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**A MIDDLE ORDOVICIAN FAUNA  
FROM BRAESIDE, OTTAWA VALLEY, ONTARIO**

**H. Miriam Steele and G. Winston Sinclair**

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**By**

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**(Bryozoa by Thomas E. Bolton; Ostracoda by M. J. Copeland)**

**DEPARTMENT OF  
ENERGY, MINES AND RESOURCES  
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## PREFACE

This well-preserved and previously unstudied Middle Ordovician fossil assemblage provides additional information on which to correlate rocks of part of the Ottawa Formation with the stratotype in New York State. Precise determination of stratigraphic units in the Ottawa Embayment permits greater accuracy in determination of Phanerozoic history along the southern flank and in outliers on the Canadian Shield. Such studies provide much of the younger structural and tectonic information of a Precambrian area of great economic importance to Canada.

Y.O. Fortier,  
Director, Geological Survey of Canada

Ottawa, February 8, 1971

BULLETIN 211 — Eine mittelordovische Fauna  
aus Braeside im Ottawa-Tal (Ontario)  
Von H. M. Steele und G. W. Sinclair

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БЮЛЛЕТЕНЬ 211 — Фауна среднего ордовика  
из окрестности деревни Бресайд, долина  
реки Оттава, провинция Онтарио  
Х. М. Стил и Г. В. Синклер

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A MIDDLE ORDOVICIAN FAUNA FROM BRAESIDE,  
OTTAWA VALLEY, ONTARIO

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Abstract

A well-preserved fauna from the Middle Ordovician Wilderness Stage near Braeside, Ontario, consists of seven species of paleocyphods, thirteen gastropods, one hyolithid, eight cephalopods, eight brachiopods, eight corals, six trilobites, two crinoids, one edrioasteroid, one stellaroid, nineteen ostracodes, and eight genera of bryozoans. Fine silicification of the molluscs and brachiopods has resulted in the preservation of delicate internal and external features. Most corals and some bryozoans are coarsely silicified and poorly preserved. The trilobites, echinoderms and ostracodes are delicately preserved but unsilicified. Specimens are sufficiently common to permit assessment of morphological variations in several species; many previously erected species from the Ottawa Valley appear conspecific. Six new species are described.

Résumé

Un assemblage faunique en bon état de conservation de l'étage du Wilderness de l'Ordovicien moyen, découvert près de Braeside, Ontario, comprend sept espèces de pélicypodes, treize gastéropodes, un hyolithidé, huit céphalopodes, huit brachiopodes, huit coraux, six trilobites, deux crinoïdes, un édrioastéroïde, un stellaroïde, dix-neuf ostracodes et huit genres de bryozoaires. La silicification très fine des mollusques et des brachiopodes a assuré la préservation de caractères internes et externes délicats. La majorité des coraux et quelques bryozoaires sont inégalement silicifiés et mal conservés. Les trilobites, échinodermes et ostracodes sont bien conservés mais non silicifiés. Les échantillons sont suffisamment répandus pour permettre l'évaluation des variations morphologiques de plusieurs espèces, et nombre d'espèces fauniques antérieurement relevées dans la vallée de l'Outaouais semblent correspondre aux espèces fauniques de Braeside. L'auteur décrit six nouvelles espèces.

## INTRODUCTION

A well-preserved fauna was collected from Ordovician beds in the Braeside quarry of Smith Construction Company Limited, two miles west of Braeside, Ontario (Fig. 1), Concession A, McNab Township, Renfrew County (GSC Locality 76063). The flanks of the hill into which the quarry is cut are covered with Pleistocene sand and gravel containing abundant pelecypod shells. Ordovician limestone beds at three levels near the quarry are glacially polished and striated.

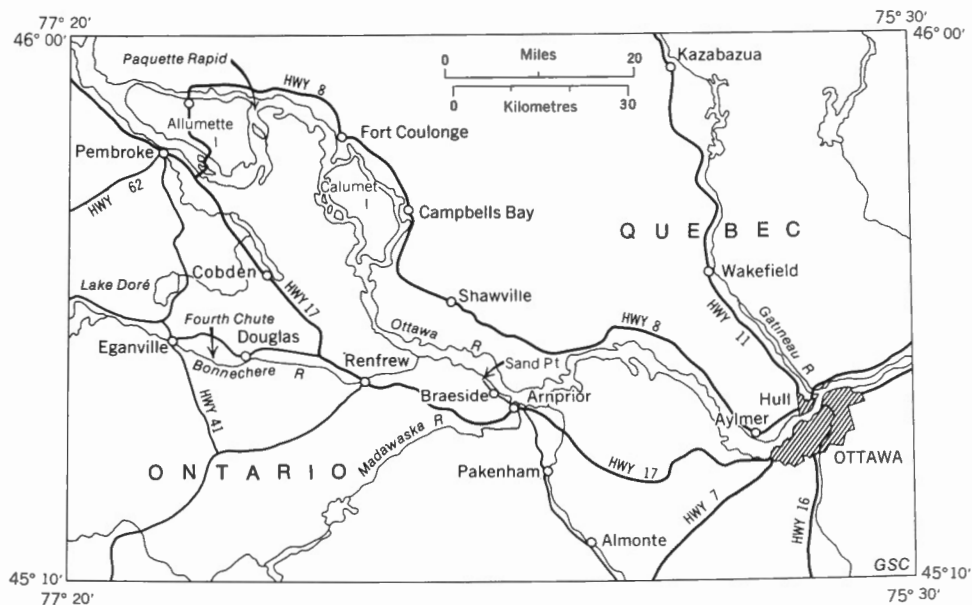


Figure 1. Locality map, Braeside area, Ontario.

All specimens were collected from a five-foot-thick section of flat-lying, thin-bedded (one-half inch to six inches), shaly calcarenite exposed in an area of less than 1,000 square feet (Fig. 2). Most of the specimens were obtained by dissolving about 500 pounds of limestone in 10 to 15 per cent formic acid. The residues contained abundant, finely silicified pelecypods, gastropods and brachiopods. The morphological descriptions of these well-preserved specimens (Table I) add greatly to the knowledge of previously described species from the Middle Ordovician of Ottawa Valley and northeaster North America. Cephalopods, coelenterates and bryozoans are common and often silicified but

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usually are poorly preserved. Unsilicified echinoderms, trilobites and ostracodes are well preserved and occur commonly on rock surfaces or in shaly interbeds. A paleoecological and environmental study of sedimentation during the Wilderness Stage in the Ottawa Valley is in progress.

#### Acknowledgments

A study of the Braeside molluscan fauna was presented by Steele in 1966 to the University of Ottawa in partial fulfillment of the Master of Arts degree. E. Thorpe photographed the fossils, J.J. Callahan prepared the fossil thin sections.



Figure 2. Fossiliferous beds at base of Smith Construction Company Limited quarry near Braeside (115789).

#### STRATIGRAPHY

(G. Winston Sinclair)

In the Ottawa area, a stratigraphic interval, for the lower part of which the informal name "Braeside" is here applied, has been assigned several names which have served to obscure its relationships. Historically, the name "Black River" became attached to such rocks exposed at Petit Chaudiere Rapid in the Ottawa River. Lithologically, they did not resemble the Black River Group of New York State and faunally it was very difficult to make a comparison, because typical Black River fossils other than large cephalopods were unknown. Nevertheless, in Canadian usage, "Black River" came to mean the Petit Chaudiere beds, and fossils found in these beds, the "Black River fauna". This fauna was described by Billings, Raymond and Narraway, Foerste, and Wilson. As the

Table I. Faunal list, Braeside beds

Cryptophragmus sp.	Hormotoma salteri canadensis Ulrich and Scofield
Lambeophyllum profundum (Conrad)	Helicotoma planulata Salter
Paleoalveolites carterensis (Bassler)	Subulites cf. regularis Ulrich and Scofield
Tetradium fibratum Safford	Holopea sp.
T. clarki Okulitch	Hyalithes cf. baconi (Whitfield)
T. columnare (Hall)	Loganoceras regulare (Billings)
Foerstephyllum halli (Nicholson)	Zitteloceras sp.
Favistina sp.	Actinoceras cf. aequale Flower
Lichenaria typa Winchell and Schuchert	Ormoceras sp.
"Aulopora" wilsonae Sinclair	Michelinoceras spp.
Cornulites sp.	"Spyroceras" sp.
Heterotrypa sp.	Monomuchites? decrescens (Billings)
DeKayia sp. cf. D. typica Fritz	"Cycloceras" cylindratum (Foerste)
Homotrypa sp. cf. H. lowvillensis Fritz	Nanillaenus conradi (Billings)
Nicholsonella sp. cf. N. wilsonae Fritz	Bumastoides milleri (Billings)
Monotrypella sp.	Raymondites spiniger (Hall)
Pachydictya spp.	Ceraurus pleurexanthemus Green
Phyllodictya(?) sp.	Isotelus sp.
Stictopora sp.	Calyptaulax? sp.
Rostricellula cf. minnesotensis (Sardeson)	Bythocypris? cylindrica (Hall)
Glyptorthis rocklandensis (Wilson)	B.? granti Ulrich
Pionodema cooperi n. sp.	Cryptophyllum oboloides Ulrich and Bassler
Doleroides germanus n. sp.	Byrsolopsina planilateralis (Kay)
Hallina canadensis n. sp.	Saccolatia arrecta (Ulrich)
Oepikina tumida Wilson	Diplopsis sp. cf. D. frequens (Steusloff)
Rafinesquina sp.	Krausella arcuata Ulrich
Strophomena sp.	K. calvini (Kay)
Cyrtodonta grattanensis Wilson	Apatochilina? sp.
Vanuxemia inconstans Billings	Punctaparchites rugosus (Jones)
Cyrtodontula ottawana n. sp.	Hallatia particylindrica Kay
Cleionychia naba n. sp.	Tetradella ulrichi Kay
Ctenodonta nasuta (Hall)	Levisulculus michiganensis Kesling
Tancrediopsis contracta (Salter)	Schmidtella affinis Ulrich
T. "abrupta" (Billings)	Leperditella sp. cf. L. tumida (Ulrich)
Lophospira milleri (Miller)	Dicranella bicornis Ulrich
L. perangulata (Hall)	Macronotella sp.
L. serrulata (Salter)	Eurychilina subradiata Ulrich
Trochonema wilsonae n. sp.	Eoleperditia? sp.
Raphistomina fissurata n. sp.	Ectenocrinus n. sp.
Clathrospira subconica (Hall)	new crinoid genus, aff. Archaeocrinus
Tetranota cf. bidorsata (Hall)	Urasterella cf. grandis (Meek)
Phragmolites? sp.	Foerstediscus cf. grandis Bassler
Pterotheca expansa (Emmons)	

Table II. Faunal list, Paquette Rapid, Ottawa River. (As recognized by A.E. Wilson, 1946a, *et seq.* There has been no attempt to reverse or correct these identifications)

<i>Solenopora? paquettiana</i> Ami	<i>Zygospira recurvirostris</i> (Hall)
<i>Hindia parva</i> Ulrich	
<i>Receptaculites occidentalis</i> Salter	<i>Ctenodonta abrupta</i> Billings
	<i>C. astartaeformis</i> Salter
<i>Streptelasma corniculum</i> Hall	<i>C. contracta</i> Salter
<i>Lambeophyllum? apertum</i> (Billings)	<i>C. gibberula</i> Salter
<i>L.? apertum rotundum</i> Wilson	<i>C. levata</i> (Hall)
<i>L. profundum</i> (Conrad)	<i>C. Loganii</i> Salter
<i>Lindstromia whiteavesi</i> Foerste	<i>C. nasuta robusta</i> Ulrich
<i>Foerstephyllum halli</i> (Nicholson)	<i>Cyrtodonta affinis minuta</i> Wilson
<i>F. magnifica</i> (Okulitch)	<i>C. angusta</i> Wilson
<i>Lichenaria typa</i> Winchell and Schuchert	<i>C. canadensis</i> Billings
<i>Tetradium fibratum</i> Safford	<i>C. leucothea</i> Billings
<i>Calapoecia canadensis</i> Billings	<i>C. obtusa</i> (Hall)
<i>Paleoalveolites paquettensis</i> Okulitch	<i>C. rugosa</i> Billings
<i>Aulopora? wilsonae</i> Sinclair	<i>C. simplex</i> Wilson
	<i>C. spinifera</i> Billings
	<i>Vanuxemia phaseola</i> Wilson
<i>Stromatocerium rugosum</i> Hall	<i>V. rotundata</i> (Hall)
<i>S. rugosum tumidium</i> Wilson	<i>Clionychia subundata</i> Ulrich
<i>Labechia antiqua</i> Wilson	<i>C. undata</i> (Emmons)
<i>L. subcylindrica</i> James?	<i>Conocardium immaturum</i> Billings
	<i>C. paquettense</i> Wilson
<i>Eodinobolus canadensis</i> (Billings)	<i>Lyrodesma acuminatum</i> Ulrich
<i>E. magnificus</i> (Billings)	<i>Modiolopsis nais</i> Billings
<i>Plectorthis ottawaensis</i> Wilson	<i>Colpomya faba</i> (Emmons)
<i>P. pulchella</i> Wilson	<i>Goniophora carinata</i> (Hall)
<i>Platystrophia amoena</i> McEwen	
<i>Skenidioides billingsi</i> Schuchert and Cooper	<i>Priscochiton canadensis</i> (Billings)
<i>Hesperorthis tricenaria</i> (Conrad)	<i>Macroscenella superba</i> (Billings)
<i>Glyptorthis bellarugosa</i> (Conrad)	<i>Micropileus obesus</i> Wilson
<i>Onniella paquettensis</i> Sinclair	<i>Tryblidium erato</i> (Billings)
<i>Dalmanella rogata</i> (Sardeson)	<i>Sinuities cancellatus</i> (Hall)
<i>Dinorthis iphigenia media</i> Wilson	<i>S. cancellatus angularis</i> Wilson
<i>Doleroides gibbosus</i> (Billings)	<i>Salpingostoma billingsi</i> Wilson
<i>Sowerbyella sericea</i> (Sowerby)	<i>S. expansum</i> (Hall) var.
<i>Rafinesquina subtrigonalis</i> Wilson	<i>Phragmolites compressus</i> Conrad
<i>Oepikina platys</i> Wilson	<i>Tetranota charon</i> (Billings)
<i>Strophomena filitexta</i> (Hall)	<i>T. sexcarinatus</i> Ulrich and Scofield
<i>S. filitexta obesa</i> Wilson	<i>Tropidodiscus? argo</i> (Billings)
<i>S. venustula</i> Wilson	<i>Pterotheca expansa</i> (Emmons)
<i>Camarella hemiplicata</i> (Hall)	<i>Lophospira helicteres</i> (Salter)
<i>C. panderi</i> Billings	<i>L. medialis</i> Ulrich and Scofield
<i>C. volborthi</i> Billings	<i>L. milleri</i> (Miller)
<i>Eichwaldia subtrigonalis</i> Billings	<i>L. peracuta</i> Ulrich and Scofield
<i>Rhynchotrema increbescens</i> (Hall)	<i>L. perangulata</i> (Hall)
<i>L.? ottawaensis</i> (Billings)	<i>L. procris</i> (Billings)
	<i>L. saffordi</i> Ulrich and Scofield
	<i>L. serrulata</i> (Salter)

Table II. (Continued)

<i>L. ventricosa</i> (Hall)	<i>Anaspyroceras?</i> <i>paquettense</i> (Foerste)
<i>Hormotoma bellicincta</i> (Hall)	" <i>Spyroceras</i> " <i>allumettense</i> Foerste
<i>H. gracilis</i> (Hall)	" <i>S.</i> " <i>arcuoliratum</i> (Hall)
<i>H. salteri canadensis</i> Ulrich and Scotfield	" <i>S.</i> " <i>cylindratum</i> Foerste
<i>H. simplex paquettensis</i> Wilson	<i>Gorbyoceras tetreauense</i> Wilson
<i>H. trentonensis crassa</i> Wilson	<i>Paquettoceras allumettense</i> Foerste
<i>Omospira alexandra</i> (Billings)	<i>Centrocyrtoceras</i> cf. <i>subannulatum</i> (d'Orbigny)
<i>Liospira micula</i> (Hall)	<i>Barrandeoceras?</i> <i>vagrans</i> (Billings)
<i>L. vitruvia</i> (Billings)	<i>Actinoceras abortivum</i> Flower
<i>Eotomaria dryope</i> (Billings)	<i>A. billingsi</i> Foerste
<i>E. dryope plana</i> Wilson	<i>A.?</i> <i>glenni</i> Foerste and Teichert
<i>E. larvata</i> (Salter)	<i>A. paquettense</i> Foerste and Teichert
<i>E. supracingulata</i> (Billings)	<i>A. ruedemanni</i> Foerste and Teichert
<i>Ectomaria pagoda</i> (Salter)	<i>Gonioceras anceps</i> Hall
<i>Straparollina asperostriata</i> Billings	<i>G. paquettense</i> Flower
<i>S. circe</i> Billings	<i>G. obtusum</i> Flower
<i>S. eurydice</i> Billings	<i>Sactoceras?</i> <i>ottawaense</i> (Billings)
<i>Maclurites logani</i> (Salter)	<i>Ormoceras allumettense</i> (Billings)
<i>Helicotoma planulata</i> Salter	<i>O. obscurum</i> Wilson
<i>H. planulata muricata</i> Salter	<i>O. paquettense</i> Foerste
<i>H. spinosa</i> Salter	<i>Deiroceras paquettense</i> Foerste
<i>Raphistomina aperta</i> (Salter)	<i>Troedssonoceras pertinax</i> (Billings)
<i>R. aperta ampla</i> Wilson	<i>Allumettoceras paquettense</i> (Foerste)
<i>R. lapicida</i> (Salter)	<i>A. tenerum</i> (Billings)
<i>Trochonema umbilicatum</i> (Hall)	<i>Tripterocheras hastatum</i> (Billings)
<i>T. umbilicatum canadense</i> Ulrich and Scotfield	<i>Beloitoceras clochense</i> Foerste?
<i>Eunema strigillatum</i> Salter	<i>Oncoceras constrictum</i> Hall
<i>Daidia cerithioides</i> (Salter)	<i>O.?</i> <i>scalariforme</i> Wilson
<i>Gyronema semicarinarum</i> (Salter)	<i>Richardsonoceras falx</i> (Billings)
<i>Trechonemella?</i> <i>arachne</i> (Billings)	<i>Zitteloceras billingsi</i> (Salter)
<i>Cyclonema hallianum</i> Salter	<i>Z. hallianum</i> (d'Orbigny)
<i>Holopea nereis</i> Billings	<i>Loganoceras paquettense</i> Foerste
<i>H. nereis spiralis</i> Wilson	<i>L. regulare</i> (Billings)
<i>H. lavinia conica</i> Wilson	<i>Cyrtocerina typica</i> Billings
<i>H. obliqua</i> Hall	
<i>H. pyrene</i> Billings	<i>Raymondites ingalli</i> (Raymond)
<i>H. rotunda</i> Ulrich and Scotfield	<i>Isotelus gigas</i> deKay
<i>Subulites regularis</i> Ulrich and Scotfield	
<i>Cyrtospira parvula</i> (Billings)	<i>Hemiphragma ottawaense</i> (Ford)
<i>Loxonema murrayana</i> Salter	<i>Nicholsonella wilsonae</i> Fritz
<i>Nanno kingstonensis</i> Whiteaves	<i>Pachydictya acuta</i> Hall
<i>Vaginoceras multitubulatum</i> (Hall)	<i>Monotrypella aequalis</i> Ulrich
<i>Murrayoceras multicameratum</i> (Emmens)	
<i>Michelinoceras?</i> <i>ontarioense</i> (Foerste)	<i>Leperditia canadensis paquettiana</i> Jones
<i>Kionoceras allumettense</i> Foerste	<i>Cytheropsis concinna</i> Jones
<i>K.?</i> <i>paquettense</i> Foerste	<i>C. siliqua</i> Jones
	<i>Macronotella rugosa</i> (Jones)

terms "Leray" and "Chaumont" were successively introduced in New York State they were adopted and applied to the beds under discussion.

The lower, or "Braeside", beds are characterized lithically by their diversity. Finely fragmental limestone, to 3 feet thick, alternates with 3- to 5-foot intervals of more thinly bedded limestones of many varieties. Some beds are calcilutites and might (if the fossils were ignored) be mistaken lithologically for subjacent Lowville rocks. Others are crinoidal, and resemble parts of the Ottawa "Cystid beds". Most are 1- to 2-inch beds of brittle, very slightly argillaceous, limestone which on weathering tend to break into sharp chips.

The upper contact of the "Braeside" unit is exposed at many places between Ottawa and Pembroke. There, the upper, more massive "Paquette Rapid" limestone beds, such as those exposed in the upper part of the Braeside quarry (Hewitt, 1964, Fig. 3), tend to protect the less competent "Braeside" beds beneath them. The subjacent Lowville unit is less frequently seen west of Ottawa and its presence in the Bonnechere and Pembroke outliers has not been clearly demonstrated.

The term "Black River" was applied to both the "Braeside" and "Paquette Rapid" beds, but it should be stressed that each has a distinct, related fauna. Billings acknowledged this in 1858, but subsequent terminology ("Leray" and "Chaumont") has obscured it. For convenience, we list our "Braeside" fauna (Table I), and that of the "Paquette Rapid" beds (Table II) compiled uncritically from Wilson's several publications. It will be seen that many species occur in both faunas, as would be expected in adjacent beds of the same stage.

Some of the more striking differences may be least important, for example the lack in the "Braeside" of *Maclurites* and its associates such as *Eodinobolus* and *Receptaculites*. These genera seem to be tied to a coarsely fragmental facies and to occur wherever conditions permit. Much more important are the small brachiopods, which are usually abundant and ubiquitous. The "Paquette Rapid" genera *Hesperorthis*, *Paucicmura* (*Dalmanella*, auctt.) and *Sawerbyella* are lacking in the "Braeside", where their niche is occupied by *Pionodema* and *Doleroides*. Other such comparisons are possible from the tables.

#### SYSTEMATIC PALEONTOLOGY

##### PELECYPODA

Genus *Cyrtodonta* Billings, 1857

Type species. *Cyrtodonta rugosa* Billings, 1857

*Cyrtodonta grattanensis* Wilson

Plates I-III; Plate VI, figures 6, 7; Plate VII, figures 1, 2

*Cyrtodonta canadensis* Billings, 1857, p. 20, Fig. 9 (not Figs. 8, 10); 1858, p. 434, Fig. 9 (not Figs. 8, 10); 1858, p. 182, Fig. 9 (not Figs. 8, 10).

*Cyrtodonta grattanensis* Wilson, 1956, p. 34, Pl. III, figs. 19, 20.

*Cyrtodonta modesta* Wilson, 1956, p. 37, Pl. III, fig. 18.

*Cyrtodonta mediocris* Wilson, 1956, p. 36, Pl. IV, fig. 11.

*Cyrtodonta* cf. *subangulata*, Wilson, 1956, p. 36, Pl. IV, fig. 10.

*Cyrtodonta oviformis*, Wilson, 1956, p. 38, Pl. III, fig. 17.

*Cyrtodonta glabella*, Wilson, 1956, p. 33, Pl. III, fig. 14 (not figs. 12, 13).

Material. Nine specimens with both valves (four attached, five separated); twenty-three left valves, twenty-seven right valves. Hypotypes, GSC Nos. 22252-22285, 22314-22315.

### Description.

#### Exterior.

Valves obliquely subquadrate to elliptical; moderately thick; tumidity moderate to strong. Anterior margin and hinge line meeting at an angle between 35 (Pl. II, fig. 2; Pl. VII, fig. 1) and 64 degrees (Pl. I, fig. 7); usually 45 to 55 degrees. Posterior margin and hinge line meeting at between 110 and 139 degrees. Hinge line straight with narrow external ligamental area behind the beak; no lunule or escutcheon present. Beak incurved, small but prominent, situated close to anterior end. Umbo broadly rounded; umbonal ridge weak, extending obliquely toward posterior ventral margin. Surface of shell sloping moderately steeply from umbonal ridge to anterior margin; sloping gently to posterior margin. Posterior and ventral margins broadly rounded; anterior margin straight but often possessing a sinus, either weak (Pl. II, figs. 1, 4, 6) or pronounced (Pl. I, fig. 6; Pl. III, fig. 6). Growth lines concentric about umbo, meeting in front of the beak, closely spaced posteriorly, more widely separated along the diagonal.

#### Interior.

Hinge plate yoke-shaped. Anterior lateral teeth on hinge plate, immediately beneath and in front of beak, usually three in number but rarely one (Pl. VII, fig. 1), two (Pl. II, figs. 4, 6), or four (Pl. II, fig. 1; Pl. III, figs. 2, 5, 6); teeth slightly variable, usually prominent, nearly straight and subparallel or slightly oblique to hinge line. Anterior adductor scar distinct and subcircular, situated beneath the anterior lateral teeth on the floor of the valve. Many valves with an elongate impression about the width of the muscle scar, parallel to anterior margin of shell and extending from muscle scar to middle of the valve; impression either weak or prominent (Pl. I, fig. 6; Pl. II, figs. 3, 6, 7; Pl. III, figs. 3, 5, 6) but never as deeply impressed as muscle scar and always separate from it. Some valves with a low ridge adjacent to inner boundary of this impression (Pl. II, figs. 3, 6, 7; Pl. III, figs. 5, 6), extending from beneath umbo to middle of the valve. Posterior adductor scar larger than anterior adductor scar but very faint, situated behind posterior lateral teeth on floor of the valve.

Discussion. Specimens of *Cyrtodonta grattanensis* from Braeside show that considerable morphological variation occurs within this species. Statistical and ecological studies of this species are planned for the future. Many species of *Cyrtodonta*, often based on poorly preserved specimens, have previously been recorded from the Ottawa area. Some of those species are here placed in synonymy.

1. From Paquette Rapid, Allumette Island, near Pembroke, Ontario.
- C. rugosa* Billings: (Billings, 1857b, p. 18; 1858a, p. 179; 1858b, p. 432; Wilson, 1956, p. 40). Designated as the type species by Williams and Breger, 1916, p. 149. Syntype, GSC No. 1186 here designated as lectotype (holotype of Wilson, 1956); paralectotypes, GSC Nos. 1186a, b.
- C. leucothea* Billings: (Billings, 1862, p. 46; Wilson, 1956, p. 36). Syntypes, GSC No. 1188 (holotype of Wilson, 1956), 1188a, b (paratypes of Wilson).
- C. simplex* Wilson: (Wilson, 1956, p. 41). Holotype, two valves of one specimen, GSC Nos. 11565, a.
- C. affinis minuta* Wilson: (Wilson, 1956, p. 31). Holotype, GSC No. 11563; paratypes, GSC Nos. 11563a, b.
- C. canadensis* Billings: Billings, 1857b, p. 20; 1858a, p. 182; Wilson, 1956, p. 32). Syntype, GSC No. 1177 here designated as lectotype (holotype of Wilson); paralectotype, GSC No. 1177a.



*C. angusta* Wilson: (Wilson, 1956, p. 31). Holotype, GSC No. 11564; paratype, GSC No. 11564a.

Visible internal and external features indicate that *C. leucothea*, *C. simplex*, and *C. affinis minuta* are conspecific with *C. rugosa*. It is possible that additional material from Paquette Rapid would suggest conspecificity of all previously designated species from that locality. However, compared with *C. rugosa*, *C. canadensis* is much larger and *C. angusta* more tumid. For the present, *C. canadensis* and *C. angusta* must remain as separate species.

*C. obtusa* (Hall): (Billings, 1857b, p. 22; 1858a, p. 184; 1858b, p. 436; Wilson, 1956, p. 37). Hypotypes, GSC Nos. 1187, a, b, e.

*C. spinifera* Billings: (Billings, 1857b, p. 22; 1858a, p. 183; 1858b, p. 435; Wilson, 1956, p. 41). Syntypes, GSC Nos. 1185b (holotype of Wilson), 1185, a, c (paratypes of Wilson).

Compared with a mature specimen of *Cyrtodonta*, a mature specimen of *Vanuxemia* has a thicker shell, more steeply sloping anterior surface, thicker more contorted anterior teeth which are situated more obliquely to the hinge line, more prominent beak, and umbo situated closer to the anterior margin of the shell. The anterior adductor scar of *Cyrtodonta* is situated on the floor of the valve (Ulrich, 1894, p. 550); in a mature *Vanuxemia* it is carved out of the hinge plate. Immature specimens of *Cyrtodonta* are similar to the adults but smaller. On the basis of material from Braeside, it appears as if immature specimens of *Vanuxemia* have morphological characteristics intermediate between those of mature cyrtodontas and mature vanuxemias; they are often circular with submarginal beaks, and have anterior adductor scars impressed partially in the hinge plate and partially on the floor of the valve (see following discussion of *Vanuxemia*). The above specimens of *C. obtusa* and *C. spinifera* with circular outline, submarginal beaks, and anterior adductor scars situated both in the hinge plate and on the floor of the valve appear to be juvenile specimens of the genus *Vanuxemia*.

## 2. From areas other than Paquette Rapid.

*C. grattanensis* Wilson: (Wilson, 1956, p. 34). Holotype, GSC No. 1179; Leray beds, lower part of the gorge, Fourth Chute, Bonnechere River, Ontario.

*C. modesta* Wilson: (Wilson, 1956, p. 37). Holotype, GSC No. 1183a; paratype, GSC No. 1183b; Leray beds, La Petite Chaudière, Quebec.

