbilicus open, sharply defined by the lower carina, its width more than doubled in the last whorl; aperture slightly higher than wide, its plane vertically oblique as in the species, the base of the aperture being posterior to its top making an angle of 45 degrees to the vertical of a cross-section of the whorl; growth lines directed slightly backward from the suture to the first upper ridge, more obliquely backward to the edge of the periphery, thence slightly backward across the peripheral band, below the band very obliquely backward with a slight curve over the margin of the umbilicus within which they become almost vertical.

The variety differs from the species, as Ulrich pointed out, in its narrower and higher outline due to the greater ratio of height to width of the whorls and the consequent smaller apical angle, and in the tendency of the aperture to incline to the axis below the periphery instead of above it.

Occurrence. Leray beds, localities 21, 55, 135; Leray-Rockland beds, localities 1, 156; Cobourg beds, localities 86, 87, 92, 101, 105, 154, 240, 261.

Type. Plesiotype, G.S.C. No. 1205, Leray-Rockland beds, Allumette Island, Paquette Rapids, Quebec.

Genus, *Eunema* SalterGenotype, *Eunema strigillatum* Salter

Small to moderate size; turreted; high spire acutely angular; four to seven whorls gradually enlarging, the upper part concave between the carinæ, the lower part convex, the last whorl having a tendency to free itself; whorl section longer than wide; periphery defined by a broad vertical band; three revolving carinæ, a fourth visible at the suture on the upper part of the last whorl when not enveloped by the succeeding whorl; umbilicus covered by the aperture; aperture almost vertical, outline oval except at the angular interruptions of the carinæ; growth lines slightly backward to the top of the band, thence vertical or very slightly forward over the peripheral band and the lower convexity to the position of the umbilical perforation where they curve gently backward.

Ulrich and Scofield¹ considered *Eunema* to be a subgenus of *Trochonema*, differing in the high spire, the umbilicus, and the more nearly vertical aperture, which differences they do not consider as important as the similarity of the aperture.

¹ Geol. Minnesota, 3, pt. 2, 1897, p. 1046.

Brookes Knight¹ has considered it to be a separate genus and later² it has again been listed as a subgenus.

The umbilicus of Billings' type specimen *Eunema strigillatum*, which Ulrich and Scofield did not illustrate with the other species of their subgenus, is closed entirely except where the last whorl is freed. It, also, possesses a ridge almost vertical but with a gentle curve paralleling the curve of the inner side of the aperture, and in several specimens the ridge and the inner side of the aperture are attached to one another. Even though this vertical ridge, by a stretch, might be considered an umbilical ridge it certainly is not revolving. In Brookes Knight's illustration (op. cit.) a faint indication of a revolving line is visible, but it is the position of the bifurcation of a number of striæ, not a ridge. On the other hand, all other specimens assigned by Ulrich and Scofield to *Eunema* as a subgenus of *Trochonema* have an open umbilicus bounded by a revolving ridge.

Eunema is treated as a genus here for the above reason, and because of its other superficial but distinct differences and the ease with which it can be recognized as differentiated from *Trochonema* without entering into the controversial question of what constitutes a genus or subgenus.

Eunema erigone Billings?

Plate X, figure 7

Eunema erigone Billings, Geol. Surv., Canada, Pal. Foss. 1 (Adv. sheet 1862), 1865, p. 35, fig. 37.

More ventricose than is usual with the species; holotype measuring 32 mm. in height and 26.5 mm. in width, taken from the illustration; turbinate, obtusely conical; apical angle 80 degrees; four or five volutions; whorls rapidly enlarging, each embracing less than half the preceding one, the last whorl constituting more than half the whole specimen, upper part of whorl bearing a concave shoulder, a broad almost vertical band forming the periphery, lower part ventricose; umbilicus unknown; sutures deep in cast; aperture obtusely oval; surface unknown.

The writer has not seen a specimen corresponding to Billings' illustration. The description given here is from the original. In the old collections is a specimen marked '*Eunema erigone* Billings' from the type locality of the species, but no aperture is present and the last whorl is fragmentary, not enough being preserved to show a band, if present. What might have been termed the band of the preceding whorl is composed of the part of that whorl not covered by the body whorl plus the upper part of the concave shoulder of the body whorl, which accelerates its curve as it approaches the preceding whorl joining it with an almost imperceptible suture. The apical angle is about 50 degrees, omitting the last ventricose whorl. The form appears to be a worn specimen of *Holopea nereis spiralis* as described here. Billings mentions only one specimen. If this is his type, the writer doubts the validity of the species.

Occurrence. Leray beds, locality 209.

Types. Lost or not recognized.

¹ Geol. Soc. Amer., Spec. Paper, 32, 1941, p. 119, Pl. 41, figs. 1a, 1b.

² Index Fossils of North America, 1947, p. 461.

Eunema strigillatum Salter

Plate X, figures 8, 9

Eunema strigillatum Salter, Geol. Surv., Canada, Can. Org. Rem., dec. 1, 1859, p. 29, Pl. 6, fig. 4.*Trochonema (Eunema) strigillatum* Salter, Ulrich and Scofield, Pal. Minnesota, 3, pt. 2, 1897, p. 1052.*Eunema strigillatum* Salter, Knight, Geol. Soc. Amer., Spec. Pap. 32, 1941, pp. 1046, 1052.

Small or medium size; high spire; apical angle 44 degrees; five to seven volutions, whorl concave on top, convex below; peripheral band broad; three sharp carinæ, a fourth visible at the suture when the last whorl is free; umbilicus covered except in the last whorl when free; sutures deep; aperture longer than wide, almost vertical, the inner lip just touching or resting upon a curved ridge that may have a siphonal function; growth lines gently backward on the upper part of the whorl, becoming slightly forward across the band and the lower convex part of the whorl, thence backward with a gentle curve to the umbilicus, two or three lines amalgamating about halfway between the lower edge of the band and the umbilicus and continuing as one to the umbilicus.

The reasons for the continued use of *Eunema* as a genus are given under the genus description.

Occurrence. Leray-Rockland beds, locality 1.

Type. Holotype (as chosen by Knight), G.S.C. No. 1202b; paratypes, Nos. 1202a-e; Leray-Rockland beds, Allumette Island, Paquette Rapids, Quebec.

Genus, *Daidia* gen. nov.Genotype, *Eunema?* *cerithioides* (Salter)

Shell small, turreted, with high spire and acute apex; nine whorls in the genotype, the only species known; whorls tightly coiled, higher than wide in section, upper half of whorl gently concave, lower half gently convex; periphery below the middle; a narrow band dividing the upper and lower part of the whorl; three carinæ present, the upper one at the angular apex of each whorl situated very close to the preceding whorl, the other two defining the upper and lower edge of the band; umbilicus minute, perhaps covered in complete specimens, aperture acute above and narrowly rounded below; ornamented by striæ which produce pustules where they cross each carina, directed slightly backward on the upper concave part of the whorl, becoming perpendicular across the band and on the lower half of the whorl.

Daidia differs from *Eunema* in its tightly coiled, high, narrow whorls, in its fewer carinæ, and its pustulose carinæ.

The name comes from *δαῖς*, a light or torch, a translation of Allumette, the island from which the type specimen comes.

Daidia cerithioides (Salter)

Plate XI, figures 15, 16

Eunema cerithioides Salter, Geol. Surv., Canada, Can. Org. Rem., dec. 1, 1859, p. 30; Billings, Geol. Canada, 1863, p. 145, figs. 89a, b; Pal. Foss. 1 (Adv. sheet 1862), 1865, p. 35, fig. 36.

Trochonema (Eunema) cerithioides (Salter) Bassler, U.S. Geol. Surv. Bull. 92, 1915, p. 1301.

Small, holotype measuring 19 mm. in height and 9 mm. at its widest; very slender, cone-shaped, slightly turreted; apical angle 33 degrees; seven or eight volutions; whorls very gradually enlarging, each overlapping less than half the preceding whorl, very angular at the top, upper part vertical but slightly concave, a narrow band just below the middle defined by two rows of minute pustules, convex below; periphery near the base of the last whorl; umbilicus closed; sutures shallow but clearly defined by the sharp upper angle of the whorl; aperture longer than wide, angular above and having the lower part of the lip broadened and slightly reflexed, inner lip worn away; growth lines more evident on the upper concave part of the whorl, directed gently backward, thence almost vertical over the narrow band, each divided in two on the lower part, the whole crossed by three rows of minute pustules, one just below the suture and one above and below the narrow band.

The form is closely related to *Eunema* but has definite differences, particularly in the very angular upper part of the whorl and the sloping sides, which differences may prove to have generic value, but to date only the type specimen has been found, and it is felt that more specimens should be available to establish generic characteristics.

Occurrence. Leray-Rockland beds, locality 1.

Type. Holotype, G.S.C. No. 1206, Leray-Rockland beds, Allumette Island, Paquette Rapids, Ottawa River.

Genus, *Gyronema* Ulrich and ScofieldGenotype, *Gyronema pulchellum* Ulrich and Scofield

Generally small, trochiform or turreted; apical angle rather acute; shell apparently thin; four or five volutions; upper surface of whorl sloping, lower surface convex; periphery defined by a carina or by a band with a carina above and below it; umbilicus small or wanting; an indeterminate number of coarse revolving liræ with finer ones between, more on the lower part of the last whorl than are visible on the upper; surface concave between the carinæ; sutures not clearly defined; aperture basically subcircular but interrupted by the carinæ; inner lip thin, reflexed, non-sinuate; growth lines fine, directed obliquely backward.

Gyronema like *Eunema* has been considered a subgenus of *Trochonema*. It has the angular carinæ of both *Trochonema* and *Eunema*, but the revolving liræ on the lower surface of the last whorl differentiate it from either. In addition the spire is more acute than that of *Trochonema* and its last whorl lacks the tendency to free itself that is evident in *Eunema*.

Gyronema semicarinatum (Salter)

Plate XII, figures 18-20

Cyclonema semicarinatum Salter, Geol. Surv., Canada, Can. Org. Rem., dec. 1, 1859, p. 27, Pl. 6, figs. 2 and 2a.

Gyronema semicarinatum (Salter), Ulrich and Scofield, Pal. Minnesota, 3, pt. 2, 1897, p. 1057, Pl. 78, figs. 17 and 18.

Very small, holotype measuring 14 mm. in height and 9 mm. in width; turreted; apical angle approximately 60 degrees; shell thin; five or six volutions; whorls gradually enlarging, upper part sloping, lower part ventricose; periphery sharply angular; several carinæ and numerous liræ present, the surface between the suture and the upper carina being flat and horizontal, the surface between the upper carina and the peripheral carina being flat but sloping, that between the numerous revolving liræ on the under ventricose side being concave, only one or two of the liræ visible on the upper whorls between the periphery and the succeeding suture, but both liræ and some finer revolving lines prominent on the lower side of the last whorl; sutures not deep; umbilicus small; aperture almost circular except for the interruption of the carinæ, inner lip slightly reflexed, not enough to cover the umbilicus and receiving the end of the lira nearest the umbilicus; growth lines directed gently backward from suture to carina and from carina to carina to lira to the umbilicus.

Occurrence. Leray-Rockland beds, locality 1.

Type. Holotype, G.S.C. No. 1208, Leray-Rockland beds, Allumette Island, Paquette Rapids, Ottawa River, Quebec.

Genus, *Trochonemella* OkulitchGenotype, *Lophospira? notabilis* Ulrich and Scofield

Height and width approximately equal; trochiform; apical angle almost 90 degrees; three or four volutions; upper part of whorl concave between the carinæ, lower part convex; last whorl loosely coiled; periphery formed by a broad revolving band; prominent slit-notch at the top of the peripheral band and oblique to the shell axis; three marked carinæ, one each at the upper and lower edges of the band and one between the upper edge of the band and the suture; sutures angular but not deep; umbilicus small, obscure ridge at turn in some species; aperture almost round except where interrupted by the carinæ and slit-notch, with the inner lip free from or barely touching the preceding whorl; growth lines almost straight from suture to lower edge of the peripheral band, thence obliquely backward to the umbilicus except in a few species included in the genus by the author, which species have a slight forward curve below the band, thence turn obliquely backward.

Trochonemella differs from *Lophospira* in its depressed spire, its stronger and wider slit-notch, its more accentuated carinæ, and its strong ornamentation. The genus seems to be intermediate between *Trochonema* and *Ulrichospira* Donald. It differs from *Trochonema* in its smaller umbilicus,

in lacking the carina below the peripheral band, and in its strongly emphasized growth lines. The description of *Ulrichospira similis*, genotype of *Ulrichospira*, is accompanied by a drawing only, and both description and drawing are incomplete, making exact comparison difficult. Neither umbilicus nor aperture is present though the direction of the growth lines suggests the aperture. As drawn, *Ulrichospira* seems close to *Lophospira* in the carinæ, the high spire and consequent shape of the whorls, and in the direction of the growth lines and consequent shape of the aperture. It resembles *Trochonemella* in the wider, more marked slit-notch.

Trochonemella has been considered variously as a distinct genus and as a synonym of *Ulrichospira*. The genus is here retained for the present until more and better specimens make possible a clearer definition of *Ulrichospira*.

Trochonemella? arachne (Billings)

Plate XII, figures 15, 16

Pleurotomaria arachne Billings, Geol. Surv., Canada, Pal. Foss. 1, 1865 (Adv. sheet 1862), p. 31, fig. 32.

Lophospira ? arachne (Billings), Bassler, U.S. Geol. Surv. Bull. 92, 1915, p. 757.

Small, averaging 14 mm. in height and 12 mm. in the widest part; trochiform; apical angle 75 to 80 degrees; four or five rapidly enlarging whorls, concave above the peripheral band, convex below; peripheral band broad, vertical; umbilicus small; three carinæ, the upper one near the suture outlined by a row of prominent tubercles, middle and lower carinæ defining the peripheral band, middle carina bearing a small but definite slit-notch, each strong line within it concave to the anterior, ending in a tiny tubercle, thus outlining each edge of the notch by a row of tubercles, lower carina less marked by finer tubercles; aperture almost round, a little longer than wide, inner edge of the lip slightly thickened but free; growth lines directed backward from the suture to the upper carina, each ending in a tubercle on the carina, thence still backward but each split into two or three finer lines interrupted by the slit-notch, then almost vertical over the peripheral band to the lower carina, thence still slightly backward, two or three lines re-uniting into coarser threads just before reaching the umbilicus.

Trochonemella? arachne (Billings) is much smaller than *Trochonemella? notabilis* and smaller than *Trochonemella? montrealensis*, and it also differs from the latter in the direction of the growth lines below the peripheral band as drawn in that species.

The reason for the query is given under the description of the genus.

Occurrence. Lowville beds, localities 135, 140; Leray-Rockland beds, locality 1.

Type. Holotype, G.S.C. No. 1223a; paratype, G.S.C. No. 1223; Leray-Rockland beds, Paquette Rapids, Allumette Island, Quebec.

Trochonemella? montrealensis Okulitch

Plate XII, figure 17

Trochonemella montrealensis Okulitch, Ottawa Field Nat. 49, 1935, No. 6, p. 101, Pl. 2, fig. 2.

Small, height and width subequal, measuring 12 to 19 mm. in diameter; trochiform; apical angle 80 to 82 degrees; four or five volutions, almost flat on top, concave to the peripheral band and on it, convex below; three prominent carinæ, one near the suture, one each on the upper and lower edge of the peripheral band; slit-notch on the upper carina of the peripheral band, shallow but wide with coarse growth lines concave to the anterior; umbilicus small, on a well-preserved specimen showing an obscure ridge close to the turn into the umbilical perforation, aperture unknown, except as suggested by the growth lines; the latter straight from suture to the first carina, obliquely backward to the slit-notch, thence gently forward over the concave peripheral band, thence obliquely backward with a slight curve, concave to the anterior, to the umbilicus at the edge of which they form an obscure ridge; very fine growth lines superimposed upon the coarser ones on the umbilicus edge near the aperture. It may be that better preserved specimens might show these fine growth lines to be characteristic of the whole shell.

The form is queried because the description of the type specimen lacks some of the features here preserved. The size, the characters common to both, and the horizon correspond.

Occurrence. Pamela-Lowville beds, locality 125; Lowville beds, localities 140, 268; Leray beds, locality 156.

Type. Plesiotype, G.S.C. No. 9771, Lowville beds, lot 3, con. III, R.F., Gloucester tp., Ontario.

Genus, *Cyclonema* HallGenotype, *Pleurotomaria bilix* Conrad

Small to moderate size; turbinate, some forms almost conical; apical angle 70 to 90 degrees; about five volutions; whorls rapidly enlarging, somewhat embracing, more or less ventricose, greatest width near the base, upper part sloping towards the apex but maintaining a gentle convexity, lower part flattened and gently convex; periphery near the base of the whorl, varying from broadly to abruptly rounded; umbilicus lacking; sutures not deep; aperture broader than high, outline from circular to subquadrate, inner lip closely reflected, slightly excavated; growth lines obliquely backward with a gentle undulation, in some forms crossed by prominent revolving liræ. The revolving lines in *Cyclonema* are over all the surface of the whorls, whereas in *Gyronema* they are confined to the lower part. The upper carinæ of *Gyronema*, however, readily differentiate the two genera. For differences between *Cyclonema* and *Holopea* See under the description of the latter species.

Cyclonema cushingi Ruedemann

Plate XIII, figures 9-11

Cyclonema cushingi Ruedemann, New York State Mus. Bull. 162, 1912, p. 110, Pl. 7, figs. 8-10.

Large, 35 to 40 mm. when complete; outline more conical than is usual for the genus; apical angle about 55 degrees; five or six volutions; whorls flattened on the sides and the base, with an indefinite shoulder near the suture; periphery narrowly rounded and situated near the base; umbilicus very small; sutures shallow but somewhat accentuated by the slight shoulder of the upper part of the whorl; aperture seen only in a small specimen, subquadrate, showing a little of the excavation; growth lines directed backward, crossed by revolving lines, in some places of two sizes with a smaller one between two larger.

The specimens from this region do not show the great regularity of finer and coarser revolving lines that is implied in Ruedemann's description, but the variation is probably a slight local characteristic. There are several sizes, but as they grade into one another they are considered to represent the same species.

Cyclonema cushingi differs from *Cyclonema bilix* and *Cyclonema hallianum* in its flatter sides and base, and consequent more conical spire, and in the alteration of the revolving lines.

Occurrence. Rockland beds, locality 156; Hull beds, localities 40, 42; Sherman Fall beds, localities 52, 138; Cobourg beds, localities 105, 227.

Type. Plesiotypes, G.S.C. Nos. 9772 and 9772a, Hull beds, cement quarries, Hull, Quebec.

Cyclonema hallianum Salter

Plate XIII, figures 14, 15

Cyclonema hallianum Salter, Geol. Surv., Canada, Can. Org. Rem., dec. 1, 1859, p. 26, Pl. 6, fig. 1.

Large for the genus, one specimen measuring 32 mm., lacking the upper whorl; apical angle approximately 70 degrees; five or six rapidly enlarging whorls, more rounded than some species of the genus but nevertheless somewhat flattened on sides and base; section of whorl circular to subquadrate; periphery near the base of the whorl; umbilicus very small; sutures well defined but not deep; aperture not seen; growth lines strong, directed obliquely backward from the top, and crossed by very fine revolving lines, which are frequently obliterated.

Cyclonema hallianum differs from *C. bilix* in the more rounded whorl and the less prominent revolving lines.

Occurrence. Leray beds, locality 137; Leray-Rockland beds, locality 1; Hull beds, locality 46.

Type. Lectotype, G.S.C. No. 1195, Leray-Rockland beds, Allumette Island, Paquette Rapids, Ottawa River; plesiotype, G.S.C. No. 9773, Leray beds, lot 6, con. III, R.F., Gloucester tp., Ontario. Salter's type has been lost, and the lectotype is chosen from the original material.

Cyclonema montrealense Billings

Plate XIII, figures 12, 13

Cyclonema montrealense Billings, Geol. Surv., Canada, Pal. Foss. 1 (Adv. sheet 1862), 1865, p. 30, fig. 28.

Small to medium size, average height about 15 to 20 mm., many smaller, and largest one seen 30 mm.; broad in relation to its height; apical angle 85 to 90 degrees; three or four volutions, the initial one usually lacking; whorls very rapidly enlarging, the upper part and sides convex, the lower surface considerably flattened but still gently convex and in old specimens becoming more ventricose in the last whorl; periphery near the base, rather sharply rounded; umbilicus small or absent; sutures shallow but definite because of the convexity of the succeeding whorl; aperture not well preserved on any specimen, but the shape of the whorl and the growth lines suggest that height and width are subequal; growth lines directed backward, very fine and coarse, crossed by strong revolving lines that are finer on the base than on the sides.

Cyclonema montrealense differs from the two preceding forms in its more rapidly enlarging whorls with the consequent change in shape and apical angle, and in particular from *Cyclonema cushingi* in the convex rather than the flattened side of the whorl, it differs from *Cyclonema hallianum* in its more squat outline and in having the whorl section more equal in height and width.

Occurrence. Lowville beds, localities 133, 268; Leray beds, locality 137; Rockland beds, locality 146; Hull beds, locality 37.

Type. Holotype, G.S.C. No. 1694, from undefined Trenton beds at Smith quarries, Montreal, Quebec.

Genus, *Holopea* HallGenotype, *Holopea symmetrica* Hall

Small to large; turbinate outline; blunt apical angle; four to five volutions, the upper one usually missing; whorls rapidly enlarging, circular in section, a few species showing a slight tendency to flatten at the shoulders; in some cases a tendency to coil loosely; no slit or notch; umbilicus very small; sutures definite because of the rotundity of the succeeding whorl; aperture round, with a straightened outer lip; growth lines usually strong, in some cases crossed by a few revolving lines, and in some cases accentuated by indefinite undulations.

Holopea is very like *Cyclonema* in general outline, but has a more rounded whorl, the peripheral boundary is nearer the middle of the last whorl, and it has none or very few of the revolving lines.

A comparison of the outlines of the several species of *Holopea* here described is shown in Figure 5.

Holopea informis Wilson

Plate XIV, figures 1, 2

Holopea informis Wilson, Roy. Soc., Canada, 3rd ser. 26, 1932, p. 386, Pl. 3, figs. 7, 8.

Small, with very low spire, holotype measuring 15 mm. in height and 20 mm. in width; apical angle much greater than a right angle; about three volutions; whorl enlarging very rapidly, very rotund, each one embracing one-half to three-quarters of the preceding one; umbilicus small in the mould; sutures shallow; aperture and growth lines not preserved; faint broad undulations present.

Holopea informis is more naticoid than any other species in its method of growth, and in this respect somewhat resembles *Holopea ampla* though the whorls are more enveloping and the whole much smaller. The holotype and only other specimen found to date are very poorly preserved, but the form is distinctly different from any other species.

Occurrence. Lowville beds, localities 209, 278.

Type. Holotype, G.S.C. No. 6606, Lowville beds, lot 17, con. IV, Cornwall tp., Ontario.

Holopea lavinia Billings

Plate XIV, figure 16

Holopea lavinia Billings, Geol. Surv., Canada, Pal. Foss. I (Adv. sheet 1862), 1865, p. 28.

Rather large for the genus, the holotype measuring 42 mm. in height and 32 mm. in width, lacking both top and part of the aperture; evenly conical, apical angle 65 degrees; five to seven volutions; body whorl two-thirds of whole size, each whorl enveloping about two-thirds of the preceding one, the upper exposed part sloping towards the apex, the lower exposed part of the last whorl very ventricose, the region of the greatest width marked by a sharpening of the curve, which almost becomes angular in the mould; umbilicus not seen; sutures shallow, only slightly breaking into the general slope of the upper surface; aperture and growth lines not seen.

Holopea lavinia is near *Holopea excelsa* in size but differs in the slope of the upper part of the whorl, in the amount of each whorl enveloped by the succeeding one, and in the proportionately large size of the last whorl. It differs from other species in these three characteristics and in its large size.

Occurrence. Leray-Rockland beds, locality 15.

Type. Holotype, G.S.C. No. 1706, Leray-Rockland beds, lot 25, con. V, Admaston tp., Renfrew co., Ontario.

Holopea lavinia conica n.var.

Plate XIV, figure 15

Medium size, holotype measuring 40 mm. in height, 28 mm. in width when complete; upper surface conical with very gently convex sides, lower surface ventricose; apical angle approximately 75 degrees; about four rapidly enlarging whorls; whorl bearing a broad almost flat shoulder,

ventricose below, each whorl embracing about two-thirds of the preceding one, up to the shoulder, the slope of the combined shoulders producing the cone-shaped upper part; periphery marked by the angular margin of the shoulder of the last whorl; sutures shallow; umbilicus covered by the reflexed inner lip; aperture only partly preserved, showing the reflexed lip, produced downward, almost caniculate, having an angular junction with the convex curve of the outer margin, the aperture again having a slight angle at the lower edge of the shoulder; ornamentation obliterated.

The variety differs from the species in the flat shoulders with a more angular periphery and in the conical upper half of the shell caused by the enveloping of the lower part of the whorl up to the angular edge of the broad shoulder. The greatest width of the variety is at this angular edge, not in the ventricose lower part as in the species.

Occurrence. Leray-Rockland beds, locality 1.

Type. Holotype, G.S.C. No. 9776, Leray-Rockland beds, Paquette Rapids, Ottawa River.

Holopea media n.sp.

Plate XIV, figure 3

Small, height of largest specimen 20 mm. from apex to lower edge of aperture, width 18 mm., lacking the aperture; turreted; apical angle approximately 65 degrees; about four volutions; whorls rapidly and evenly enlarging, rotund; almost circular in section, each whorl embracing less than half the preceding one, the last whorl forming one-half the shell; umbilicus small in the mould, possibly covered when the shell is preserved; sutures moderately deep; aperture not seen; growth lines obliterated but numerous stout ridges evident, almost vertical to the axis of the whorl.

Holopea media is comparable to *Holopea ottawaensis* in size, but its whorls enlarge more gradually, and are less embracing, and it has a more acute apical angle. It differs from *Holopea concinnula* in its subequal height and width and in lacking the suggestion of angularity of the outline of the whorl.

The specific name "*media*" is suggested by its medium size. The form is here described with hesitancy because the specimens are all poor moulds, but it differs from any other, and so far as known it is confined to the upper beds.

Occurrence. Cobourg beds, localities 51, 87.

Type. Holotype, G.S.C. No. 9788, Cobourg beds, north of Carling avenue, between LeBreton and Booth streets, Ottawa, Ontario.

Holopea nereis Billings

Plate XIV, figures 9, 10

Holopea nereis Billings, Geol. Surv., Canada, Pal. Foss. I (Adv. sheet 1862), 1865, p. 27.

Larger than most species of the genus, a plesiotype measuring 40 mm. in height from apex to lower edge of aperture, and 38 mm. in width at the last whorl, lacking both tip and aperture; slightly turreted; apical angle 75 to 80 degrees; four or five volutions; whorls ventricose, almost round in

section, rapidly enlarging, each whorl enveloping about one-third the preceding one, resulting in a spire higher than that of some other species; a shoulder about one-quarter the circumference from the suture, more evident in moulds than in a complete specimen; umbilicus small in moulds, probably closed when the shell is preserved; sutures not deep but marked in moulds because accentuated by the shoulder; aperture and growth lines not seen.

Holopea nereis is larger than *Holopea obliqua* and can be distinguished from it and from *Holopea undulata* by the shoulder. Its turreted outline differentiates it from the more conical-spined *Holopea lavinia*.

In the small tray containing the specimens of the old collections, presumably arranged by Billings, were two forms of *Holopea*; one specimen, No. 1197, corresponds to the original measurements and is here considered to be one of Billings' cotypes. The others belong to the following described variety.

Occurrence. Leray-Rockland beds, localities 1, 4, 147; Rockland beds or Hull beds, locality 209; Cobourg beds, localities 87, 113.

Type. Cotype, G.S.C. No. 1197, Leray-Rockland beds, Allumette Island, Ottawa River; plesiotype, G.S.C. No. 9775, Leray-Rockland beds, north side of Bonnechère River, east of townsite.

Holopea nereis spiralis n.var.

Plate XIV, figures 11, 12

Medium to large, the largest specimen found measuring 39 mm. in height and 34 mm. in width, lacking the aperture; spiral above, ventricose below; apical angle 55 to 60 degrees; five or six volutions, the last one very large, being two-thirds of the whole shell, lower part very convex, upper part bearing a broad concave trough or groove instead of a slightly convex or flat shoulder, the junction of the convex and concave sections being slightly angular on the upper whorls and rounded on the last whorl, the concave groove in each case enveloping the preceding whorl to a little below the groove, resulting in a spiral groove on the upper part of the shell culminating in a sharp apex; periphery about the middle of the last ventricose whorl; suture line almost imperceptible, lost in the spiral groove; umbilicus small, covered by the reflexed lip when it is preserved; aperture convex on the outer edge, the concave groove making a slight invagination in the upper part, lip straight on the inner edge with a gentle angulation at the lower end where it unites with the convex outer edge.

The variety name is suggested by the spiral effect of the concave shoulder, which differentiates it from the species and the variety *Holopea lavinia conica*.

Occurrence. Leray-Rockland beds, locality 1.

Type. Holotype, G.S.C. No. 9777; paratype, G.S.C. No. 1197c; Leray-Rockland beds, Allumette Island, Ottawa River, Quebec.

Holopea obliqua Hall

Plate XIV, figures 13, 14

Holopea obliqua Hall, Pal. New York, 1, 1847, p. 170, Pl. 37, figs. 2a-d.

Medium size, height and width subequal, largest specimen present measuring 35 mm. in height and 32 mm. in width, with tip and lowest part lacking; outline quite oblique, much longer on one side than on the other; apical angle 85 to 95 degrees; three or four volutions; each whorl rising from a deep suture, the obliquity of the sloping upper half increasing as the size of the whorl increases, more ventricose below; umbilicus small, perhaps covered by reflexed lip in the complete shell; aperture not seen, but whorl section considerably higher than wide; growth lines mostly obliterated, the few present being directed backward, lost in a number of undulations especially evident on the top of the whorl.

The species is distinguished from *Holopea rotunda* by the obliquity of its outline accentuated by the more flattened outer edge of the upper part of the whorl rising from the deep suture.

Hall's original forms were from high in the Trenton. The few specimens here from about the same horizon are considerably crushed but seem to belong to this species. The forms from the Leray-Rockland beds are somewhat smaller but are closer to the originals as illustrated by Hall. The slight differences do not warrant a separation. The species seems to be one of those that recurs in higher beds.

Occurrence. Leray-Rockland beds, locality 1; Cobourg beds, localities 79, 174.

Type. Plesiotypes, G.S.C. No. 1220a, Leray-Rockland beds, Paquette Rapids, Ottawa River, and No. 9778, Cobourg beds, Lorne avenue, at the cliff, Ottawa, Ontario.

Holopea ottawaensis n.sp.

Plate XIV, figure 5

Small, height and width subequal, average specimen approximately 16 mm.; apical angle about 90 degrees; three or four volutions; whorls ventricose, rapidly enlarging, increase in length greater than in width, each whorl embracing a half or more of the preceding, the last whorl comprising three-quarters of the whole specimen; umbilicus covered by matrix in all the moulds seen; sutures shallow; aperture not seen, but whorl section rounded so far as can be seen, a little longer than wide and slightly produced below; growth lines and ornamentation not preserved on the only specimens found, which are moulds.

Holopea ottawaensis is very similar to *Holopea ophelia* of Chazy age, but differs in the plane of the coil, which is not so nearly horizontal as in the Chazy species, and in that the whorls of *Holopea ottawaensis* have a greater increase in length than in width, the reverse of *Holopea ophelia*. It differs from *Holopea informis* in the more gradual enlarging of the whorls, with less inrolling and, consequently, having a more definite apical angle.

Occurrence. Lowville beds, localities 135, 140; Rockland beds, locality 24.

Type. Holotype, G.S.C. No. 9779, Rockland beds, southwest corner of lot 20, con. V, Hull, Quebec.

Holopea paludiniiformis Hall

Plate XIV, figures 18, 19

Holopea paludiniiformis Hall, Pal. New York, 1, 1847, p. 171, Pl. 37, figs. 3a and 3b.

Medium size, height 35 to 40 mm., width 30 to 35 mm.; apical angle about 70 degrees; four or five rapidly enlarging volutions; each whorl only slightly embracing the lower part of the preceding whorl, not so ventricose as some species, the upper part of the whorl without a shoulder but having an angular edge where it turns in contact with the preceding whorl; umbilicus of mould small; sutures marked but not deep; aperture not seen, but whorl section longer than wide and somewhat extended below; ornamentation obliterated. Only moulds have been seen.

Holopea paludiniiformis differs from *Holopea rotunda* in its more acute apical angle, in the proportion of length to width of whorl section, and consequently in the outline of the complete shell, and from *Holopea nereis* in lacking the shoulder.

Occurrence. Cobourg beds, localities 82, 98, 175, 188, 194.

Type. Plesiotype, G.S.C. No. 9774, Cobourg beds, lots 11 and 12, cons. IX and X, Clarence tp., Ontario.

Holopea parvula Ulrich and Scofield

Plate XIV, figure 6

Holopea parvula Ulrich and Scofield, Geol. Minnesota 3, pt. 2, p. 1067, Pl. 79, fig. 19.

Small, height 5 to 7 mm., width 6 to 10 mm., outline squat with a low spire; apical angle greater than a right angle; three or four volutions; whorls rotund, rapidly enlarging, the last whorl forming about four-fifths of the whole shell; umbilicus not seen, given as wide in the original description; but not illustrated; suture lines deep; aperture not seen, but whorl section almost circular; growth lines not preserved, but numerous backward directed wrinkles present.

Holopea parvula is smaller than any other described form except *Holopea symmetrica*. It differs from that species in its low spire, more rapidly increasing whorls, and in its greater width in proportion to its height.

Occurrence. Cobourg beds, locality 87.

Holopea pyrene Billings

Plate XIV, figure 4

Holopea pyrene Billings, Geol. Surv., Canada, Pal. Foss. I (Adv. sheet 1862), 1865, p. 27, fig. 26; Ulrich and Scofield, Pal. Minnesota, 3, pt. 2, 1897, p. 1067, Pl. 79, figs. 13-18.

Rather small for the genus, holotype, 20 mm. in diameter, widest in the upper half; obliquely turbinate with depressed spire; apical angle considerably greater than a right angle; three to four volutions; whorls very ventricose, rapidly enlarging but not enveloping; umbilicus large for the genus; sutures deep, clearly separating each rounded whorl; aperture ovate, slightly oblique, the wider end at the top; fine growth lines; surface marked by strong undulations slightly oblique to the whorl axis.

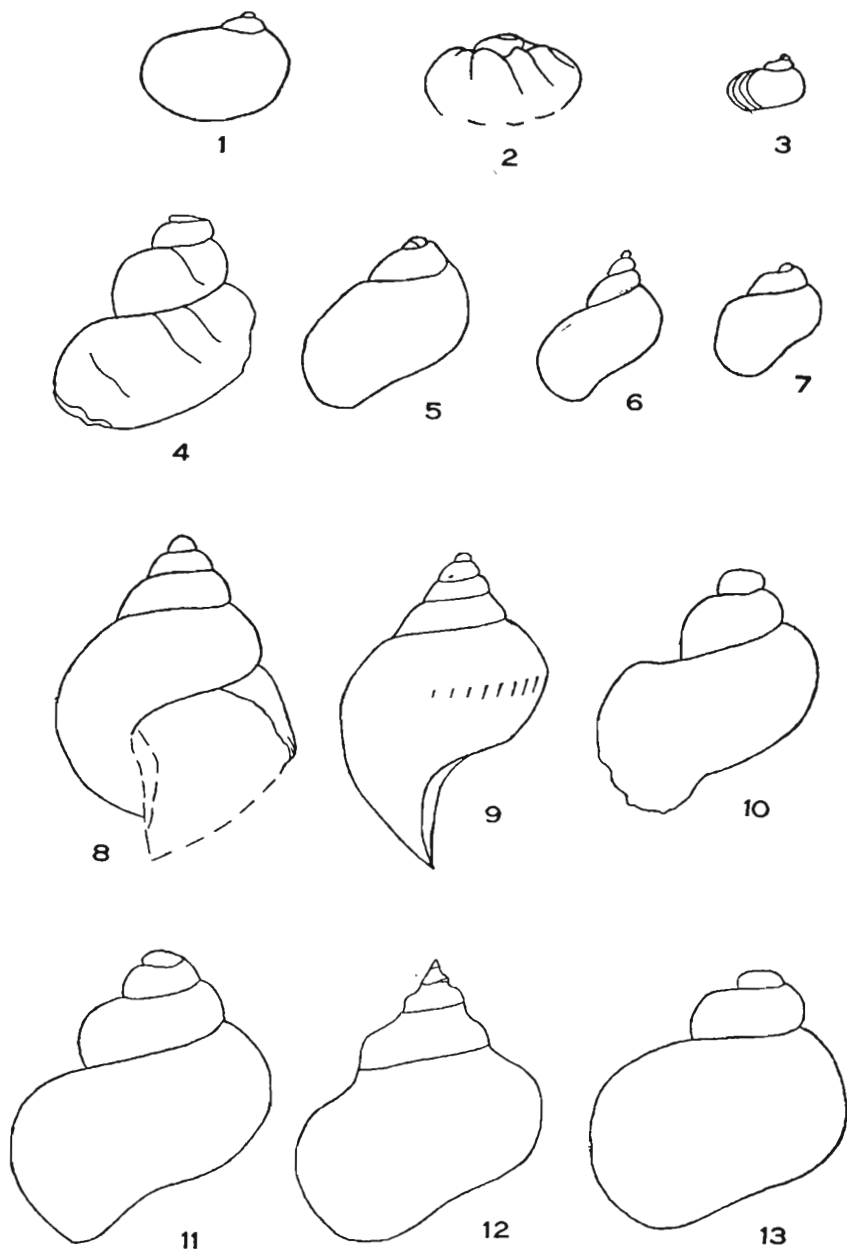


Figure 5. *Holopea* species. Comparison of profile. 1, *H. informis*; 2, *H. pyrene*; 3, *H. parvula*; 4, *H. undulata*; 5, *H. obliqua*; 6, *H. media*; 7, *H. ottawaensis*; 8, *H. lavinia*; 9, *H. lavinia conica*; 10, *H. paludiniformis*; 11, *H. nereis*; 12, *H. nereis spiralis*; 13, *H. rotunda*. (Natural size.)

Billings mentions only the holotype. One other specimen is included in the collections. Both indicate that the forms of this region are somewhat smaller than the Minnesota form. They do not differ, however, in any other respect so far as can be seen.

Holopea pyrene differs from any other species in its depressed spire and in the striking ornamentation of transverse ridges.

Occurrence. Leray beds, locality 136; Leray-Rockland beds, locality 1.

Type. Holotype, G.S.C. No. 1196, Leray-Rockland beds, Allumette Island, Paquette Rapids, Ottawa River.

Holopea rotunda Ulrich and Scofield

Plate XIV, figures 7, 8

Holopea rotunda Ulrich and Scofield, Geol. Minnesota 3, pt. 2, 1897, p. 1066, Pl. 79, figs. 20, 21.

Medium to large size, height and width about equal; apical angle 85 to 90 degrees; about four volutions; whorls rapidly enlarging, very rotund, touching about one-half the preceding one; umbilicus small or covered by the slightly reflexed lip; sutures deep because of the roundness of the whorls; aperture not preserved in any specimen found, but as given in the original description and figures almost circular modified by a slight depression where contiguous with the preceding whorl and by the inner lip, its height slightly greater than its width; ornamentation, backward directed wrinkles, any finer lines obscured.

Holopea rotunda is of about the same size as *Holopea nereis* and its varieties, but can be distinguished by its lack of a shoulder. It differs from others in the roundness of the whorls.

Occurrence. Leray-Rockland beds, locality 1.

Holopea undulata Wilson

Plate XIV, figure 17

Holopea undulata Wilson, Roy. Soc., Canada, 3rd ser., 26, 1932, p. 404, Pl. 6, figs. 12 and 13.

Rather large for the genus; height of the holotype 31 mm., lacking the tip and the aperture, width of the last whorl preserved 25 mm.; apical angle 60 to 65 degrees; four or five volutions; whorls gradually enlarging, each whorl embracing less than half the preceding one, whorl section longer than wide; sutures comparatively deep on the mould; umbilicus small in the mould; aperture not seen; growth lines not visible, but large undulating ridges present, directed obliquely backward.

The whorls enlarge more rapidly than in *Holopea paludiformis*. The form is not unlike *Holopea excelsa*, but the oblique ridges differentiate it from either of these species.

Occurrence. Cobourg beds, locality 238.

Type. Holotype, G.S.C. No. 6669, Cobourg beds, Cameron farm, southwest of Gravel Hill, Ontario.

Genus, *Subulites* ConradGenotype, *Subulites elongatus* Conrad

Small to large; tapering, elongate; apical angle acute; numerous volutions; whorls high, deeply embracing, outer surface flat or slightly convex; no band, and notch obscure if present; umbilicus covered; sutures very shallow, scarcely breaking the even slope; aperture elongate and narrow; height to width averaging 4 to 1, acuminate above, siphonal channel at the base, and somewhat truncate on the outer widest part; growth lines fine, rarely preserved.

It is difficult to differentiate on paper the several species of *Subulites*. There are forms with slightly different apertures, different apical angle, and with a different rate of enlargement of the whorls. To distinguish these forms with accuracy it is necessary to see the specimens together or to have good illustrations.

The genus differs from *Cyrtospira* in having a straight instead of a curved spire, and from *Fusispira* in having less inflated whorls and a narrower aperture.

Subulites acutus Wilson

Plate XV, figure 3

Subulites acutus Wilson, Roy. Soc., Canada, Trans. 3rd ser. 26, 1932, sec. 4, p. 403, Pl. 6, fig. 9.

Length not known; holotype, which consists of two and a half whorls including the body chamber but lacking the lower projection of the aperture, measuring 11 mm. in width, 40 mm. in length, approximately 70 mm. in length if complete; whorls enlarging rapidly in length, slowly in width, sides almost straight; apical angle 15 or 16 degrees; umbilicus covered; sutures shallow; aperture preserved only in the upper part; growth lines not seen.

Subulites acutus has a more acute apical angle than any described species except *Subulites conradi*, but its whorls enlarge more rapidly lengthwise in proportion to its width and it maintains its slender pencil-like proportions throughout.

Occurrence. Leray-Rockland beds, localities 83, 181, 270; Rockland beds, locality 156.