*C. mediocris* Wilson: (Wilson, 1956, p. 36). Holotype, GSC No. 13435; Leray beds, Mechanicsville, Ottawa, Ontario.

*C. cf. subangulata* (Hall): (Wilson, 1956, p. 42). Hypotype, GSC No. 11566; Leray beds, La Petite Chaudière, Quebec.

*C. oviiformis* Ulrich: (Wilson, 1956, p. 38). Hypotype, GSC No. 11536; Leray beds, La Petite Chaudière, Quebec.

*C. glabella* (Ulrich): (Wilson, 1956, p. 33). Hypotype, GSC No. 11535; Leray beds, Val Tetreau, Quebec.

The same stratigraphic horizon occurs at La Petite Chaudière, Val Tetreau, and Mechanicsville, localities on both sides of the Ottawa River at Ottawa, at Braeside, and the lower part of the gorge at Fourth Chute of the Bonnechere River. The above species *sensu* Wilson are represented by one or two specimens each, and therefore appear to be morphologically different. However, Wilson's specimens fit within the wide range of characteristics possible for *C. grattanensis* found at Braeside. The above mentioned are here assigned to *C. grattanensis*. The name *C. grattanensis* is used, because its type specimen is fairly well preserved and Wilson's specimens of *C. modesta*, *C. mediocris*, *C. cf. subangulata*, *C. oviiformis*, and *C. glabella* are more poorly preserved.

*C. subcarinata* Billings: (Billings, 1857b, p. 19; 1858a, p. 181; 1858b, p. 433; Wilson, 1956, p. 43). Syntype, GSC No. 1184 (holotype of Wilson) here designated lectotype; Black River beds, Point Claire, Quebec.

*C.?* *subquadrata* Wilson: (Wilson, 1956, p. 43). Holotype, GSC No. 11567; Lowville beds, lot 3, Con. III, Gloucester Tp., near Ottawa, Ontario.

The holotype of *C.?* *subquadrata* is poorly preserved but the strong umbonal ridge suggests synonymy with *C. subcarinata* Billings.

*C. breviscula* Billings: (Billings, 1859c, p. 446; Wilson, 1956, p. 31). Holotype, GSC No. 1051; Pamela beds, Skead Road, Ottawa, Ontario.

The above species appears to be valid.

3. Type material of the following species is too poorly preserved to permit generic identification or comparison with other species:

*C. rocklandensis* Wilson: (Wilson, 1956, p. 39). Holotype, GSC No. 11537; paratype, GSC No. 11537a; Leray beds, Rockland, Ontario.

*C.?* *planumbona* Wilson: (Wilson, 1921, p. 52; 1956, p. 39). Holotype, GSC No. 6223; paratype, GSC No. 6223a; Pamela beds, Maclaren's Landing, Ontario.

*C.?* *cornwallia* Wilson: (Wilson, 1932b, p. 401; 1956, p. 33). Holotype, GSC No. 6661; Sherman Fall beds, Con. V, Osnabruck Tp., Ontario.

Genus *Vanuxemia* Billings, 1857

Type species. *Vanuxemia inconstans* Billings, 1857

*Vanuxemia inconstans* Billings

Plate IV, figures 1-11; Plate V, figures 1-5

*Vanuxemia inconstans* Billings, 1857, p. 25, Figs. 15, 16; 1858, p. 438, Figs. 15, 16; 1858, p. 186, Figs. 15, 16; Wilson, 1956, p. 46, Pl. VI, figs. 3-5.

Material. Forty-nine valves: twenty-nine right valves, twenty left valves. Hypotypes, GSC Nos. 22286-22311.

#### Description.

##### Exterior.

Shell tumid. Large specimens sub-ovate with shell gradually expanding from umbo to ventral margin (Pl. IV, fig. 11; Pl. V, fig. 5); small specimens more circular (Pl. IV, figs. 1, 4, 5). Shell of all specimens thick. Beak prominent and incurved, in large specimens situated above the anterior end of hinge plate (Pl. IV, figs. 7-10; Pl. V, figs. 1, 4) but in smaller specimens situated slightly behind anterior end (Pl. IV, figs. 1, 4, 5). Umbo broadly rounded. Surface of shell steeply sloping from umbo to anterior margin; gently sloping to posterior margin. Hinge line straight or gently curved, in some specimens curving slightly over anterior teeth (Pl. V, fig. 4). Cardinal area gently arched; no lunule or escutcheon. Ligamental area externally situated behind the beak, sometimes with faint longitudinal striations (Pl. IV, figs. 3, 6-8; Pl. V, fig. 4). Posterior and ventral margins broadly rounded. Anterior region of small specimens broadly rounded and projecting forward beyond hinge line (Pl. IV, figs. 1, 4, 5), curvature and prominence of this area decreasing with size of specimens. Immediately beneath beak of large specimens anterior margin forms a depression into which the hinge plate projects as a small anterior ear. Ornamentation limited to strong concentric growth lines, meeting in front of the beak and at posterior end of hinge line, and more widely separated along the diagonal.

### Interior.

Hinge plate yoke-shaped. Two to four anterior teeth, elongate, slightly curved, infrequently sharply bent (Pl. V, fig. 4), and often striate, situated above anterior muscle scar, subparallel to and at anterior end of hinge plate. Two to four posterior teeth situated obliquely to hinge line at posterior end of hinge plate, elongate, straight or very slightly curved, and occasionally striate. Anterior adductor impression circular and strong, in large specimens embedded in hinge plate (Pl. IV, figs. 3, 6, 8, 10; Pl. V, figs. 1, 4) but in smaller specimens partially in hinge plate and partially on floor of valve (Pl. IV, figs. 1, 4, 5). Posterior adductor impression faint or absent, circular to elliptical and situated on floor of valve beneath posterior end of teeth.

Discussion. Specimens of *Vanuxemia inconstans* from Braeside, indicate that considerable morphological variation occurs within the species. Circular, immature specimens with submarginal beaks and muscle scars partially on the floor of the shell resemble the genus *Cyrtodonta*. However, the anterior muscle scar of a young *Cyrtodonta* is situated entirely on the floor of the valve. As a young *Vanuxemia* increases in size the hinge plate appears to expand anteriorly and incorporate the anterior adductor impression. Statistical and ecological studies of this species are planned.

1. List of species of *Vanuxemia* previously recorded from Ottawa area.

*V. inconstans* Billings: (Billings 1857b, p. 25; 1858a, p. 186; 1858b, p. 438; Wilson, 1956, p. 46). Designated as type species by Miller (1889, p. 515). GSC No. 1174c here designated lectotype; GSC Nos. 1174a, b, paralectotypes; Black River beds, Fourth Chute, Bonnechere River, Ontario.

Billings did not record the stratigraphic horizon at Fourth Chute from which the type specimens of *V. inconstans* were collected. The original label has been lost but Wilson stated that these specimens came from Leray-Rockland beds. Wilson usually used the term "Leray-Rockland" in reference to beds at the top of the gorge at Fourth Chute. The fossils at that level are highly silicified and *V. inconstans*, if present, is very rare. However, this species is common lower in the gorge, in beds faunally similar to those at Braeside, and it is from there that the type specimens were probably collected.

*V. canadensis* Wilson: (Wilson, 1956, p. 45). Holotype, GSC No. 11569; paratypes, GSC Nos. 11569a, 11570. Nos. 11569, a, upper Trenton beds, Highway 17, about 4 miles west of L'Orignal, Ontario; No. 11570, upper Trenton beds, Jackson Quarry, near L'Orignal, Ontario.

*V. tatrix* Wilson: (Wilson, 1956, p. 51). Holotype, GSC No. 11576; paratypes, GSC Nos. 11576a, 11577. Nos. 11576, a, upper Trenton beds, Highway 17, about four miles west of L'Orignal, Ontario; No. 11577, Leray beds, lots 3 and 4, Con. III, Gloucester Tp., Ontario.

No internal structures are visible on the holotype of *V. tatrix* but external shape indicates it to be a *Cyrtodonta*. Paratype, GSC No. 11577 also appears to be a *Cyrtodonta* but not *C. tatrix*. The specimen is too poorly preserved to permit accurate identification. Paratype, GSC No. 11576a belongs to *V. canadensis* Wilson.

*V. suberecta* Ulrich: (Wilson, 1956, p. 50). Hypotype, GSC No. 11575; Leray beds, lot 3, Con. III, Gloucester Tp., Ontario.

*V. rotundata* (Hall): (Wilson, 1956, p. 49). Hypotype, GSC No. 11573; Leray beds, quarry southeast of Green's Creek and Highway 17, Ottawa.

*V. gibbosa* Ulrich?: (Wilson, 1956, p. 46). Hypotype, GSC No. 11571; Leray beds, Val Tetreau, Quebec.

The hypotypes of *V. suberecta* and *V. rotundata* are steinkerns of the same species. The hypotype of *V. gibbosa* is poorly preserved, but its gibbosity and stratigraphic occurrence suggest that *V. gibbosa*, *sensu* Wilson, also belongs to that species. Comparison with the diagrams of Ulrich's (1894, Pl. XXXVIII, figs. 8-14, 20-22) steinkerns is difficult. More specimens and further study is required to determine the affinities of this species.

*Vanuxemia obtusa* (Hall) *sensu* Billings (*see* above under *Cyrtodonta*) is morphologically similar to immature specimens of *V. inconstans* found at Braeside. However, more material from Paquett Rapid and further study is needed to determine conspecificity.

*V. phaseola* Wilson: (Wilson, 1956, p. 48). Holotype, GSC No. 11572; paratype, GSC No. 11572a; Paquette Rapid, Ottawa River, Ontario.

The holotype belongs to the species *Vanuxemia obtusa* (Hall) *sensu* Billings. The paratype is too incomplete for generic identification.

*V. parvula* Whiteaves: (Whiteaves, 1908, p. 111; Wilson, 1956, p. 47). Syntype, GSC No. 6804 here designated lectotype; paralectotype, GSC No. 6804a; Pamelia beds, east side of falls, Hogsback, Ottawa, Ontario.

*V. skeadensis* Wilson: (Wilson, 1956, p. 49). Holotype, GSC No. 11574; paratype, GSC No. 11574a; Pamelia beds, hillside National Research Council Laboratories, north of Highway 17, Ottawa, Ontario.

The holotype and paratype of *V. skeadensis* are poorly preserved steinkerns. They are slightly larger than the type specimens of *V. parvula* but appear to belong to that species.

*V. ampla* (Ulrich): (Wilson, 1956, p. 44). Hypotype, GSC No. 13437; Hull beds, east side of Fairly Lake, Hull, Quebec.

This specimen is too poorly preserved to permit generic identification of comparison with other specimens.

Genus *Cyrtodontula* Tomlin, 1931

Type species. *Whitella obliquata* Ulrich, 1890

*Cyrtodontula ottawana* n. sp.

Plate VI, figures 3-5

Material. One specimen; both valves separated. Holotype, GSC No. 22312.

Description.

Exterior.

Shell obliquely subquadrate and tumid. Anterior margin at 50 degrees to hinge line; posterior margin at 140 degrees to hinge line. Shell of each valve thin. Hinge line straight; cardinal area with a wide escutcheon. Beak incurved, small but prominent, situated very close to anterior end of hinge line. Umbo tumid umbonal ridge prominent, extending toward ventral margin of the shell. Surface of shell sloping steeply from umbonal ridge to anterior margin; sloping gently to the posterior margin. Ventral margin broadly rounded; anterior and posterior margins almost parallel and nearly straight, although anterior margin with a pronounced sinus a little above midway between dorsal and ventral margins of shell. Growth lines strong, concentric about umbo, meeting in front of beak, closely spaced posteriorly and more widely separated along the diagonal.

Measurements: length of hinge line - 23 mm; length of diagonal - 44 mm; greatest length parallel to hinge line - 36 mm.

Interior.

Hinge plate very narrow except for a slightly expanded area in front of beak. Two very small anterior teeth in each valve situated on expanded

region of hinge plate. Internal surface with a faint ridge at posterior end of hinge line; ridge adjacent to a slight internal depression in posterior upper corner of shell, oblique to hinge line and meeting it about two-thirds the distance from anterior margin. Anterior adductor scar distinct and circular, situated in front of teeth on floor of valve. Inner edge of scar partially outlined by a slight ridge extending from beneath hinge plate. Posterior adductor scar faint, situated on floor of valve at posterior end of hinge line. Pallial line visible.

Discussion. The present species, compared with previously described species of *Cyrtodontula*, has the beak closer to the anterior end. The external shape is similar to that of *Cyrtodonta*, but *Cyrtodontula* has a more steeply sloping anterior surface and a more pronounced sinus in the anterior margin.

Genus *Cleionychia* Ulrich, 1892

Type species. *Ambonychia lamellosa* Whitfield, 1882

*Cleionychia naba* n. sp.

Plate V, figures 6-9

Material. One nearly complete left valve; fragments of the beak regions of six other specimens. Holotype, GSC No. 22313.

Description.

Exterior.

Shell obliquely subquadrangular and tumid. Posterior margin broadly rounded; ventral margin not preserved; anterior margin broadly rounded with a distinct indentation immediately beneath beak (Pl. V, figs. 6, 8). Shell thin except in beak region. Hinge line straight. Beak prominent, aligned with hinge line at anterior end of shell. Umbo broadly rounded. Umbonal ridge wide but poorly defined, extending obliquely toward the posterior ventral extremity. Surface of shell sloping steeply from umbonal ridge to anterior margin, more steeply sloping near hinge line than toward the ventral margin; shell very gently sloping toward posterior margin. Growth lines present near margin of shell, constructed beneath beak (Pl. V, fig. 9) and more separated ventrally. Borings present on surface of this shell (Pl. V, fig. 7).

Measurements: length of diagonal - 60 mm; greatest length parallel to hinge line - 52 mm; greatest height - about 35 mm.

Interior.

Hinge plate edentulous at anterior end, missing at posterior end; 3 mm wide at a point 35 mm behind beak, becoming narrower toward anterior end and disappearing at beak (Pl. V, fig. 8). Underside of beak hollowed into an elongate depression (Pl. V, fig. 8) with growth lines projecting forward in the depression and curving back slightly beneath beak. Floor of valve very poorly preserved.

Discussion. Good specimens of *Cleionychia* are rare because the shell is very thin and seldom preserved. Much of the former work: Hall (1861), Whitfield (1895), Ulrich (1894), Wilson (1956), was based on steinkerns. The present specimen is larger and longer relative to height than any previously recorded.

Genus *Ctenodonta* Salter, 1852

Type species. *Tellinomya nasuta* Hall, 1847

*Ctenodonta nasuta* (Hall) *sensu* Salter, 1859

Plate VI, figures 1, 2

?*Tellinomya nasuta* Hall, 1847, p. 152, Pl. XXXIV, figs. 3a-c; 1856, p. 392, Figs. 1-3.

*Ctenodonta nasuta*, Salter, 1859, p. 35, Pl. 8, figs. 1, 2; Logan, 1863, p. 176, Figs. 166a, b; Ulrich, 1894, p. 584, Pl. XLIII, fig. 30; Wilson, 1956, p. 26, Pl. II, figs. 19, 20.

Material. Four left valves, two right valves. Hypotypes, GSC Nos. 22316-22318.

Description.

Exterior.

Species transversely elongate; subovate with anterior margin broadly rounded and posterior margin sharply rounded; ventral margin nearly straight. Beak small, incurved and pointed posteriorly, situated just anterior to middle of shell. Umbo moderately tumid. Ligamental area situated in a narrow external groove, sharply defined behind dorsal projection of hinge plate, extending one-third to one-half the distance from beak to posterior margin of shell. Exterior of shell depressed along hinge line behind beak. Surface marked by growth lines.

Interior.

Hinge plate extending anteriorly about half the distance from beak to anterior end and posteriorly about half the distance from beak to posterior end; upper margin nearly straight; lower margin biconvex so that hinge plate beneath beak constricted to nearly half the width on each side. Teeth convexly curved outward near the outer ends, straight and oblique with tops directed outward near beak, straight and vertical beneath beak. Adductor impressions not seen. Hypotype, GSC No. 22316 with strongly impressed muscle scars in underside of hinge plate at each end of the teeth.

Discussion. Hall (1847, p. 153) based the genus *Tellinomya* on internal and external casts of *T. nasuta* from the Trenton of Middleville, New York State. In 1852 Salter proposed the name *Ctenodonta* for specimens having a hinge line with a "double series of bent teeth, connected by smaller ones beneath the beak" (see Salter, 1859, p. 34). Salter rejected the name *Tellinomya* as a synonym of *Ctenodonta* since Hall's specimens showed no characteristics of the hinge and teeth. However, he accepted Hall's specific name *nasuta*, naming specimens from Paquette Rapid *C. nasuta* (Hall). Ulrich (1894, p. 518) considered *Tellinomya* and *Ctenodonta* to be congeneric. He rejected the preoccupied name *Tellinomya* in favour of *Ctenodonta* and defined the genotype as *Ctenodonta nasuta* (Hall). He also described *C. nasuta* var. *robusta* from Paquette Rapid. *Robusta* compared with *nasuta* has "the anterior end higher and larger and the posterior end shorter, so that the beaks, instead of being in front of the midlength are just behind that point, the muscular impressions are deeper and the hinge plate is on the whole narrower and much less constricted in the middle" (Ulrich, 1894, p. 585).

The present specimens are similar to *C. nasuta* (Hall) *sensu* Salter (1859, p. 35) from Paquette Rapids. Examination of the holotype of *C. nasuta robusta* Ulrich in the United States National Museum would determine if it is conspecific with Salter's specimens of *C. nasuta*.

Genus *Tancrediopsis* Beushausen, 1895

Type species. *Ctenodonta contracta* Salter, 1859

*Tancrediopsis contracta* (Salter)

Plate V, figure 11

*Tellinomya cuneata* Hall, 1856, p. 392, Figs. 6, 7.

*Ctenodonta contracta* Salter, 1859, p. 37, Pl. VIII, figs. 4, 5; Logan, 1863, p. 175, Figs. 160a, b; Wilson, 1956, p. 23, Pl. II, figs. 7-9.

*Tancrediopsis cuneata* (Hall), McAlester, 1963, p. 5.

Material. Three specimens with both valves attached; six right valves, five left valves, two indeterminable valves. Hypotype, GSC No. 22319.

Description. See McAlester, 1963, pp. 5, 10 for a detailed description of this species.

Discussion. Hall (1856, p. 392) figured the species *Tellinomya cuneata* from Paquette Rapid. Salter (1859, p. 37) described *Ctenodonta contracta*, a probable synonym for *T. cuneata*, also from Paquette Rapid. Due to priority, McAlester (1963) re-erected *T. cuneata*, a name unused for more than fifty years except by Bassler (1915, p. 302). Because the type of *T. cuneata* is lost, synonymy with *contracta* is subjective; availability of the type *C. contracta* Salter, and general usage, indicates that *T. contracta* (Salter) should be the name of the species.

*Tancrediopsis "abrupta"* (Billings)

Plate V, figure 10

*Ctenodonta abrupta* Billings, 1862, p. 46, Figs. 48a-c; Logan, 1863, p. 175, Figs. 161a, b; Wilson, 1956, p. 21, Pl. II, figs. 3-6.

*Tancrediopsis "abrupta"*, McAlester, 1963, p. 12.

Material. Three specimens with both valves articulated; four right valves, three left valves. Hypotype, GSC No. 22320.

Description. See McAlester, 1963, pp. 5, 10 for a detailed description of this species.

Discussion. McAlester (1963, p. 12) assigned this species provisionally to *Tancrediopsis "abrupta"* Billings as "the name ... is not yet certain".

GASTROPODA

Genus *Lophospira* Whitfield, 1886

Type species. *Murchisonia bicincta* Hall, 1847

*Lophospira milleri* (Miller)

Plate VIII, figures 6-12

*Murchisonia bicincta* Hall, 1847, p. 177, Pl. XXXVIII, figs. 5a-h.

*Murchisonia milleri* Miller, 1877, p. 244.

*Lophospira bicincta*, Ulrich and Scofield, 1897, p. 964, Pl. LXXII, figs. 1-5.

*Lophospira milleri*, Knight, 1941, p. 179, Pl. 39, figs. 4a, b; Wilson, 1951, Pl. V, fig. 4.

*Lophospira saffordi*, Wilson, 1951, p. 38, Pl. V, fig. 5.

Material. Sixty-five specimens; various states of preservation. Hypotypes, GSC Nos. 22321-22340.

Description. Spire moderately high, five or six tricarinate whorls coiled about a narrow umbilicus. Middle carina strongest, forming periphery of shell. Upper and lower carinae situated about equal distances from middle carina; upper carina about one-third the distance between upper suture and whorl periphery, separated from preceding whorl by a flat, slightly concave or slightly convex area. Upper and lower carinae separated from middle carina by concave areas, more strongly concave about periphery than below. Upper carina sharply differentiated (Pl. VIII, figs. 7, 10, 11), broadly rounded (Pl. VIII, figs. 8, 9, 12) or barely visible (Pl. VIII, fig. 6); lower carina obscure (Pl. VIII, figs. 8, 9, 12) or slightly raised (Pl. VIII, figs. 7, 10, 11); both usually more sharply defined on early whorls. Peripheral carina rounded (Pl. VIII, figs. 9, 12) or trilineate (Pl. VIII, figs. 8, 10, 11), if trilineate having weak elevated lines marginating a stronger central ridge. Base broadly rounded into the narrow umbilicus. Each whorl overlapping lower carina of preceding whorl. Growth lines faint or obscure, extending gently back from upper suture and swinging strongly back from below upper carina to the periphery, swinging strongly forward beneath periphery and passing vertically into umbilicus. Broad notch at periphery (Pl. VIII, fig. 7). Lip slightly thickened with inner lip reflexed about umbilicus (Pl. VIII, fig. 7).

Discussion. Prominence of carinae is highly variable within the species. Peripheral carinae are rounded or trilineate where degree of roundness may be a peculiarity of the specimen or of preservation. Specimens with trilineate peripheral carinae have either sharply defined (Pl. VIII, figs. 10, 11) or obscure (Pl. VIII, fig. 8) upper and lower carinae indicating that this variation is a peculiarity of the specimen, not of preservation.

#### *Lophospira perangulata* (Hall)

*Murchisonia perangulata* Hall, 1847, p. 41, Pl. X, fig. 4 (not Pl. XXXVIII, figs. 7a, b).

*Murchisonia bicincta* var. *perangulata*, Salter, 1859, Pl. IV, fig. 7.

*Lophospira perangulata*, Ulrich and Scofield, 1897, p. 972, Pl. LXXIII, figs. 1-7; Wilson, 1951, p. 37, Pl. IV, fig. 13.

Material. Nine poorly preserved specimens.

Description. Shell small, 4 to 9 mm, with five or six whorls coiled about a narrow umbilicus. Upper carina lacking; peripheral carina prominent, sharp and faintly trilineate; bottom carina prominent and sharp. Peripheral carina separated from upper suture by a very gently concave area and separated from bottom carina by a strongly concave area. Base broadly rounded into narrow umbilicus. Each whorl overlapping lower carina of preceding whorl. Growth lines faint or obscure, projecting strongly back from upper suture although slightly concave forward on inner part of the whorl; swinging strongly forward beneath periphery and passing vertically into umbilicus. Aperture not preserved.



Discussion. Ulrich and Scofield (1897, p. 972) gave 10 to 20 mm as the size range for this species. The Braeside specimens are slightly smaller but agree with the description in all other respects. This species, unlike juvenile specimens of *L. milleri*, has no upper carina.

*Lophospira serrulata* (Salter)

Plate IX, figures 1-6

*Murchisonia serrulata* Salter, 1859, p. 20, Pl. IV, fig. 1.

*Lophospira serrulata*, Ulrich and Scofield, 1897, p. 968, Pl. LXXII, figs. 51-55; Pl. LXXIII, fig. 57; Wilson, 1951, p. 38, Pl. V, figs. 8, 9.

Material. Twenty-two specimens. Hypotypes, GSC Nos. 22341-22355.

Description. Spire moderately high, having five or six whorls coiled about a narrow umbilicus with last whorl having a tendency to uncoil (Pl. IX, figs. 1, 2, 5); each whorl with four carinae. Upper carina prominent, slightly less than half the distance from preceding suture to second carina and separated from upper suture by a slightly concave area. Second carina strongest, forming periphery of whorl and separated from upper carina by a strongly concave area; rounded, or trilineate with two weak elevated lines margining a stronger central one (Pl. IX, fig. 6) where the central line, especially on the early whorls, is often with a serrated edge (Pl. IX, figs. 2, 5, 6). Third carina prominent, about same distance from periphery as upper carina and separated from periphery by a strongly concave area. Fourth carina weakest, encircling the umbilicus and visible only on body whorl (Pl. IX, figs. 1, 4), and separated from third carina by a slightly concave area. Growth lines prominent, extending gently back from upper suture and swinging more sharply back below upper carina to periphery, swinging sharply forward to third carina and from there extending sharply back, crossing fourth carina and passing vertically into umbilicus. Long slit developed at periphery. Inner lip greatly thickened but outer lip not as thick.

1. List of species of *Lophospira* previously recorded from Ottawa area.

- L. heliotes* (Salter): (Salter, 1859, p. 20; Wilson, 1951, p. 38). Syntype, GSC No. 1246c here designated lectotype; paralectotypes, GSC Nos. 1246, a, b; Paquette Rapid, Ottawa River.
- L. serrulata* (Salter): (Salter, 1859, p. 20; Wilson, 1951, p. 38). Syntype, GSC No. 1245 here designated lectotype (holotype of Wilson); paralectotypes, GSC Nos. 1245a, b; Paquette Rapid, Ottawa River.
- L. milleri* (Miller): (Wilson, 1951, p. 36). Hypotype, GSC No. 9743; Paquette Rapid, Ottawa River.
- L. saffordi* Ulrich and Scofield: (Wilson, 1951, p. 38). Hypotype, GSC No. 9747; Paquette Rapid, Ottawa River.

Wilson's hypotypes of *L. milleri* and *L. saffordi* belong to the same species, *L. milleri*.

- L. ventricosa* (Hall): (Wilson, 1951, p. 39). Hypotypes, GSC Nos. 1253, a; Paquette Rapid, Ottawa River.
- L. peracuta* Ulrich and Scofield: (Wilson, 1951, p. 36). Hypotype, GSC No. 9744; Paquette Rapid, Ottawa River.

Wilson's hypotypes of *L. ventricosa* and *L. peracuta* belong to one species. These specimens do not fit the description of *L. peracuta* as given by

Ulrich and Scofield (1897, p. 976). Comparisons with Hall's (1847, p. 41, Pl. 10, fig. 3) description and illustration of *L. ventricosa* are difficult. Synonymy is uncertain, although more material and further study may indicate conspecificity with *L. milleri*.

*L. perangulata* (Hall): (Wilson, 1951, p. 37). Hypotype, GSC No. 9745; Paquette Rapid, Ottawa River.

*L. medialis* Ulrich and Scofield: (Wilson, 1951, p. 35). Hypotype, GSC No. 9746; Paquette Rapid, Ottawa River.

Wilson's hypotypes of *L. perangulata* and *L. medialis* belong to the same species. These specimens fit the description given by Ulrich and Scofield (1897, p. 972, Pl. 73, figs. 1-7) for *L. perangulata*. However comparisons with Hall's (1847, p. 41, Pl. 10, fig. 4) description and drawings is difficult. Braeside material indicates that great variation is possible within one species of *Lophospira*. Additional material from the Ottawa Valley might indicate other synonymies among previously listed species. Statistical and ecological work on this species is planned.

*L. procris* (Billings): (Billings, 1862, p. 34; Wilson, 1951, p. 37). Holotype, GSC No. 1241; Paquette Rapid, Ottawa River.

This species does not belong to the genus *Lophospira*.

Genus *Trochonema* Salter, 1859

Type species. *Pleurotomaria umbilicata* Hall, 1847

*Trochonema wilsonae* n. sp.

Plate VIII, figures 1-5

Material. Thirteen specimens. Holotype, GSC No. 22356; paratypes, GSC Nos. 22357-22360.

Description. Holotype with a short spire (12 mm); broad base- diameter of body whorl 21 mm; apical angle 110 degrees. Four or five whorls coiled about an open umbilicus, each whorl with five carinae. Top carina situated about one-third the distance from preceding whorl to second carina and separated from each by a slightly concave area. Second carina situated a little above mid-whorl, very slightly in from periphery. Third carina situated on periphery, slightly below mid-whorl, separated from second carina by a wide, gently concave peripheral band. Second and third carinae more prominent than the first. Fourth carina weaker than the preceding, bordering the umbilicus and separated from third carina by a gently sloping, flat, or slightly convex area. Fifth carina nearly obscure, situated well within the steeply sloping umbilicus. Each whorl partially overlapping peripheral band of preceding whorl. Growth lines strongly oblique back from upper suture to second carina, gently concave forward on peripheral band, strongly oblique back between third and fourth carinae, and steeply sloping into umbilicus. Growth lines in youngest region of shell very pronounced. Inner lip thickened and slightly reflexed about umbilicus. Outer lip missing. Ornamentation limited to prominent growth lines on body whorl. Paratypes vary slightly in prominence of growth lines and sharpness of carinae.

Discussion. In coiling, each whorl in this species overlaps higher on the peripheral band of preceding whorls than in other species of *Trochonema*. The result is a shorter spire and larger apical angle in *T. wilsonae*.