Type. Holotype, G.S.C. No. 6667, Leray-Rockland beds, Mille Roches quarries, Ontario.

Subulites canadensis Ulrich and Scofield

Plate XV, figures 9, 10

Subulites canadensis Ulrich and Scofield, Pal. Minnesota, 3, pt. 2, 1897, p. 1071, Pl. 81, fig. 3.

Large, 90 to 100 mm. in length and 20 to 22 mm. in width; apical angle 15 to 18 degrees; whorls gently convex, rapidly enlarging so that there are fewer in number in proportion to the length than in some species, body whorl somewhat ventricose, tapering rather abruptly; sutures shallow, very oblique; umbilicus covered; aperture very acute at the top, wide at the base.

The species is most closely allied to *Subulites subelongatus* d'Orbigny (= *Subulites elongatus* Emmons), differing from it mainly in size. Specimens of *Subulites canadensis* correspond to those of *Subulites subelongatus* x 2 as illustrated in Geological Society of America Special Paper 32, Plate 92, figures 9b, 9c.

Occurrence. Lowville beds, localities 135, 140; Leray-Rockland beds, localities 56, 72; Hull beds?, locality 46.

Type. The description and illustration of the holotype are both composite according to the authors. Several specimens on hand are thought to come from the type locality, but they, too, are incomplete, so that no primary type is yet chosen. Plesiotype, G.S.C. No. 9789, Lowville beds, quarry one-quarter mile southeast of intersection of Montreal road and Green Creek, east of Ottawa, Ontario.

Subulites conradi Ulrich and Scofield

Plate XV, figures 1, 2

Subulites conradi Ulrich and Scofield, Pal. Minnesota, 3, pt. 2, 1897, p. 1071, Pl. 81, figs. 4, 5.

Elongate, somewhat fusiform; the type illustrated by the authors measuring 95 to 100 mm. if produced, greatest width 15 mm. at middle of body whorl; apical angle approximately 15 degrees; whorls enlarging moderately as compared with some species, sides very gently convex, body whorl tapering gradually; sutures shallow; aperture acute above, gently rounded at the base, slightly oblique; growth lines not seen.

Subulites conradi is like *Subulites acutus* in the apical angle, but it is larger and more robust. It is more fusiform than most species of the genus.

Occurrence. Lowville beds, locality 135; Leray beds, localities 181, 275.

Subulites gloucesterensis n.sp.

Plate XV, figure 8

Large, approximately 90 mm. in length and 30 mm. in width; sub-fusiform in outline; apical angle 25 to 30 degrees; about six volutions when complete, whorls rapidly enlarging, more in width than is usual with the species; sides flat but sloping towards the apex at a greater angle than in some species; body whorl almost half the height of the whole specimen, ventricose, but contracting abruptly making a subangular curve produced into a siphon; umbilicus covered; sutures shallow; aperture not so angular at the top as in some species, midway becoming wider than the contracted whorl, its lower extremity not preserved; growth lines not seen.

Subulites gloucesterensis differs from other species in its rapid rate of enlargement, especially in width, and in the abrupt narrowing of the ventricose body whorl.

The species is not unlike *Polyphemopsis elongatus* Portlock of the Caradoc, which some authorities include under *Subulites*. It resembles the Caradoc species in its rate of enlargement in both length and width, but differs from the illustrations of that species in the subangular contraction of the body whorl and in the wider aperture.

Occurrence. Leray beds, locality 136.

Type. Holotype, G.S.C. No. 1192, Leray beds, lot 4, con. III, R.F., Gloucester tp., Ontario.

Subulites regularis Ulrich and Scofield

Plate XV, figures 4-7

Subulites regularis Ulrich and Scofield, Pal. Minnesota, 3, pt. 2, 1897, p. 1072, Pl. 81, fig. 35; Pl. 82, figs. 47, 48.

Length 40 to 100 mm.; apical angle 18 to 20 degrees; very slender; eight to ten volutions; whorls very gradually enlarging, almost straight on the outer edge, the last whorl rather abruptly contracted; aperture comparatively wide, being its widest just below the middle, the upper part straight, the lower part rounding more abruptly to the base than in some species.

The Lowville specimens are small, and may be a variety. They correspond with the figure illustrated in Geol. Minnesota 3, 1897, Pl. 82, fig. 47. The Leray-Rockland specimens are more normal in size though all are fragmentary.

Occurrence. Lowville beds, localities 125, 135, 140, 211; Leray-Rockland beds, locality 1; Hull beds, locality 46.

Type. Plesiotypes, G.S.C. No. 9790, Leray-Rockland beds, Paquette Rapids, Ottawa River, and in the private collection of G. W. Sinclair.

Genus, *Cyrtospira* Ulrich and Scofield

Genotype, *Cyrtospira tortilis* Ulrich and Scofield

Small to moderate size; axis curved, generally in one direction, but occasionally with the apex turned slightly in a direction opposite the dominant curve; apical angle 35 to 50 degrees; four to six volutions; whorls rapidly enlarging, side of whorl gently convex, more so on one side than on the other, body whorl constituting more than half the shell, and prolonged into a siphon at the base; umbilicus covered; sutures shallow; aperture more than half the height of the last whorl, almost straight on the outer side, inner side adapting itself to the curve of the outer wall of the last whorl; growth lines and ornamentations not seen.

Cyrtospira was at first included in the genus *Subulites*, but is distinct from that genus in the curve of its axis.

Cyrtospira cf. abbreviata (Hall)

Plate XII, figures 13, 14

Subulites abbreviatus Hall, 3rd Rept. New York State Cab. Nat. Hist. 1850, p. 172, Pl. 3, figs. 2a-c.

Cyrtospira abbreviata (Hall), Ulrich and Scofield, Pal. Minnesota, 3, pt. 2, 1897, p. 1070.

Small and slender, width of only specimen found 6.5 mm.; height 20 mm., lacking the base of the last whorl; greatest width about centre of last whorl; outline almost straight on the aperture side, arcuate on the opposite side; apical angle about 25 degrees; three or four volutions; whorls rapidly enlarging, each whorl convex on one side and almost straight on the opposite side; umbilicus covered; sutures very shallow, hardly visible on the mould; only the upper part of the very narrow aperture preserved; growth lines obliterated.

Cyrtospira cf. abbreviata differs from *Cyrtospira parvula* in being smaller, and much slenderer. It resembles *Cyrtospira abbreviata* in shape and in rate of enlargement, but it is smaller than Hall's illustration of that species, no measurements of which were cited. Judging from some of the other specimens on Hall's plate, *Cyrtospira abbreviata* may have been enlarged in the drawing. For these reasons the specimen in this area is referred to *Cyrtospira abbreviata*.

Occurrence. Hull beds, locality 46.

Type. Plesiotype, G.S.C. No. 9791, Hull beds, Hull, Quebec.

Cyrtospira parvula (Billings)

Plate XII, figure 12

Subulites parvulus Billings, Geol. Surv., Canada, Pal. Foss. I (Adv. sheet 1862), 1865, p. 36.

Cyrtospira parvulus (Billings), Bassler, U.S. Geol. Surv. Bull. 92, 1915, p. 370.

Small; largest and most complete specimen present 25 mm. in length, and 10 mm. at its widest, which is midway in the length of the shell, and in the upper third of the last whorl; arcuate in outline, the more convex curve being on the side opposite the aperture, the inner concave curve having the longer radius; apical angle approximately 50 degrees; four or five volutions; whorls enlarging rapidly, sides gently convex on the upper whorls, more so on one side than on the other, the difference in convexity accentuated in the body whorl; umbilicus not seen; suture lines very oblique, slightly impressed; aperture curved, comprising half the height of the shell, not well preserved in specimens to hand; growth lines and ornamentation not seen.

Cyrtospira parvula is most closely allied to *Cyrtospira tortilis*, the genotype, from which it differs in its larger size, and in having more rapidly enlarging whorls.

Occurrence. Leray-Rockland beds, locality 1; Hull beds?, locality 209.

Type. Lectotype, G.S.C. No. 1190a, Leray-Rockland beds, Allumette Island, Paquette Rapids, Ottawa River. The lectotype is the most complete of Billings' cotypes.

Genus, *Loxonema* PhillipsGenotype, *Loxonema sinuosum* Sowerby

Medium to large; high-spined; apical angle acute; numerous volutions; whorls generally ventricose, flattened on the upper part of the whorl in some species, gradually enlarging, impressed at the top but not enveloping one another; umbilicus covered; sutures moderately deep; aperture generally subcircular with a broad sinus on the outer lip, but no band; growth lines fine, frequently fasciculate, transverse, except where the broad sinus is outlined.

Loxonema differs from *Hormotoma* in lacking the peripheral band.

Loxonema murrayana Salter

Plate XI, figure 17

Loxonema murrayana Salter, Geol. Surv., Canada, Can. Org. Rem., dec. 1, 1859, p. 31, Pl. 6, fig. 6.

Large; holotype probably 75 mm. in length when complete, 22 mm. maximum width; high-spined; apical angle approximately 30 degrees; shell comparatively thin for the genus; seven or eight volutions; whorls gradually enlarging, evenly ventricose except for a very narrow shoulder; umbilicus covered; sutures deep; aperture almost circular, with the inner side of the lip slightly reflexed; growth lines single or fasciculate, directed backward from the suture with a broad curve around the sinus, thence forward in the long lower limb, which makes an abrupt backward turn just before disappearing into the covered umbilicus.

A number of *Loxonema* are flattened on the upper part of the whorl and some in section show a shoulder on the inner mould obliterated externally by a thick shell. The comparatively thin shell of *Loxonema murrayana* reveals a narrow shoulder on the outer surface.

Loxonema murrayana is smaller than the Richmond forms, and larger than many of the Silurian forms. It is distinguished by its size and by its ventricose whorls topped by the narrow shoulder.

Occurrence. Leray beds, locality 202; Leray-Rockland beds, locality 1.

Type. Holotype, G.S.C. No. 1189, Leray-Rockland beds, Allumette Island, Paquette Rapids, Ottawa River.

Loxonema? sp.

Plate XI, figures 18, 19

Size not known; spire low for the genus; apical angle approximately 62 degrees; number of volutions not known; whorls ventricose, rapidly enlarging, increasing more laterally than vertically, impressed but not enveloping; whorl section subcircular, interrupted at the subangular top and periphery;

periphery slightly angular, about one-third distance from lower part of whorl; small umbilicus in mould, about one-quarter the width, possibly covered or lessened in complete form; sutures comparatively deep; aperture, growth lines, and ornamentation not seen.

The two moulds present lack apex and base. They are too poor to use as a basis of a new species yet they are very distinct and easily recognized by their method of coiling. They are definitely different from other gastropod forms found in this area, and as such are included here in spite of their incompleteness.

Occurrence. Cobourg beds, localities 80, 234.

Type. No type named. Figured specimen, G.S.C. No. 9792, Cobourg beds, corner of Booth and Elm streets, Ottawa.

Genus, *Fusispira* Hall

Genotype, *Fusispira ventricosa* Hall

Fusiform, spire elevated; apical angle acute; thick shell; notch obscurely indicated in the columnar lip; no band; rapidly enlarging, rounded whorls, the last one tapering suddenly at the base for carrying the siphonal canal; sutures distinct; umbilicus covered; aperture large, elongated, produced below for the carrying of the siphonal canal; surface apparently smooth.

The genus is most closely allied to *Subulites*, from which it differs in its fusiform outline, ventricose whorls, more impressed sutures, and thicker shell.

A comparison in the outlines of the several species of *Fusispira* here described is shown in Figures 6 and 7.

Fusispira angusta Ulrich and Scofield

Plate XVI, figure 9

Fusispira angusta Ulrich and Scofield, Pal. Minnesota, 3, pt. 2, 1897, p. 1079, Pl. 81, figs. 28 and 29.

Long and slender, length 100 to 110 mm., width 20 to 25 mm.; apical angle 18 to 20 degrees; shell thick; five to seven volutions; whorls enlarging rapidly more in length than in width, high and narrow for the genus, with sides gently convex, almost flat, sutures oblique and deep; aperture narrow, height about three times the width; ornamentation unknown.

The species is distinguished from others by its high, rather flat-sided whorls and oblique, deep sutures.

Occurrence. Cobourg or Sherman Fall beds, locality 51.

Type. Plesiotype, Cobourg or Sherman Fall beds, Philemon Island, Hull, Quebec, in the private collection of G. W. Sinclair.

Fusispira elongata Hall

Plate XVI, figure 8

Fusispira elongata Hall, 24th Rept. New York State Cab. Nat. Hist. 1872 (Extract 1871, p. 6), p. 229.

Long and slender, length about 110 to 115 mm., width 25 to 30 mm. when complete; apical angle approximately 28 degrees; probably about eight volutions; whorls gradually enlarging, outer side moderately convex, last whorl forming one-half or more of the whole length of the shell, produced at the base into a long slender siphon; umbilicus lacking; sutures moderately deep; aperture slender, widest near the middle where the last whorl is contracted; growth lines and ornamentation not known.

Fusispira elongata is long and proportionately more slender than any other species. It is more robust than *Fusispira angusta* and less robust than *Fusispira nobilis ingens*.

Occurrence. Cobourg beds, localities 51, 87, 90, 92, 215, 231.

Type. Plesiotype, G.S.C. No. 9780, Cobourg beds, west half of lot 27, con. III, Roxborough tp., Ontario.

Fusispira inflata nepeana n.var.

Plate XVI, figure 6

Moderate size for the genus, holotype if complete probably measuring 70 mm. in length, its width 30 to 35 mm. at the last whorl; apical angle approximately 35 degrees; five or six volutions; whorls enlarging uniformly until the last one, which abruptly becomes much larger changing the regularity of the outline, whorls ventricose, particularly the body whorl; umbilicus covered; sutures comparatively deep; aperture moderately wide with a rather sharp turn corresponding to the contraction of the last whorl; growth lines and ornamentation obliterated.

Fusispira inflata nepeana differs from the species and from *Fusispira ventricosa* in degree only, the upper whorls enlarge more rapidly, making the spire a little more obtuse and the contrast between the spire and the enlarged body whorl less distinct. The rate of whorl increase is comparable to that of *Fusispira angusta subplana*, but the last whorl enlarges more abruptly.

Occurrence. Leray-Rockland beds, locality 55.

Type. Holotype, G.S.C. No. 9781, Leray-Rockland beds, lots G and H, con. C, R.F., Nepean tp., Ontario.

Fusispira nobilis Ulrich and Scofield

Plate XVII, figures 2-4

Fusispira nobilis Ulrich and Scofield, Minnesota Pal. 3, pt. 2, 1897, p. 1078, Pl. 80, figs. 2-4.

Long and comparatively slender; 100 mm. or more in length, 32 to 37 mm. in width; apical angle 27 to 30 degrees; six or seven volutions; whorls enlarging uniformly and with moderate rapidity, sides more convex than in some species, last whorl gradually rounded below into a comparatively short siphon, the whorl comprising less than half the whole length of the specimen; umbilicus lacking; sutures comparatively deep; aperture angular above, widest in the middle corresponding to the contraction of the last whorl, becoming narrower and sharply rounded below; faint revolving lines in some specimens; growth lines not seen.

Fusispira nobilis is longer and proportionately more slender than most other species. It is smaller, with less rapidly enlarging whorls, than either of the following varieties, and the top of the aperture is more acute.

Occurrence. Hull beds, locality 36; Sherman Fall beds, locality 180; Cobourg beds, localities 92, 94, 154, 256.

Type. Plesiotype, G.S.C. No. 9782, Hull beds, Hull, Quebec.

Fusispira nobilis ingens n.var.

Plate XVII, figures 5, 6

The largest form described, being approximately 150 mm. in length, and 40 to 45 mm. in width; apical angle 20 to 25 degrees; about five or six volutions; whorls enlarging very rapidly, more in length than in width, the last whorl quite half the whole length, contracting evenly with no abrupt angularity visible in the mould; umbilicus lacking; sutures moderately shallow; aperture somewhat rounded on top, very wide about midway, narrowing towards the base, the end of which is not preserved; growth lines and ornamentation unknown.

Fusispira nobilis ingens is larger than the species or the variety *Fusispira nobilis medialis*. Its whorls enlarge more rapidly in length, as evidenced by its having three volutions to four of the variety and three to six of the species in 100 mm. Each whorl expands proportionately less rapidly than either of the others as seen by the apical angle, and the upper angle of the aperture is less acute.

The variety is called 'ingens' because of its size.

Occurrence. Cobourg beds, localities 94, 154.

Type. Holotype, G.S.C. No. 9783, Cobourg beds, west end Fourth avenue, Ottawa, Ontario.

Fusispira nobilis medialis n.var.

Plate XVII, figure 1

Large, 120 to 130 mm. in length, and 30 to 32 mm. in width when complete; apical angle 20 to 25 degrees; six or seven volutions; whorls increasing uniformly more rapidly in length than in width, sides gently convex, last whorl contracted to a narrow siphon, the whorl length less than half that of the specimen; umbilicus lacking; sutures moderately shallow for the size of the whorls; aperture angular on top, exceptionally wide in the middle rounding down to the end of the siphon.

Fusispira nobilis medialis differs from the species in having whorls which increase more rapidly in length, resulting in fewer whorls in a given length; in having proportionately less expanding whorls, as shown by the apical angle; and in having a more broadly rounded aperture.

The variety is called '*medialis*' because it is intermediate between the species *Fusispira nobilis* and the variety *Fusispira nobilis ingens*.

Occurrence. Cobourg beds, localities 80, 82, 86, 92, 204.

Type. Holotype, G.S.C. No. 9784, Cobourg beds, corner Booth and Elm streets, Ottawa, Ontario.

Fusispira planulata Ulrich and Scofield

Plate XVI, figure 4

Fusispira planulata Ulrich and Scofield, Pal. Minnesota, 3, pt. 2, 1897, p. 1078, Pl. 81, figs. 26 and 27.

Small, average length 55 mm., width 15 mm.; apical angle 20 to 21 degrees; five or six volutions; whorls increasing gradually in size, moderately high and rather flat-sided; sutures deep for the size of the species; aperture narrow at the top and more acutely rounded at the base than most species of the genus; ornamentation unknown.

The authors of *Fusispira planulata* compare it to *Fusispira nobilis*, but it is much smaller and has much smaller and more gradually increasing whorls. In length it more nearly approaches *Fusispira terebriformis* but it is more slender, the apical angle is less, and the whorls are flatter.

Occurrence. Sherman Fall beds, locality 114; Cobourg beds, locality 108.

Type. Plesiotype, Sherman Fall beds, east side of Governor Bay, Ottawa, in the private collection of G. W. Sinclair.

Fusispira subbrevis obesa n.var.

Plate XVI, figure 7

Moderate to large size, length approximately 90 mm. when complete, width 40 to 45 mm.; very ventricose; apical angle about 45 degrees; four or five volutions; whorl sides gently convex almost straight to the very much inflated body whorl, which eventually curves rather abruptly tapering towards a short and narrow end, the final stage of which is lost; body whorl comprising more than half the whole specimen; umbilicus lacking; sutures shallow; aperture and growth lines or other ornamentation unknown.

Fusispira subbrevis obesa n.var. differs from the species in the more rapid enlargement of all the whorls and the more ventricose body whorl.

The only two specimens seen are very poor, but they are here described because even in their incompleteness they differ so widely from any other specimen.

Occurrence. Cobourg beds, locality 80.

Type. Holotype, G.S.C. No. 9785, Cobourg beds, corner Booth and Elm streets, Ottawa, Ontario.

Fusispira subfusiformis (Hall)

Plate XVI, figure 5

Murchisonia subfusiformis Hall, Pal. New York, 1, 1847, p. 180, Pl. 39, figs. 2a-b.

Fusispira subfusiformis (Hall), 24th Ann. Rept. New York State Mus. Cab. Nat. Hist., 1872, p. 229.

Medium size for the species, average height 75 to 80 mm., average width 25 mm., high spire with a contraction at the base of the last whorl, which results in a fusiform outline; apical angle 25 to 32 degrees; six or seven volutions; whorls longer than wide, outer edge gently convex, the last one abruptly contracted and produced into a siphon; umbilicus covered; sutures comparatively shallow; aperture longer than broad, angular on top, more or less rounded below; growth lines not preserved.

Fusispira subfusiformis differs from *Fusispira convexa* in that the apical angle is less, the whorls are slightly more rounded, the suture is deeper, and the aperture is narrower and longer.

Occurrence. Cobourg beds, localities 80, 86, 100, 188, 194.

Type. Plesiotype, G.S.C. No. 9786, Cobourg beds, corner Elm and Booth streets, Ottawa.

Fusispira subfusiformis germana Wilson

Plate XVI, figures 2, 3

Fusispira subfusiformis germana Wilson, Roy. Soc., Canada, Trans. 3rd ser. 26, 1932, p. 404, Pl. 6, figs. 10, 11.

Shorter and broader than some species, length of part of holotype preserved 40 mm., probably whole about 50 or 55 mm. when complete, greatest width 25 mm.; apical angle 40 to 45 degrees; probably five volutions when complete; whorls enlarging rapidly and uniformly, gently convex; umbilicus covered; sutures comparatively shallow; aperture short and broad; growth lines and ornamentation unknown.

Fusispira subfusiformis germana differs from the species in having more rapidly enlarging whorls and, consequently, a more obtuse apical angle.

Occurrence. Cobourg beds, localities 188, 232.

Type. Holotype, G.S.C. No. 6668, Cobourg beds, lot 35, con. III, Charlottenburgh tp., Ontario.

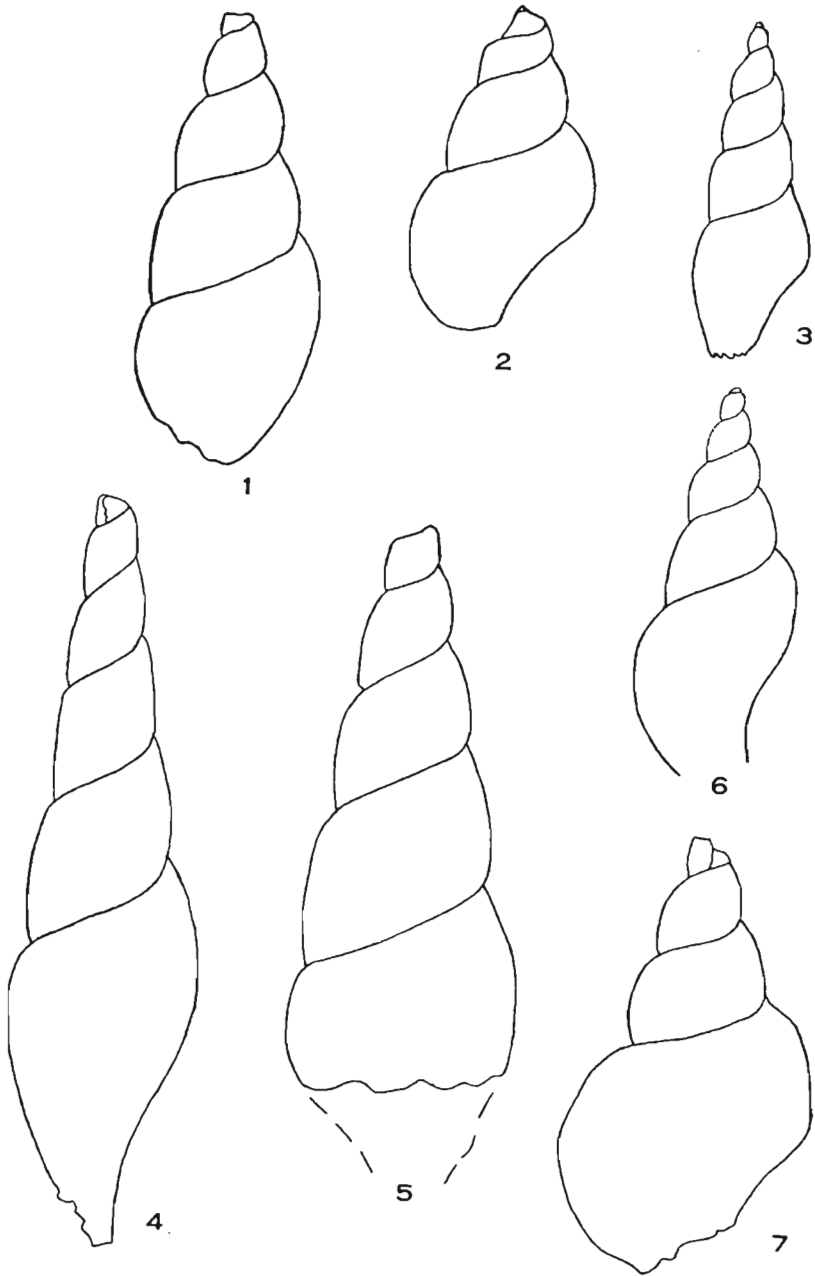


Figure 6. *Fusispira* species. Comparison of profile and rate of coiling. 1, *F. subfusiformis*; 2, *F. subfusiformis germana*; 3, *F. planulata*; 4, *F. angusta*; 5, *F. elongata*; 6, *F. terebriformis*; 7, *F. inflata nepeana*. (Natural size.)

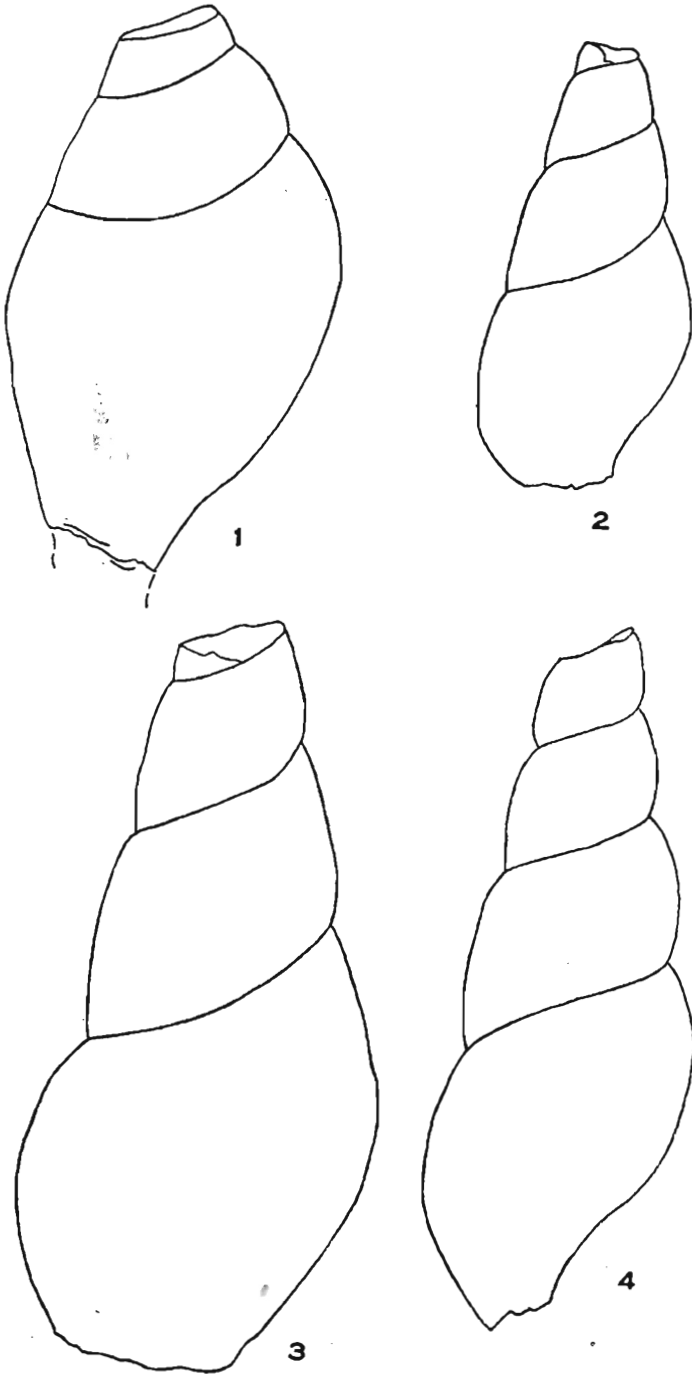


Figure 7. *Fusispira* sp. Comparison of profile and rate of coiling. 1, *F. subbrevis obesa*; 2, *F. nobilis*; 3, *F. nobilis ingens*; 4, *F. medialis*. (Natural size.)

Fusispira terebriformis Hall

Plate XVI, figure 1

Fusispira terebriformis Hall, 24th Rept. New York State Cab. Nat. Hist., 1872 (Extract 1871, p. 6), p. 230, Pl. 8, fig. 4.

Moderately small for the genus, length approximately 55 to 60 mm., width 20 to 22 mm.; apical angle 30 to 32 degrees; narrow outline; about six volutions; whorls gradually enlarging, more in length than in width, outer edge gently convex; no umbilicus; sutures comparatively deep; aperture long and narrow, prolonged into a siphon; growth lines obliterated.

Fusispira terebriformis is near *Fusispira subfusiformis germana* in size but differs in its more numerous, smaller whorls, and from other species in the gradual enlargement of the whorls, resulting in less contrast between the upper whorls and the body whorl. It is narrow like *Fusispira angusta subplana*, but has less rapidly increasing whorls and, consequently, more coils in a given length.

The type of the species comes from younger beds, but in spite of the difference of age it is felt that the present form corresponds to Hall's description and illustration.

Occurrence. Hull or Sherman Fall beds, locality 34.

Type. Plesiotype, G.S.C. No. 9787, Hull or Sherman Fall beds, Hull electric tracks between Hull station and Val Tetreau.

DESCRIPTION OF CONULARIDA SPECIES

The relationship of this group has always been doubtful. For some years they were considered to be cephalopods. The horizontal ornamentation and the apical diaphragm, with its peculiar siphuncle-like round perforation, lent support to the theory. Then they were separated from the cephalopods but still considered to be mollusks related to the pteropods, where they reposed for many years. More recently Kiderlen¹ and Bouček² have considered them to belong to the Scyphozoa and to have developed from *Serpulites*, which itself is of somewhat doubtful lineage.

The enumeration and description of the forms of the Ottawa-St. Lawrence Lowland is given here as a matter of convenience and without prejudice as to their connection with Mollusca or Scyphozoa.

Genus, *Conularia* MillerGenotype, *Conularia quadrisulcata* Sowerby

Shell an elongated pyramid; marginal grooves, weak or absent; medial longitudinal groove not prominent; no rod present; apex divided from the rest by a diaphragm; aperture constricted by a triangular prolongation of each of the four faces; ornamented by distinct, closely set ridges, crossed by fine longitudinal striæ, which, in some instances, cause a serration of the transverse ridges.

Conularia trentonensis Hall

Plate XVIII, figures 1, 2

Conularia trentonensis Hall, Pal. New York, 1, 1847, p. 222, Pl. 59, figs. 4a-f.

Obtusely quadrate; margins sulcate, folded in; faces gently convex when not crushed; median groove very slightly impressed, with no rod; apical angle 22 to 25 degrees; apical diaphragm smooth and convex, with an excentric siphuncle (?); aperture not seen; surface ornamented by fine, sharp, transverse ridges, oblique from the margins forward to the median line, having serrate edges where well preserved, and by fine longitudinal striæ across the concave spaces between the ridges.

One specimen from the large quarries at Hull exhibits finer longitudinal striæ and, consequently, a finer serration upon the transverse ridges. The latter, however, are the usual number within 5 mm. The fineness of the ornamentation might suggest the genus *Archaeoconularia*, but the median groove is not definitely infolded. A better specimen might show that it is a variety of *Conularia trentonensis*, but for the present it is included here.

Ruedemann³ has created a variety, *Conularia trentonensis multicosta*, upon the number of transverse ridges, there being 15 to 17 in 5 mm. in the variety, and, he states, 6 to 9 in 5 mm. in the species. The form in this locality has 10 to 13 in 5 mm., somewhat depending upon the region measured.

¹ Kiderlen, H.: Neues Jahrb. f. Min. B., Bd. 77, Abt. B, 1937, pp. 113-169.

² Bouček, B.: in Schindewolf's Handbuch der Palaeozoologie Bd. 2A, 1939, pp. 113-131.

³ Ruedemann, R.: New York State Mus. Bull. 162, 1912, p. 115.

Occurrence. Hull beds?, localities 32, 43, 209, 211; Hull beds, locality 40; Hull or Cobourg beds, locality 216; Sherman Fall beds, locality 34; Cobourg beds, localities 84, 92, 117.

Type. Plesiotypes, G.S.C. No. 1726, Hull or Cobourg beds, labelled Vankleek Hill, Ontario (Vankleek Hill is on glacial debris, the nearest outcrops are in Hull and Cobourg beds), 9793, Cobourg beds, Arthur street, Ottawa, Ontario.

Genus, *Conularina* Sinclair

Genotype, *Conularia triangulata* Raymond

Shell small to moderate size; marginal grooves wide and flat or narrow and rather deep; medial ridge low, with shallow depressions on either side, forming low ridges on the inner surface; no rod; apex and aperture unknown; surface ornamented by fine, irregular, transverse striæ, in some instances crossed by oblique folds near the margins.

The genus differs from *Conularia* in lacking the longitudinal striæ and any serration.

Conularina narrawayi Sinclair

Plate XVIII, figure 3

Conularia narrawayi Sinclair, Amer. Carnegie Mus. 29, 1942, p. 224, Pl. 2, fig. 4.

Shell small, straight, and regularly tapering; marginal grooves narrow, rather deep with sharply rounded edges and irregular wrinkling in the bottom, which is strengthened by an internal thickening; faces slightly convex; medial ridge narrow, with its flanking depressions inconspicuous; apex and aperture unknown; ornamented by irregular, slightly arched, transverse wrinkles.

The species has not been seen by the writer.

Occurrence. Leray beds, locality 29.

Type. Holotype, No. 18905 Royal Ontario Museum of Palæontology, Toronto, Ontario, Leray beds at Val Tetreau, Quebec.

Genus, *Euconularia* Sinclair

Genotype, *Conularia loculata* Wiman

Small conularids; marginal grooves very little impressed, having an obscure strengthening; median septum of each face slender, arising from the inner layer and becoming bifid internally, not affecting the course of the external ridges; apex and aperture unknown; transverse ridges relatively coarse, directed forward from the margins to each median septum, without serration, the whole lacking longitudinal striæ.

The main characteristics of the genus is the lack of longitudinal striæ and serration, and the internally bifid median septa.

Euconularia amoena Sinclair

Plate XVIII, figures 4, 5

Euconularia amoena Sinclair, Trans. Roy. Soc., Canada, 3rd ser., 38, 1945, sec. 4, p. 92, Pl. 1, figs. 7, 8.

Small and slightly curved, marginal grooves narrow and rather deep with sharply rounded edges, strengthened by thickening; faces slightly concave, apical angle about 12 degrees at the apex, increasing slightly towards the aperture; median septum indicated by a faint dark line; apex and aperture unknown; surface crossed by undulating ridges but lacking serration or longitudinal striæ; interior not seen.

The species is larger than the genotype *E. loculata* and has more definite marginal grooves.

Occurrence. Trenton beds, exact horizon unknown, locality 119.

Type. Holotype, No. 23279 Royal Ontario Museum of Palæontology.

The writer has not seen the specimen. The description is taken from the original citation.

Genus, *Metaconularia* FoersteGenotype, *Conularia aspera* Lindström

Medium to large pyramids; marginal grooves wide and shallow, with indefinite boundaries and lacking any thickening for strength; shell rather thin, of two layers the inner one receiving an impression from the ornamentation of the outer one; median region of each face bearing two subparallel septa with a shallow furrow between; septa embedded between the two layers, each circular or ovate in section, the whole affecting the inner shell more definitely than the outer; apex having a horizontal terminal diaphragm with its outline indented by the septa; numerous fine pustules present; arranged in transverse and vertical rows, not interrupted at the marginal grooves, placed closely together or at a distance, round or oval in shape, if oval the long axis being parallel with that of the whole shell.

Metaconularia is readily distinguished from other forms by the presence of the two subparallel rods in the median ridge of each face.

Metaconularia calderi Sinclair

Plate XIX, figures 1-4

Metaconularia calderi Sinclair, Trans. Roy. Soc., Canada, 3rd ser. 34, 1940, sec. 4, 1940, p. 110, Pl. 3, figs. 3-5.

Moderate to large size, tapering regularly; shell thin; marginal grooves wide and shallow, apparently strengthened by some inner thickening; faces flat, not always equal; two longitudinal subparallel septa in the mid-region of each face with a shallow furrow in the mid-line between; septa close at the apex but diverging slightly towards the anterior; apical angle about 30 to 35 degrees; apex closed by a flat or gently convex, smooth diaphragm with a central siphuncle(?), diaphragm having its edges slightly indented by the septa, and showing minute, short crenulations at its margin; surface

with broad wrinkles near the apex, the whole face, including the groove between the septa, covered with horizontal and vertical rows of minute pustules, usually elongated with the long axis parallel with the axis of the whole, more closely set horizontally than vertically.

The larger specimen present is crushed, making the section decidedly oblong; the apical diaphragm is more nearly square in outline.

Occurrence. Sherman Fall beds?, locality 97; Cobourg beds, locality 87.

Type. Plesiotypes, G.S.C. No. 9795, Sherman Fall beds?, small island below Parliament Hill, Ottawa, and 9794, Cobourg beds, Booth street, Ottawa, Ontario.

Metaconularia? dubia Sinclair

Plate XVIII, figures 6, 7

Metaconularia? dubia Sinclair, Roy. Soc., Canada, 3rd ser., 34, 1940, sec. 4, p. 107, Pl. 3, figs. 1, 2.

Rather large; marginal grooves rather wide and shallow with gently rounded edges; faces apparently subequal and gently convex; mid-line with a longitudinal groove with sharply infolded edges; septa unknown; aperture unknown; apex closed by a diaphragm with irregular finely pitted surface; surface with horizontal and vertical rows of minute equidistant pustules.

The species has not been seen by the writer but its author states that the "absence or non-preservation of the septa creates some doubt as to the generic reference".

Occurrence. Leray beds, locality 29.

Type. Holotype, No. 18889 Royal Ontario Museum of Palæontology, Toronto, Leray beds, Val Tetreau, Quebec.

TABLE IV
Range of *Conularia*

Species	Ottawa formation Faunal beds						
	Pamella	Lowville	Lery	Rockland	Hull	Sherman Fall	Cobourg
<i>Conularia tremtonensis</i> Hall.....					?	X	X
<i>Conularina narrawayi</i> Sinclair.....			X				
<i>Euconularia amoena</i> Sinclair?.....						?	
<i>Melaeconularia calderti</i> Sinclair.....			X			?	X
<i>M. ? dubia</i> Sinclair.....							

PLATE I

(All figures natural size except where otherwise stated)

- Figures 1-3. *Priscochiton canadensis* (Billings). 1, from the side, showing the cone-shaped outline; 2, from the back, showing the rounded anterior; 3, from the interior, showing the two minute concave plates. All x 2. Holotype, G.S.C. No. 1252, Leray-Rockland beds, Allumette Island, Paquette Rapids, Quebec. (Page 16.)
- Figures 4, 5. *Archinacella clochensis* Foerste. 4, from the top; 5, from the side, showing the gentle concave outline of the posterior below the beak. Holotype, G.S.C. No. 8418, for comparison, Lowville beds, on La Cloche peninsula, northeast of La Cloche Island, Lake Huron, Ontario. (Page 17.)
- Figure 6. *Archinacella clochensis* Foerste. The sides near the posterior are slightly worn, making the posterior of the specimen appear narrow. Plesiotype, G.S.C. No. 9725, Lowville beds, lot 2, con. II, R.F., Gloucester tp., Ontario. (Page 17.)
- Figures 7, 8. *Archinacella explanata* n.sp. 7, from the side showing the slightly concave posterior below the low apex; 8, view from the top. Holotype, G.S.C. No. 9726, Lowville beds, lot 3, con. III, R.F., Gloucester tp., Ontario. (Page 17.)
- Figures 9, 10. *Archinacella subrotunda* Ulrich and Scofield. 9, side view, showing the vertical outline; 10, from the top, showing the aperture shape, and the median ridge. Plesiotype, G.S.C. No. 9727, Cobourg beds, at the corner of Booth and Elm streets, Ottawa, Ontario. (Page 18.)
- Figures 11, 12. *Micropileus obesus* n.sp. 11, showing the erect apex and very convex line from the apex to the anterior margin; 12, from the posterior end. Holotype, G.S.C. No. 9731, Lowville beds, lot 3, con. III, R.F., Gloucester tp., Ontario. (Page 20.)
- Figures 13, 14. *Micropileus ottawaensis* n.sp. 13, from the side, showing the outline; 14, from the top, showing lateral compression, and concentric undulations. Holotype, G.S.C. No. 9728, Lowville beds, lot 3, con. III, R.F., Gloucester tp., Ontario. (Page 20.)
- Figures 15, 16. *Tryblidium* sp. 15, top of a specimen, worn on the left-hand side with the sharpness of apex partly lost by a slight tilting; 16, side view, showing apex projecting beyond the posterior margin. G.S.C. No. 9729, Pamela beds, Skead road east of Ottawa, Ontario. (Page 21.)
- Figures 17, 18. *Tryblidium erato* (Billings). 17, from the back, showing the acute apex; a part of the left side is broken away; 18, from the side, showing the elevation and slight backward projection of the apex. Holotype, G.S.C. No. 1251, Leray-Rockland beds, Allumette Island, Paquette Rapids, Quebec. (Page 21.)
- Figures 19-21. *Macroscenella superba* (Billings). 19, from the interior, showing the almost circular aperture with a gentle posterior invagination at the upper side of the illustration; 20, showing the size and shape of the anterior, with a small area of ornamentation not covered by secondary silica; 21, ornamentation, x 2. Holotype, G.S.C. No. 1250a, Leray-Rockland beds, Allumette Island, Paquette Rapids, Quebec. (Page 19.)