Genus *Raphistomina* Ulrich and Scofield, 1897

Type species. *Raphistoma lapicida* Salter, 1859

*Raphistomina fissurata* n. sp.

Plate IX, figures 7-10

Material. Four specimens; one well preserved. Holotype, GSC No. 22361.

Description. Holotype with five whorls coiled about an open umbilicus, a gently convex spire, more strongly convex base, and angular periphery. Above the periphery: inner two-thirds of whorl gently convex and outer third moderately concave. Below the periphery: outer surface slightly concave and inner surface strongly convex with base sharply rounded into umbilicus. Above the periphery: growth lines sharply oblique backward from upper suture, appearing gently convex forward on inner part and gently concave forward on outer part of whorl. Growth lines near aperture arching sharply back, forming a selenizone and short slit at periphery, although older regions of periphery rounded with no selenizone. Below the periphery: growth lines radial, appearing slightly concave forward near periphery and gently convex forward near umbilicus. Lip thickened and slightly reflexed about umbilicus. Suture sharply incised beneath the preceding whorl, forming a smoothly sloping spire with little interruption at sutures except at the last whorl which descends a little beneath periphery of preceding whorl (Pl. IX, fig. 7). Ornamentation limited to growth lines, appearing coarser below periphery than above. Sharp break in shell terminating growth lines in last whorl; subsequent shell material growing from under preceding shell with growth lines reappearing beyond broken edge.

Measurements: length of diameter - 33 mm; height - 17 mm; spiral angle 145 degrees.

Discussion. This new species of *Raphistomina* has a prominent selenizone and slit near the aperture, although Ulrich and Scofield (1897, p. 942) when erecting the genus claimed that no slit was present. The rounded periphery on older regions of the shell suggests that selenizone and slit were either not developed on earlier whorls, or if originally present were obliterated with age.

The sharp break in the last whorl of the holotype appears to be an injury subsequently healed by growth from under the broken edge. Separation between the body whorl and previous whorl may be emphasized by direction of this new growth.

This species is similar to *R. lapicida* but with (1) short peripheral selenizone and slit near the aperture, (2) last whorl descending farther below the periphery of the preceding whorl, (3) smaller umbilicus with lip slightly reflexed about the umbilicus, (4) stronger growth lines, and (5) slightly greater size.

Genus *Clathrospira* Ulrich and Scofield, 1897

Type species. *Pleurotomaria subconica* Hall, 1847

*Clathrospira subconica* (Hall)

Plate VII, figures 6, 7

*Pleurotomaria subconica* Hall, 1847, pp. 174, 304, Pl. XXXVII, figs. 8a-e; Pl. LXXXIII, figs. 3a-e; Logan, 1863, p. 180, Fig. 174.

*Clathrospira subconica*, Ulrich and Scofield, 1897, p. 1006, Pl. LXIX, figs. 47-50; Pl. LXX, figs. 5, 6; Knight, 1941, p. 78, Pl. 34, figs. 4a, b; Wilson, 1951, p. 57, Pl. VII, fig. 3.

Material. Eighteen specimens. Hypotypes, GSC Nos. 22362-22367.

Description. See Ulrich and Scofield (1897, p. 1006) for a detailed description of this species.

Measurements: hypotype, GSC No. 22362, height - 42 mm; width of body whorl - 46 mm; apical angle - 76 degrees.

Hypotype, GSC No. 22362 has a sharp break in the shell of the body whorl (Pl. VII, figs. 6, 7). Subsequent growth appears from under the broken edge.

Discussion. The figured specimen is large for the species but within the range given by both Hall (1847, p. 175) and Ulrich and Scofield (1897, p. 1007). The sharp break in the last whorl appears to be an injury subsequently healed by growth from under the broken edge.

Genus *Tetranota* Ulrich and Scofield, 1897

Type species. *Bucania bidorsata* Hall, 1847

*Tetranota* cf. *bidorsata* (Hall)

Plate X, figures 4, 15

*Bucania bidorsata* Hall, 1847, p. 186, Pl. XL, figs. 8a-g.

*Tetranota bidorsata*, Ulrich and Scofield, 1897, p. 877, Pl. LXV, figs. 10-18; Knight, 1941, p. 347, Pl. 8, fig. 4; Wilson, 1951, p. 30, Pl. IV, figs. 1, 2.

Material. Nine poorly preserved specimens, various sizes. Hypotypes, GSC Nos. 22368-22370.

Description. Shell planispiral, compressed dorsal-ventrally. Dorsal surface with four rounded concentric ridges and a wide concave selenizone. Two prominent central ridges bordering the selenizone and separated from the less prominent lateral ridges by concave areas, slightly wider than the selenizone. Broadly rounded circum-umbilical ridge bordering umbilicus and separated from lateral ridge by a concave area similar in width to the area separating the central and lateral ridges. Umbilical slope steep with inner surface of whorl slightly convex. Successive whorl height about three times that of preceding whorl. Innermost whorls not seen. Growth lines on dorsal surface extending obliquely back from circum-umbilical ridge to central ridge but not seen on the selenizone; on ventral surface extending vertically into umbilicus. Outer lip of hypotype, GSC No. 22368 flaring into two subquadrate lobes with convex surfaces. Inner edges of lobes straight, meeting at about 95 degrees in a broad anterior sinus (Pl. X, fig. 15). Outer lip of hypotype, GSC No. 22369 (Pl. X, fig. 4) not complete, but growth lines indicate a small rounded lobe in front of umbilical ridge. Apertures not seen. Shell thin, and often very poorly preserved.

Measurements: GSC No. 22368, height - 18 mm, length - 30 mm; GSC No. 22369, height - 2 mm, length - 4.5 mm.

Discussion. Both mature and immature specimens are present. This species is close to *T. bidorsata* although poor preservation of both the holotype and present specimens makes comparisons difficult. Present specimens differ from the holotype by having a flared outer lip and by lacking tendency toward a double circum-umbilical salient (Knight, 1941, p. 347). The outer lip of the holotype is not preserved and the Braeside material, if better preserved, might show a double circum-umbilical salient. Compared with the Braeside specimens

*T. bidorsata* as shown by Ulrich and Scofield (1897, Pl. LXV, fig. 15) has rounded, more laterally flared lobes with a smaller sinus.

*T. sexcarinata* has strong growth lines and six prominent ridges, the outer pair not bordering the umbilicus.

Genus *Phragmolites* Conrad, 1838

Type species. *Phragmolites compressus* Conrad, 1838

*Phragmolites?* sp.

Plate X, figures 1-3

Material. Two small specimens. Figured specimens, GSC Nos. 22371, 22372.

Description. Shell planispiral with a conspicuous dorsal keel and three or four loosely coiled whorls embracing only keel of previous whorl. Dorsal surface convex with convexity decreasing toward keel until surface slightly concave at base of keel. Inner surface of whorl almost vertical although very slightly convex, meeting outer surface at an acutely angular edge. Each whorl about three times height of preceding whorl. Ornamentation very faint (Pl. X, fig. 3).

Discussion. In comparison with the genus *Phragmolites* the present specimens have (1) only faint indication of zigzag surface ornamentation produced by periodical flaring of the aperture, and (2) no slit occupying the centre of a bilineate keel.

These specimens appear to be *Phragmolites* on which surface ornamentation has not been preserved. The fossils are possibly too small to show a bilineate structure of the keel or an associated slit.

Genus *Pterotheca* Salter, 1853

Type species. *Atrypa transversa* Portlock, 1843

*Pterotheca expansa* (Emmons) *sensu* Wilson

Plate X, figures 5-8

*Delthyris expansus* Emmons, 1842, pp. 396, 397, Fig. 109, no. 2.

*Pterotheca expansa*, Wilson, 1951, p. 33, Pl. II, figs. 19, 20.

Material. Twenty-eight specimens. Hypotypes, GSC Nos. 22373-22375.

Description. See Wilson (1951, p. 33) for a detailed description of this species.

Genus *Hormotoma* Salter, 1859

Type species. *Murchisonia gracilis* Hall, 1847

*Hormotoma salteri canadensis* Ulrich and Scofield

Plate X, figure 9

*Murchisonia gracilis*, Salter, 1859, p. 22, Pl. V, fig. 1

*Hormotoma salteri canadensis* Ulrich and Scofield, 1897, p. 1016, Pl. LXX, figs. 44-51; Wilson, 1951, p. 42, Pl. IV, fig. 14.

Material. Twenty-five specimens, various sizes. Hypotypes, GSC Nos. 22376-22381.

Description. Spire very high, mature specimens having thirteen or fourteen bead-like whorls coiled about a narrow umbilicus. Middle of large whorls occupied by a wide depressed band covering about one-fourth of the whorl; band obscure or absent on small whorls. Growth lines fine and often obscure, projecting sharply back from upper suture and sharply forward below peripheral band. Sinus and perhaps a slit present on outer lip of large specimens; sinus barely visible in small specimens. Base rounded. Inner lip reflexed about and obscuring the umbilicus.

Discussion. The present mature specimens are similar to Salter's paratypes. Immature specimens generally lack surface features but are otherwise similar.

Genus *Subulites* Emmons, 1842

Type species. *Subulites elongatus* Emmons, 1842

*Subulites* cf. *regularis* Ulrich and Scofield

Plate X, figure 16

*Subulites regularis* Ulrich and Scofield, 1897, p. 1072, Pl. LXXXI, fig. 35; Pl. LXXXII, figs. 47, 48; Wilson, 1951, p. 89, Pl. XV, figs. 4-7.

Material. Twenty-one poorly preserved specimens. Hypotypes, GSC Nos. 22382, 22383.

Description. Spire high, apical angle 20 degrees. Whorls high, outer surface slightly convex and sutures shallow, barely indenting continuous slope of the whorls. Body whorl elongate and tapering; aperture and umbilicus not seen. No ornamentation seen.

Genus *Holopea* Hall, 1847

Type species. *Holopea symmetrica* Hall, 1847

*Holopea* sp.

Material. One small specimen, GSC No. 22396.

Description. Specimen very small. Four strongly rounded, rapidly enlarging whorls; whorls loosely coiled, enveloping only base of preceding whorl; sutures deeply impressed. Base and aperture not preserved. Growth lines not seen.

Measurements: height - 5+ mm; width of body whorl - 5 mm; apical angle - 85 degrees.

Discussion. This specimen is possibly a juvenile form.

CALYPTOPTAMATIDA

Genus *Hyalithes* Eichwald, 1840

Type species. *Hyalithes acutus* Eichwald, 1840

*Hyalithes* cf. *baconi* Whitfield

Plate X, figures 10-14

*Hyalithes baconi* Whitfield, 1877, p. 77; 1882, p. 225; Foerste, 1920, p. 211, Pl. XXI, figs. 10, 11; Pl. XXII, figs. 10, 11.

Material. Seventeen incomplete specimens. Hypotypes, GSC Nos. 22384-22388.

Description. Cross-section subtriangular; ventral surface almost flat although very slightly convex (Pl. X, fig. 13); dorsal surface more strongly convex, having a rounded median ridge flanked on each side by a concave area (Pl. X, fig. 14). Ornamentation faint or absent. Shell striated transversely by growth lines, six occurring in 1 mm, having a slight upward curve on dorsal surface and a stronger upward curve on ventral surface. Transverse stria crossed by finer vertical striae, ten occurring in 1 mm. Apex of the shell appearing to have conical thickenings, visible on etched specimens where one surface of shell often dissolved away in a conical shape toward the apex (Pl. X, figs. 10-12). Walls moderately thick although the flatter surface usually thinner and dissolving away more readily.

Discussion. The present specimens, although smaller than typical specimens of *H. baconi*, display the same external shape and ornamentation. Conical thickenings in the apex of the shell have not formerly been described for the species.

CEPHALOPODA

Genus *Loganoceras* Foerste, 1932

Type species. *Cyrtoceras regulare* Billings, 1857

*Loganoceras regulare* (Billings)

Plate XI, figures 1-6

*Cyrtoceras regulare* Billings, 1857, p. 314.

*Loganoceras regulare*, Foerste, 1932, Pl. XXV, figs. 1A, B, 2A, B; 1933, p. 70.

*Loganoceras paquettense* Foerste, 1932, Pl. XXV, figs. 5A-C; 1933, p. 72.

*Manitoulinoceras(?) canadense* Foerste, 1932, Pl. XXV, figs. 8A, B; 1933, p. 127.

*Loganoceras regulare*, Wilson, 1961, p. 101, Pl. XXXV, figs. 5-7.

*Loganoceras paquettense*, Wilson, 1961, p. 101, Pl. XXXV, figs. 3, 4.

*Loganoceras? canadense*, Wilson, 1961, p. 100, Pl. XXXV, figs. 1, 2.

Material. Phragmocone pieces of two specimens. Hypotypes, GSC Nos. 22397, 22398.

**Description.** Small, cyrtoconic shell with circular cross-section. Size-increase rapid, with diameter of hypotype, GSC No. 22397 increasing from 3 mm to 11 mm in a ventral length of 32 mm. Growth lines distinct, transverse except on the venter where a bend toward the apex indicates the hyponomic sinus (Pl. XI, fig. 4); crowded dorsally, more separated ventrally. Septa concave toward the apex. Distance between the septa indeterminable on hypotype, GSC No. 22397, but on No. 22398 septa 2 mm apart on the venter and 1 mm apart on the dorsum at diameter of 14 mm. Siphuncle about 1 mm across at septal diameter of 11 mm and almost in contact with the ventral wall (Pl. XI, figs. 1, 5).

Unusual septal development visible on hypotype, GSC No. 22398 (Pl. XI, figs. 1, 2) where one septum appears to have grown on two septal growth levels; stepped appearance of septum results. Suture, continuous with upper level of the stepped septum, indicates a once continuous septum at that level. Step also visible on underside of the septum as seen through a hole in the side of the conch. Surface of hypotype, GSC No. 22398 covered by an irregular bumpy growth (Pl. XI, figs. 1, 2).

**Discussion.** Foerste (1933, pp. 70, 72) described *L. regulare* (Billings) and *L. paquettense* sp. nov. from Paquette Rapid and (1933, p. 127) an internal cast of *Manitoulinoceras*(?) *canadense* sp. nov. from La Petite Chaudière, Ottawa. He stated that the conch of *L. paquettense* curves more strongly lengthwise and enlarges at a more rapid rate than that of *L. regulare*. Wilson (1961, p. 100) assigned *M.*(?) *canadense* to *Loganoceras*? *canadense* and stated that this species differs from *L. regulare* "in being a little less curved in the adult region and in its more rapid enlargement".

Comparisons of the three holotypes suggest them to be conspecific. *L. paquettense* is a small fragment with the same dimensions as a section of *L. regulare*, and *L.*(?) *canadense* is a fragment farther from the apex than *L. regulare* (Fig. 3). GSC No. 1296 is here designated the lectotype (holotype of Foerste, 1933, p. 70).

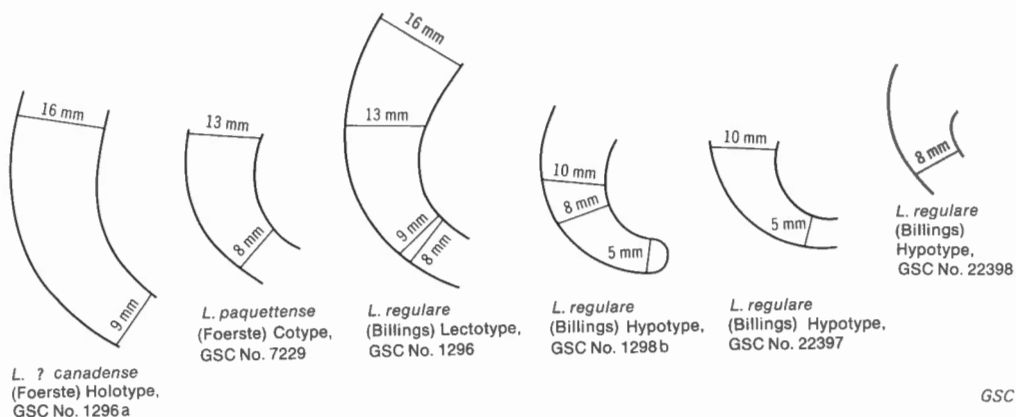


Figure 3. Comparison of specimens of Loganoceras.



Genus *Zitteloceras* Hyatt, 1884

Type species. *Cyrtoceras hallianum* D'Orbigny, 1850

*Zitteloceras* sp.

Plate XI, figures 17, 18

Material. Fragment of one specimen. Figured specimen, GSC No. 22399.

Description. Cross-section elliptical, compressed dorsal-ventrally. Striae raised and wavy, about five occurring in 5 mm; not preserved on dorsal surface; horizontal on lateral surface and forming a moderately deep, rounded saddle on ventral surface. Fine lines parallel to raised striae in interspaces between them. Internal features not seen.

Discussion. This fragment is too small to permit specific identification.

Genus *Actinoceras* Bronn, 1835

Type species. *Actinoceras bigsbyi* Bronn, 1835

*Actinoceras* cf. *aequale* Flower

Plate XII, figure 16

*Actinoceras aequale* Flower, 1957, p. 35, Pl. 3, figs. 1-5, Text-fig. 3F; Wilson, 1961, p. 48, Pl. XV, figs. 1-3.

Material. Three fragments of phragmocones. Hypotype, GSC No. 22400 (polished section).

Description. Large, smooth shell, compressed dorsal-ventrally. Sutures transverse except for a broad, shallow lobe on the venter. Dorsal-ventral diameter increasing from 40 mm to 50 mm in length of 50 mm. Distance between septa about 11 mm; therefore, length to width ratio of camerae about 1:4. Siphuncle situated close to venter with distance from ventral wall increasing orad. Septal necks long, brims short, connecting rings strongly curved. Width of siphuncle about 9 mm at septal neck, about 19 mm at widest part of connecting ring. Cameral deposits and siphuncle deposits lacking. Thin secondary deposits of calcite present on septal necks and connecting rings of all specimens.

Discussion. The present specimens closely resemble *A. aequale* Flower, originally described from Lowville beds near Ottawa. Compared with the holotype, the present specimens are incomplete and do not show cameral length to width ratio variation with growth. Siphuncle deposits, typical of the species (Flower, 1957, p. 36), are absent here.

Genus *Ormoceras* Stokes, 1840

Type species. *Ormoceras bayfieldi* Stokes, 1840

*Ormoceras* sp.

Plate XII, figure 17

Material. One broken phragmocone fragment. Figured specimen, GSC No. 22401.

Description. Shell medium size and smooth with circular cross-section. Width of shell increasing from 20 mm to 30 mm in length 95 mm; therefore angle of increase about 6 degrees. At greatest width, distance between septae about 6 mm; therefore, length to width ratio of camerae about 1:5. Siphuncle close to ventral wall. Septal necks and brims short and connecting rings strongly curved. Width at septal neck about 4 mm, expanding to about 9 mm at widest part of connecting ring. Most of this specimen recrystallized.

Discussion. Comparison with previously described species is difficult as many species are based on external features. Present material is scanty and poorly preserved.

Genus *Michelinoceras* Foerste, 1932

Type species. *Orthoceras michelini* Barrande, 1866

*Michelinoceras* sp. 1

Plate XI, figure 13

Material. Five fragments of phragmocones. Figured specimen, GSC No. 22402.

Description. Shell smooth and slender with an apical angle of about 4 degrees. Distance between septae 2+ mm at shell width 9 mm; therefore length to width ratio of camerae about 1:4. Siphuncle small, straight and centrally situated. Septal necks and brims short; connecting rings straight or slightly curved. Siphuncle length 2+ mm and width 1.5 mm at shell width 9 mm.

Discussion. Comparison with previously described species is difficult as many species are based on external features alone. Present specimens are few and poorly preserved and identification is possible only to generic level.

*Michelinoceras* sp. 2

Plate XI, figure 10

Material. Four fragments of phragmocones. Figured specimen, GSC No. 22403.

Description. Shell smooth and slender with an apical angle of about 2 degrees. Distance between septae 3+ mm at shell width 10 mm; therefore, length to width ratio of camerae about 1:3. Siphuncle small, straight, centrally situated and poorly preserved. Siphuncle necks short and connecting rings straight or slightly curved.

Discussion. As with *M.* sp. 1, comparison with previously described species is difficult and specific identification is not possible.

*Michelinoceras* sp. 3

Plate XI, figures 11, 12

Material. Three fragments of phragmocones. Figured specimen, GSC No. 22404.

Description. Shell smooth and slender with an apical angle of less than 2 degrees. Distance between septa 2.5 mm at shell width 5 mm; therefore, length to width ratio of camerae about 1:2. Siphuncle small and centrally situated; siphuncle necks and connecting rings not preserved.

Discussion. The present specimens and *M. beltrami* (Clarke) have slender phragmocones and similar cameral ratios. However, comparison with *M. beltrami* is not possible as the siphuncle is unknown in either specimen.

Genus *Spyroceras* Hyatt, 1884

Type species. *Orthoceras crotalum* Hall, 1861

"*Spyroceras*" sp.

Plate XI, figures 14-16

Material. Two small silicified fragments. Figured specimens, GSC Nos. 22405, 22406.

Description. Small annulated, slightly curved, shell with prominent longitudinal striae. Circular cross-section, with diameter of the largest fragment increasing from 2 to 7.5 mm in 50 mm length; therefore, angle of increase about 7 degrees. Annulations distinct but low and broad, almost transverse, five occurring in 10 mm. Thirty-two primary longitudinal ribs about circumference of the small fragment; secondary ribs faintly indicated in several grooves. Septa transverse but cameral length indeterminable. Siphuncle centrally situated but not preserved.

Discussion. No previously described species appears to be similar. However, the present material is inadequate for the designation of a new species.

Hyatt erected the genus *Spyroceras* for specimens having annulated shells with longitudinal markings (Flower, 1946, p. 213). Shimizu and Obata (1935) introduced many new generic names for cephalopods with *Spyroceras*-type external markings. Two of these genera, *Anaspyroceras* and *Gorbyoceras* have been recognized by Flower (1946, p. 214). *Anaspyroceras* has an orthochoanitic siphuncle and *Gorbyoceras* a cyrtchoanitic siphuncle. *Spyroceras* is a Middle Devonian form with a crytochoanitic siphuncle bearing organic deposits which grow orad along the connecting ring in each segment of the siphuncle and finally fuse and form a continuous lining (Flower, 1946, p. 218).

Because Ordovician specimens have been previously assigned to *Spyroceras* without sufficient information regarding internal structures, Flower continues to use the generic name until further study indicates proper generic position (Flower, 1946, p. 215). "*Spyroceras*" is used here because of lack of information concerning internal structure.

Genus *Monomuchites* Wilson, 1961

Type species. *Monomuchites costalis* Wilson, 1961

*Monomuchites? decrescens* (Billings)

Plate XI, figures 19, 20

*Orthoceras decrescens* Billings, 1857, p. 337.

*Cyloceras decrescens*, Foerste, 1932, p. 84, Pl. 12, figs. 1a-c.

*Monomuchites decrescens*, Wilson, 1961, p. 25, Pl. V, figs. 7, 8.

Material. Fragments of two specimens; both with phragmocone and living chamber. Hypotype, GSC No. 22407.

Description. Shell medium size, with annulations but no longitudinal ornamentation, about seven annulations occurring in a length equal to diameter of shell. Cross-section subcircular. Septa 3 mm apart at diameter 22 mm; concave with concavity about 4 mm. Angle of taper and shape of sutures indeterminable. Siphuncle subcentral with short septal necks and slightly curved

connecting rings. Siphuncle width at septal neck about 2 mm; indeterminate at connecting ring.

Discussion. The name *Cycloceras* has been widely used for all specimens having an annulated exterior with no longitudinal ornamentation. Teichert (in Moore, 1964, p. K259) recommends application of the generic name *Cycloceras* to the type specimen only, as the "type specimen is based on an internal mold of a body chamber on which even position of the siphuncle is indiscernable". Wilson (1961, p. 24) defined a new genus *Monomuchites* to include specimens similar to *Cycloceras* but having only one suture between two annular rings, for, according to her, McCoy's original description of *Cycloceras* stated that two chambers occurred between two annular rings. Flower (1962, p. 32) stated that "relative spacing of septa and annuli fails to differentiate obviously valid species, groups or genera". However, he stated that in the genus *Monomuchites* segments of the siphuncle, broadly expanded in the young and slender in adult, are occupied by annuli. These siphuncular features are not evident in the holotype of *M. costalis*, the type species. Until further revision, however, the generic name *Monomuchites* is used for this species.

*"Cycloceras" cylindratum* (Foerste)

Plate XI, figures 7-9

*Orthoceras arcuoliratum* Hall, 1847, p. 198, Pl. XLII, figs. 7b, c (not 7a).

*Spyroceras cylindratum* Foerste, 1932, p. 97, Pl. 11, figs. 6A, B, 7A, C.

'*Spyroceras*' *cylindratum*, Wilson, 1961, p. 35, Pl. IX, figs. 1-5.

'*Spyroceras*' *arcuoliratum*, Wilson, 1961, p. 35, Pl. VIII, figs. 2, 3.

Material. Four small fragments of phragmocones. Hypotype, GSC No. 22408.

Description. Small, annulated shell with no longitudinal ornamentation. Cross-section circular. Diameter of largest fragment increasing from 5 to 5.5 mm in 20 mm length; therefore, angle of increase about 2 degrees. Five annulations occurring in length equal to diameter of shell. Annulations slightly undulating on about two-thirds of shell but on remaining third rising abruptly into rounded arches with heights slightly more than one annulation above their lower limit. Septa concave but seldom preserved. Sutures transverse, about 3 mm apart, so that less than two camerae occur in length equal to diameter of shell. Siphuncle centrally situated.

Discussion. Foerste (1932) erected *Spyroceras cylindratum* on specimens from Watertown, New York State, and Paquette Rapid, Ontario, and chose the specimen from Watertown as the holotype. As the Watertown specimen figured by Hall (1847, Pl. 42, figs. 7b, c) is an interior cast, comparison with silicified material from Paquette Rapid, is not possible and different species or genera may be present in each case.

Foerste (1932, p. 98) assigned this species to the genus *Spyroceras* claiming that in cross-illumination one specimen from Paquette Rapid distinctly striated vertically". He felt that coarse silicification had obliterated the striae in other specimens. However, neither the paratype nor other specimens in the collection of the Geological Survey of Canada appear to have had longitudinal striations. The Braeside specimens are similar to those from Paquette Rapid and also appear never to have had longitudinal ornamentation. A genus other than *Spyroceras* is, therefore, suggested. The species is here assigned to the genus "*Cycloceras*" until further study indicates proper generic position.

Wilson (1961, p. 35) recorded "*S*". *arcuoliratum* (Hall) from Paquette Rapid. This specimen, however, does not have a larger apical angle as suggested by Wilson. It appears to belong to the species "*C*". *cylindratum* (Foerste).

Colour markings on cephalopods

Plate VII, figures 3-5

Longitudinal colour markings are present on seven specimens. The smooth exteriors and diameter sizes of the specimens suggest *Actinoceras* although exact affinities are indeterminable because sectioning in a dorsal-ventral direction would destroy the colour markings.

The markings are longitudinal bands confined to one side of the specimen. The lines, dark brown on the light brown or grey background of the rest of the shell, vary in width with the specimen and appear to become narrower and more widely separated at the lateral regions of the colour-marked area. Deeper weathering of the colour bands on two specimens suggests a dissimilarity between the bands and the rest of the shell (Pl. VII, fig. 3). Ruedemann (1921, p. 84) also records differential weathering between the colour markings and the rest of the shell but on his specimens the colour bands show greater resistance than the rest of the shell. Teichert (*in* Moore, 1964, p. K24) stated that the "color markings of fossil shells are in fact patterns of pigmentation...indicating presence of former color patterns". Foerste (1930, p. 145) suggested that the prismatic layer, which carries the colour markings is covered by the mantle or a horny layer during the life of the animal. This mantle or horny layer may show colours but the colours are not retained by the shell in fossil form. However, he suggested that there is a relation between the colour markings of the fossils and the effect of light on the living animal. Distinct colour markings are found today primarily on the shells of animals living in shallow seas. If these marks are confined to one side it is assumed that the animal lived in a horizontal position with the colour markings on the dorsal side of the shell (Ruedemann, 1921, p. 84).

BRACHIPODA

Genus *Rostricellula* Ulrich and Cooper, 1942

Type species: *Rostricellula rostrata* Ulrich and Cooper, 1942

*Rostricellula* cf. *minnesotensis* (Sardeson)

Plate XIII, figures 1-18

?*Rhynchonella minnesotensis* Sardeson, 1892, p. 333, Pl. 4, figs. 21-23.

*Rhynchotrema increbescens*, Wilson, 1926, p. 21, Pl. IV, fig. 5; 1946, p. 120, Pl. XI, fig. 13.

?*Rostricellula minnesotensis*, Cooper, 1956, pp. 639-640, Pl. 131,A, figs. 1-7; Pl. 139,A, figs. 1-11.

Material. Nine specimens with both valves attached, three separated; four pedicle valves; four brachial valves. Hypotypes, GSC Nos. 22414-22424.

Description.

Exterior.

Shell outline subpentagonal, slightly wider than long with greatest width anterior to middle of valve. Both valves equally convex; large shells globose, globosity not as pronounced on smaller shells. Interarea narrow; beak prominent and strongly incurved, apical angle 90 to 95 degrees. Anterior commissure uniplicate, weak on small specimens and very pronounced on large specimens. Pedicle valve with sulcus beginning just anterior to middle of valve, moderately deep with long tongue in large specimens, neither as pronounced in smaller specimens. Sulcus with three, rarely four costae. Brachial valve with fold beginning about one-third distance behind beak, moderately pronounced on some large specimens and weak on others; weak on all small specimens. Fold with four costae. Flanks of each valve rounded and marked by six costae.