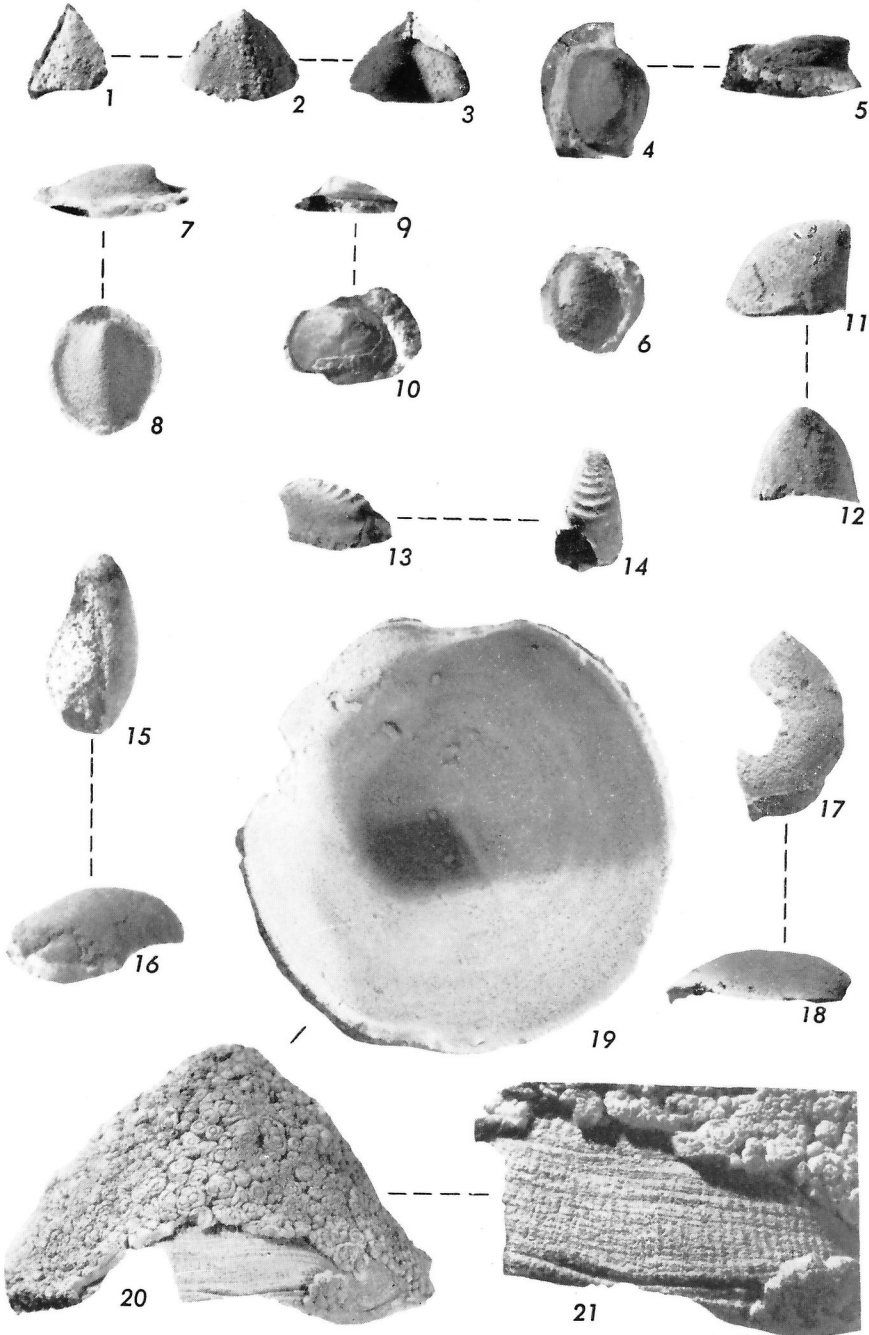


PLATE II

- Figures 1, 2. *Platyceras? perplexa* n.sp. 1, from top showing the ridge; 2, from the front showing the curved apex. Holotype, G.S.C. No. 9730, Cobourg beds, at dam west of Alexandria, Ontario. (Page 22.)
- Figures 3, 4. *Cyrtolites disjunctus* Ulrich and Scofield. Reprint from Pal. Minnesota 3, pt. 2, 1897, Pl. 62, figs. 48, 49. (Page 23.)
- Figures 5, 6. *Cyrtolites cf. subplanus* Ulrich and Scofield. 5, from side; 6, from back, showing the ornamentation, x 2. Plesiotype in the private collection of G. W. Sinclair, Leray beds, Merivale road southwest of Ottawa, Ontario. (Page 23.)
- Figures 7, 8. *Sinuities bilobatus corrugatus* (Hall). 7, side view; 8, from back, showing the extent of the corrugations. Plesiotype, G.S.C. No. 9733, Sherman Fall beds, in Canadian Pacific Railway cutting south of Aylmer road, Hull, Quebec. (Page 24.)
- Figures 9, 10. *Sinuities bilobatus corrugatus* (Hall). 9, side view; 10, from back showing corrugations and deep sinus. Plesiotype, G.S.C. No. 9734, Cobourg beds, Falls of Ottawa-St. Lawrence Lowland. (Page 24.)
- Figures 11, 12. *Sinuities cancellatus* (Hall). 11, side view; 12, from back, showing the even convexity as compared with figures 13 and 14. Plesiotype, G.S.C. No. 1260, Leray-Rockland beds, Allumette Island, Paquette Rapids, Quebec. (Page 25.)
- Figure 13. *Sinuities cancellatus angularis* n.var., showing the narrowly rounded dorsum. Holotype, G.S.C. No. 1700c, Cobourg beds, Ottawa, unspecified. The broken aperture is more expanding than it appears in the illustration. (Page 25.)
- Figure 14. *Sinuities cancellatus liratus* nom. nov., showing the acutely angular dorsum. Plesiotype, G.S.C. No. 9732, Cobourg beds, Ottawa, Ontario. (Page 26.)
- Figure 15. *Bucania halli* Ulrich and Scofield. Side view showing the deep, open umbilicus. Plesiotype, G.S.C. No. 9735, Lowville beds, lot 3, con. III, Gloucester tp., Ontario. (Page 27.)
- Figure 16. *Bucania halli* Ulrich and Scofield. Reprint from Pal. Minnesota 3, pt. 2, 1897, Pl. 66, fig. 5. (Page 27.)
- Figures 17, 18. *Phragmolites compressus* Conrad. 17, side view; 18, back view showing the sharp keel and the trace of the irregular aperture. Plesiotype, G.S.C. No. 1257, Leray-Rockland beds, Allumette Island, Paquette Rapids, Quebec. (Page 29.)
- Figures 19, 20. *Pterotheca expansa* (Emmons). 19, from back showing the sharp ridge-like selenizone, G.S.C. No. 1255; 20, from interior, showing triangular platform, and narrow sinus, G.S.C. No. 1255a. Plesiotypes, G.S.C. Nos. 1255 and 1255a, Leray-Rockland beds, Allumette Island, Paquette Rapids, Quebec. (Page 33.)
- Figures 21, 22. *Bucania punctifrons* (Emmons). 21, dorsum showing slit-band, x 2. 22, side view showing umbilicus and semiangular margin of umbilicus. Plesiotype, G.S.C. No. 9737, Sherman Fall beds, 1½ miles west of Finch, Ontario. (Page 27.)
- Figure 23. *Bucania punctifrons* (Emmons) showing ornamentation, x 4. Plesiotype, G.S.C. No. 9736, same beds and locality as 9737. (Page 27.)

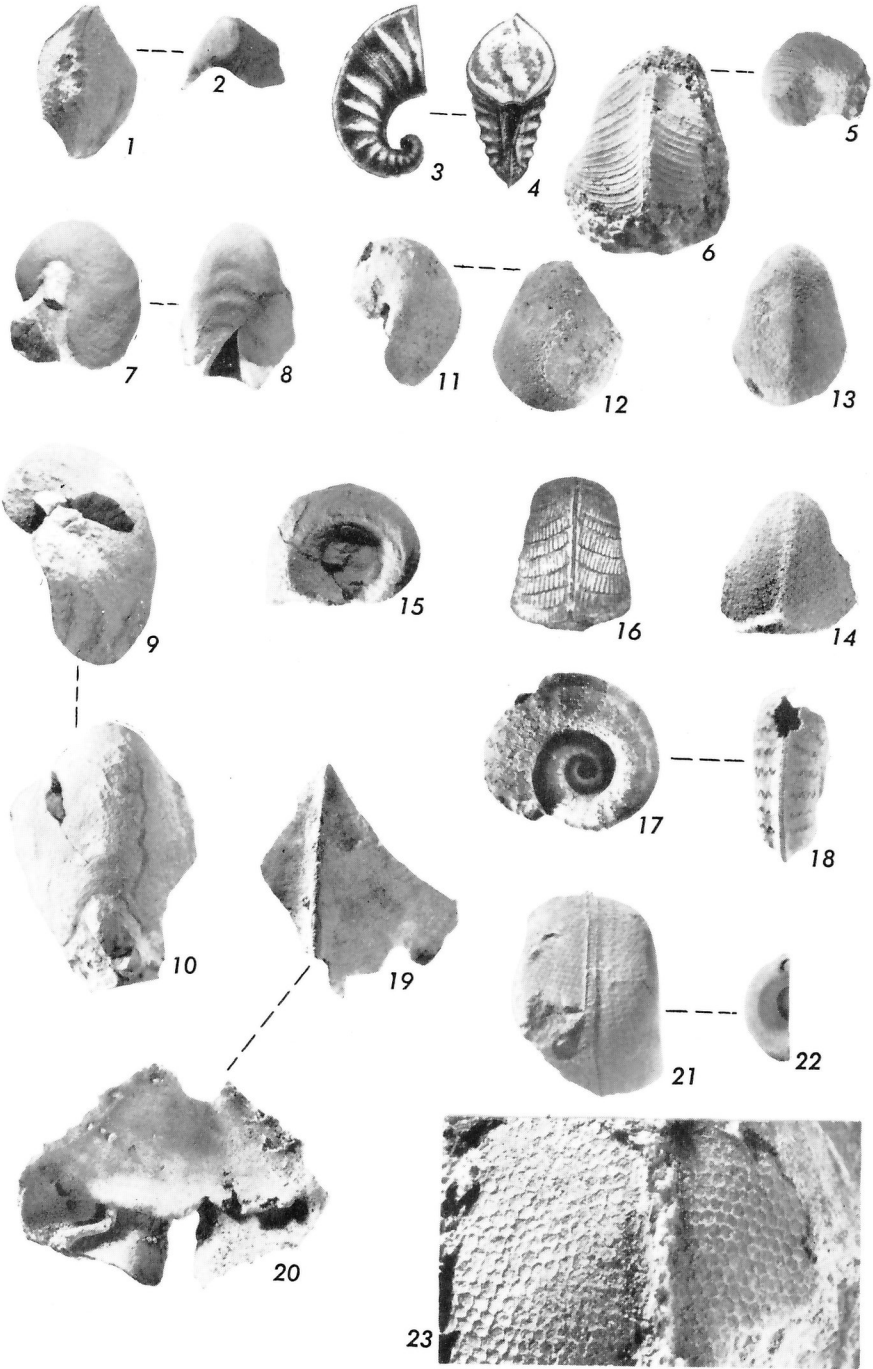
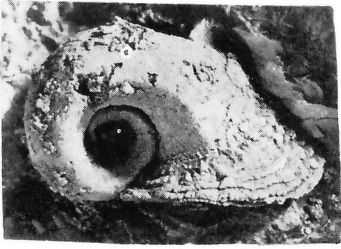
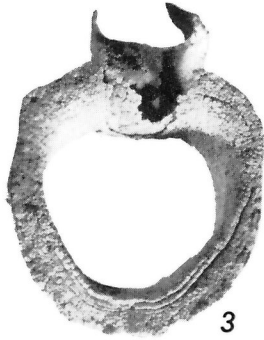


PLATE III

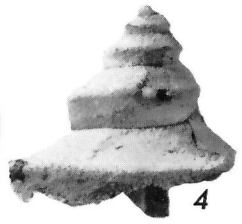
- Figures 1, 2. *Salpingostoma billingsi* n.sp. 1, side view, showing umbilicus, and ornamentation near the aperture; 2, from back, x 2, showing intersecting lines and band. Holotype, G.S.C. No. 1259, Leray beds, Front con., Cumberland tp., Ontario. (Page 28.)
- Figure 3. *Salpingostoma billingsi* n.sp., showing aperture shape. Paratype, G.S.C. No. 9738, Leray-Rockland beds, Allumette Island, Paquette Rapids, Quebec. (Page 28.)
- Figure 4. *Lophospira peracuta* (Hall), showing the flat or concave upper surface of the whorl and the single carina. Plesiotype, G.S.C. No. 9744, Leray-Rockland beds, Allumette Island, Paquette Rapids, Quebec. (Page 36.)
- Figures 5, 6. *Salpingostoma expansum* (Hall), var. 5, showing umbilicus and rapidly expanding aperture; 6, showing the broad dorsum and aperture. Plesiotype, G.S.C. No. 9739, Leray-Rockland beds, lot 3, con. III, R.F., Gloucester tp., Ontario. (Page 28.)
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- Figure 8. *Lophospira angustina* Ulrich and Scofield. Reprint from Pal. Minnesota 3, pt. 2, 1897, Pl. 71, fig. 1. (Page 34.)



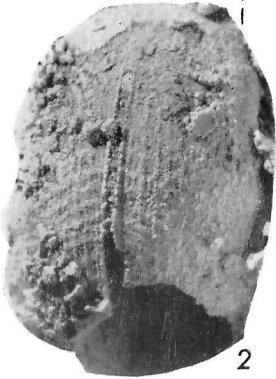
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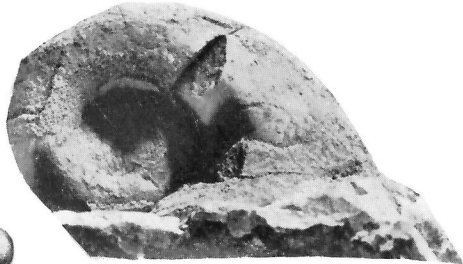
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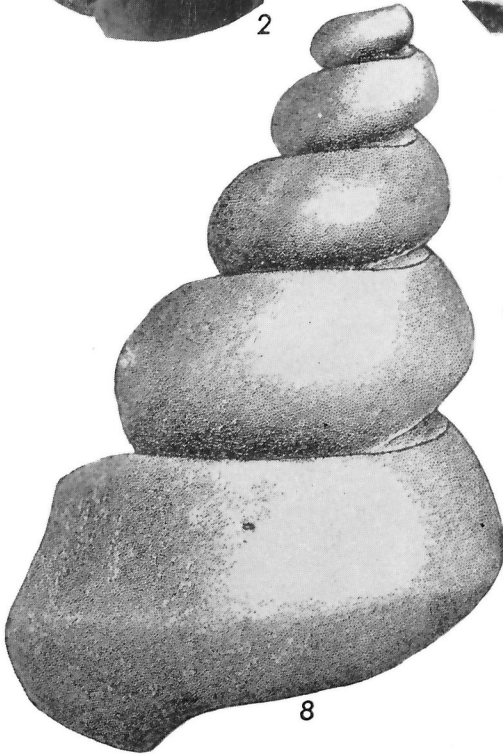
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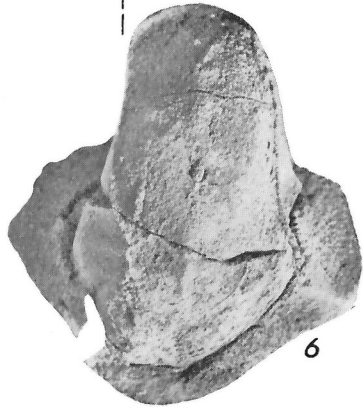
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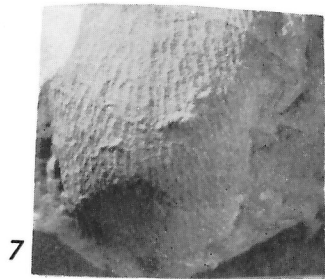
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PLATE IV

- Figures 1, 2. *Tetranota bidorsata* (Hall). 1, showing umbilicus; 2, showing the broad median band and just the edge of the lateral bands. Plesiotypes, G.S.C. Nos. 9740 and 9740a, Leray beds, Val Tetreau, Quebec. (Page 30.)
- Figures 3, 4. *Tetranota charon* (Billings). 3, side view, showing umbilicus; 4, anterior view showing wide aperture. Holotype G.S.C. No. 1249b, Leray-Rockland beds, Paquette Rapids, Quebec. (Page 31.)
- Figure 5. *Tetranota charon* (Billings), showing four bands. Paratype, G.S.C. No. 1249a. Same beds and locality as above. (Page 31.)
- Figure 6. *Tetranota charon* (Billings), showing the dorsum. Paratype, G.S.C. No. 1249c. Same beds and locality as above. (Page 31.)
- Figure 7. *Tropidodiscus? argo* (Billings), showing the aperture of a small specimen. Paratype, G.S.C. No. 1262b, Leray-Rockland beds, Allumette Island, Paquette Rapids, Quebec. (Page 32.)
- Figures 8, 9. *Tropidodiscus? argo* (Billings). 8, from the front; 9, from the side. Holotype, G.S.C. No. 1262a. Same beds and locality as above. (Page 32.)
- Figures 10, 11. *Tetranota saxcarinata* Ulrich and Scofield. 10, small specimen showing the six carinae; 11, large specimen. Plesiotypes, G.S.C. Nos. 9741a and 9741, Leray? beds, lot 3, con. III, R.F., Gloucester tp., Ontario. (Page 31.)
- Figure 12. *Lophospira medialis* Ulrich and Scofield, slightly tilted; it does not show the upper ridge. Plesiotype, G.S.C. No. 9746, Leray-Rockland beds, Allumette Island, Paquette Rapids, Quebec. (Page 35.)
- Figure 13. *Lophospira perangulata* (Hall), comparatively large specimen showing the acute margin. Plesiotype, G.S.C. No. 9745, Leray-Rockland beds, Allumette Island, Paquette Rapids, Quebec. (Page 37.)
- Figure 14. *Hormotoma salterii canadensis* Ulrich and Scofield, showing rate of coiling and mature size. Paratype, G.S.C. No. 1228b, Leray-Rockland beds, Allumette Island, Paquette Rapids, Quebec. (Page 42.)
- Figure 15. *Hormotoma gracilis* (Hall), showing the bead-like whorls and slender spire. Plesiotype, 1228y, Leray-Rockland beds, Allumette Island, Paquette Rapids, Quebec. (Page 41.)
- Figure 16. *Hormotoma bellicincta* (Hall), showing the compact whorls. Plesiotype, G.S.C. No. 1243, Leray-Rockland beds, Allumette Island, Paquette Rapids, Quebec. (Page 40.)
- Figure 17. *Hormotoma simplex* Wilson, an exfoliated specimen. Paratype, G.S.C. No. 6666, Cobourg beds, lot 22, con. III, Roxborough tp., Ontario. (Page 42.)
- Figure 18. *Hormotoma simplex* Wilson, showing apex and rate of coiling. Holotype, G.S.C. No. 6665, Cobourg beds, boundary road between con. IX, Cornwall tp., and con. IX, Charlottenburgh tp., Ontario. (Page 42.)
- Figure 19. *Hormotoma simplex* Wilson, almost complete specimen. Plesiotype, G.S.C. No. 9750, west end of Fifth avenue, Ottawa, Ontario. (Page 42.)
- Figures 20, 21. *Hormotoma simplex paquettensis* n. var. 20, showing the aperture; 21, part of a larger specimen showing the tightly coiled whorls. Holotype (21), G.S.C. No. 1221b; paratype (20), G.S.C. No. 1221, both from Leray-Rockland beds, Allumette Island, Paquette Rapids, Quebec. (Page 43.)
- Figures 22, 23. *Lophospira ventricosa* (Hall). 22, large specimen showing ventricose lower whorl with slightly developed lower and upper ridge; 23, showing approximate angle of apex. Plesiotypes, G.S.C. Nos. 1253 and 1253a, Leray-Rockland beds, Allumette Island, Paquette Rapids, Quebec. (Page 39.)
- Figures 24, 25. *Tropidodiscus? disculus* (Billings). 24, side view; 25, view of the same specimen from posterior, showing acute dorsum. Neotype, G.S.C. No. 9742, Cobourg beds, foot of Sussex street, Ottawa, Ontario. (Page 32.)