Interior.

Pedicle valve: teeth small, supported by strong dental plates and separated from sides of shell by narrow umbonal cavities. Delthyrial cavity deep (Pl. XIII, fig. 13), separated from muscle field by a small transverse ridge at base of teeth. Muscle area expands toward anterior region, consisting of large flabellate diductor scars enclosing smaller hemi-elliptical adductor scars.

Brachial valve: hinge plate divided. Converging brachiophore bases join prominent median septum to form a raised, shallow notothyrial platform. Cardinal process absent. Elevated median septum extends into middle of valve. Brachiophore process long, slender and curved. Dental sockets prominent on each side of brachiophores.

Discussion. Compared with *R. minnesotensis* (as described by Cooper, 1956), some large specimens from Braeside are slightly more globose with a slightly more pronounced fold in the brachial valve. Such variation is probably acceptable within *R. minnesotensis*. The species previously has not been reported outside Minnesota, Wisconsin and Illinois. Because of the distance between this area and Braeside, it is advisable to describe the Braeside material as *Rostricellula* cf. *minnesotensis* until additional studies can be undertaken.

The Braeside species is also found at Paquette Rapid. A specimen (hypotype, GSC No. 1146f) was described by Wilson (1926; 1946a) as *Rhynchotrema increbescens* (Hall).

Genus *Glyptorthis* Foerste, 1914

Type species. *Orthis insculpta* Hall, 1847

*Glyptorthis rocklandensis* (Wilson)

Plate XIII, figures 19-27

*Eridorthis rocklandensis* Wilson, 1946, p. 36, Pl. III, figs. 17a-c, 18.

*Glyptorthis bellarugosa*, Wilson, 1946, p. 35, Pl. III, figs. 13-15.

Material. Four brachial valves, four pedicle valves. Hypotypes, GSC Nos. 22425-22432.

Description.

Pedicle valve.

Exterior.

Shell moderately convex with greatest convexity about 8 mm behind beak; outline quadrate, width greater than length; cardinal angles about 90 degrees. Weak sulcus present and anterior margin slightly sulcate. Interarea wide and moderately concave; beak small but not incurved. Surface costate with seven costae occurring in 5 mm; number of generations indeterminable; costae crossed by concentric imbrications, occasionally raised into frills, ten imbrications occurring in 5 mm.

Interior.

Teeth triangular and strong. Dental plates prominent, diverging toward floor of valve and separated from sides of valve by broad umbonal cavities. Muscle area heart-shaped, strongly impressed and slightly elevated anteriorly by adventitious shell material; relative lengths and widths of adductor and diductor scars indeterminable. Pallial markings not seen. Interior and lateral edges of shell costate.

Brachial valve.

Exterior.

Shell moderately convex with greatest convexity about 6 mm behind the beak. Anterior margin straight although slight suggestion of sulcus in older region of the shell. Interarea narrow; hinge line wide and straight. Markings same as on pedicle valve.

Interior.

Notothyrial cavity moderately deep and slightly concave. Thick brachiophores border notothyrial cavity and form inner boundaries of large dental cavities. Notothyrial platform raised and thickened anteriorly, separated from muscle area by converging brachiophore bases; bases in larger specimen (hypotype, GSC No. 22425) form a ledge that slopes slightly back under the platform (Pl. XIII, fig. 22); platform supports linear cardinal process. Thick median septum divides muscle area longitudinally, and extends from notothyrial platform to middle of valve. Muscle area strongly impressed; posterior adductor scars smaller than anterior scars and separated from them by a slightly arched ridge perpendicular to median septum; in larger specimen (hypotype, GSC No. 22425) anterior adductors situated partly under the sloping ledge at front of notothyrial platform (Pl. XIII, fig. 22). Anterior adductors divided longitudinally into two impressions. Anterior and lateral margins of shell costate. Pallial markings not seen.

Discussion. Wilson (1946a, p. 36) erected *E. rocklandensis* on the basis of her claim that the fold of the brachial valve arises from a sulcus in the young specimen, and a sulcus in the pedicle valve arises from a fold in the young specimen. Cooper (1956, p. 384) stated that this inversion is common in many orthoid brachiopods and the presence of a strong fold and sulcus is a more important generic characteristic of *Eridorthis*. Wilson's holotype is warped and poorly preserved. The fold and sulcus, considerably off centre, are weak. The species is here assigned to the genus *Glyptorthis*.

Wilson (1946a, p. 35) described specimens from Paquette Rapid as *Glyptorthis bellarugosa* (Conrad). These specimens, compared with *bellarugosa* are wider with respect to length, lack a large median costa in the pedicle valve, and have imbrications more widely spaced.

Genus *Pionodema* Foerste, 1912

Type species. *Orthis subaequata* Conrad, 1843

*Pionodema cooperi* n. sp.

Plate XIV, figures 1-24

Material. Forty-six specimens with both valves, thirty-nine attached, seven separated; thirty-five pedicle valves, fifty-four brachial valves. Holotype, GSC No. 22433; paratypes, GSC Nos. 22434-22479.

Description of holotype. Holotype (Pl. XIV, figs. 1-5) with articulated valves; moderately globose and subrectangular with greatest width just anterior to umbo; both valves equally convex and deep. Hinge line straight. Pedicle interarea prominent, apsacline and strongly incurved; delthyrium open; beak small, incurved. Brachial interarea small, slightly anacline, gently curved; notothyrium open; beak small, incurved. Marginal angles rounded and obtuse. Fold on brachial valve and sulcus on pedicle valve weak; anterior commissure uniplicate. Surface multicostate, about seventeen costae in 5 mm. Growth lines present, converging at ends of the hinge line and more widely separated laterally and anteriorly.

Measurements: length - 12 mm; brachial length - 11 mm; width - 13.5 mm; length of hinge line - 9 mm; height - 7.5 mm.

Description of paratypes.

Exterior.

Exterior shape varies considerably. Ratio length to width relatively constant (just  $<1$  for pedicle valve). Length of hinge line with respect to length and width of specimen greatly variable. Globosity varying from strongly swollen (Pl. XIV, figs. 11-13) to gently swollen (Pl. XIV, figs. 8-10). Strength of sulcation of the anterior commissure varies from rectimarginate (Pl. XIV, fig. 9) to strongly uniplicate (Pl. XIV, fig. 12). Many valves show fold of brachial valve arising from a sulcus, and sulcus of pedicle valve arising from a fold in young specimens. Two specimens with small plates in apex of delthyrium.

Interior.

Pedicle valve: delthyrial cavity deep. Small ridge present in the internal apex of some shells (Pl. XIV, figs. 21, 22). Teeth small, triangular, supported by prominent divergent dental plates with anterior ends continuing forward as slight ridges along lateral margins of muscle field (Pl. XIV, figs. 21, 22). Crural fossettes small and oblique to hinge line (Pl. XIV, fig. 21). Umbonal cavities broad. Muscle impressions generally indistinct. Adductor scars long and narrow, situated on a slight ridge in delthyrial cavity; diductor scars longer than wide, extending farther toward anterior margin than adductor scars; adjustor scars elongate and at base of dental plates. Median ridge present in some specimens, extending from adductor scars to middle of shell.

Brachial valve: brachiophores long, curved, and supported by divergent brachiophore plates (Pl. XIV, fig. 20). Sockets small, defined by small fulcral plates. Umbonal cavities large. Notothyrial chamber shallow. Cardinal process small with myophore poorly preserved and shaft extending forward and merging with median septum (Pl. XIV, figs. 17-20, 24). Median septum usually low and broad, extending almost to middle of shell and bisecting muscle area (Pl. XIV, fig. 24). Muscle impressions faint with anterior adductor scars larger than posterior adductors and divided longitudinally into larger inner and smaller outer impressions (Pl. XIV, fig. 24). Pallial markings present in three specimens (Pl. XIV, figs. 19, 20, 24). Genital markings at upper lateral edges of posterior adductors seen in one specimen (Pl. XIV, fig. 24).



Discussion. Growth lines indicate that length of the hinge line increases very slowly with respect to length and width increase of the specimen. Larger specimens are generally more globose than smaller ones, but considerable variation is present. *P. cooperi* appears to be morphologically close to *P. subaequata* but generally more globose and with a smaller hinge to width ratio. *Pionodema* has not previously been recorded from the Ottawa area.

Genus *Doleroides* Cooper, 1930

Type species. *Orthis gibbosa* Billings, 1857

*Doleroides germanus* n. sp.

Plate XIII, figures 28-31

Material. One specimen with both valves separated; five pedicle valves, fragments of four brachial valves. Holotype, GSC No. 22481; paratypes, GSC Nos. 22482-22488.

Description of holotype.

Exterior.

Subrectangular with greatest width just anterior to umbo; both valves deep and about same convexity. Hinge line straight. Pedicle interarea large, apsacline and strongly incurved; delthyrium open; beak small, incurved. Brachial interarea small, slightly anacline, gently incurved. Marginal angles slightly rounded and obtuse. Fold on brachial valve and sulcus on pedicle valve weak. Surface multicostate with about twelve costae occurring in 5 mm.

Measurements: length - 14 mm; brachial length - 13.5 mm; width - 16.5 mm; hinge line - 11.5 mm.

Interior.

Pedicle valve: delthyrial cavity deep. Teeth small and triangular, supported by strong dental plates with anterior ends continuing forward as slight ridges along lateral margins of muscle field. Umbonal cavities broad but shallow. Muscle impressions strong; adductor scars hemi-elliptical and divided longitudinally by a faint median ridge, elevated toward anterior region of muscle area; diductors elongate and expanded in front, extending slightly farther toward anterior margin than adductor impressions; adjustor scars impressed into the sides of dental plates. Muscle area bordered anteriorly by a low ridge of adventitious shelly material. No pallial markings seen.

Brachial valve: notothyrial cavity deep and bordered laterally by long, blunt brachiofores; brachiofore plates converging just anterior to cardinal process. Cardinal process large with a thick shaft and compressed myophore. Sockets prominent, defined by small fulcral plates. Median septum thick, extending from cruralium to about middle of valve and bisecting muscle impressions into right and left sets. Muscle scars strongly impressed. Anterior adductor scars larger than posterior scars, divided into a larger inner impression and smaller outer impression and separated from posterior scars by a slightly arched ridge perpendicular to median septum. Genital markings present at posterior lateral edges of posterior adductor scars. Pallial markings not seen.

Discussion. The interior of the pedicle valve of this species is very similar to that of *Pionodema cooperi* n. sp. However, compared with *Doleroides*, the exterior surface of *Pionodema* is more finely costate.

This species is smaller and less globose than *D. gibbosus*, but more globose than *D. ottawanus*. Both *gibbosus* and *ottawanus* are found in the Ottawa Valley.

Genus *Hallina* Winchell and Schuchert, 1892

Type species. *Hallina saffordi* Winchell and Schuchert, 1892

*Hallina canadensis* n. sp.

Plate XV, figures 1-18

Material. More than one hundred specimens with both valves attached; six pedicle valves. Holotype, GSC No. 22489; paratypes, GSC Nos. 22490-22504.

Description of holotype. Shell small, subcircular and moderately globose, shoulders broadly rounded, apical angle 110 degrees. Total surface of shell costate, sixteen costae on each valve; no growth lines seen. Pedicle valve more strongly convex than brachial valve, containing a prominent fold with enlarged median furrow; flanks of the fold slightly concave and steeply sloping to margins of shell. Sulcus of brachial valve moderately shallow, containing five costae with median costa enlarged and slightly elevated. Anterior commissure strongly unisulcate. Beak partially preserved, small and incurved; interarea small and poorly preserved.

Measurements: length - 5.0 mm; brachial length - 4.5 mm; width - 5.0 mm; thickness - 3.5 mm.

Description of paratypes. Compared to the holotype, one specimen is wider with respect to length and has twenty-six finer costae (Pl. XV, figs. 6-9). Shoulders of some valves more angular (Pl. XV, fig. 18). Teeth of pedicle valve prominent and curved (Pl. XV, fig. 10), supported by moderately strong dental plates (Pl. XV, fig. 11). Interior of brachial valve unknown.

Discussion. Small specimens are longer than wide but, with growth, width increases faster than length. Medium-sized specimens have equal length and width and large specimens are wider than long.

Two growth forms occur together in these beds although the larger shell with finer more numerous costae is rare. Two species may be represented but the larger shell is here treated as a variation of the same species.

*Hallina* has not previously been recorded from the Ottawa area. Similar shells from this horizon undoubtedly have in the past been identified as *Zygospira* (Wilson, 1946a, p. 122). The exteriors of *Hallina* and *Zygospira* are similar. However, the presence of strong dental plates in the pedicle valve interior permits accurate generic identification of the Braeside material.

Genus *Oepikina* Salmon, 1942

Type species. "*Oepikina septata* Salmon, 1942

*Oepikina tumida* Wilson

Plate XII, figures 1-15

"*Oepikina tumida* Wilson, 1944, p. 197, Pl. II, fig. 16, Text-fig. 10, no. 10; 1946, p. 93, Pl. VI, fig. 16, Text-fig. 10, no. 10.

Material. Twenty-two specimens with both valves, twenty attached, two separated; seven pedicle valves; one brachial valve. Hypotypes, GSC Nos. 22505-22520.

Description.

Exterior.

Shell concavo-convex with U-shaped outline; slightly wider than long with greatest width at hinge line or slightly anterior to hinge line. Cardinal angles about 90 degrees, often extended into short blunt ears. Hinge line straight. Pedicle interarea small, straight, apsacline; delthyrium partially closed by a small convex plate; beak small and straight. Brachial interarea very small; beak small and straight. Posterior portion of shell very gently curved, almost flat. Geniculation broadly rounded, occurring about 12 mm from beak and forming about 125 degrees angle between anterior and posterior portions of the shell. Therefore, convexity of small specimens low but mature specimens strongly tumid. Surface parvicostellate although costae usually preserved only near anterior margin of the shell. Pseudopunctae not preserved.

Interior.

Pedicle valve: short, stout teeth supported by strong dental plates diverging at about 90 degrees. Muscle area large and subcircular, extending just anterior to middle of the shell. Flabellate diductor scars enclosing raised adductor scars on either side of a faint median septum. Median septum extends to anterior end of muscle area. Adductor scars bordered laterally by a faint ridge and posteriorly by shell material in the shape of an inverted "Y" (Pl. XII, fig. 7). Diductor impressions often striated longitudinally and divided longitudinally into narrow inner scars and broad shorter outer scars (Pl. XII, fig. 7). Muscle area surrounded by a prominent ridge of adventitious shell material; ridge strongest laterally, becoming fainter toward the anterior margin. Subperipheral ridge in some specimens, prominent posteriorly but fainter in anterior part of the shell, terminating posteriorly where ridge meets hinge line at obtuse angles beside the teeth.

Brachial valve: large cardinal process consists of two triangular lobes meeting floor of valve at about 90 degrees. Posterior region of each lobe prominently grooved; lower ends covered by a convex chilidium and separated by a small median ridge (Pl. XII, figs. 3, 4). Prominent socket ridges situated obliquely to hinge line on each side of cardinal process in front of dental sockets. Muscle area moderate size, extending nearly to middle of valve, slightly elevated above floor of valve and surrounded by a faint ledge of adventitious shell material. Median septum low and broad in posterior region, becoming obscure at anterior end of adductor muscle scars, and continuing anteriorly as a sharp knife-like ridge. Two pairs of lateral septa present. Anterior pair nearly parallel to median septum and slightly shorter, each faint posteriorly but extending into a sharp knife-like ridge anterior to the muscle area. Posterior pair very faint, marked in anterior region by a slight swelling at edge of the muscle area. Anterior adductor scars long and slender, situated on each side of median septum and separated from posterior adductors by a small shell ridge. Posterior adductor scars oval, divided into two unequal areas by posterior lateral septa with anterior area smaller than posterior area (Pl. XII, fig. 2). Prominent broadly-rounded subperipheral ridge present.

Discussion. Wilson (1944, p. 197) described the holotype of *O. tumida* from Leray-Rockland beds at Mechanicsville, Ottawa, Ontario. As the holotype shows only the external surface, the present material adds greatly to knowledge of the morphology of the species.

Genus *Rafinesquina* Hall and Clarke, 1892

Type species. *Leptaena altermata* Conrad, 1838

*Rafinesquina* sp.

Plate XIV, figures 25-27

Material. One specimen with both valves attached; three pedicle valves, five brachial valves. Figured specimens, GSC Nos. 22521-22526.

Description.

Exterior.

Shell concavo-convex; outline rounded with greatest width slightly anterior to hinge line. Hinge line straight and cardinal angles obtuse. Pedical interarea moderately large, straight and very slightly apsacline; beak small and straight; delthyrium with small plate at apex. Brachial interarea very small; beak small and straight. Convexity high; shell gently curved in anterior and posterior regions with greatest convexity occurring at about 21 mm behind the beak. Costae fine but preserved only in small areas. Pseudopunctae not preserved.

Interior.

Pedicle valve: pedicle interiors poorly preserved. Teeth large and triangular. Muscle area subcircular, extending slightly beyond middle of shell. Broad subperipheral ridge present in some specimens.

Brachial valve: large cardinal process consists of two triangular lobes meeting the floor of the valve at obtuse angles; lower ends of lobes covered by chilidium (Pl. XIV, fig. 25). Prominent socket ridges situated obliquely to hinge line on each side of the cardinal process in front of the dental sockets. Median septum and socket ridges forming an anchor-shaped mass with arms of the anchor meeting at acute angles. Muscle area elliptical and small, not reaching the middle of the valve. Median septum broad and low in muscle region but extending anteriorly as a narrow, faint ridge. Anterior and posterior adductor scars ovoid and often striated, separated by a pair of faint lateral septa extending only to edge of muscle field. Floor of the valve nearly flat; sharply rounded geniculation occurs about 23 mm behind the beak.

Discussion. Wilson (1944; 1946a) described many species of *Rafinesquina* from the Ottawa Valley. Comparisons between the present material and Wilson's specimens are difficult and specific identification is uncertain.

Genus *Strophomena* Rafinesque in deBlainville, 1825

Type species. *Strophomena rugosa* Rafinesque in deBlainville, 1825

*Strophomena* sp.

Plate XV, figures 19-25

Material. Four specimens with both valves, three attached, one separated; eleven pedicle valves, two brachial valves. Figured specimens, GSC Nos. 22527-22539.

Description.

Exterior.

Shell convexo-concave; width greater than length, greatest width occurring at hinge line. Hinge line straight and cardinal angles extended into prominent, acute ears. Pedicle interarea large, straight and apsacline; delthyrium closed by a large, convex plate; beak small and straight. Brachial interarea very small; beak very small and straight. Lateral margins and ear regions sinuate in some specimens; anterior margin broadly rounded. Brachial valve strongly convex with region of greatest convexity about 10 mm behind beak. Pedicle valve slightly convex to flat in posterior region and concave in anterior region. Surface parvicostellate with costae at anterior margin numbering sixteen to twenty in 5 mm.

Interior.

Pedicle valve: teeth strong. Muscle field subcircular to transversely elliptical and in most shells reaching almost middle of the valve, surrounded by a strongly elevated ridge of adventitious shell material, extending from base of teeth to front of muscle area. Adductor scars small and elliptical, enclosed by large flabellate diductors meeting at two nearly parallel ridges in front of the adductors. Diductor impressions often striate with the central anterior region extending forward in two narrow lobes. Broadly rounded subperipheral rims present in some specimens (Pl. XV, fig. 22).

Brachial valve: cardinal process bilobed; lobes moderately short and narrow, meeting floor of valve at angle greater than 90 degrees. Dental sockets large, shallow and oblique to hinge line, defined by triangular plates on each side of the cardinal process. Muscle area not seen.

Discussion. Wilson (1945; 1946a) described many species of *Strophomena* from the Ottawa Valley. Comparisons between the present material and Wilson's specimens are difficult and specific identification of Braeside material is uncertain.

ANTHOZOA

Genus *Lambeophyllum* Okulitch, 1938

Type species. *Cyathophyllum profundum* Conrad, 1843

*Lambeophyllum profundum* (Conrad)

Plate XVII, figures 7-12

*Cyathophyllum profundum* Conrad, 1843, p. 335.

*Streptelasma profunda*, Hall, 1847, p. 49, Pl. XII, figs. 4a-d.

*Petraia profunda*, Lambe, 1901, Pt. II, p. 105, Pl. VI, figs. 5, a, b.

*Lambeophyllum profundum*, Okulitch, 1938, p. 101, Pl. II, figs. 3, 4; Wilson, 1948, p. 32, Pl. XV, figs. 8-11.

Material. Thirty-six specimens. Hypotypes, GSC Nos. 22540-22546, 22619.

Description. See Okulitch (1938, p. 101) for a detailed description of this species.

Discussion. Corallites of this species grew alone (Pl. XVII, figs. 7, 8), attached together at the base (Pl. XVII, fig. 9) or along the calyx, or attached on one side or on both sides of a bifoliate Bryozoa (Pl. XVII, figs. 10-12).

Winchell and Schuchert (1895, p. 89) described *Streptelasma? parasiticum*, a new species for small corallites attached to the surface of bryozoans. However, internal structures were not seen. Present material shows that one species can assume several growth positions.

Genus *Paleoalveolites* Okulitch, 1935

Type species. *Tetradium? carterense* Bassler, 1932

*Paleoalveolites carterensis* (Bassler)

Plate XIX, figures 3-6

*Tetradium? carterense* Bassler, 1932, p. 196, Pl. 7, figs. 2, 3.

*Paleoalveolites carterensis*, Okulitch, 1935, p. 65, Pl. 2, figs. 1-4; Okulitch, 1938, p. 96; Bassler, 1950, p. 292, Pl. 9, figs. 1-7.

Material. Fragments of three specimens. Hypotypes, GSC Nos. 22554, 22555.

Description.

Transverse section: corallites closely packed (Pl. XIX, figs. 4, 5), or more loosely packed with interstitial areas filled with mud (Pl. XIX, fig. 3). Walls double as seen by dark lines between contiguous corallites (Pl. XIX, figs. 3, 5). Colony consisting of two types of corallites (Pl. XIX, fig. 5); outer layers of imbricating corallites with crescentic outer surfaces and more angular inner surfaces; outer layers grading into inner region of polygonal corallites having five or six sides. Septa sparsely present in both polygonal and imbricating corallites, seen in some mud-filled tubes but not in those filled with spar; four in number and varying from very short to long and slender spines meeting in the centre of the corallite. No secondary septa seen. Openings in the walls, although rare and irregularly spaced, suggest mural pores may be present (Pl. XIX, fig. 5).

Measurements:

Polygonal: average size in mm - 1.5; size range in mm - 1.0-2.0.

Imbricating: average size in mm - 1.7 x 1.9; size range in mm - 1.5 x 0.7 to 2.5 x 1.6.

Longitudinal section: corallites long and slender (Pl. XIX, fig. 6); some moderately straight, and others strongly bent with interstitial areas at the bent regions filled with mud. Walls of the tubes undulating. Tabulae sparse but present, may be flat or slightly bent.

Discussion. Okulitch, when discussing the species (1935b, p. 66), stated that tabulae are "flat and complete and are fairly closely spaced" and that "mural pores are few in number, irregularly spaced, and commonly found in the lateral corners of the corallite". Bassler (1950, pp. 292, 293) stated that tabulae and mural pores are absent. Present material indicates that tabulae are present but sparse. Openings in the corallite walls may be the result of recrystallization and poor preservation rather than the presence of mural pores. Tabulae and septa may have been originally more abundant but subsequently destroyed by recrystallization.

Polygonal corallites of this species closely resemble corallites of *Tetradium columnare* (Hall) as suggested by Bassler (1950, p. 291). However, in longitudinal sections of the Braeside material, the walls of *Paleoalveolites* are more sinuous than those of *T. columnare*.

Okulitch (1938, p. 96) erected the species *P. paquettensis* on the basis of partially dissolved and silicified material. He described that species as closely related to *P. carterensis* but differing by not having tabulae, septa and columella. Bassler (1950, p. 292) indicated that Okulitch's material was poorly preserved and that these structures are absent in the genus. Bassler stated that the specific difference was due to smaller corallite size of *P. paquettensis*. Comparisons among the Braeside material, a GSC specimen from Paquette Rapid, and descriptions and figures of Okulitch (1935b, p. 65, Pl. 2, fig. 4; 1938, p. 96, Pl. 1, fig. 5) and Bassler (1950, pp. 292, 293, Pl. 9, figs. 5, 8) suggest that *P. carterensis* and *P. paquettensis* are probably conspecific. Further material is needed to be certain of this conspecificity, but corallite size variations appear to be greater than thought by Bassler.

Genus *Tetradium* Dana, 1848

Type species. *Tetradium fibratum* Safford, 1856

*Tetradium fibratum* Safford

Plate XVIII, figures 2-4

*Tetradium fibratum* Safford, 1856, p. 237, Text-fig. 2; Lambe, 1899, p. 93, Pl. II, fig. 5; Okulitch, 1935, p. 51, Pl. I, figs. 7, 8; Okulitch, 1938, p. 91; Wilson, 1948, p. 40, Pl. XX, figs. 1, 2; Bassler, 1950, p. 288, Pl. 3, figs. 1-4; Pl. 5, fig. 16.

Material. Sixteen specimens. Hypotypes, GSC Nos. 22547-22550.

Description.

Colony: massive or subhemispherical with densely packed, radiating corallites.

Transverse section: corallites closely packed, subrectangular to subsquare with four wedge-shaped septa, although occasionally irregularly shaped with varying number of septa. In large corallites, septa projecting close to the centre, usually meeting in corallites with diameter about 1.2 to 1.4 mm. Secondary septa occasionally appearing (although often very faint) on the outer walls of large corallites (Pl. XVIII, fig. 3). Walls of all specimens recrystallized. Corallite size 0.6 to 1.4 mm.

Longitudinal section: corallites long, reasonably straight tubes with slightly undulating walls. Septa appearing as fine, wavy, usually continuous lines. No tabulae present (Pl. XVIII, fig. 4).

*Tetradium clarki* Okulitch

Plate XVIII, figure 1

*Tetradium clarki* Okulitch, 1935, p. 96, Pl. 2, figs. 1A-C; Okulitch, 1935, p. 59, Pl. II, fig. 5; Okulitch, 1938, p. 94; Wilson, 1948, p. 39, Pl. XVIII, figs. 1-3; Pl. XIX, figs. 1-3.

Material. Two specimens. Hypotype, GSC No. 22551, a, b.

Description.

Colony: growth in irregular chain-like colonies enclosing mud areas (Pl. XVIII, fig. 1). Width of chain varying from two to about eight corallite diameters.

Transverse and longitudinal sections: corallites appear the same as in the sections of *T. fibratum* Safford.

Discussion. *T. fibratum* and *T. clarki* may be the same species occurring in different growth forms.

*Tetradium columnare* (Hall)

Plate XX, figures 4-6

*Chaetetes columnaris* Hall, 1847, p. 68, Pl. XXIII, figs. 4, a.

*Tetradium columnare*, Safford, 1856, p. 237.

*Prismostylus columnaris*, Okulitch, 1935, p. 63, Pl. I, fig. 3; Okulitch, 1938, p. 95.

*Tetradium columnare*, Bassler, 1950, p. 291, Pl. 3, figs. 14-17.

Material. Two specimens. Hypotypes, GSC Nos. 22552, a-c, 22553.

Description.

Transverse section: corallites densely packed and polygonal, usually with five or six sides. Four delicate septa present in mud-filled corallites but absent in those filled with calcite. No secondary septa seen. Corallite walls show no structures. Corallite size 0.7 to 1.7 mm, usually about 1.2 mm.

Longitudinal section: corallites long, straight tubes with very faint suggestions of tabulae.

Discussion. Present material is poorly preserved. Septa and possibly tabulae may have been present in all corallites but subsequently destroyed by recrystallization.

This species, compared with *T. fibratum*, has polygonal corallites, more delicate septa and lack of undulation of the walls.

As suggested by Bassler (1950, p. 291), this species may be the polygonal corallites of *Paleoalveolites*, without the outer imbricating layers.

Genus *Foerstephyllum* Bassler, 1950

Type species. *Columnare* (?) *halli* Nicholson, 1879

*Foerstephyllum halli* (Nicholson)

Plate XX, figures 1, 2

*Columnare* (?) *halli* Nicholson, 1879, p. 200, Fig. 28; p. 201, Fig. 29, Pl. 10, figs. 3, a; Lambe, 1901, p. 100, Pl. VI, figs. 2, a.

*Lyopora halli*, Wilson, 1948, p. 37, Pl. XVI, figs. 12-15.

*Foerstephyllum halli*, Bassler, 1950, p. 269, Pl. 12, figs. 4-7; Pl. 19, fig. 7.



Material. Fragments of four specimens. Hypotype, GSC No. 22621, a, b.

Description. See Bassler (1950, p. 269) for a detailed description of this species.

Discussion. The Braeside specimens are silicified and poorly preserved.

Genus *Favistina* Flower, 1961

Type species. *Favistella undulata* Bassler, 1950

*Favistina* sp.

Plate XIX, figures 1, 2

Material. Nine fragments. Figured specimens, GSC Nos. 22556, 22557.