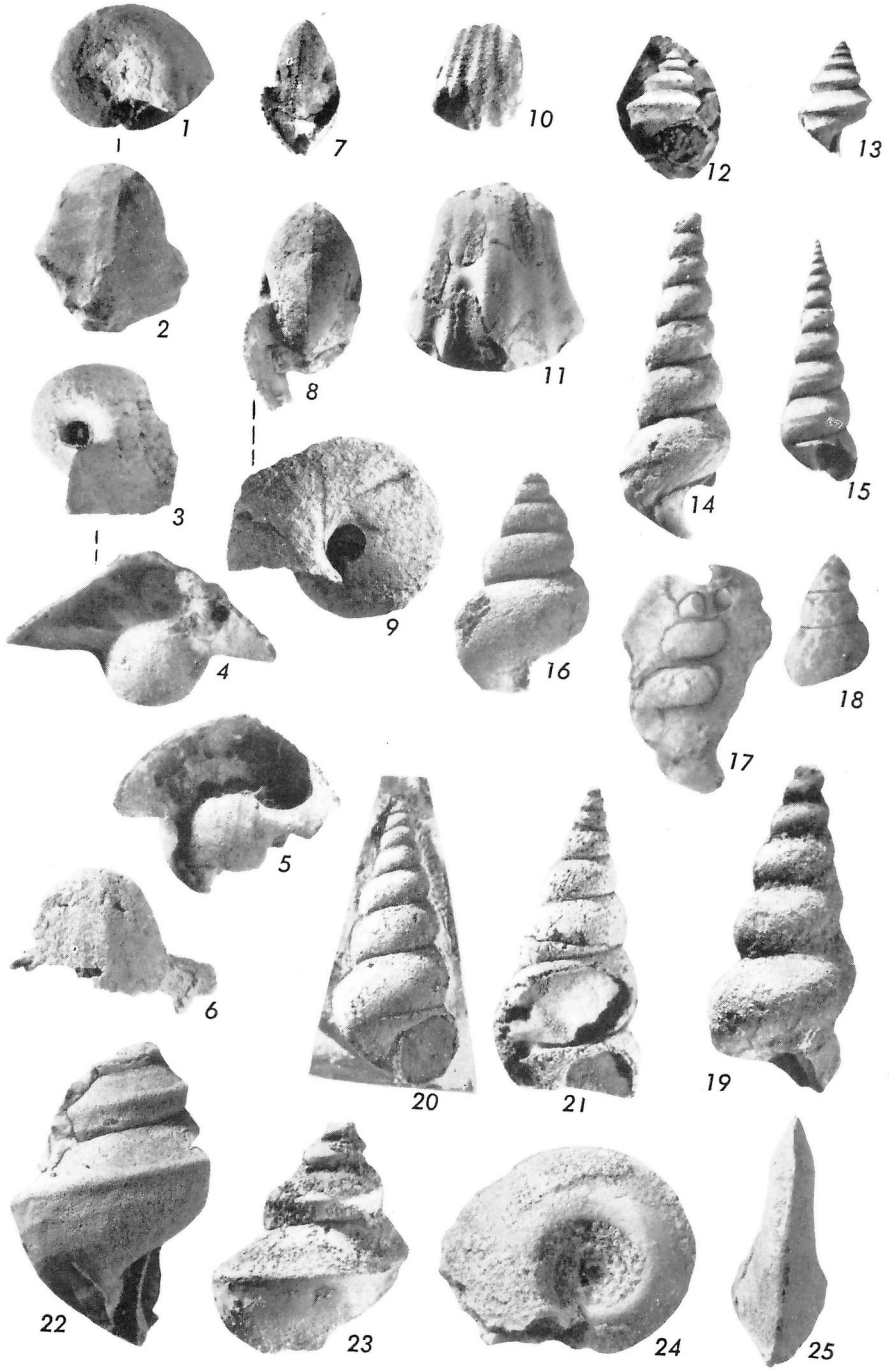


PLATE V

- Figures 1-3. *Lophospira helicteres* (Salter). 1, aperture view, not quite true; 2, from posterior; 3, x 3, showing the piled up striae. Cotype, G.S.C. No. 1246c, Leray-Rockland beds, Allumette Island, Paquette Rapids, Quebec. (Page 34.)
- Figure 4. *Lophospira milleri* (Miller), showing aperture. Plesiotype, G.S.C. No. 9743, Leray-Rockland beds, Paquette Rapids, Ottawa River. (Page 36.)
- Figure 5. *Lophospira saffordi* Ulrich and Scofield, showing rapid enlargement of whorls, and relative strength of carina. Plesiotype, G.S.C. No. 9747, Leray-Rockland beds, Allumette Island, Paquette Rapids, Quebec. (Page 38.)
- Figures 6, 7. *Lophospira procris* (Billings). 6, from posterior; 7, the same x 3, showing ornamentation. Holotype, G.S.C. No. 1241, Leray-Rockland beds, Allumette Island, Paquette Rapids, Quebec. (Page 37.)
- Figures 8, 9. *Lophospira serrulata* (Salter). 8, posterior view; 9, the same x 3, showing the ornamentation. Holotype, G.S.C. No. 1245, Leray-Rockland beds, Allumette Island, Paquette Rapids, Quebec. (Page 38.)

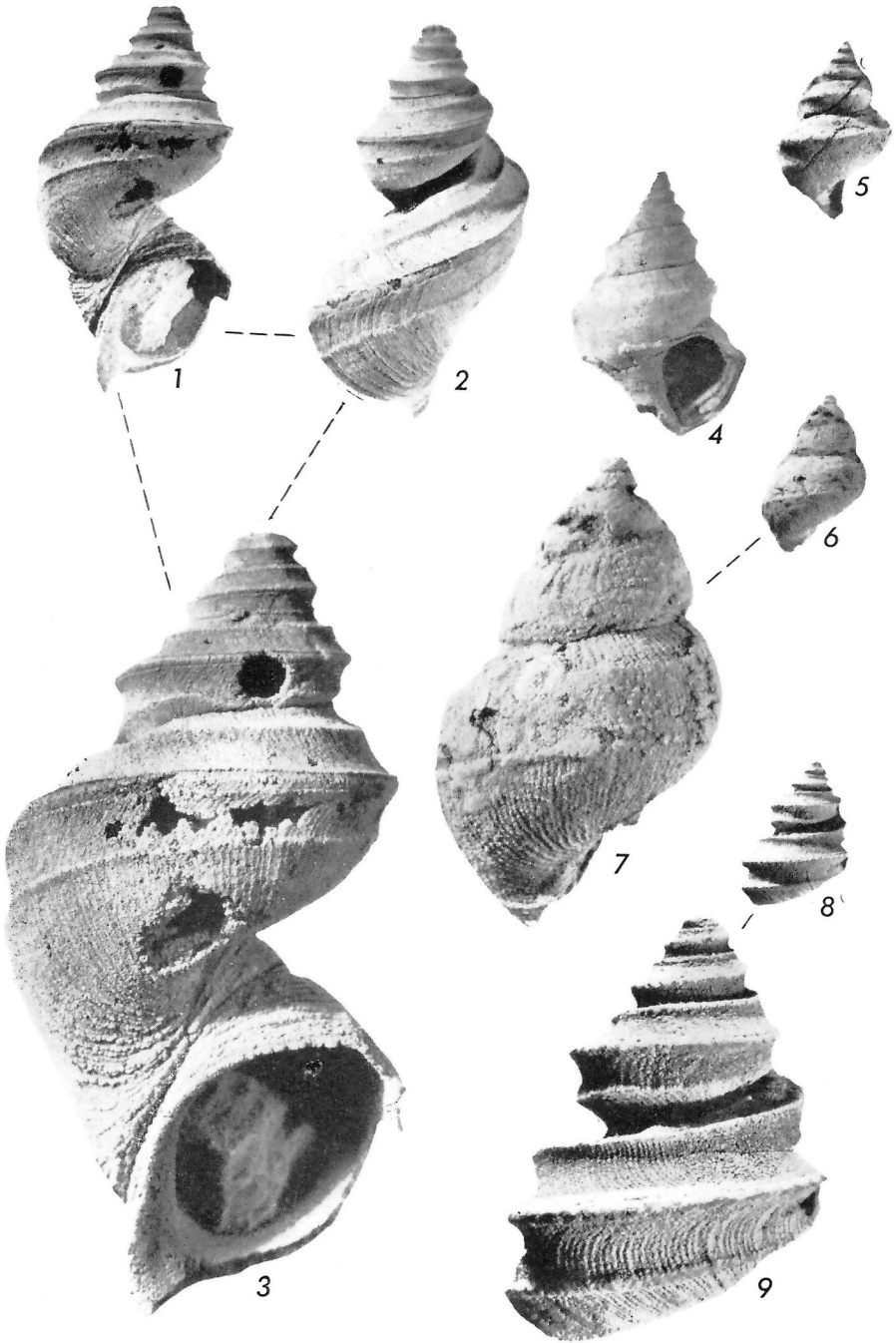


PLATE VI

- Figures 1, 2. *Hormotoma trentonensis* (Hall). 1, anterior view; 2, posterior view. Plesiotype, G.S.C. No. 9751, Cobourg beds, west end of Fifth avenue, Ottawa, Ontario. (Page 44.)
- Figure 3. *Hormotoma salteri ottawaensis* n.var., showing size and rate of whorl enlargement. Holotype, G.S.C. No. 1678g, Cobourg beds, from an unspecified locality at Ottawa, Ontario. (Page 42.)
- Figure 4. *Hormotoma salteri ottawaensis* n.var., natural cross-section, showing shape of whorl. Paratype, G.S.C. No. 9749, Cobourg beds, from base of Parliament Hill, Ottawa, Ontario. (Page 42.)
- Figure 5. *Hormotoma trentonensis crassa* n.var., showing band and ornamentation. Paratype, x 2, G.S.C. No. 9753, Leray-Rockland beds, Allumette Island, Paquette Rapids, Quebec. (Page 44.)
- Figure 6. *Hormotoma trentonensis crassa* n.var., a partly restored specimen, originally identified as *H. cf. trentonensis*. Paratype, G.S.C. No. 6662, Cobourg beds, lot 23, con. VII, Roxborough tp., Ontario. (Page 44.)
- Figure 7. *Hormotoma trentonensis crassa* n.var., showing the more rapidly enlarging and less oblique whorls as compared with the species restricted. Holotype, G.S.C. No. 9752, Cobourg beds, west end of Fifth avenue, Ottawa, Ontario. (Page 44.)

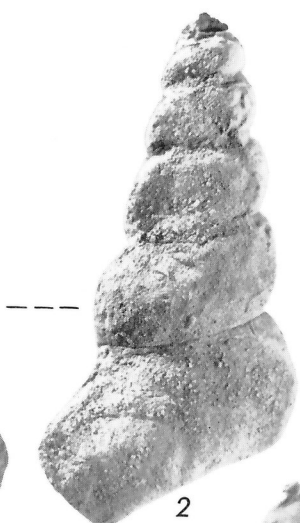


PLATE VII

- Figures 1, 2. *Clathrospira conica* Ulrich and Scofield. 1, from base, showing the carina; 2, side view, showing angle of apex. Plesiotype, G.S.C. No. 9761, Cobourg beds, corner Maple and Lorne avenues, Ottawa, Ontario. (Page 57.)
- Figure 3. *Clathrospira subconica* (Hall), showing size, apical angle, and ornamentation. Plesiotype, G.S.C. No. 9762, Leray beds, La petite Chaudière, Ottawa River at Ottawa, Ontario. (Page 57.)
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- Figures 5-7. *Straparollina circe* Billings. 5, anterior view; 6, from base; 7, from top showing ornamentation. Holotype, G.S.C. No. 1200, Leray-Rockland beds, Paquette Rapids, Ottawa River. (Page 60.)
- Figures 8, 9. *Straparollina eurydice* Billings. 8, anterior view; 9, posterior view. Holotype, G.S.C. No. 1199, Allumette Island, Paquette Rapids, Ottawa River. (Page 60.)
- Figures 10-12. *Straparollina asperostriata* (Billings). 10, showing ridge-like margin of umbilicus; 11, from top; 12, ornamentation, x 2. Cotypes, G.S.C. Nos. 1201 (11 and 12) and 1201a (10). (Page 59.)
- Figure 13. *Hormotoma major* (Hall). Reprint, Pal. Minnesota, 3, pt. 2, 1897, Pl. 71, fig. 5. (Page 41.)
- Figure 14. *Hormotoma cf. major* (Hall). Plesiotype, G.S.C. No. 9748, Cobourg beds, north of Casselman, quarry near Lemieux road, Ottawa. (Page 41.)

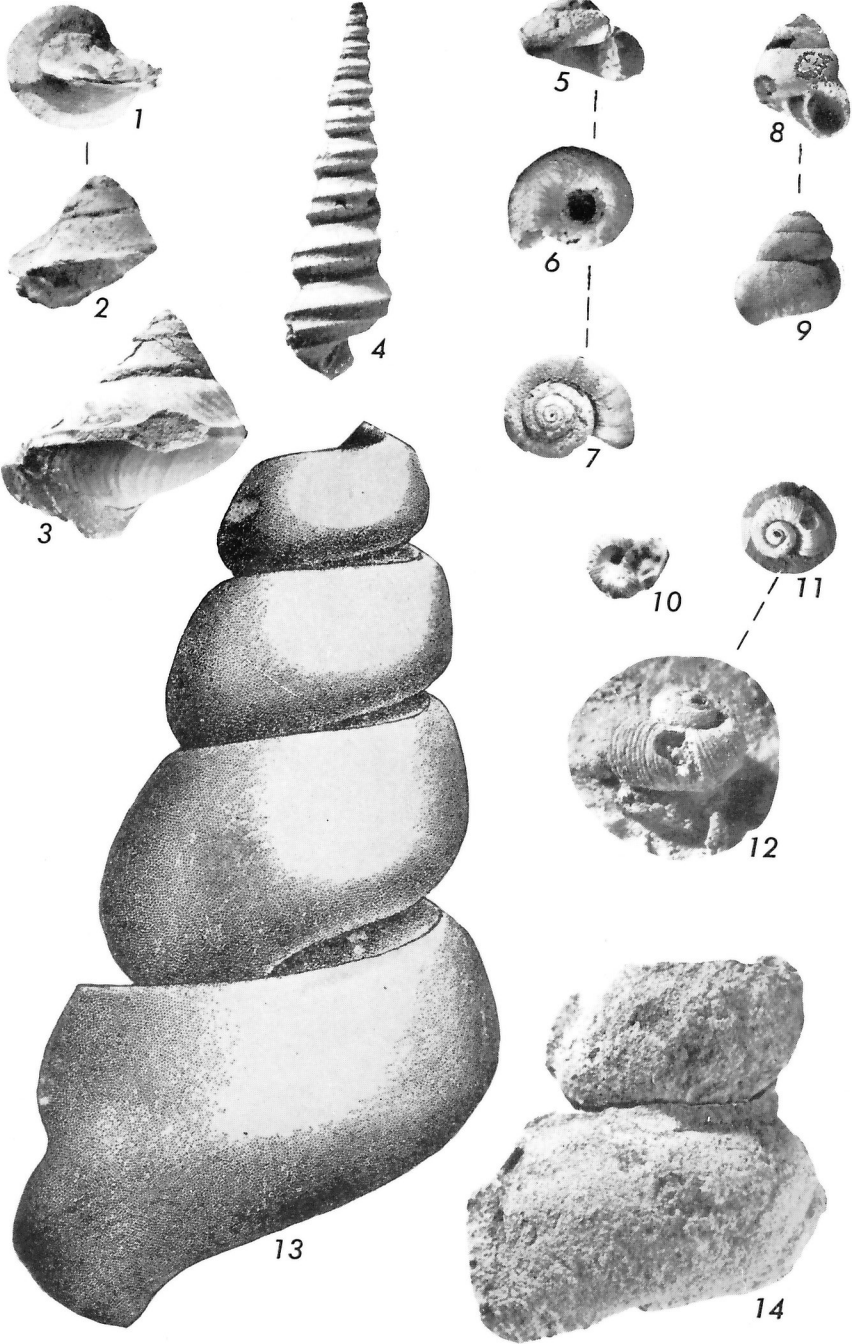


PLATE VIII

- Figures 1, 2. *Hormotoma trentonensis plana* n.var. 1, from posterior; 2, from anterior. Holotype, G.S.C. No. 9754, Cobourg beds, from an unspecified locality, Ottawa, Ontario. (Page 45.)
- Figure 3. *Hormotoma trentonensis plana* n.var. enlarged to show ornamentation. Paratype, G.S.C. No. 9755 x 2, Cobourg beds, road north from Navan, Ontario. (Page 45.)
- Figure 4. *Hormotoma trentonensis plana* n.var. Paratype, G.S.C. No. 6663, Cobourg beds, Gravel Hill, Ontario. (Page 45.)
- Figures 5-7. *Eotomaria supracingulata* (Billings). 5, side view, showing position of the band; 6, top view, showing rate of enlargement of whorls; 7, bottom view of another specimen, showing ornamentation. Holotype and paratype respectively, G.S.C. Nos. 1686 and 1686a, not from this locality but from unspecified Trenton beds, St. Joseph Island, Lake Huron, Ontario. (Page 55.)

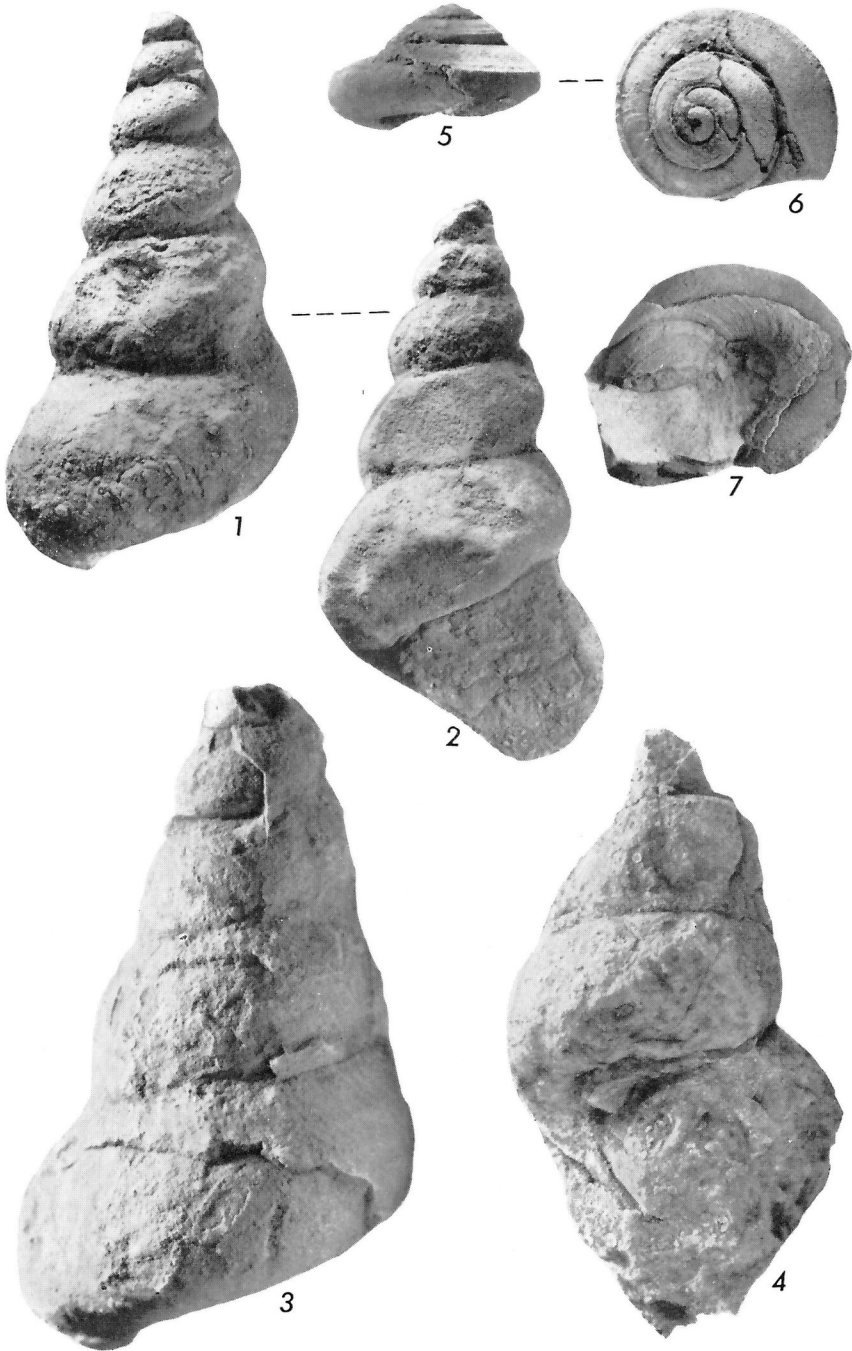


PLATE IX

- Figures 1, 2. *Liospira micula* (Hall). 1, from above, showing rate of enlargement of whorl; 2, from side showing apical angle. Plesiotype, G.S.C. No. 9757, Cobourg beds, lots 9, 10, con. VII, Kenyon tp., Ontario. (Page 50.)
- Figures 3, 4. *Liospira progne* (Billings). 3, side view, showing spire; 4, from above showing rate of enlargement of whorls. Plesiotype, G.S.C. No. 9758, Sherman Fall beds, in brook between Lunenburg and North Lunenburg, Ontario. (Page 51.)
- Figures 5, 6. *Liospira progne* (Billings). 5, from anterior, showing the aperture imperfectly and the apical angle; 6, from base showing umbilicus. Holotype, G.S.C. No. 1688a, Cobourg beds, from an unspecified locality at Ottawa, Ontario. (Page 51.)
- Figures 7, 8. *Liospira vitruvia* (Billings). 7, from side, showing apical angle; 8, from base, showing the step-like sides of the umbilicus. Plesiotypes, G.S.C. Nos. 9759a and 9759, respectively, Leray-Rockland beds, Paquette Rapids, Ottawa River. (Page 51.)
- Figure 9. *Liospira americana* (Billings), showing the rapidly enlarging whorls. Plesiotype, G.S.C. No. 9756, Cobourg beds, Percy street, Ottawa, Ontario. (Page 49.)
- Figures 10-12. *Eotomaria dryope* (Billings). 10, showing apical angle and aperture; 11, showing upper surface and ornamentation; 12, from base, showing umbilicus and ornamentation. Holotype, G.S.C. No. 1224, Leray-Rockland beds, Paquette Rapids, Ottawa River. (Page 53.)
- Figures 13-15. *Eotomaria dryope plana* n.var. 13, showing apical angle to compare with that of the species; 14, from top, showing ornamentation; 15, from base, showing umbilicus. Holotype, G.S.C. No. 9760, Leray-Rockland beds, Paquette Rapids, Ottawa River. (Page 54.)
- Figure 16. *Omospira alexandra* (Billings), small specimen, showing the acuteness of the spire. Paratype, G.S.C. No. 1242g, Allumette Island, Paquette Rapids, Quebec. (Page 48.)
- Figures 17, 18. *Omospira alexandra* (Billings). 17, anterior view, showing aperture; 18, same specimen from posterior, showing the shoulder and ornamentation. Paratype, G.S.C. No. 1242b. Same beds and same locality as above. (Page 48.)
- Figure 19. *Omospira alexandra* (Billings), showing reflexed inner lip. Holotype, G.S.C. No. 1242. Same beds and same locality as above. (Page 48.)
- Figures 20, 21, 23. *Eotomaria larvata* (Salter). Reprint from Geol. Surv., Canada, dec. 1, 1859, Pl. 2, figs. 11-13. Holotype, G.S.C. No. 1211, Leray-Rockland beds, Paquette Rapids, Ottawa River. (Page 54.)
- Figure 22. *Eotomaria larvata* (Salter), a form covered with a stromatoporoid. Reprint from above, Pl. 2, fig. 14. Paratype, G.S.C. No. 1211b. Same beds and locality as above. (Page 54.)
- Figures 24, 25. *Eotomaria larvata* (Salter). 24, from top, x 3; 25, from base, x 3. Plesiotype, G.S.C. No. 6226, Pamela beds, MacLaren Landing, Ontario. (Page 54.)

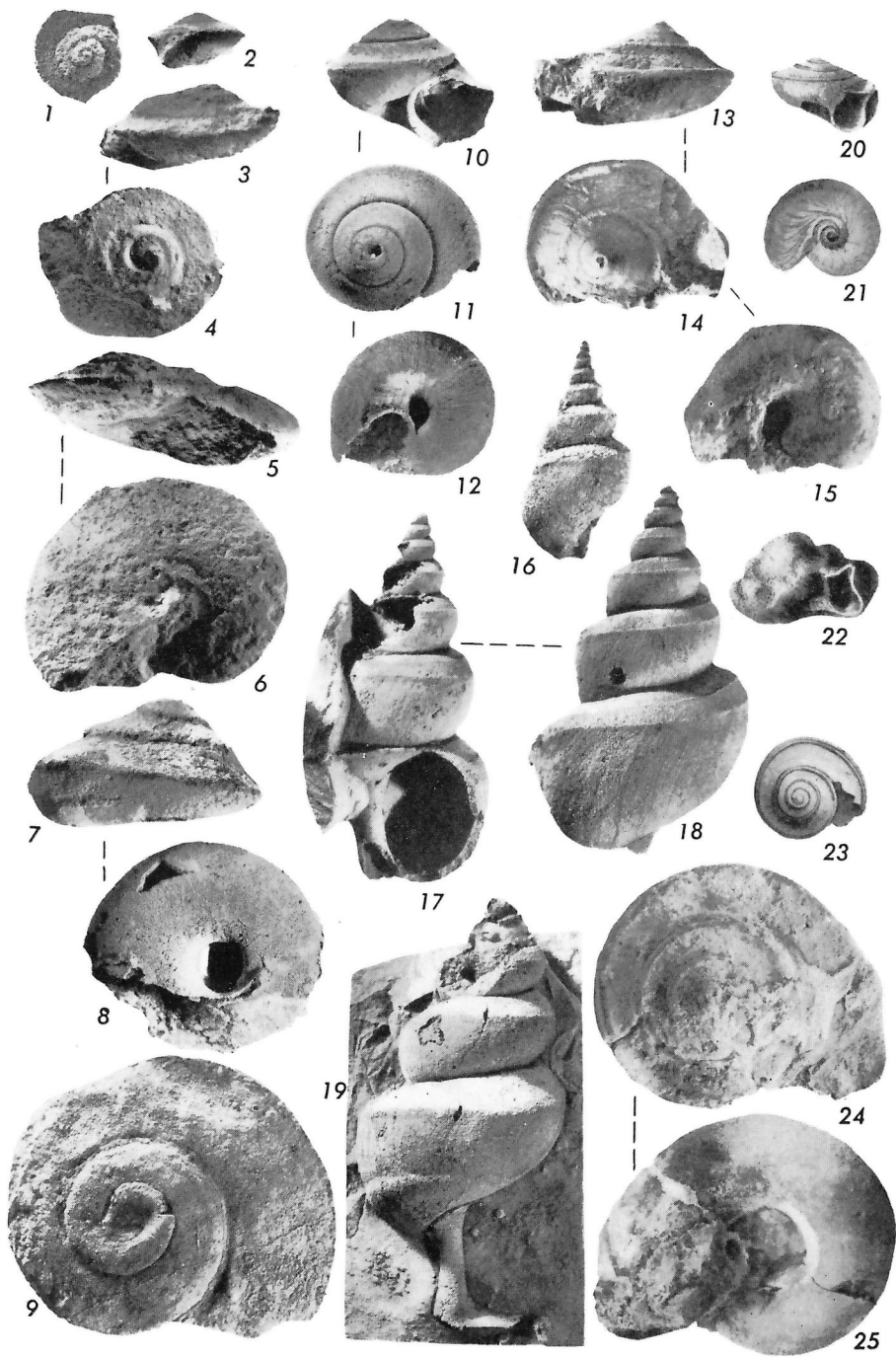


PLATE X

- Figures 1, 2. *Maclurites logani* (Salter) operculum. 1, from the interior, showing the process for muscle attachment; 2, the same, from the side. Cotype, G.S.C. No. 1263d, Leray-Rockland beds, Allumette Island, Paquette Rapids, Quebec. (Page 61.)
- Figure 3. *Maclurites logani* (Salter) operculum, from the top. Plesiotype, G.S.C. No. 9763. Same beds and locality as above. (Page 61.)
- Figures 4, 5. *Maclurites logani* (Salter). Reprints from Geol. Surv., Canada, dec. 1, 1859, Pl. 1, figs. 2, 3. Cotype, G.S.C. No. 1263g. Same beds and locality as above. (Page 61.)
- Figure 6. *Maclurites logani* (Salter). Composite figure, reprint from Geol. Surv., Canada, dec. 1, 1859, Pl. 1, fig. 1. (Page 61.)
- Figure 7. *Eunema erigonæ* Billings? Reprint, Geol. Surv., Canada, Pal. Foss. 1, 1865, p. 35, fig. 37. (Page 72.)
- Figures 8, 9. *Eunema strigillatum* Salter. 8, natural size; 9, x 2, to show ornamentation. Holotype, G.S.C. No. 1202b, Leray-Rockland beds, Allumette Island, Paquette Rapids, Quebec. (Page 73.)

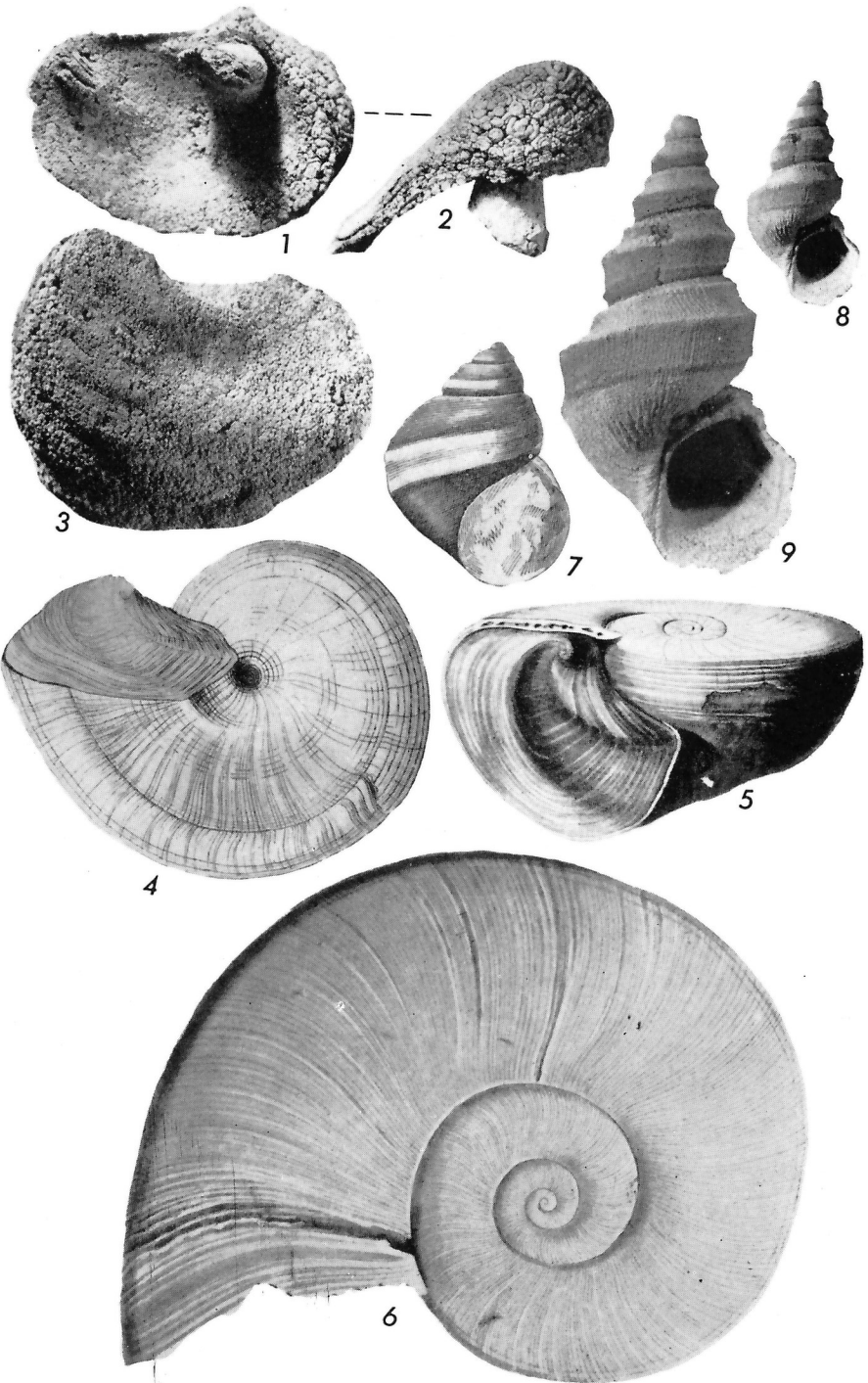


PLATE XI

- Figures 1, 2. *Helicotoma spinosa* Salter. 1, from above; 2, from base showing umbilicus. Holotype, G.S.C. No. 1209, Leray-Rockland beds, Paquette Rapids, Ottawa River. (Page 65.)
- Figure 3. *Helicotoma spinosa* Salter, showing the whorls underlying the spines more clearly than in above. Paratype, G.S.C. No. 1209a. Same beds and locality as above. (Page 65.)
- Figures 4, 5. *Helicotoma spinosa* Salter. 4, from top with spines worn down, thus more clearly showing the band surmounting the outer edge of each whorl; 5, open umbilicus revealing successive coils. Plesiotype, G.S.C. No. 9767. Same beds and locality as above. (Page 65.)
- Figures 6, 7. *Helicotoma planulata muricata* Salter. 6, from side; 7, from top, both showing the peculiar rugose striae. Plesiotype, G.S.C. No. 9766, Leray-Rockland beds, Allumette Island, Paquette Rapids, Quebec. (Page 64.)
- Figures 8, 9. *Helicotoma planulata* Salter. 8, from above, showing the short prolongation of the lower lip; 9, another specimen showing the open umbilicus and successive whorls. Paratypes, respectively, G.S.C. No. 1210h (8) and No. 1210g (9). Same beds and locality as above. (Page 64.)
- Figures 10-12. *Helicotoma planulata* Salter. Side, top, and umbilicus views, showing the various characteristics. Holotype, G.S.C. No. 1210. Same beds and locality as above. (Page 64.)
- Figures 13, 14. *Helicotoma planulata* Salter. Side and umbilicus views. Paratype, G.S.C. No. 1210e. Same beds and locality as above. (Page 64.)
- Figures 15, 16. *Daidia cerithioides* (Salter). 15, from aperture side; 16, from opposite side showing the band and ornamentation. Holotype, G.S.C. No. 1206, Leray-Rockland beds, Allumette Island, Paquette Rapids, Quebec. (Page 74.)
- Figure 17. *Loxonema murrayana* Salter, showing shape of whorl and rate of coiling. Holotype, G.S.C. No. 1189, Leray-Rockland beds, Allumette Island, Paquette Rapids, Quebec. (Page 91.)
- Figures 18, 19. *Loxonema?* sp. to show the contrast with *L. murrayana*. Figured specimen G.S.C. No. 9792, Cobourg beds, corner Booth and Elm streets, Ottawa, Ontario. (Page 91.)
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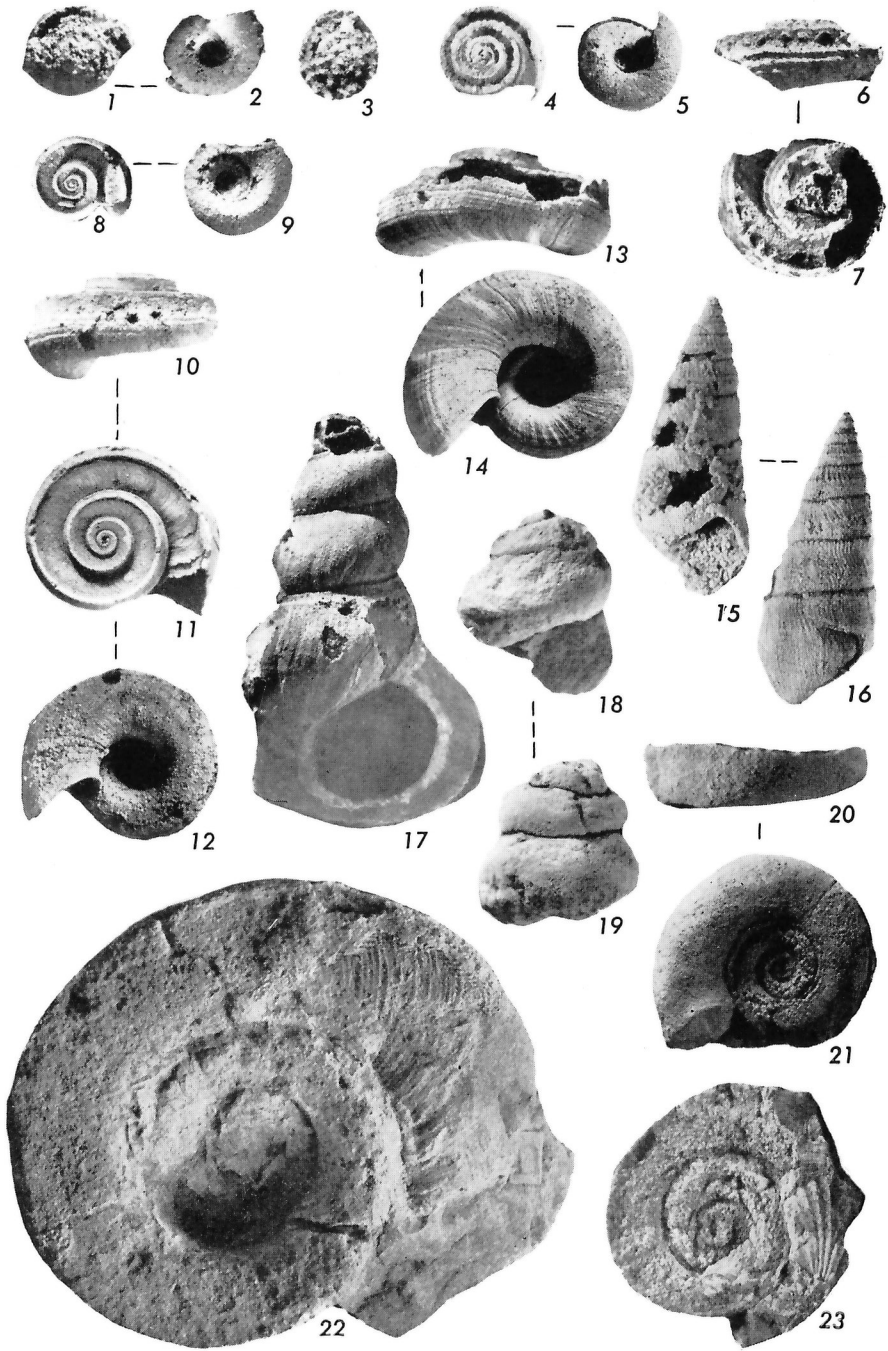


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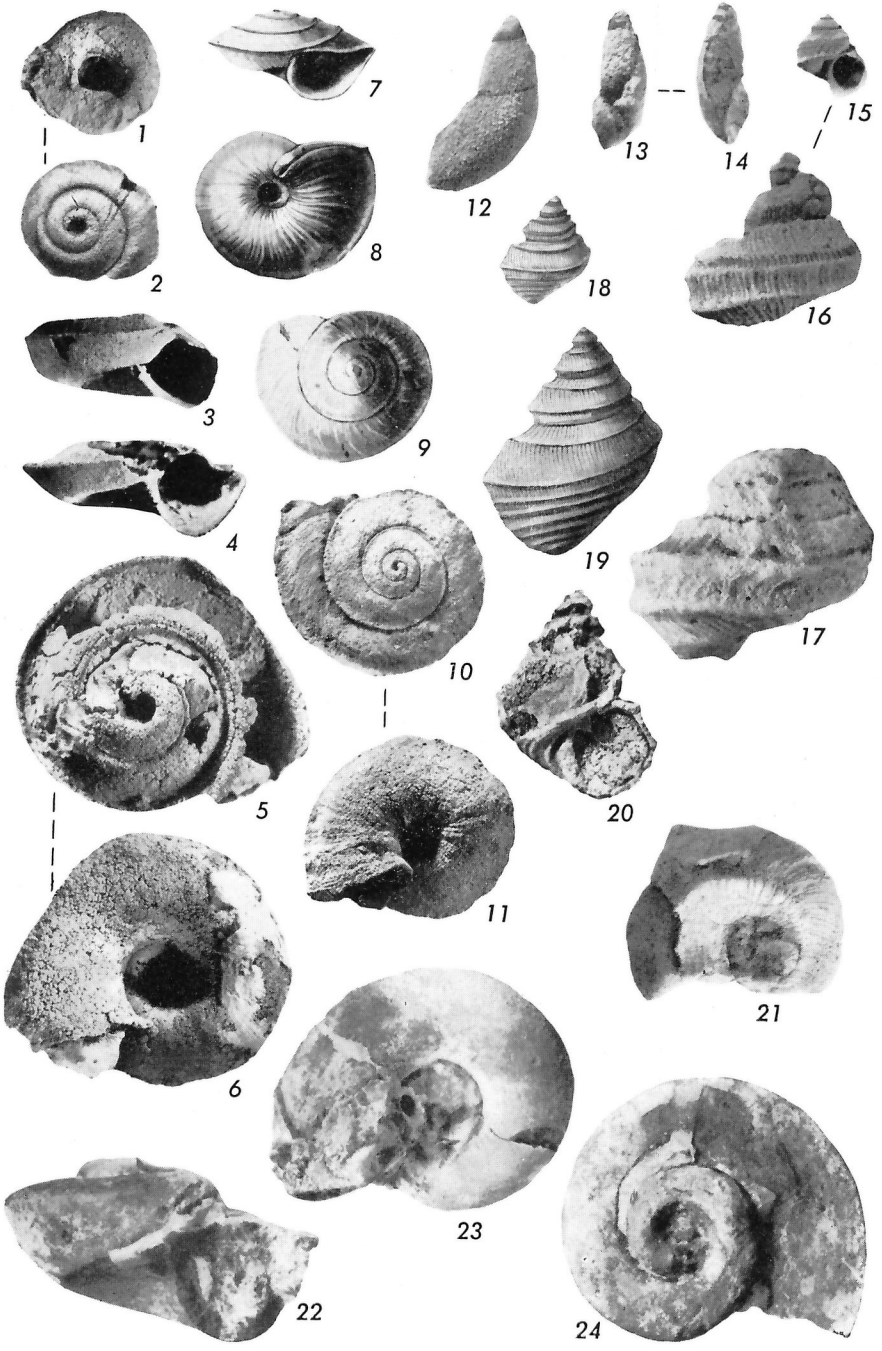