Description. Corallites polygonal to round, ranging in size from 2.0 to 4.2 mm with average size between 3 and 3.5 mm. Corallites with ten or eleven major septa reaching almost to centre of a corallite. Minor septa small when present and alternating irregularly with major septa. Tabulae generally horizontal, almost flat but often turned down slightly at the margins, three or four occurring in length equal to diameter of corallite.

Discussion. Foerste (1914, p. 123) described *Columnaria alveolata minima* from the Trenton of Kentucky having corallites with average diameter 3 mm. The Braeside species most closely resemble *F. minima* (Foerste) in size. Foerste's species however has twelve or more septa.

Genus *Lichenaria* Winchell and Schuchert, 1895

Type species. *Lichenaria typa* Winchell and Schuchert, 1895

*Lichenaria typa* Winchell and Schuchert

Plate XX, figure 3

*Lichenaria typa* Winchell and Schuchert, 1895, p. 83, Pl. G, figs. 10-13; Okulitch, 1938, p. 90; Wilson, 1948, p. 38, Pl. XVI, fig. 11; Bassler, 1950, p. 257, Pl. 10, figs. 4-7; Pl. 15, figs. 2, 3.

Material. Three colonies with diameters 10 to 15 mm. Hypotype, GSC No. 22622.

Description. See Bassler (1950, p. 257) for a detailed description of this species.

*"Aulopora" wilsonae* Sinclair

Plate XXI, figures 4-6

*Fletcheria incerta* (Billings), Wilson, 1948, p. 42, Pl. XXI, fig. 3.

*"Aulopora" wilsonae* Sinclair, 1961, p. 16, Pl. VII, figs. 1-3.

Material. Seven specimens. Hypotypes, GSC Nos. 22558-22560, a, b.

Description. See Sinclair (1961, p. 16). Thin sections suggest the presence of tabulae (Pl. XXI, fig. 5), lack of septa, and show both halisitoid and cerioid growth habits (Pl. XXI, fig. 6).

Discussion. The present material, although highly silicified and poorly preserved, shows previously unknown internal features.

Genus *Cornulites* Schlotheim, 1820

Type species. *Cornulites serpularius* Schlotheim, 1820

*Cornulites* sp.

Plate IV, figure 3; Plate XVII, figures 3, 4

Material. Seven specimens. Figured specimens, GSC Nos. 22616, 22617, 22311.

Description. Small tapering tube with circular cross-section. External surface marked by concentric rings. Tubes moderately straight, curved at the apical end, or strongly bent, occurring singly, several attached (Pl. XVII, fig. 4), or affixed to the surface of a shell (Pl. IV, fig. 3).

TRILOBITA

The following six species of Trilobita are known from the Braeside beds. Only a few specimens of each were found.

*Nanillaenus conradi* (Billings). Hypotype, GSC No. 22561 (Pl. XVII, figs. 17-20).  
Total material: one enrolled specimen and fragment of another thorax.

*Bumastus (Bumastoides) milleri* (Billings). Hypotype, GSC No. 22562 (Pl. XVII, fig. 16). Total material: four specimens. The present specimens are slightly larger than the holotype but similar in all other respects.

*Raymondites spiniger* (Hall). Hypotype, GSC No. 22618 (Pl. XVII, figs. 5, 6).  
Total material: one enrolled specimen, underside of another cranidium.

*Cercaurus pleurexanthemus* Green. Hypotype, GSC No. 22563 (Pl. XVII, figs. 1, 2).  
Total material: three specimens.

*Isotelus* sp. Numerous fragments.

*Calyptaulax?* sp. Total material: four pygidia. Several genera have similar pygidia and generic identification is indefinite.

STROMATOPOROIDEA

Genus *Cryptophragmus* Raymond, 1914

Type species. *Cryptophragmus antiquatus* Raymond, 1914

*Cryptophragmus* sp.

Plate XVII, figures 13-15

Material. One specimen. Figured specimen, GSC No. 22620.

Discussion. The only specimen is too poorly preserved to be named, but clearly shows the "genus" to be a consortium. The central tubes are

recrystallized and show no structure. The stromatoporoid element of the consortium surrounds the whole, but does not intrude into the space between the tubes.

As a *Cryptophragmus* has been described from the "Black River" of Eastern Ontario, comparison with the present specimen might be expected. The holotype (and only specimen) of *Cryptophragmus? rochensis* Wilson has been studied and is considered a poorly preserved cephalopod. R.H. Flower has kindly examined this specimen and agrees with this reassignment.

## BRYOZOA

### Plates XI, XII

Thomas E. Bolton

Representatives of both Cryptostomata and Trepostomata are present within the bryozoan fauna collected from the Braeside beds. Two broad bifoliate expansions, bearing low monticules, and many fragments of the cryptostome *Stictopora* sp. were identified (GSC Nos. 22623-22625, 22629 - Pl. XXI, figs. 1, 9, 10). Two different species of *Pachydiactya* as well as one *Phylloidiactya(?)* sp. also were recognized among the bifoliate representatives. The trepostome fauna consisted of several specimens of *Heterotrypa* sp. (GSC Nos. 22630-22632 - Pl. XXII, figs. 1-3, 5), a few *Monotrypella* sp. (GSC Nos. 22633, 22634 - Pl. XXI, figs. 2, 3, 8) and *Monotrypella(?)* or *Rhombotrypa(?)* sp., and one specimen each of *Dekayia* sp. cf. *D. typica* Fritz (GSC No. 22635 - Pl. XXII, figs. 4, 6), *Homotrypa* sp. cf. *H. lowvillensis* Fritz, and *Nicholsonella* sp. cf. *N. wilsonae* Fritz (GSC No. 22559 - Pl. XXI, fig. 7).

A bryozoan assemblage of this composition has not been detailed before from the Ottawa-St. Lawrence Lowland Ordovician rocks, so that the exact placement of the Braeside beds within the Middle Ordovician is not possible. Fritz (1957) recorded several species of *Dekayella* (= *Heterotrypa*, Boardman and Utgaard, 1966) and *Dekayia typica* from the Cobourg beds of the Ottawa Formation, *H. lowvillensis* from the Lowville and Leray beds, and *N. wilsonae* from the Leray and Rockland beds. The *Heterotrypa* specimens in the Braeside fauna are distinguished by the sparse and irregular distribution of acanthopores and relatively few mesopores; as such they resemble *H. pauca* Perry (1962) described from the Middle Ordovician Spechts Ferry Formation of the upper Mississippi Valley.

## OSTRACODA

### Plate XXIII

M.J. Copeland

Of the sixteen Middle Ordovician ostracode species identified from the Braeside fauna, fourteen occur in the Decorah Formation of Minnesota and Iowa, ten in the Bucke Formation of Lake Timiskaming, Ontario, eight in the lower 175 feet of strata at Silliman's Fossil Mount, Baffin Island, and seven in the Kirkfield Formation near Healey Falls, Ontario (Copeland, 1965, pp. 3-5; Copeland, in Sinclair, 1964, Pl. III). Also present are specimens of *Apatochilina?*, *Eoleperditia?*, and *Macronotella*. This widespread 'Decorah' ostracode faunule appears to be typically of Late Wilderness age and constitutes a distinctive micropaleontological assemblage.

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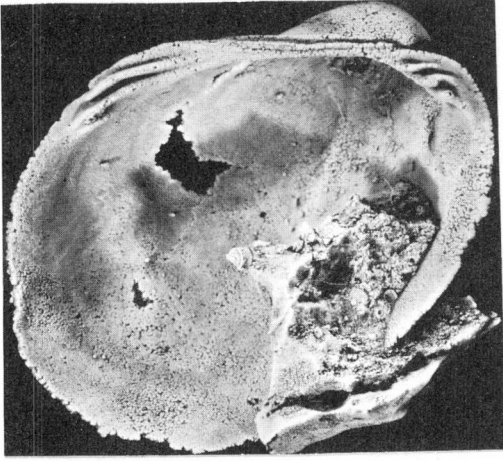


PLATES I - XXIII

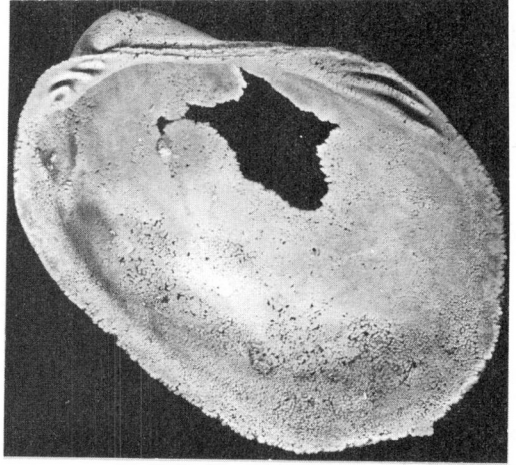
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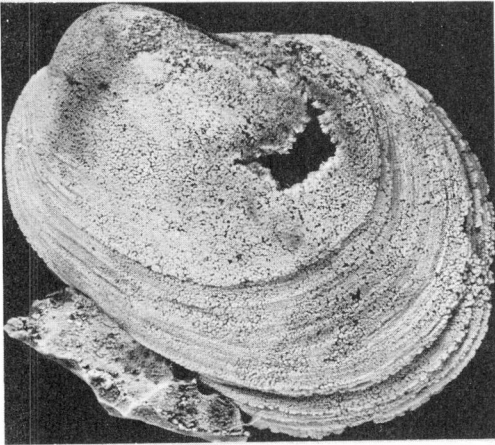
- Figures 1-7. *Cyrtodonta grattanensis* Wilson (Page 6)
- 1, 3-5. Left valve, interior, exterior, top, and anterior views. Hypotype, GSC No. 22252.
- 2, 7. Right valves, interior views. Hypotypes, GSC Nos. 22252a, 22267.
6. Left valve, interior view. Hypotype, GSC No. 22253.



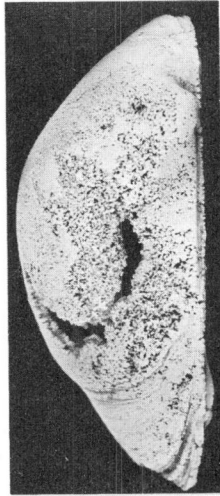
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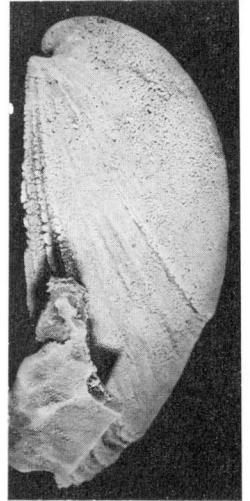
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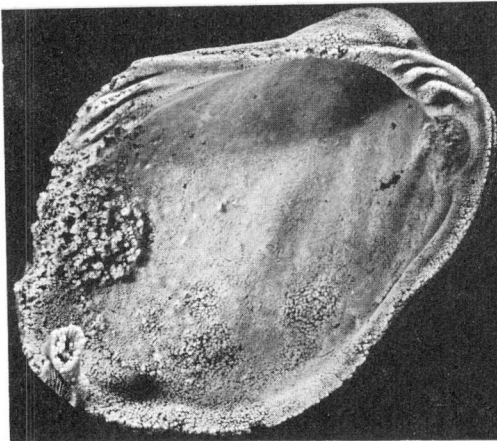
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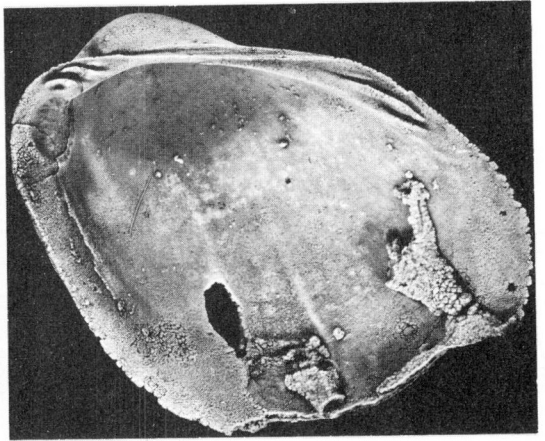
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PLATE II

(all figures x2)

Figures 1-7. *Cyrtodonta grattanensis* Wilson (Page 6)  
1, 5. Left valves, interior views. Hypotypes, GSC  
Nos. 22255, 22271.  
2-4, 6, 7. Right valves, interior views. Hypotypes,  
GSC Nos. 22272, 22259, 22256, 22257, 22262.

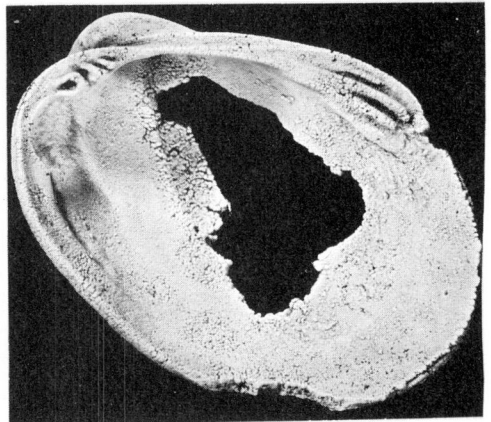
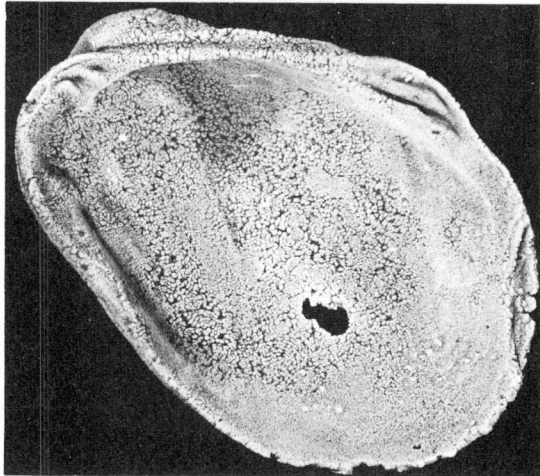
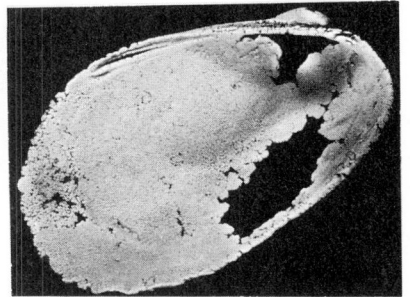
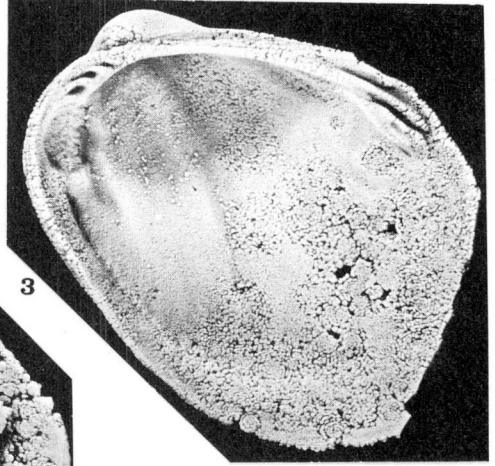
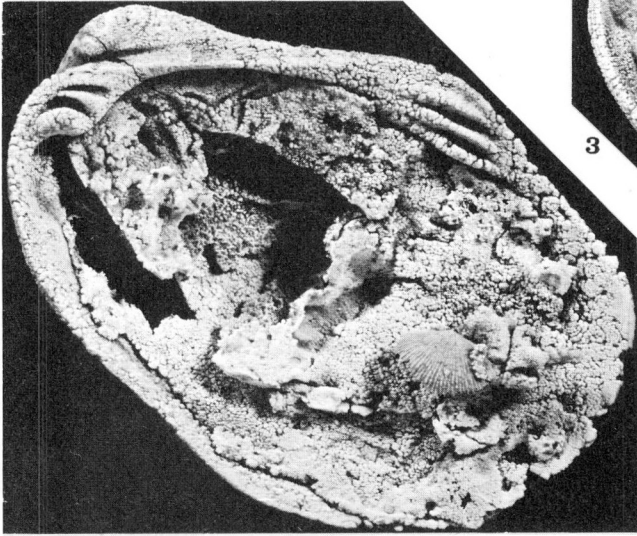
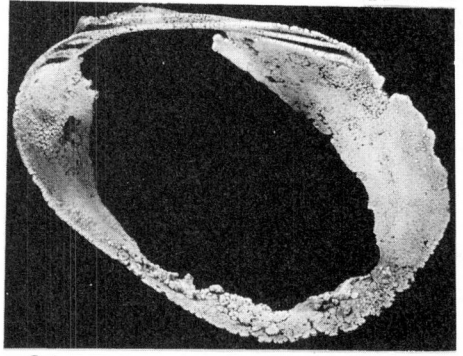
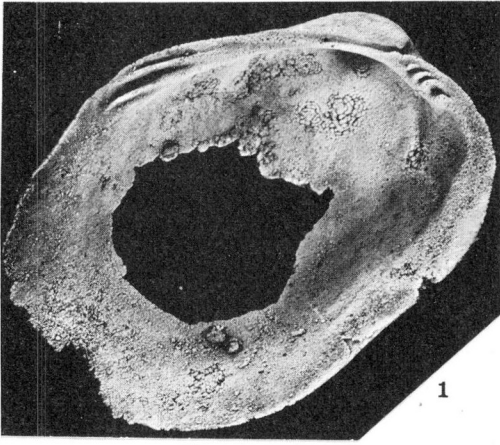
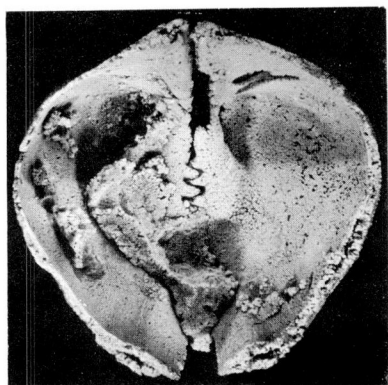




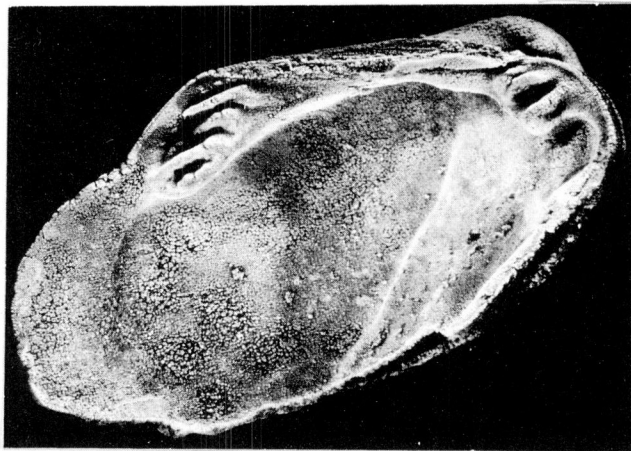
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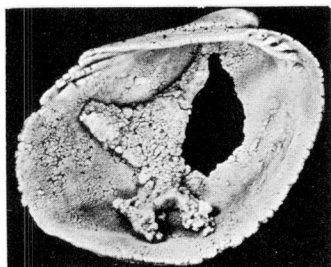
- Figures 1-7. *Cyrtodonta grattanensis* Wilson. (Page 6)
1. Both valves attached, interior view of hinge line showing anterior teeth. Hypotype, GSC No. 22284.
  - 2, 5. Left valves, interior views. Hypotypes, GSC Nos. 22258, 22285.
  3. Right valve, interior view. Hypotype, GSC No. 22265.
  4. Both valves attached, exterior view of hinge line. Hypotype, GSC No. 22275.
  - 6, 7. Right valve, interior and exterior views. Hypotype, GSC No. 22285a.



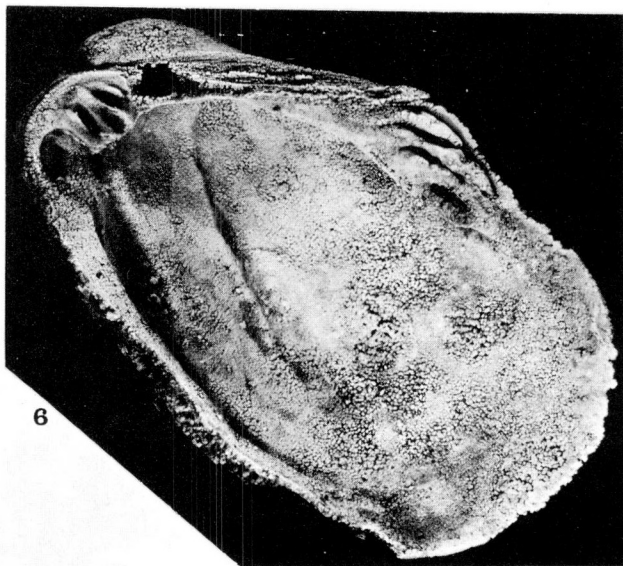
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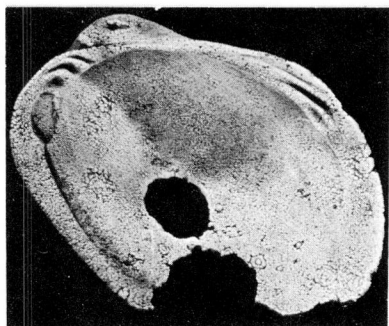
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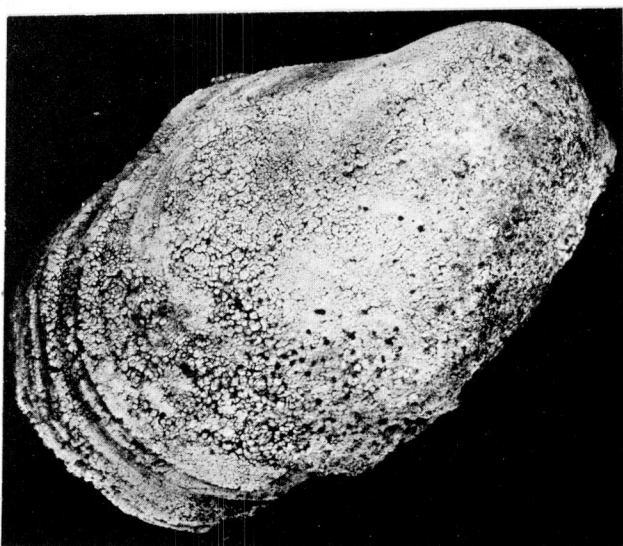
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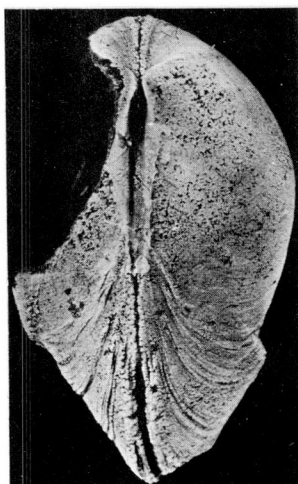
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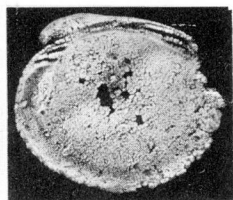


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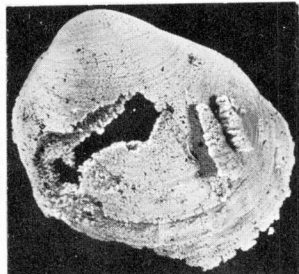
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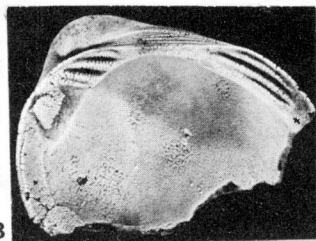
- Figures 1-11. *Vauxsema inconstans* Billings (Page 9)
- 1, 5. Right valves, interior views of small, circular specimens. Hypotypes, GSC Nos. 22286, 22287.
  2. Left valve, exterior view showing *Cornulites* sp. affixed to the surface. Hypotype, GSC No. 22311.
  3. Right valve, interior view of medium-sized specimen showing striated anterior and posterior teeth and striated ligamental area. Hypotype, GSC No. 22293.
  4. Right valve, interior view of nearly circular specimen. Hypotype, GSC No. 22288.
  6. Left valve, interior view of broken specimen showing striated anterior and posterior teeth. Hypotype, GSC No. 22294.
  - 7, 8. Right valve, top and interior views of large specimen. Hypotype, GSC No. 22305.
  - 9, 11. Left valve, top, interior and exterior views of large specimen. Hypotype, GSC No. 22296.



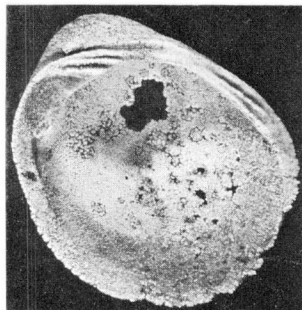
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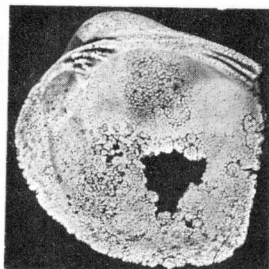
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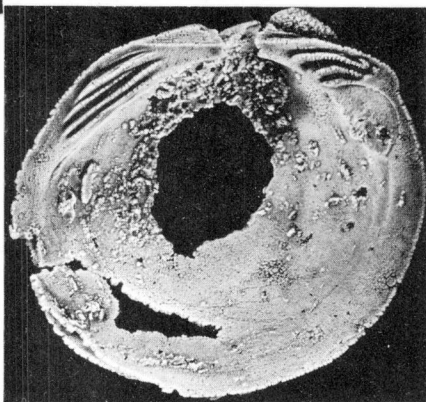
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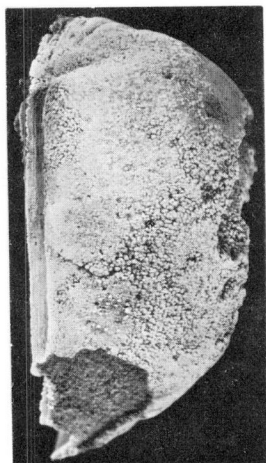
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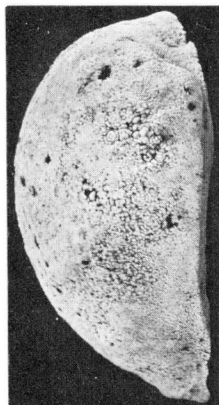
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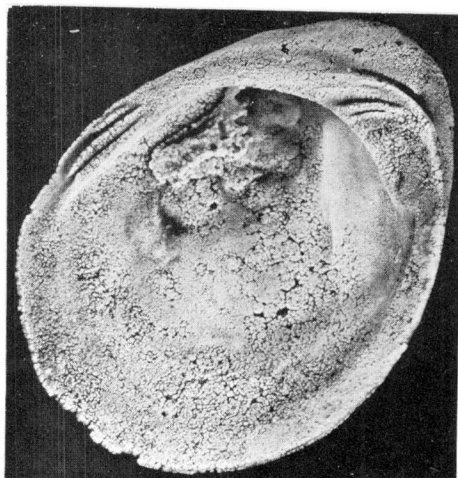
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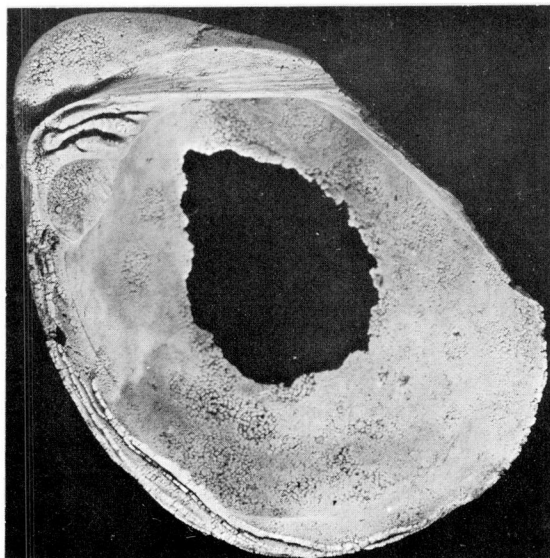
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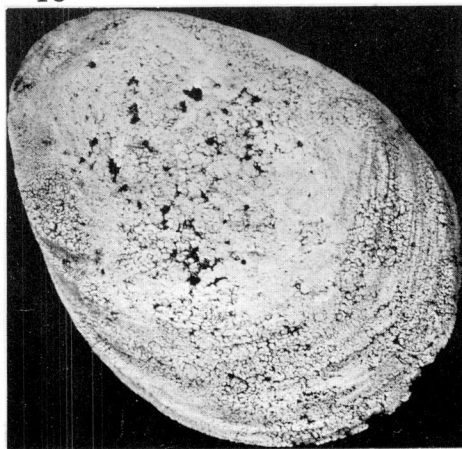
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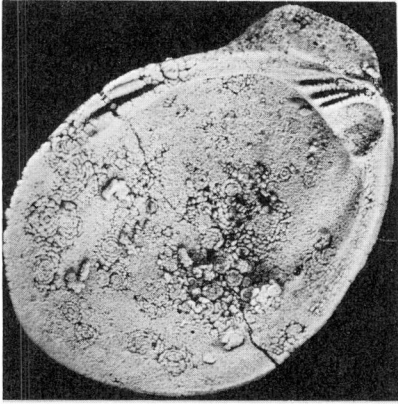


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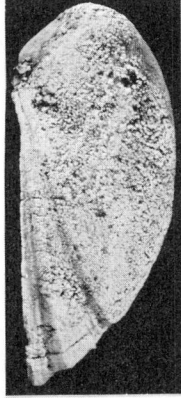
PLATE V

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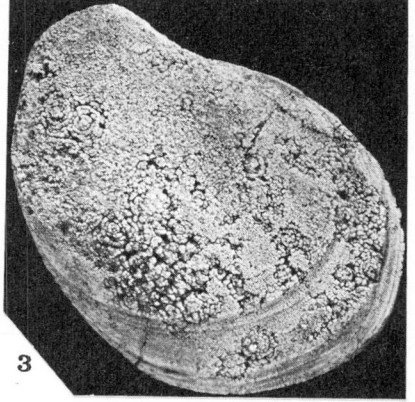
- Figures 1-5. *Vanuxemia inconstans* Billings (Page 9)  
1-3. Left valve, interior, anterior and external views showing flattened umbo. Hypotype, GSC No. 22299.  
4, 5. Right valve, large, showing constriction near hinge line, interior and exterior views. Hypotype, GSC No. 22295.
- Figures 6-9. *Cleionychia naba* n. sp. (Page 12)  
6, 7. Left valve, interior and exterior views (x1). Holotype, GSC No. 22313.  
8, 9. Left valve, interior view of hinge line and exterior view beneath beak. Holotype, GSC No. 22313.
- Figure 10. *Tancrediopsis "abrupta"* Billings (Page 14)  
Left valve, interior view. Hypotype, GSC No. 22320.
- Figure 11. *Tancrediopsis contracta* (Salter) (Page 14)  
Left valve, interior view. Hypotype, GSC No. 22319.



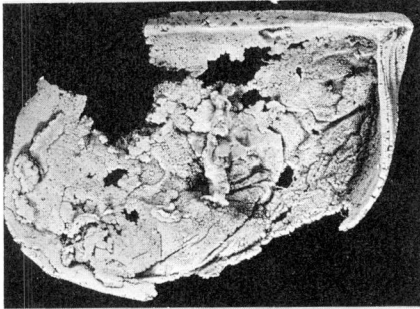
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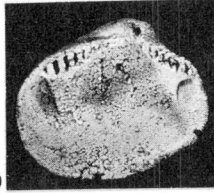
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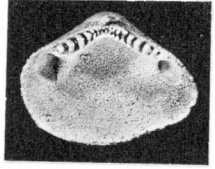
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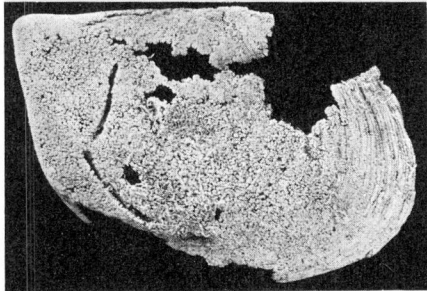
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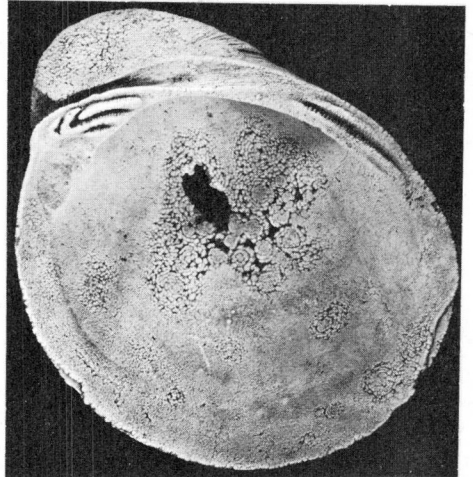
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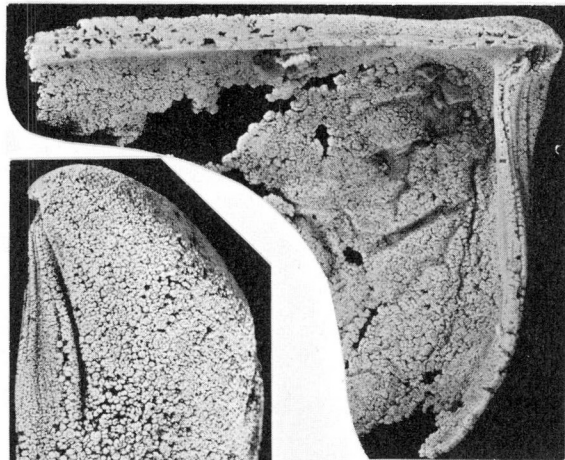
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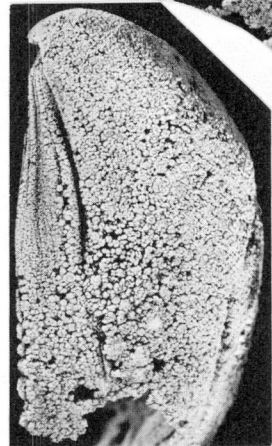
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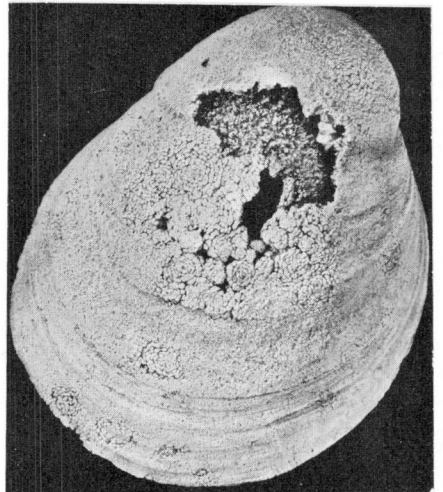
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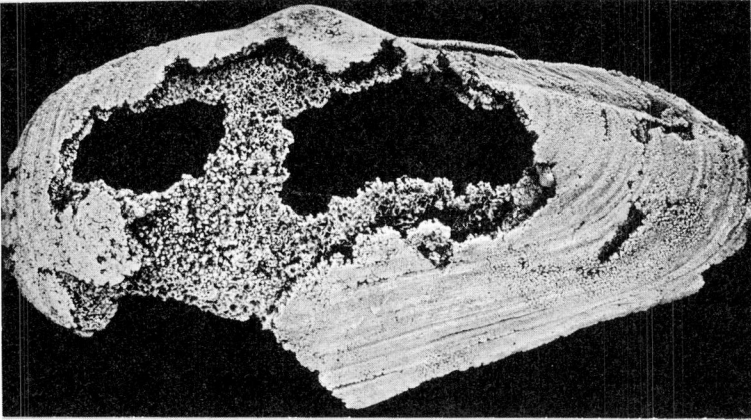


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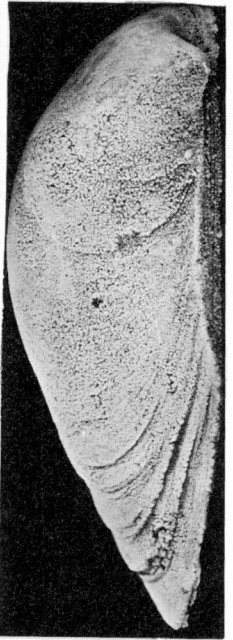
PLATE VI

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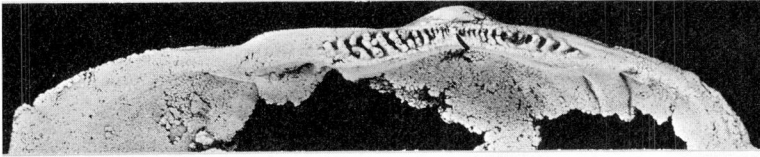
- Figures 1, 2. *Ctenodonta nasuta* (Hall) *sensu* Salter (Page 13)  
Left valve, exterior view showing dorsal projection of hinge  
plate and depression along hinge line posterior to beak,  
and interior view showing teeth and muscle scars. Hypotype,  
GSC No. 22316.
- Figures 3-5. *Cyrtodontula ottawana* n. sp. (Page 11)  
Right valve, top, interior and exterior views. Holotype,  
GSC No. 22312.
- Figures 6, 7. *Cyrtodonta grattanensis* Wilson (Page 6)  
6. Left valve, interior view showing "worm" tubes.  
Hypotype, GSC No. 22270.  
7. Both valves attached, left valve broken, interior view  
showing "worm" tubes. Hypotype, GSC No. 22269.



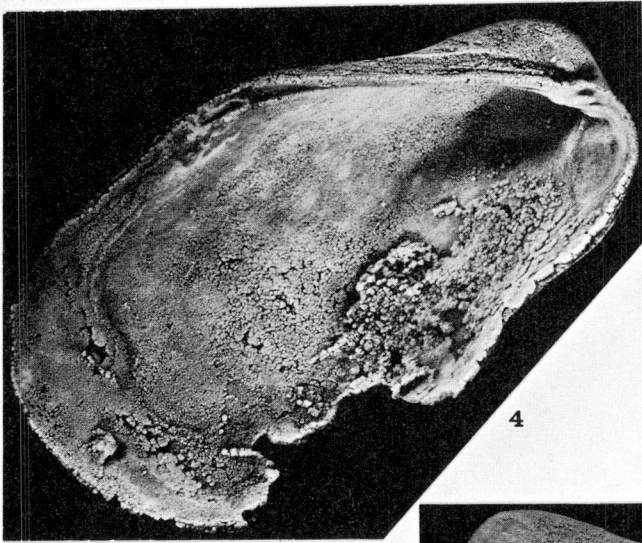
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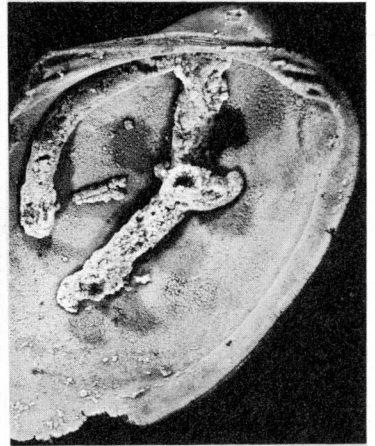
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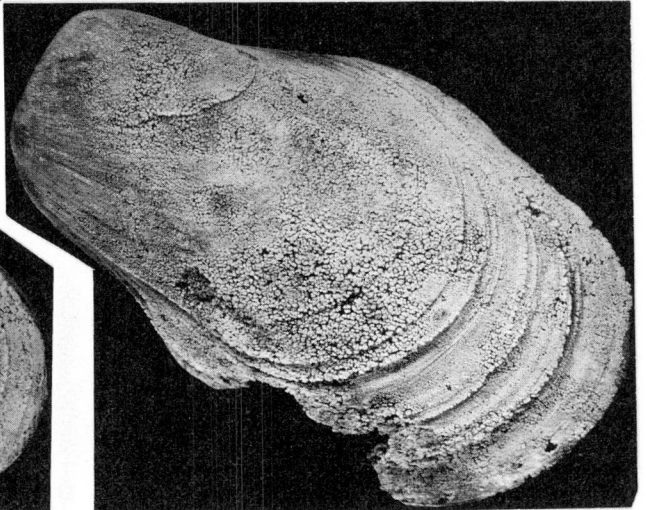
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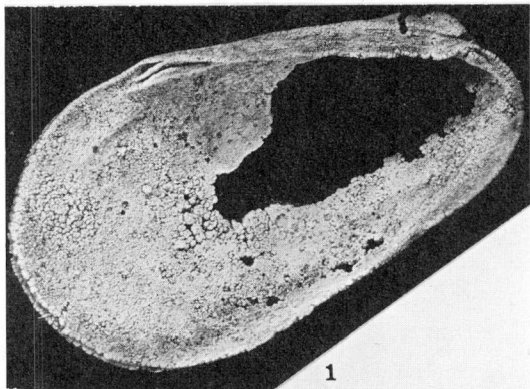
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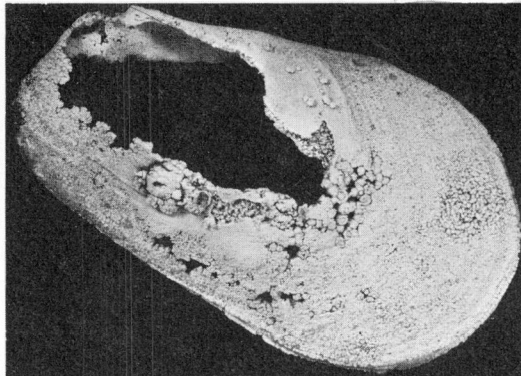
PLATE VII

(all figures x2 unless otherwise stated)

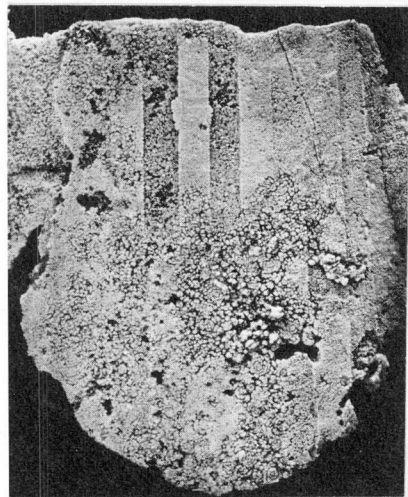
- Figures 1, 2. *Cyrtodonta grattanensis* Wilson (Page 6)  
Left valve, interior view showing anterior and posterior  
teeth, and exterior view. Hypotype, GSC No. 22314.
- Figures 3-5. Colour markings on cephalopods (Page 28)  
3. Etched specimen with colour markings more deeply  
weathered than rest of specimen. Fig. spec., GSC No.  
22409.  
4, 5. x1. Fig. specs., GSC Nos. 22411, 22413.
- Figures 6, 7. *Clathrospira subconica* (Hall) (Page 18)  
6. Side view showing growth lines, concentric ornamentation,  
and injury to body whorl (x1). Hypotype, GSC No. 22362.  
7. Enlargement of body whorl (x4). Hypotype, GSC No. 22362.



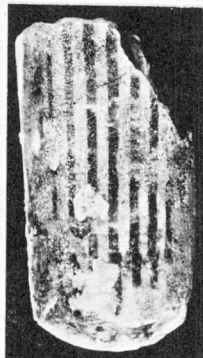
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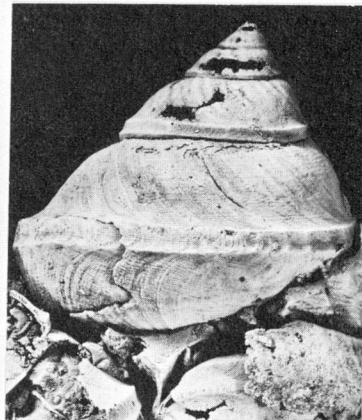
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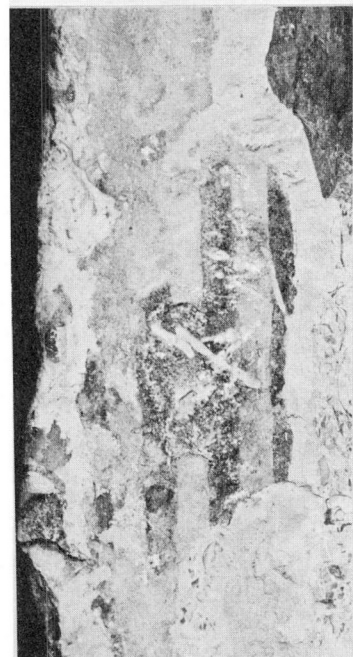
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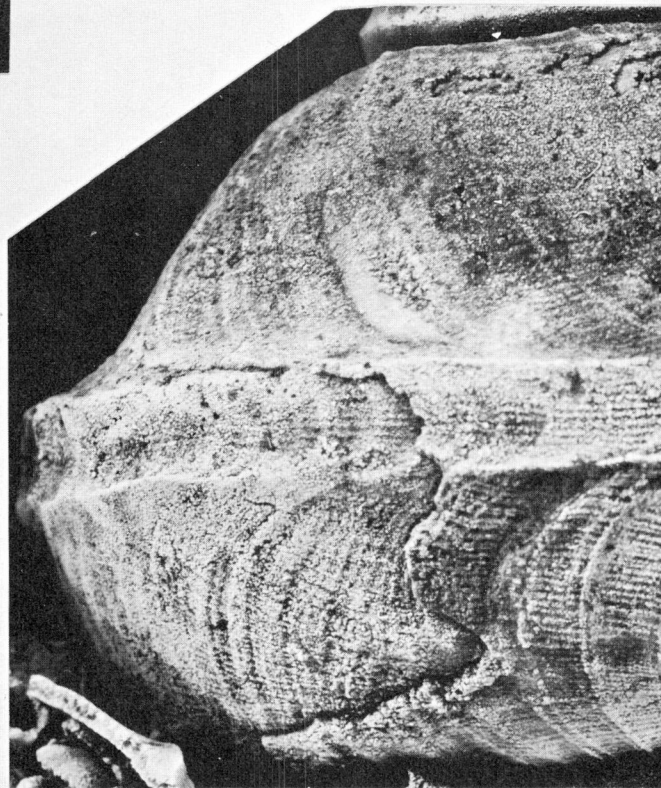
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PLATE VIII

(all figures x2)

- Figures 1-5. *Trochonema wilsonae* n. sp. (Page 17)  
1-4. Aperture, side, top and bottom views showing growth lines, and disturbed growth in youngest region. Holotype, GSC No. 22356.  
5. Aperture view. Paratype, GSC No. 22257.
- Figures 6-12. *Lophospira milleri* (Miller) (Page 14)  
6. Side view showing rounded peripheral carina, very faint upper and lower carinae. Hypotype, GSC No. 22327.  
7. Aperture view. Hypotype, GSC No. 22321.  
8. Side view showing trilineate peripheral keel, broadly rounded upper carina and very faint lower carina. Hypotype, GSC No. 22323.  
9. Side view showing broadly rounded peripheral carina, broadly rounded upper carina, obscure lower carina. Hypotype, GSC No. 22326.  
10. Side view showing trilineate peripheral keel, sharply defined upper carina, raised lower carina. Hypotype, GSC No. 22324.  
11. Aperture view showing trilineate peripheral keel, sharply defined upper and lower carinae. Hypotype, GSC No. 22322.  
12. Side view showing broadly rounded peripheral keel, broadly rounded upper carina, obscure lower carina. Hypotype, GSC No. 22325.

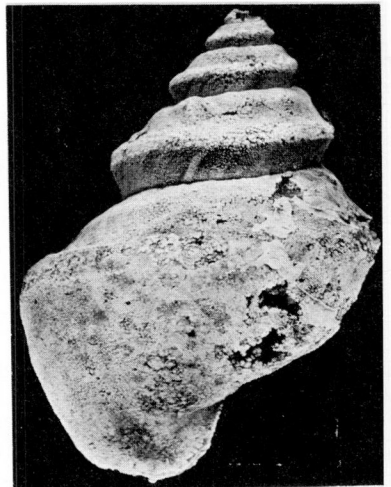
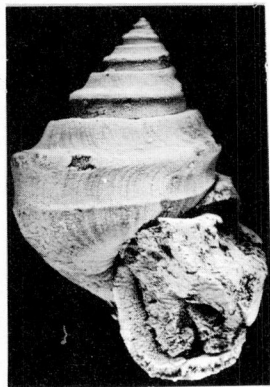
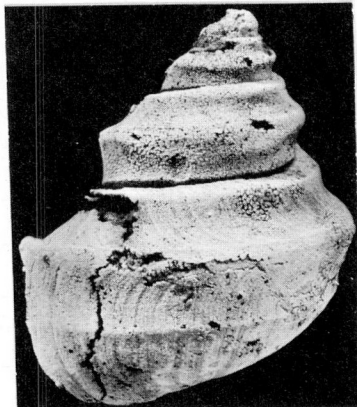
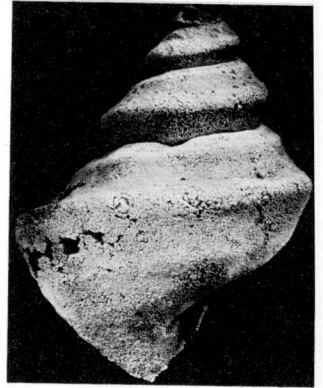
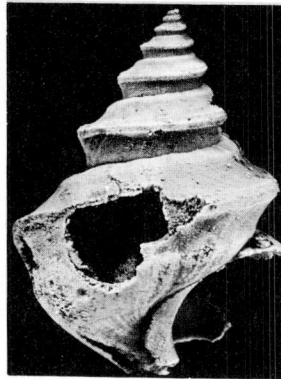
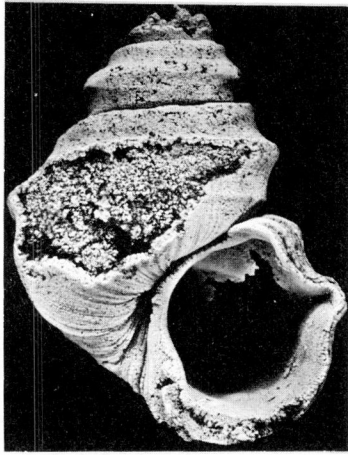
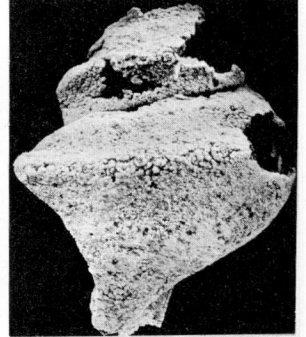
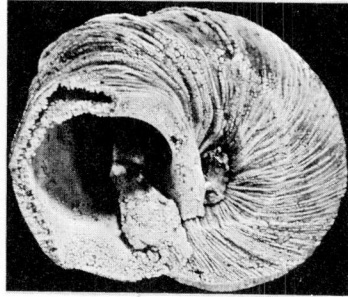
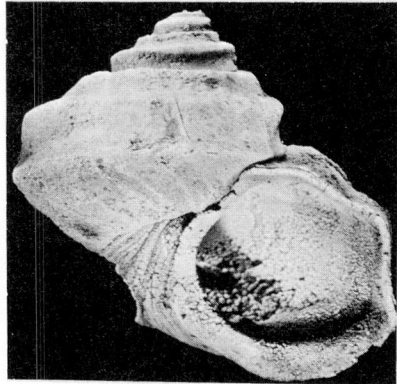
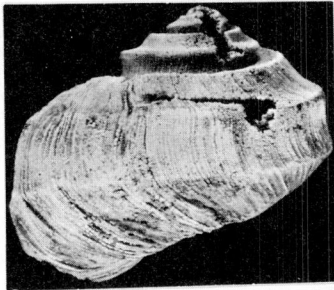
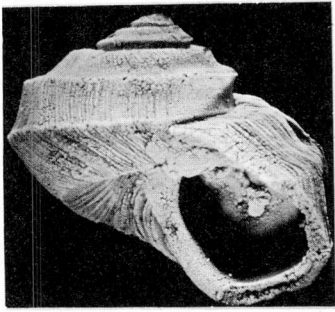
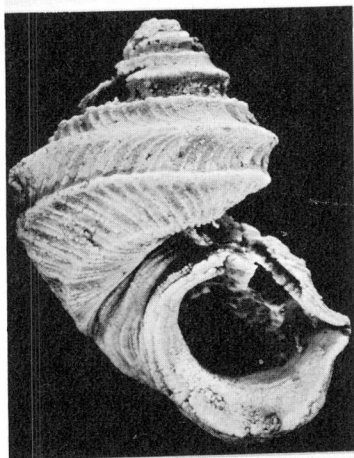


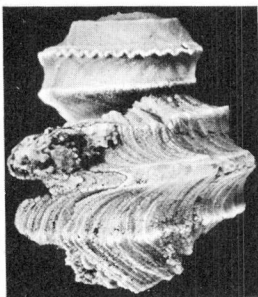
PLATE IX

(all figures x2)

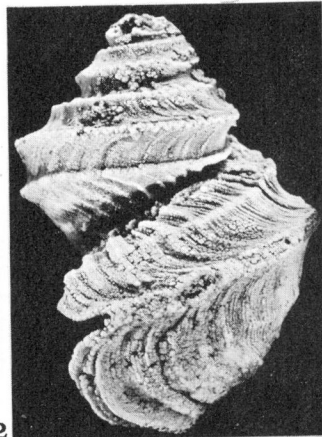
- Figures 1-6. *Lophospira serrulata* (Salter) (Page 16)  
1-4. Aperture, side showing trilineate keel with serrated central line and tendency to uncoil, top and bottom views. Hypotype, GSC No. 22341.  
5, 6. Side views showing trilineate keel with serrated central line. Hypotypes, GSC Nos. 22343, 22342.
- Figures 7-10. *Raphistomina fissurata* n. sp. (Page 18)  
Side showing selenizone and slit, aperture, top showing break in shell and subsequent healing, and bottom views. Holotype, GSC No. 22361.



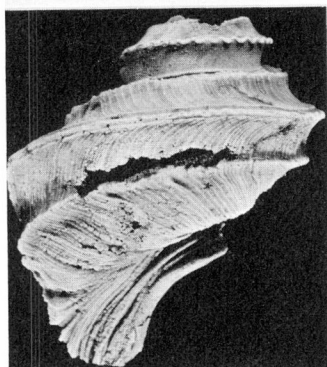
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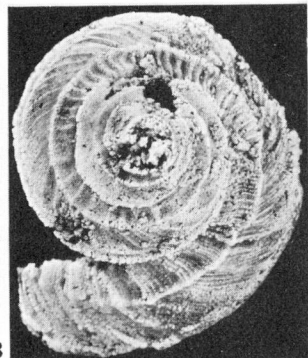
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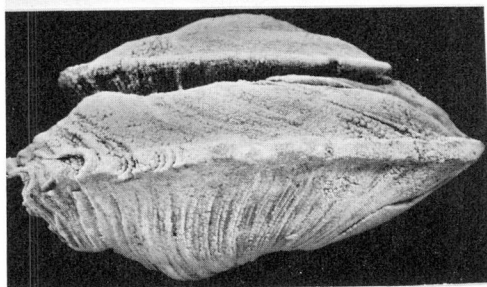
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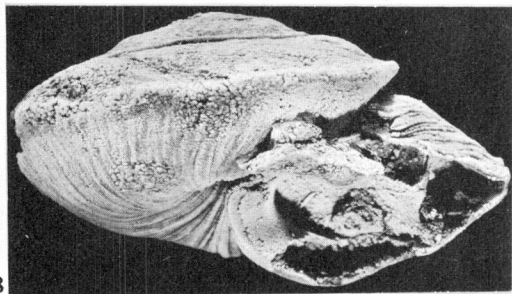
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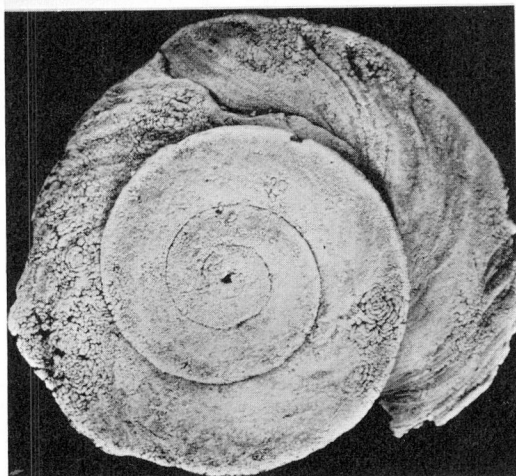
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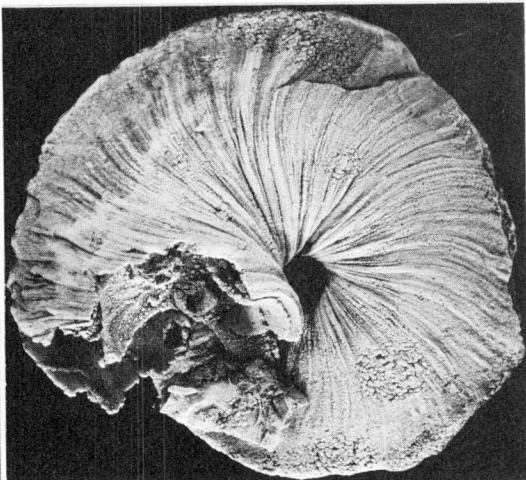
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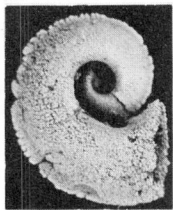
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PLATE X

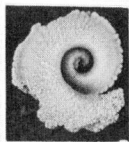
- Figures 1-3. *Phragmolites?* sp. (Page 20)  
1, 2. Left side and view of keel (x4). Fig. spec.,  
GSC No. 22371.  
3. Left side (x4). Fig. spec., GSC No. 22372.
- Figures 4, 15. *Tetranota* cf. *bidorsata* (Hall) (Page 19)  
4. Adapertural view showing four concentric ridges and  
selenizone (x4). Hypotype, GSC No. 22369.  
15. Adapertural view showing flaring outer lips (x2).  
Hypotype, GSC No. 22368.
- Figures 5-8. *Pterotheca expansa* (Emmons) *sensu* Wilson (Page 20)  
5-7. Abapertural, apertural, and side views (x2).  
Hypotype, GSC No. 22372.  
8. Abapertural view (x2). Hypotype, GSC No. 22375.
- Figure 9. *Hormotoma salteri canadensis* Ulrich and Scofield (Page 20)  
Apertural view (x2). Hypotype, GSC No. 22376.
- Figures 10-14. *Hyolithes* cf. *baconi* Whitfield (Page 22)  
10-12. Ventral views showing conical weathering (x4).  
Hypotypes, GSC Nos. 22388, 22387, 22386.  
13. Ventral view showing growth lines (x4). Hypotype,  
GSC No. 22385.  
14. Dorsal view showing growth lines (x4). Hypotype,  
GSC No. 22384.
- Figure 16. *Subulites* cf. *regularis* Ulrich and Scofield (Page 21)  
Side view (x2). Hypotype, GSC No. 22382.