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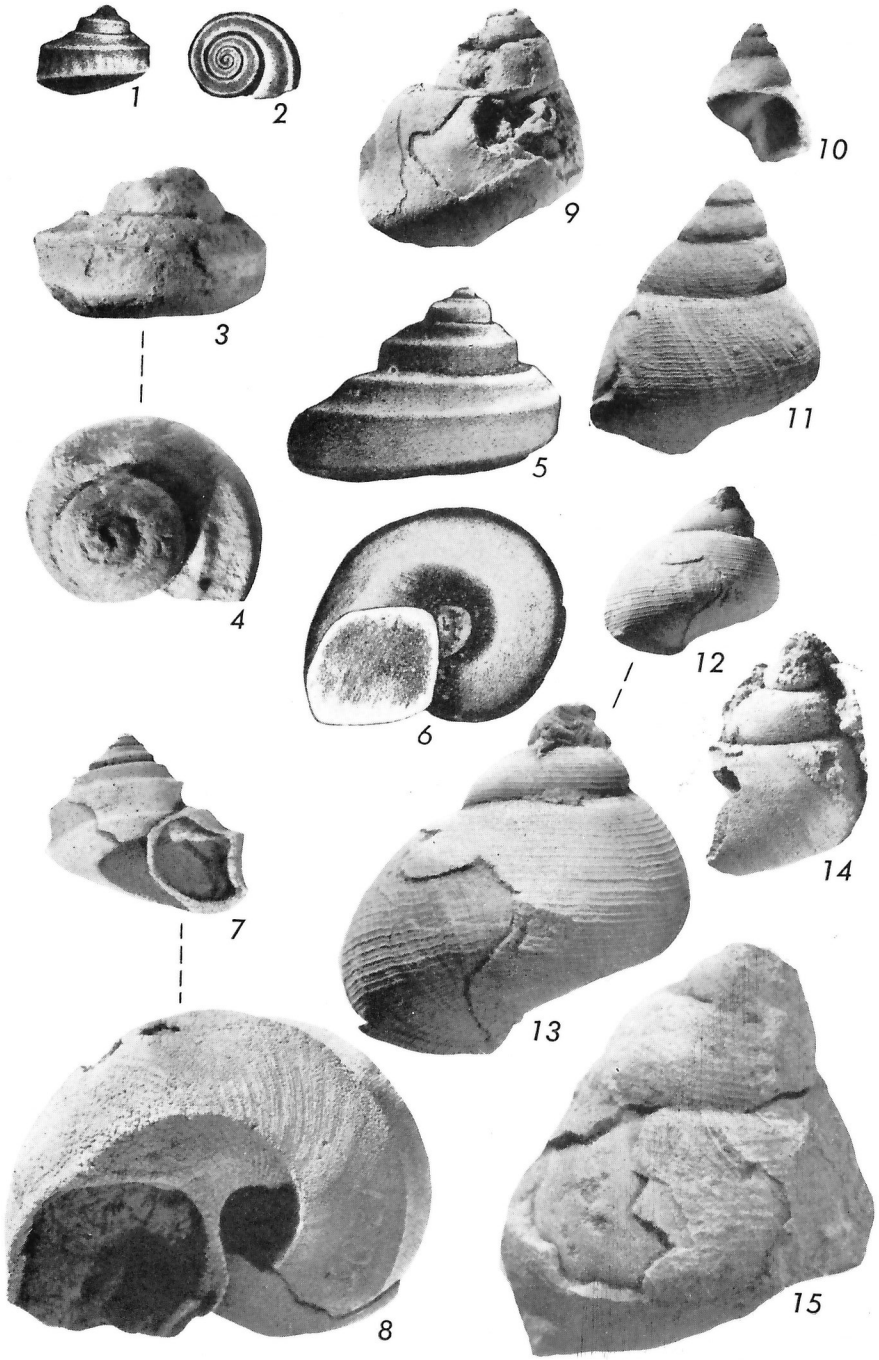


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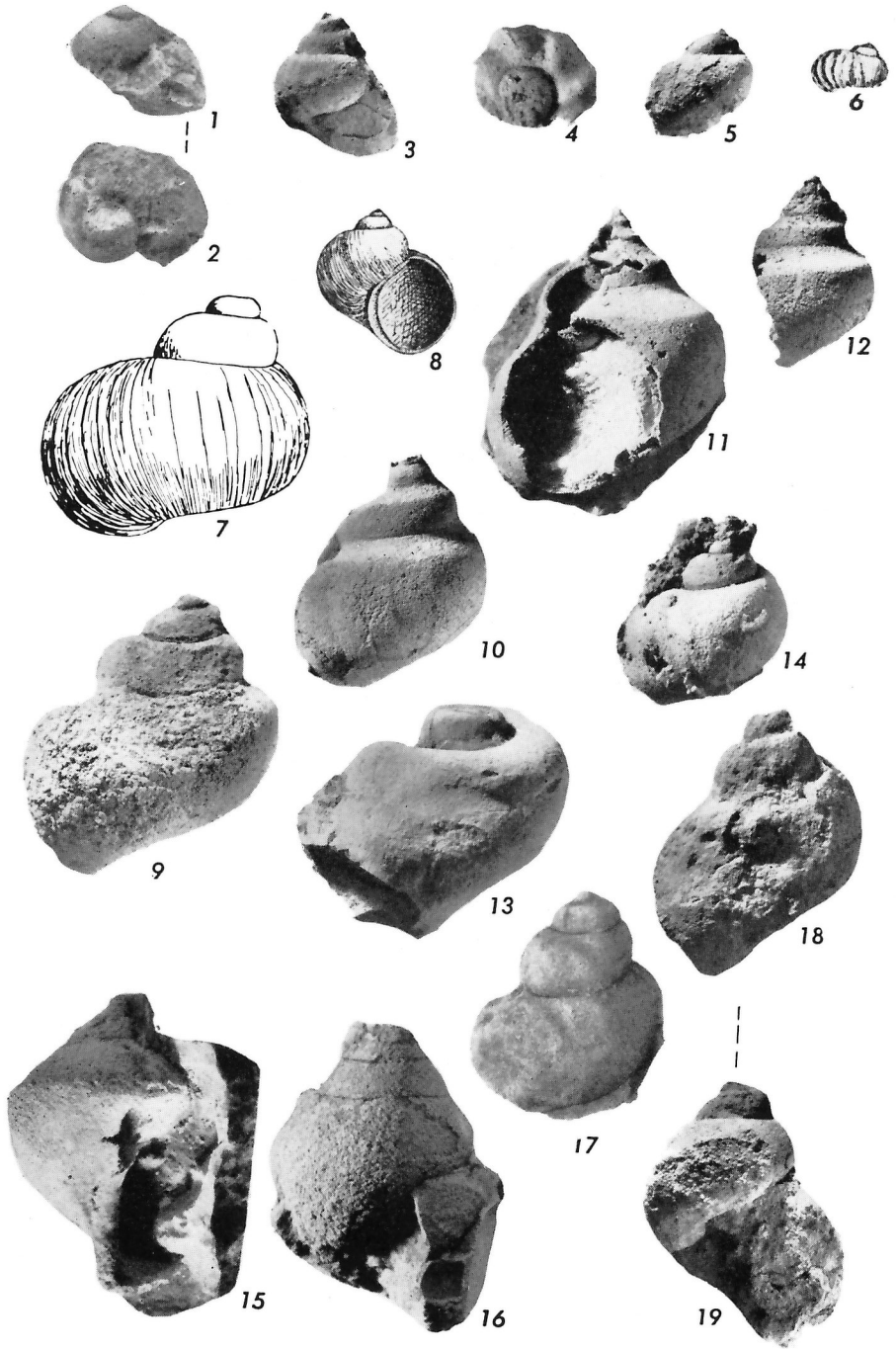


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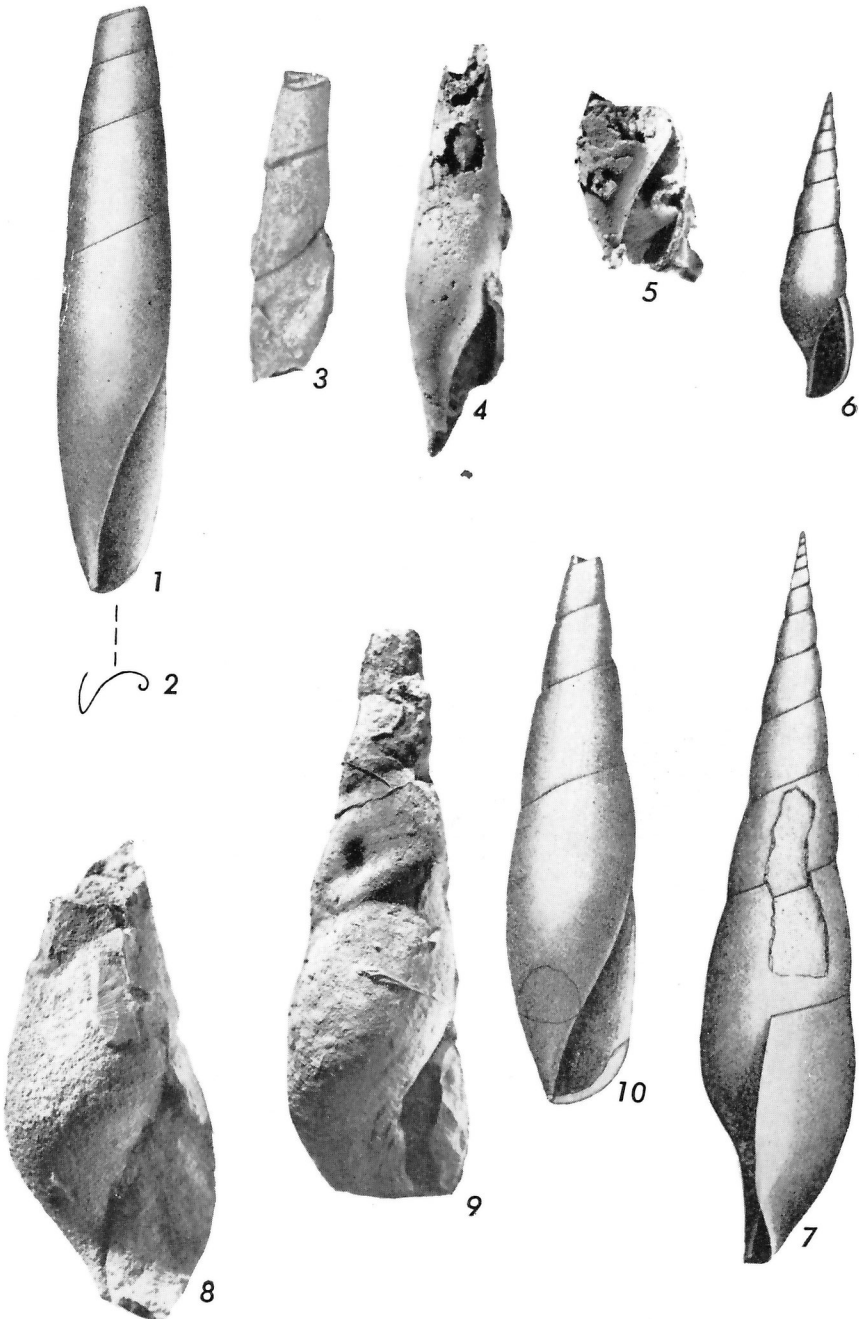


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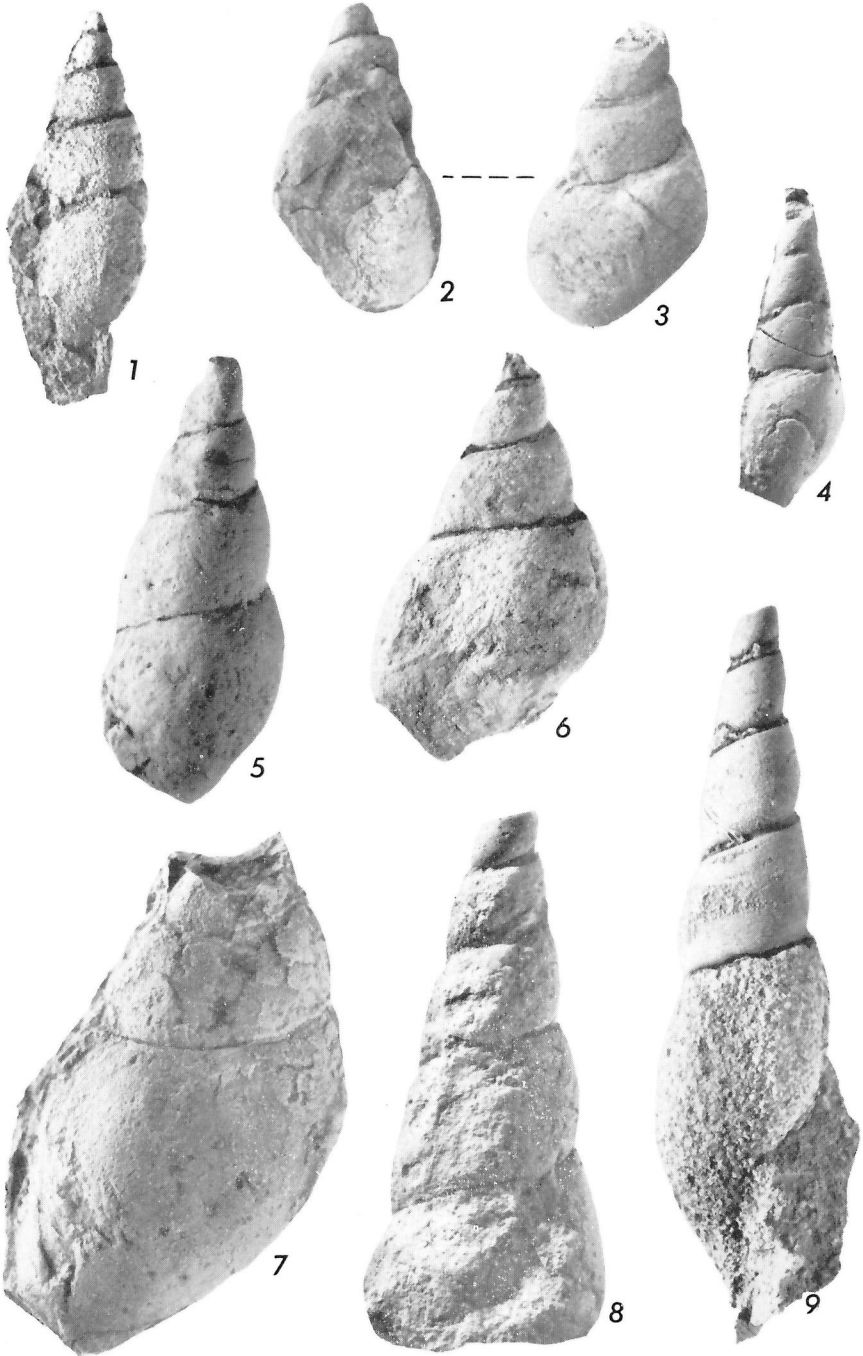


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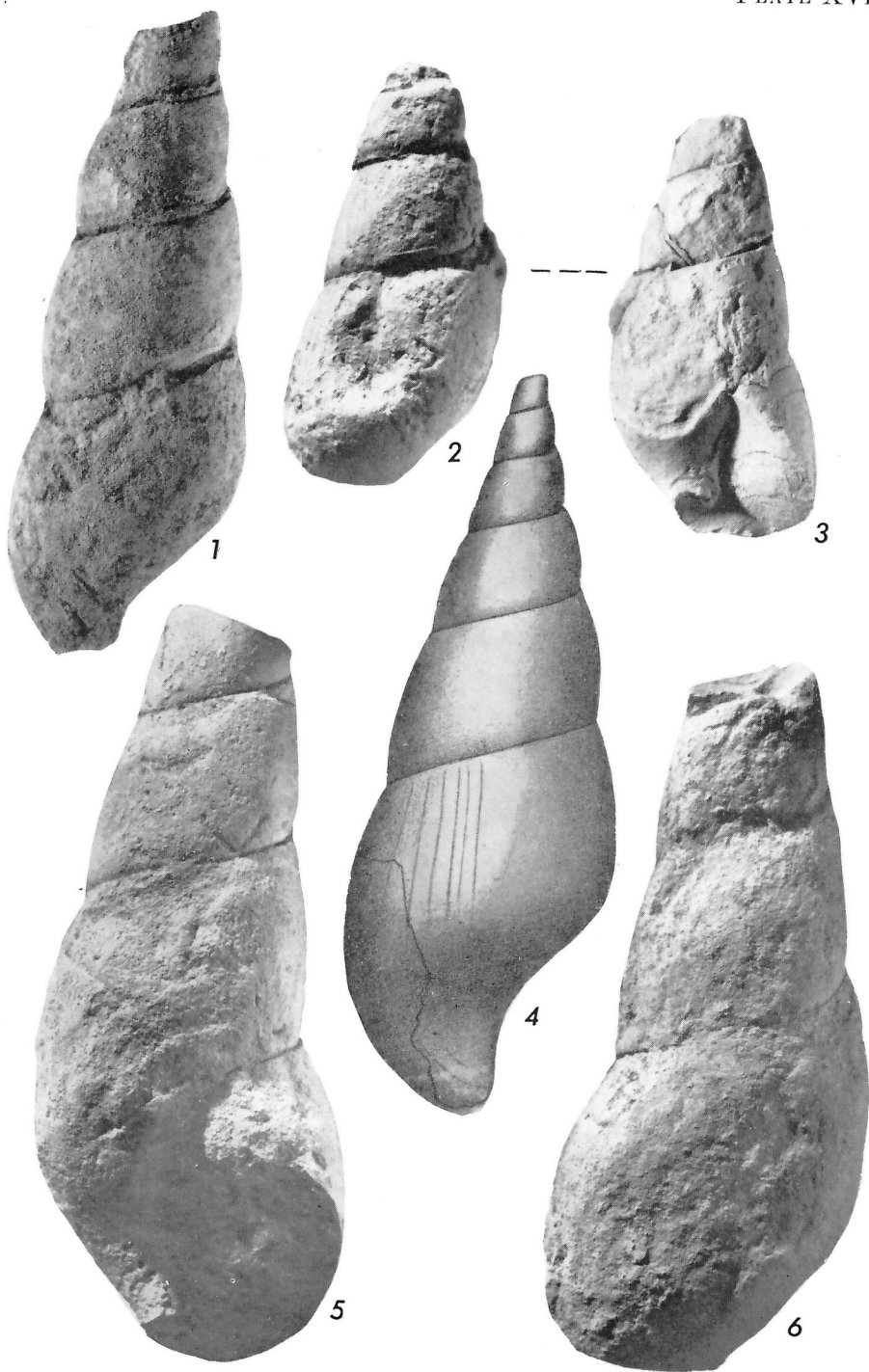


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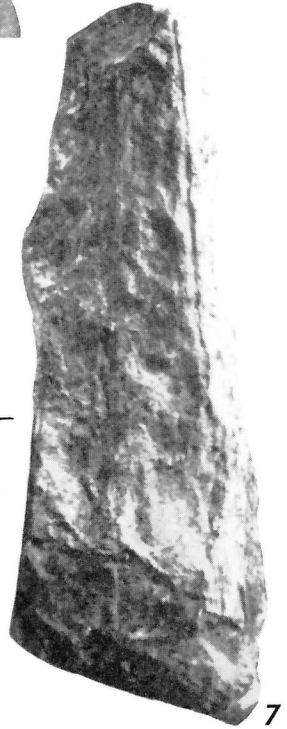
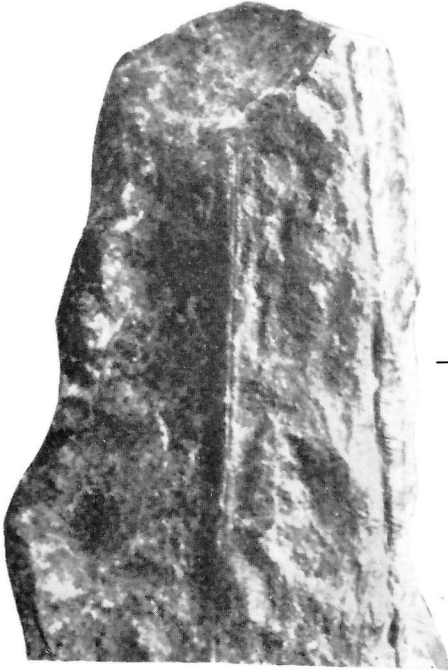
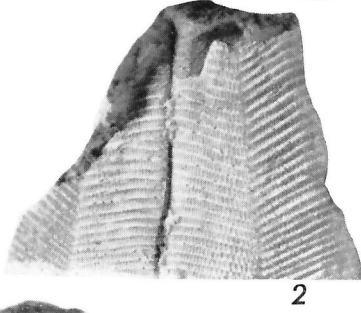
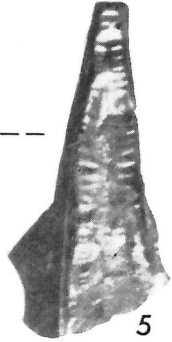
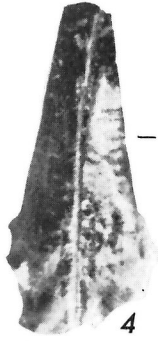
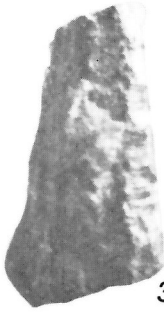
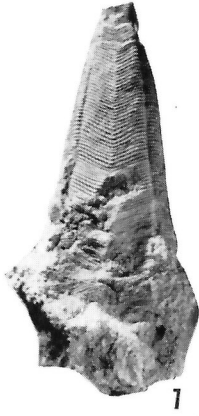
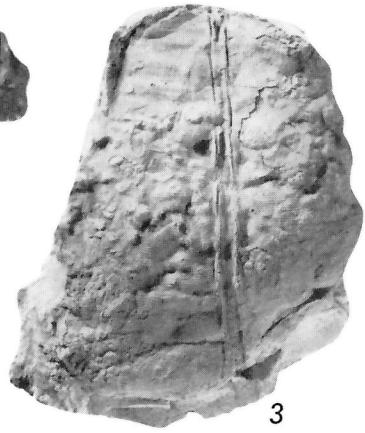
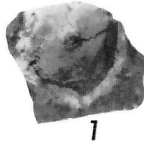


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