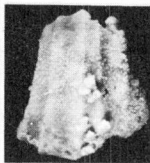
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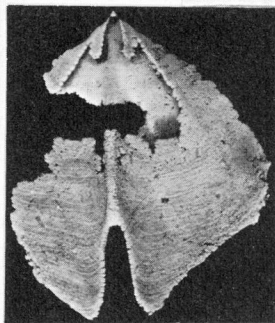
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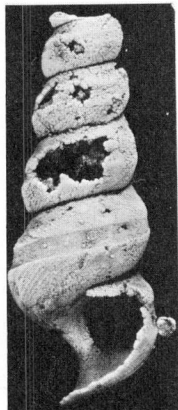
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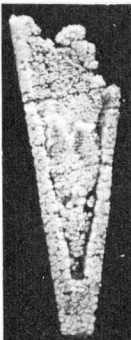
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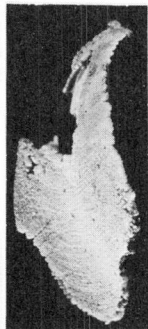
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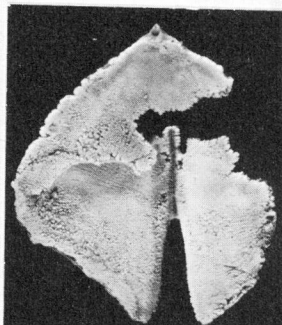
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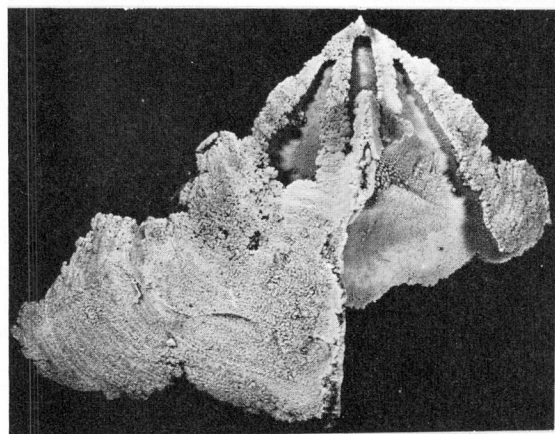
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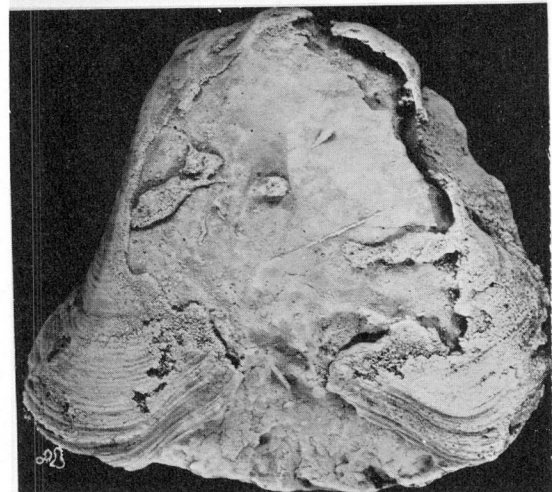
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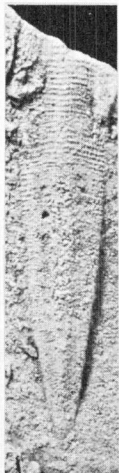
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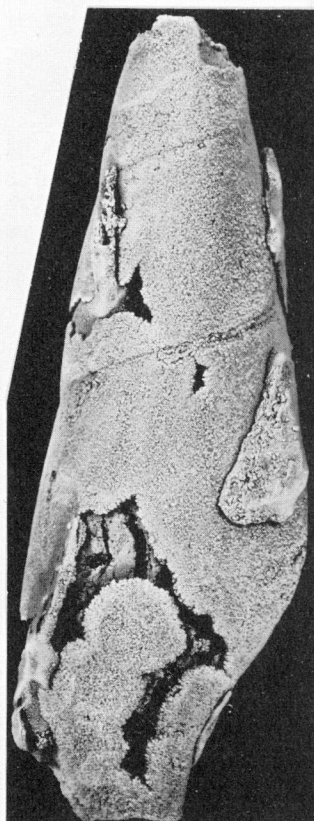
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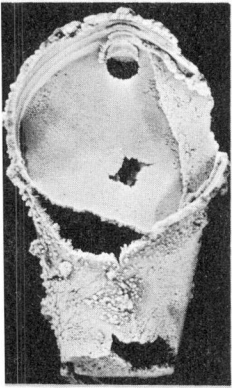
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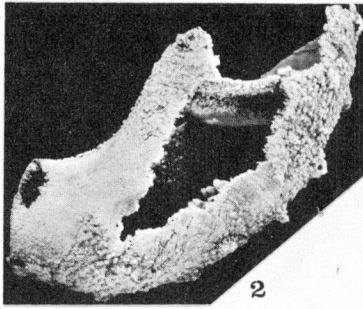
PLATE XI

(all figures x2 unless otherwise stated)

- Figures 1-6. *Loganoceras regulare* (Billings) (Page 22)  
1-3. Dorsal view showing stepped septum, side view showing stepped septum through break in the shell, and side view showing surface covered with bumpy growth. Hypotype, GSC No. 22398.  
4-6. Ventral, dorsal, and side views. Hypotype, GSC No. 22397.
- Figures 7-9. "*Cycloceras*" *cylindratum* (Foerste) (Page 27)  
Longitudinal views. Hypotype, GSC No. 22408.
- Figure 10. *Michelinoceras* sp. 2 (Page 25)  
Polished section. Fig. spec., GSC No. 22403.
- Figures 11, 12. *Michelinoceras* sp. 3 (Page 25)  
Interior and exterior views of etched specimen. Fig. spec., GSC No. 22404.
- Figure 13. *Michelinoceras* sp. 1 (Page 25)  
Polished section. Fig. spec., GSC No. 22402.
- Figures 14-16. "*Spyroceras*" sp. (Page 26)  
14, 15. Septal and longitudinal views. Fig. spec., GSC No. 22405.  
16. Longitudinal view. Fig. spec., GSC No. 22406.
- Figures 17, 18. *Zitteloceras* sp. (Page 24)  
Ventral and side views. Fig. spec., GSC No. 22399.
- Figures 19, 20. *Monomuchites?* *decrescens* (Billings) *sensu* Wilson (Page 26)  
Polished section and exterior view (x1). Hypotype, GSC No. 22407.



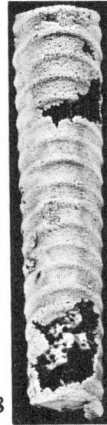
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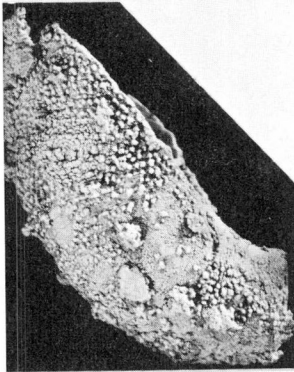
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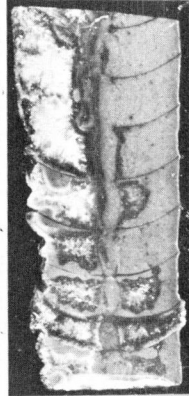
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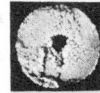
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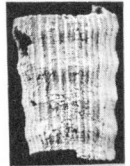
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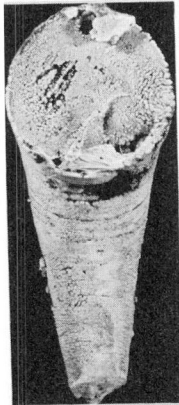
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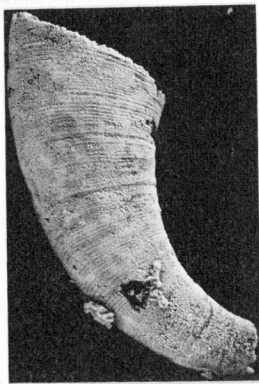
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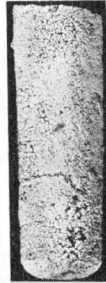
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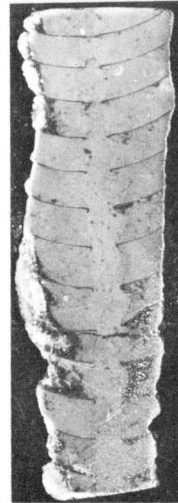
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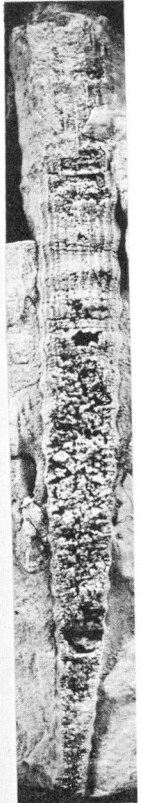
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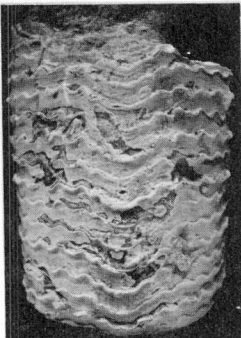
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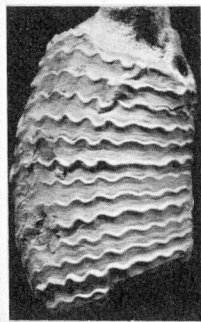
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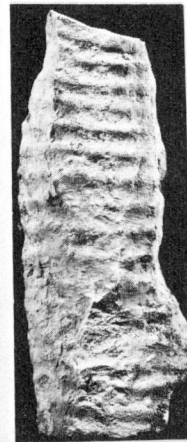
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PLATE XII

(all figures x2 unless otherwise stated)

- Figures 1-15. *Oepikina tumida* Wilson (Page 33)  
1-4. Interior pedicle valve showing muscle area, interior brachial valve showing muscle area and median and lateral septa, and anterior views brachial valve. Hypotype, GSC No. 22505.  
5, 6. Brachial valve, interior showing muscle area and median and lateral septa, and exterior views. Hypotype, GSC No. 22506.  
7. Pedicle valve, interior view showing adductor and diductor muscle scars, raised ridge around adductor scars, median septum, "Y"-shaped area posterior to adductor scars. Hypotype, GSC No. 22516.  
8, 9. Attached valves, brachial and side views. Hypotype, GSC No. 22516.  
10-13. Attached valves, side, posterior, pedicle, and brachial views. Hypotype, GSC No. 22518.  
14, 15. Attached valves, posterior and brachial views. Hypotype, GSC No. 22511.
- Figure 16. *Actinoceras* cf. *aequale* Flower (Page 24)  
Polished section (xl). Hypotype, GSC No. 22400.
- Figure 17. *Ormoceras* sp. (Page 24)  
Polished section. Fig. spec., GSC No. 22401.

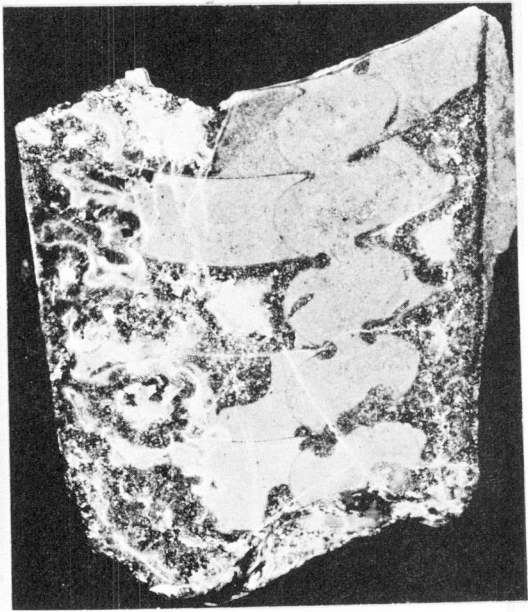
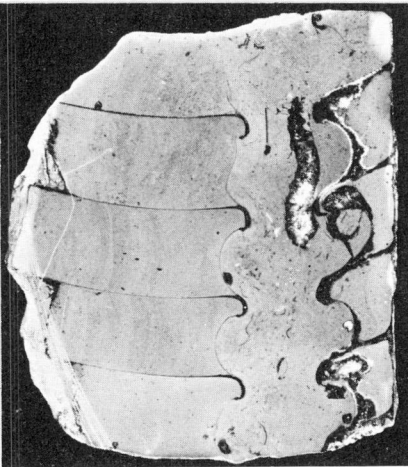
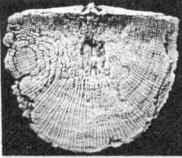
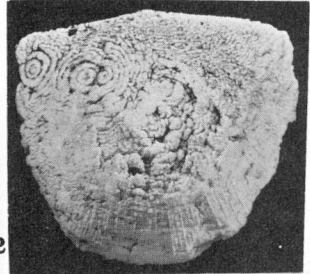
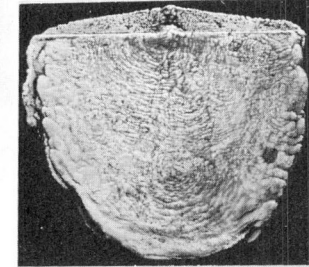
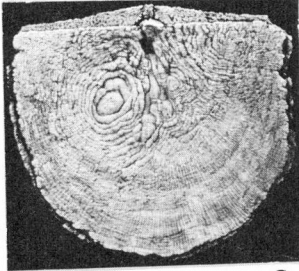
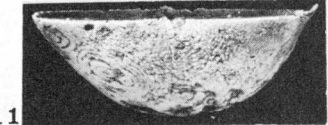
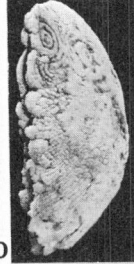
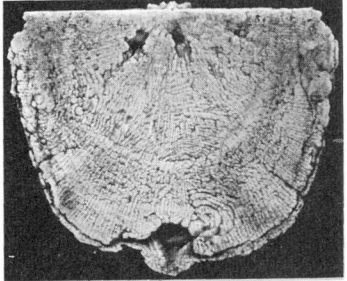
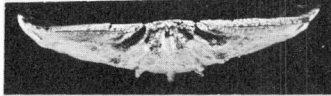
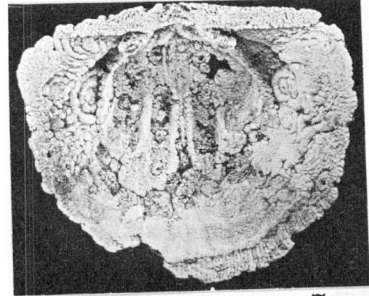
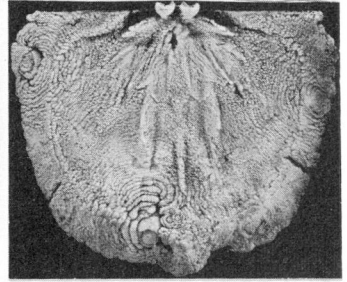
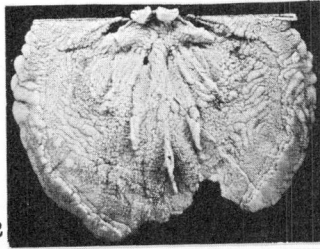
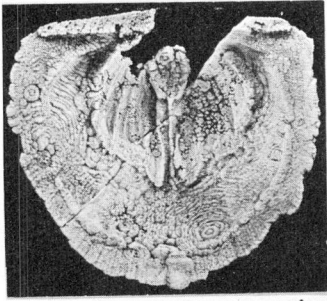
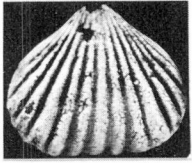


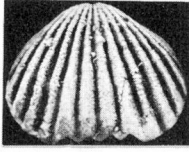
PLATE XIII

(all figures x2)

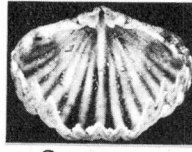
- Figures 1-18. *Rostricellula* cf. *minnesotensis* (Sardeson) (Page 28)  
1-5. Both valves unattached, pedicle exterior, brachial exterior, brachial interior (tilted), brachial interior, and brachial posterior views. Hypotype, GSC No. 22414.  
6-9. Both valves attached, pedicle, brachial, side, and anterior views. Hypotype, GSC No. 22420.  
10-12. Both valves attached, brachial, side, and anterior views. Hypotype, GSC No. 22422.  
13. Pedicle valve, interior (tilted) view showing adductor muscle scars, diductor muscle scars, dental plates, delthyrial cavity separated from muscle field by transverse ridge. Hypotype, GSC No. 22416.  
14. Brachial interior showing articulation with part of pedicle valve. Hypotype, GSC No. 22415.  
15-18. Both valves attached, side, pedicle, posterior, and anterior views. Hypotype, GSC No. 22417.
- Figures 19-27. *Glyptorthis rocklandensis* (Wilson) (Page 29)  
19-21. Deformed brachial valve, exterior, posterior, and anterior views. Hypotype, GSC No. 22426.  
22-24. Brachial valve, interior showing muscle area, notothyrial cavity, cardinal process, and dental sockets, exterior, and anterior views. Hypotype, GSC No. 22425.  
25-27. Pedicle valve, interior showing muscle area, exterior, and anterior views. Hypotype, GSC No. 22428.
- Figures 28-31. *Doleroides germanus* n. sp. (Page 32)  
Both valves separated, pedicle interior showing adductor and diductor muscle scars, exterior, brachial exterior, and brachial interior showing adductor scars, genital markings, converging brachiophore bases, notothyrial cavity, and cardinal process. Holotype, GSC No. 22481.



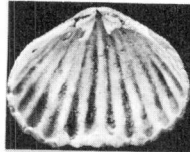
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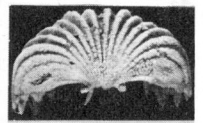
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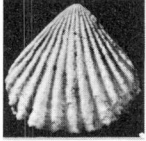
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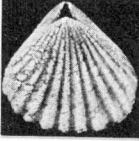
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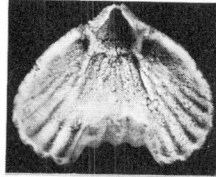
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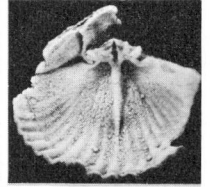
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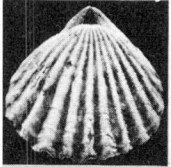
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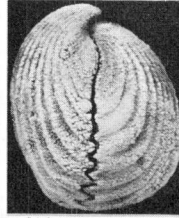
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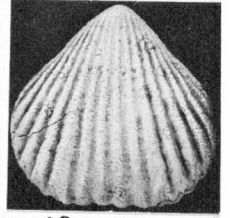
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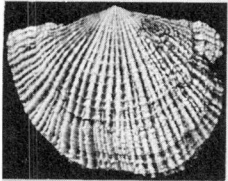
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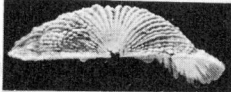
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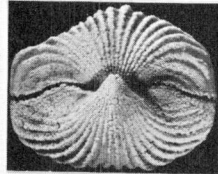
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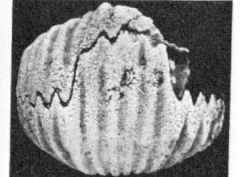
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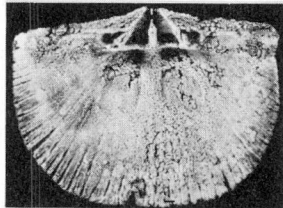
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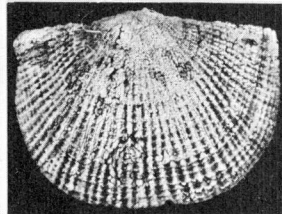
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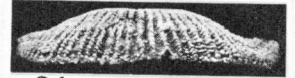
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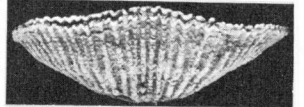
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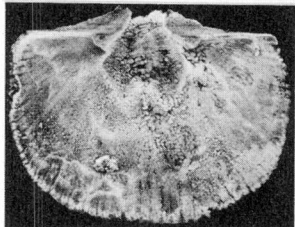
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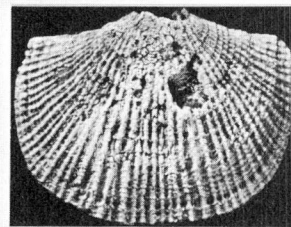
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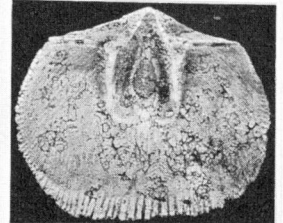
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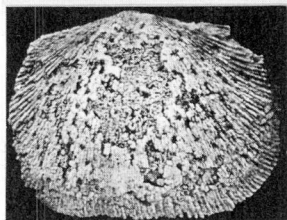
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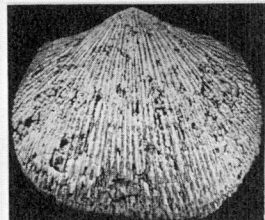
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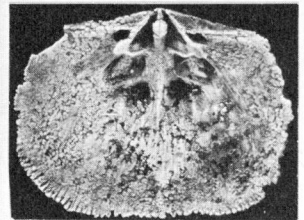
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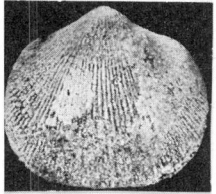


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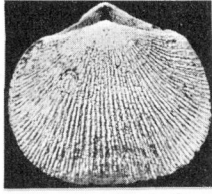
PLATE XIV

(all figures x2)

- Figures 1-24. *Pionodema proteus* n. sp. (Page 31)
- 1-5. Both valves attached, pedicle, brachial, posterior, anterior, and side views. Holotype, GSC No. 22433.
- 6-10. Both valves attached, pedicle, brachial, side, anterior, and posterior views. Paratype, GSC No. 22451.
- 11-15. Both valves attached, side, anterior, posterior, brachial, and pedicle views. Paratype, GSC No. 22436.
- 16-18. Brachial valve, anterior showing long brachiophores, interior (tilted), and interior views. Paratype, GSC No. 22466.
- 19, 20. Brachial valve, interior showing pallial markings, and interior (tilted) views showing divergent brachiophore bases. Paratype, GSC No. 22463.
- 21-23. Pedicle valve, interior (tilted) showing oblique crural fossettes and small ridge in apex, interior showing muscle area and small ridge in apex, and exterior views. Paratype, GSC No. 22456.
24. Brachial valve, interior view showing adductor scars, genital markings, pallial markings. Paratype, GSC No. 22464.
- Figures 25-27. *Rafinesquina* sp. (Page 35)
- 25, 26. Brachial valve, posterior and interior views showing muscle area. Fig. spec., GSC No. 22524.
27. Pedicle valve, interior view of muscle area. Fig. spec., GSC No. 22522.



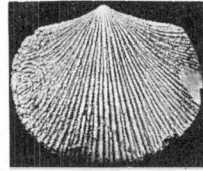
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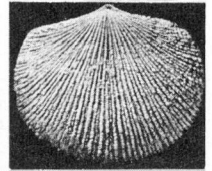
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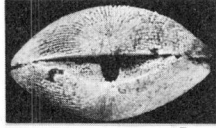
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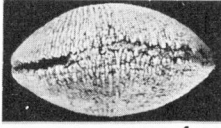
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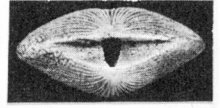
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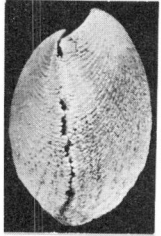
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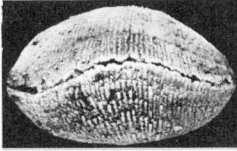
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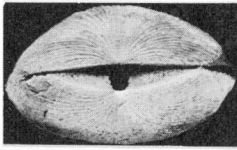
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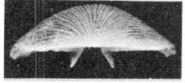
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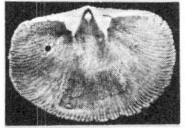
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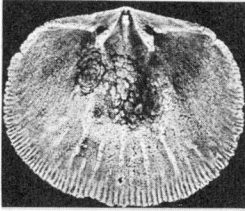
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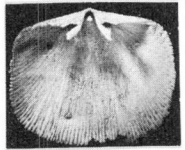
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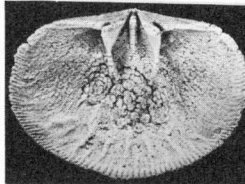
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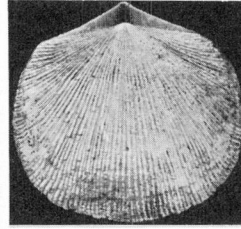
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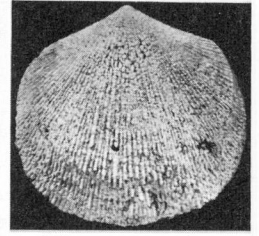
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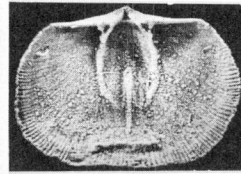
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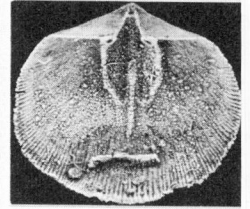
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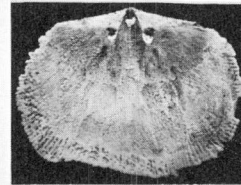
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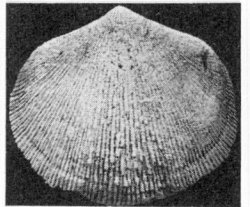
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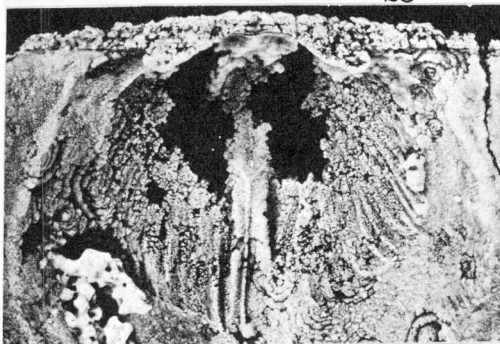
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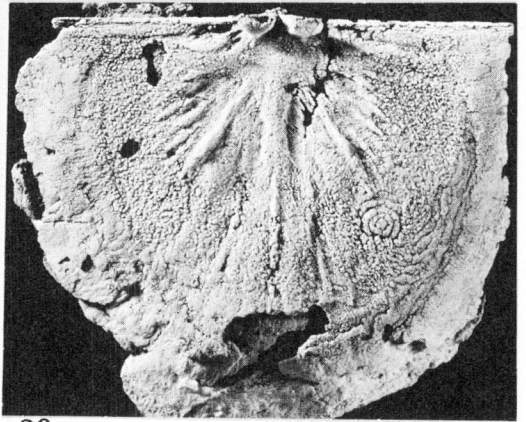
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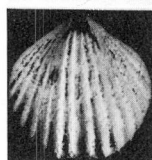


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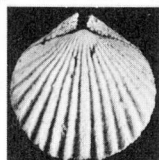


PLATE XV

- Figures 1-18. *Hallina canadensis* n. sp. (x4) (Page 33)  
1-5. Both valves attached, pedicle, brachial, side, anterior, and posterior views. Holotype, GSC No. 22489.  
6-9. Both valves attached, pedicle, brachial, side, and anterior views. Paratype, GSC No. 22490.  
10, 11. Pedicle valve, interior and interior (tilted) views showing dental plates. Paratype, GSC No. 22503.  
12, 13. Both valves attached, brachial and pedicle views. Paratype, GSC No. 22495.  
14, 15. Both valves attached, brachial and pedicle valves. Paratype, GSC No. 22497.  
16-18. Both valves attached, posterior, side, and pedicle views. Paratype, GSC No. 22492.
- Figures 19-25. *Strophomena* sp. (x2). (Page 35)  
19, 20. Pedicle valve, posterior and interior views. Fig. spec., GSC No. 22533.  
21, 23, 24. Pedicle valves, views of muscle area. Fig. specs., GSC Nos. 22537, 22532, 22534.  
22. Pedicle valve, interior view. Fig. spec., GSC No. 22529.  
25. Brachial valve, interior (tilted) view. Fig. spec., GSC No. 22530.



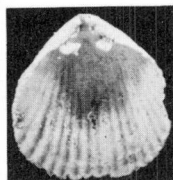
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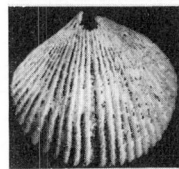
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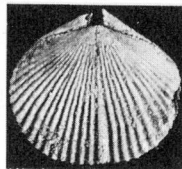
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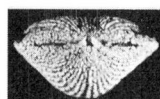
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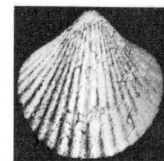
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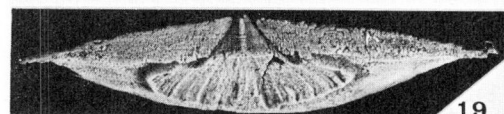
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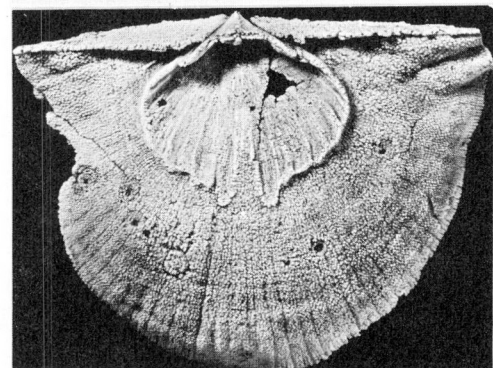
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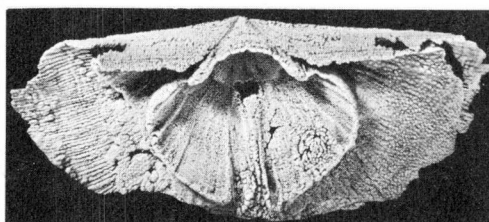
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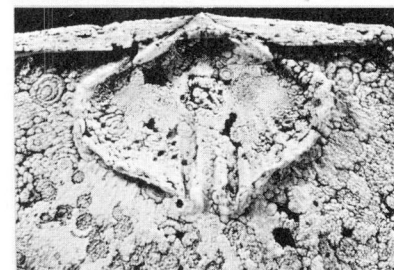
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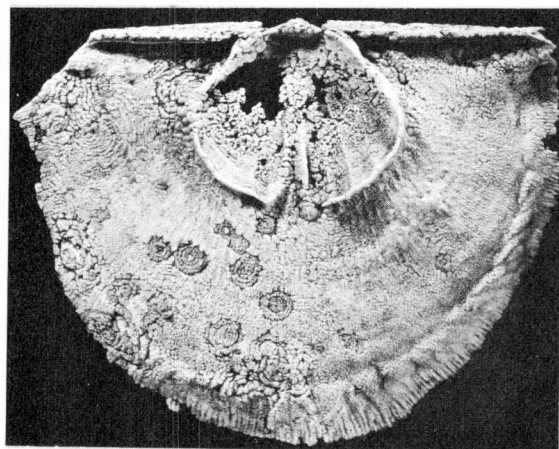
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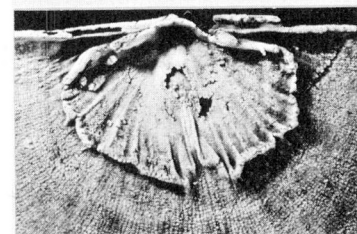
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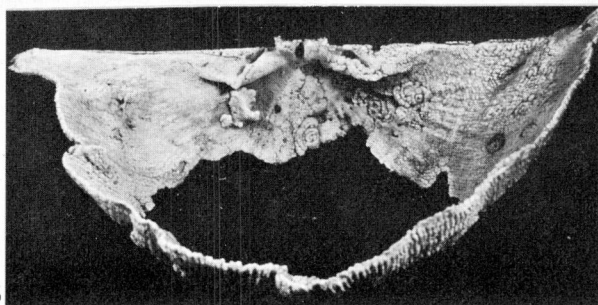
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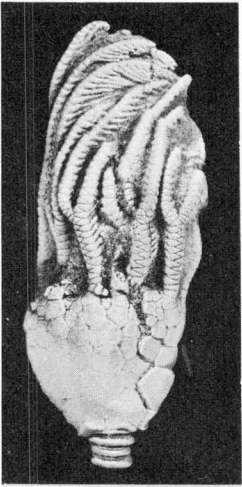


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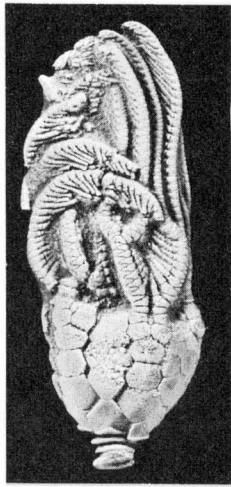
PLATE XVI

(all figures x2)

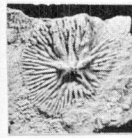
- Figures 1-4, 12. New crinoid genus, aff. *Archaeocrinus*. (Page 3)  
Fig. specs., GSC Nos. 22603, 22604, 22606.
- Figures 5-9. Crinoid attachment discs. Fig. specs., GSC Nos. 22608-22611.
- Figures 10, 11. *Ectenocrinus* n. sp. Fig. spec., GSC No. 22605.
- Figure 13. *Urasterella* cf. *grandis* (Meek). Hypotype, GSC No. 22607.



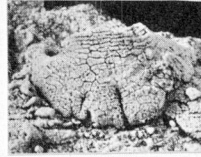
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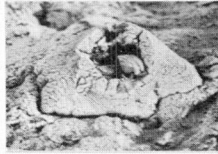
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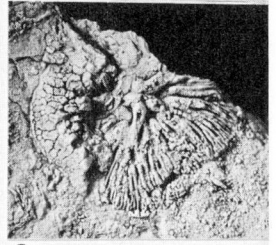
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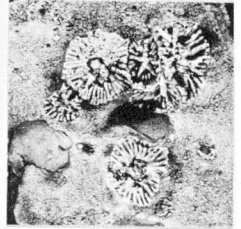
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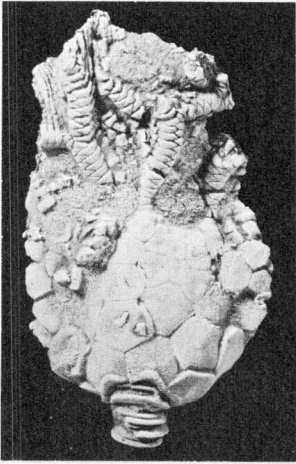
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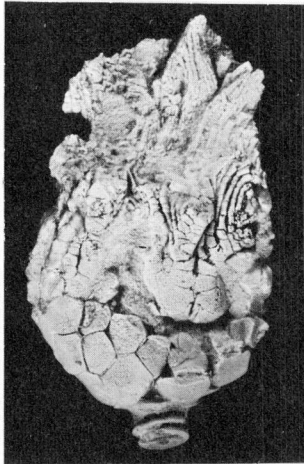
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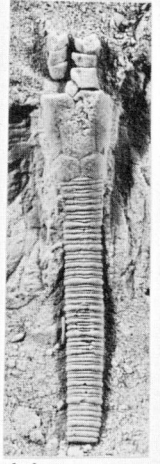
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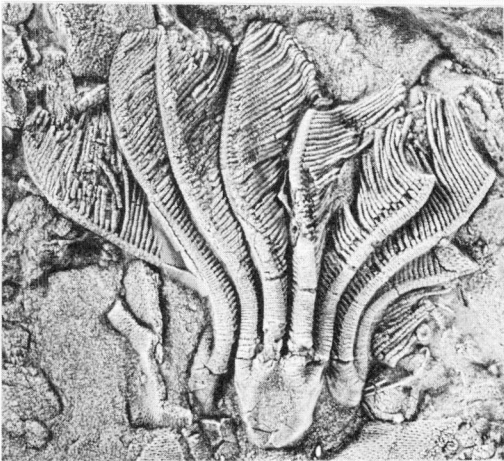
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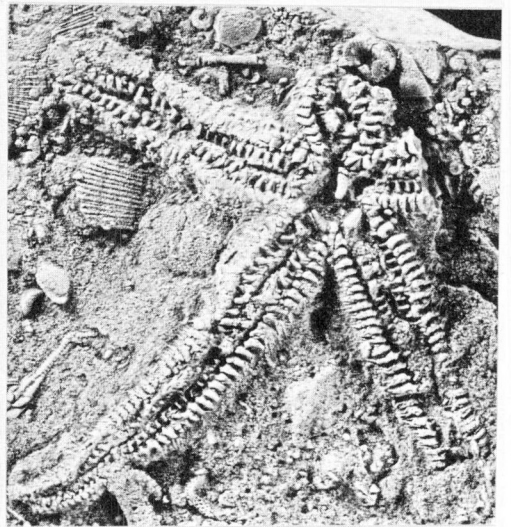
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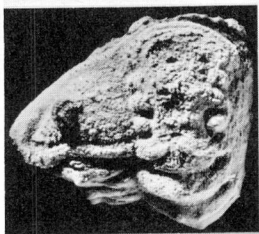


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PLATE XVII

(all figures x2 unless otherwise stated)

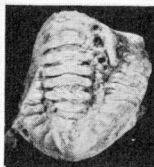
- Figures 1, 2. *Cercaurus pleurexanthemus* Green (Page 41)  
Enrolled specimen, cephalon and junction of cephalon and pygidium.  
Hypotype, GSC No. 22563.
- Figures 3, 4. *Cornulites* sp. (Page 41)  
Fig. specs., GSC Nos. 22616, 22617.
- Figures 5, 6. *Raymondites spiniger* (Hall) (Page 41)  
Enrolled specimen, thorax side and thorax and pygidium views  
(x1). Hypotype, GSC No. 22618.
- Figures 7-12. *Lambeophyllum profundum* (Conrad) (Page 36)  
7, 8. Interior and side views. Hypotype, GSC No. 22541.  
9. Two specimens attached (x1). Hypotype, GSC No. 22545.  
10. Specimens on both sides of a bryozoan. Hypotype, GSC No.  
22544.  
11, 12. Specimens on bryozoans. Hypotypes, GSC Nos. 22619,  
22543.
- Figures 13-15. *Cryptophragmus* sp. Fig. spec., GSC No. 22620. (Page 41)  
13, 15. Cross-section and surface views (x1).  
14. Surface view (x2).
- Figure 16. *Bumastus (Bumastoides) milleri* (Billings) (Page 41)  
(x1). Hypotype, GSC No. 22562.
- Figures 17-20. *Nanillaenus conradi* (Billings) (Page 41)  
Enrolled specimen, junction of cephalon and pygidium, cephalon,  
thorax, and pygidium views (x1). Hypotype, GSC No. 22561.
- Figures 21-23. *Foerstediscus* cf. *grandis* Bassler (Page 3)  
Hypotypes, GSC Nos. 22612-22614.



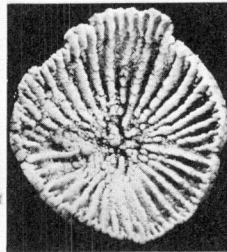
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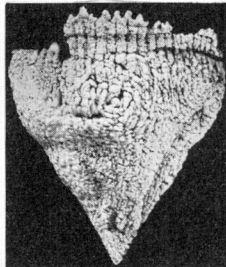
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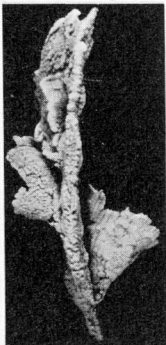
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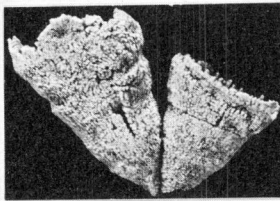
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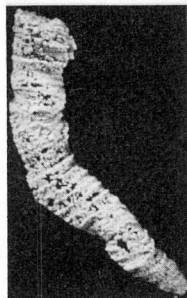
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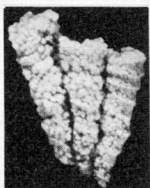
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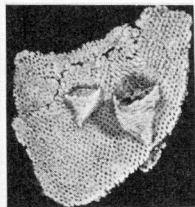
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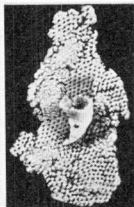
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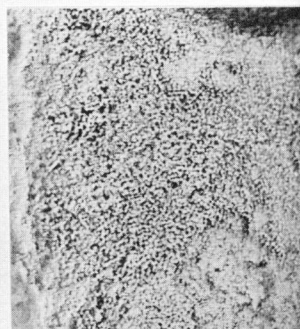
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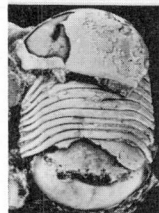
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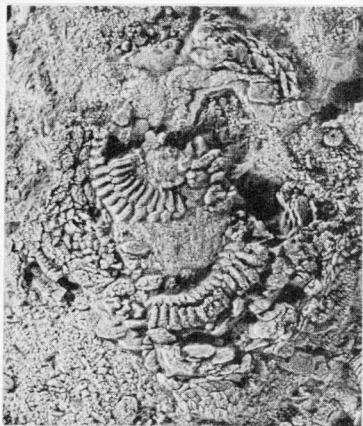
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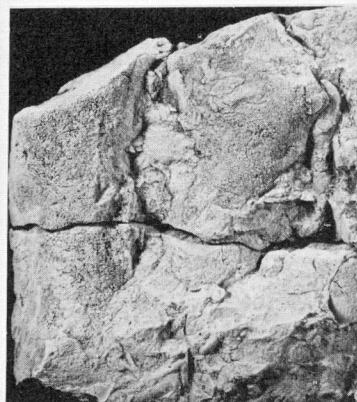
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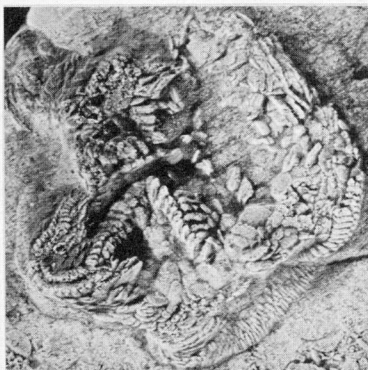
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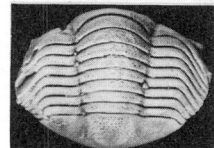
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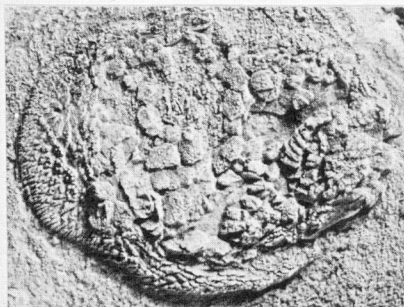
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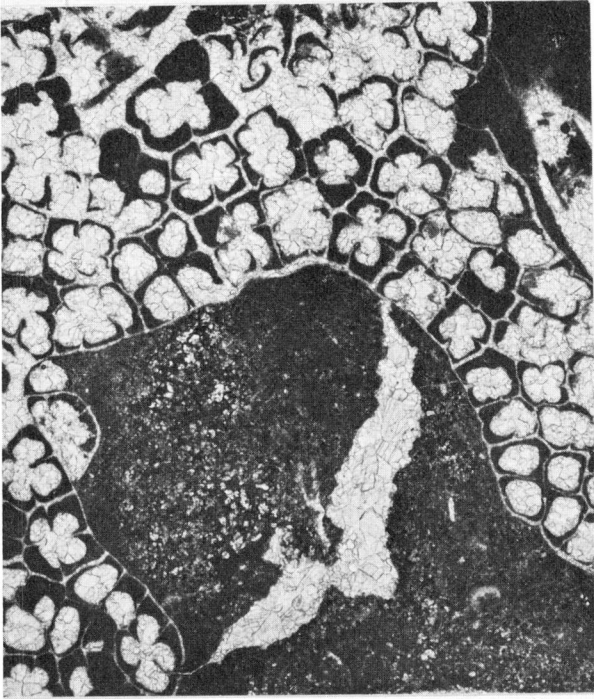


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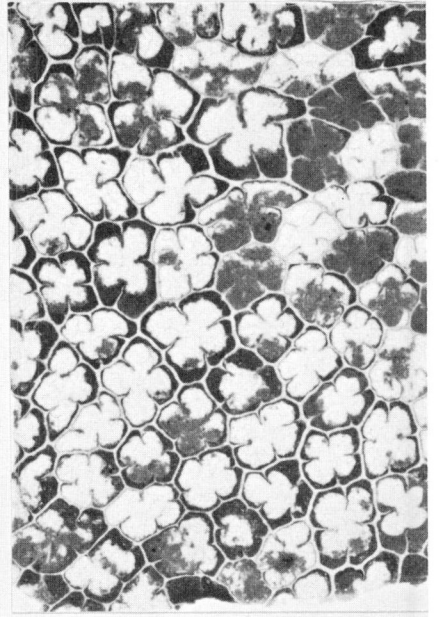
PLATE XVIII

(all figures x10)

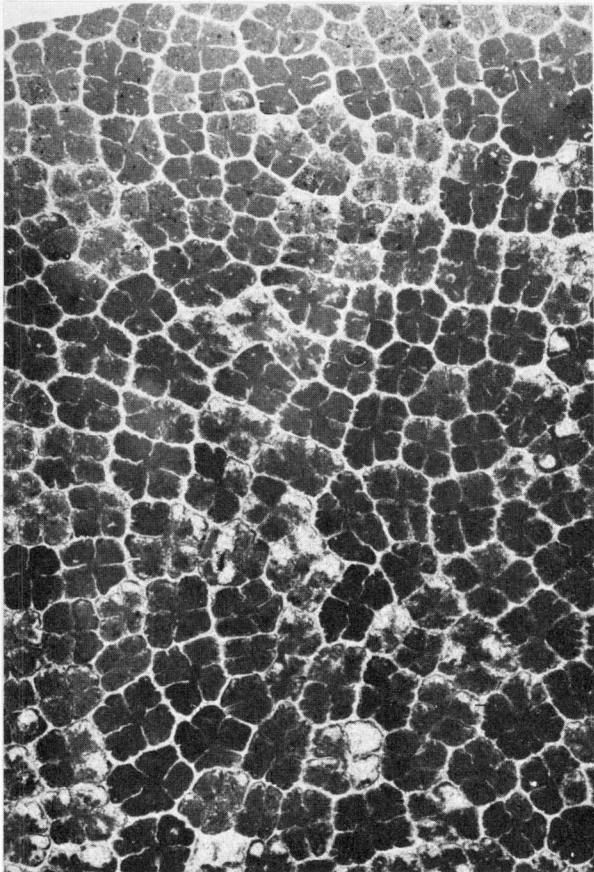
- Figure 1. *Tetradium clarki* Okulitch (Page 38)  
Transverse view showing growth in chain-like colonies.  
Hypotype, GSC No. 22551; thin section, GSC No. 22551b.
- Figures 2-4. *Tetradium fibratum* Safford (Page 38)  
2. Transverse view showing closely packed corallites, usually subsquare or subrectangular, with primary septa. Hypotype, GSC No. 22548; thin section, GSC No. 22548b.  
3. Transverse view showing closely packed corallites, primary and secondary septa. Hypotype, GSC No. 22549; thin section, GSC No. 22549b.  
4. Longitudinal view showing undulating walls and septa as fine, wavy lines. Hypotype, GSC No. 22547; thin section, GSC No. 22547a.



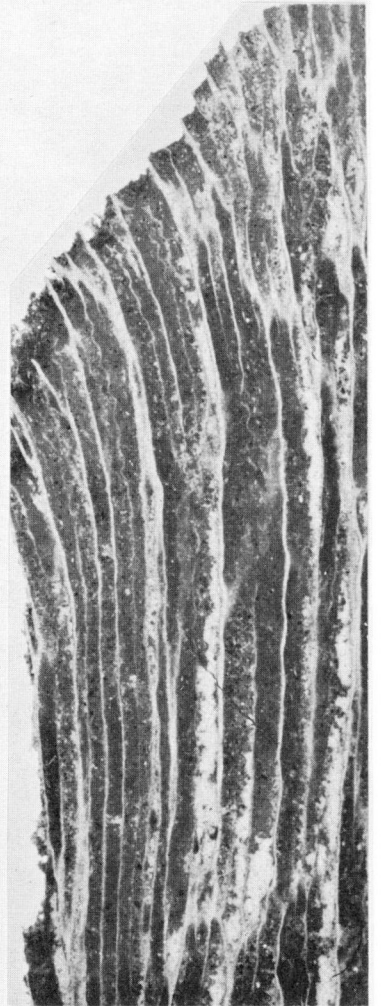
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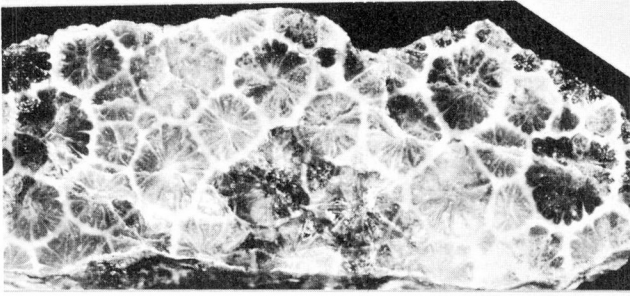


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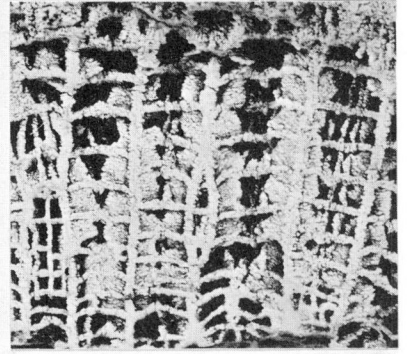


PLATE XIX

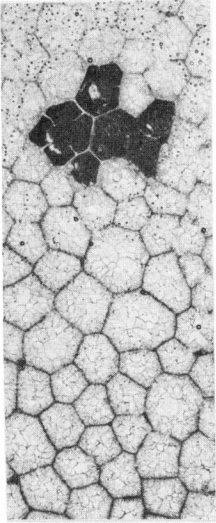
- Figures 1, 2. *Favistina* sp. (x3) (Page 40)  
1. Transverse view showing ten or eleven major septa.  
Hypotype, GSC No. 22556.  
2. Longitudinal view of naturally etched specimen showing  
tabulae turned down slightly at ends. Hypotype, GSC No. 22557.
- Figures 3-6. *Paleoalveolites carterensis* (Bassler) (x5) (Page 37)  
3, 6. Transverse view showing more loosely packed corallites  
with double wall structure and primary septa, and longitudinal  
view showing slightly undulating walls. Hypotype, GSC No.  
22554; thin sections, GSC Nos. 22554e, c.  
4, 5. Transverse views showing gradation from outer imbricating  
corallites to inner polygonal corallites, and polygonal  
corallites with primary septa; both sections show possible mural  
pores. Hypotype, GSC No. 22555; thin section, GSC No. 22554a.



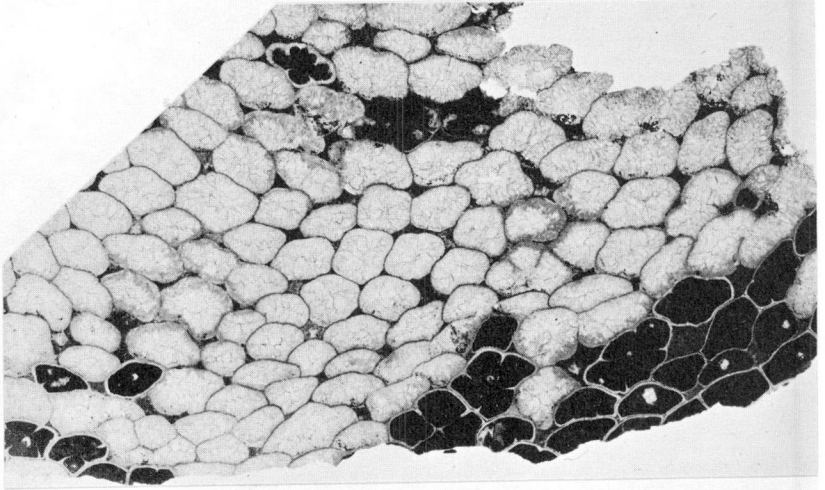
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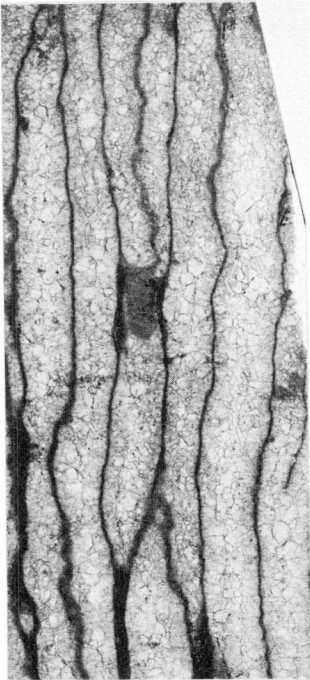
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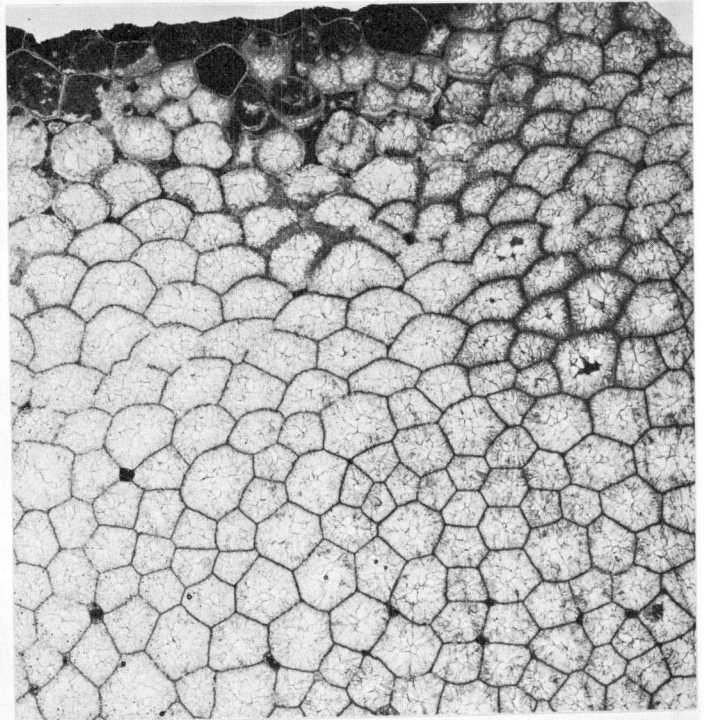
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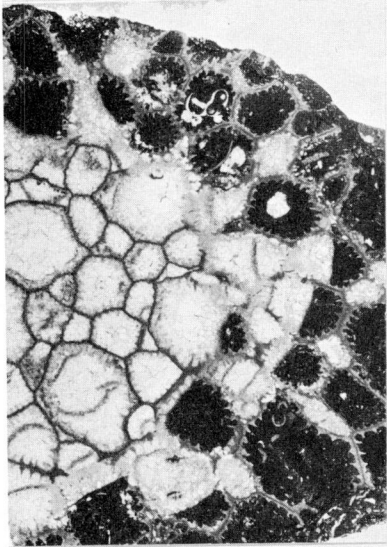
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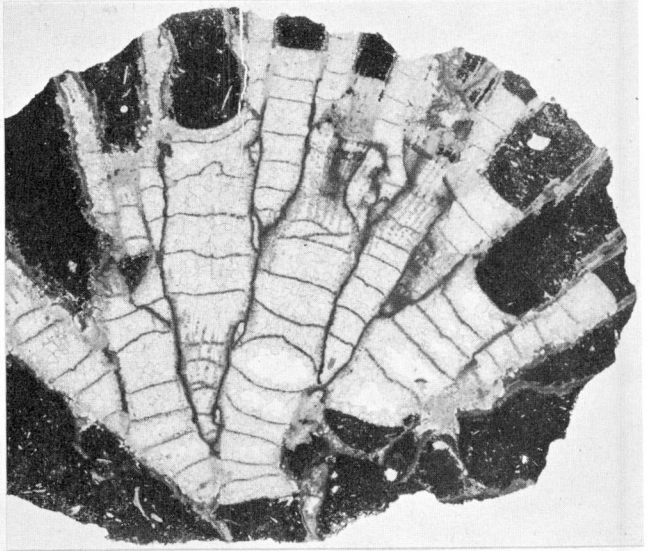
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PLATE XX

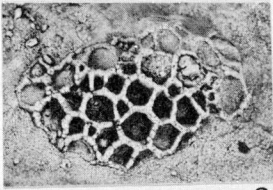
- Figures 1, 2. *Foerstephyllum halli* (Nicholson) (x3) (Page 39)  
Transverse and longitudinal views. Hypotype, GSC No.  
22621; thin sections, GSC No. 22621a, b.
- Figure 3. *Lichenaria typa* Winchell and Schuchert (x3) (Page 40)  
Transverse view of naturally etched specimen. Hypotype,  
GSC No. 22622.
- Figures 4-6. *Tetradium columnare* (Hall) (x10) (Page 39)  
Transverse view showing polygonal corallites with primary  
septa, transverse view showing polygonal corallites, and  
longitudinal view showing long straight tubes. Hypotype,  
GSC No. 22552; thin sections, GSC Nos. 22552b,c,a.



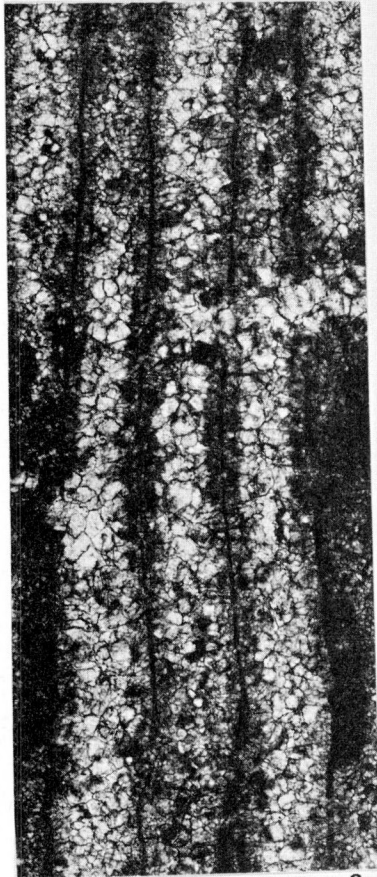
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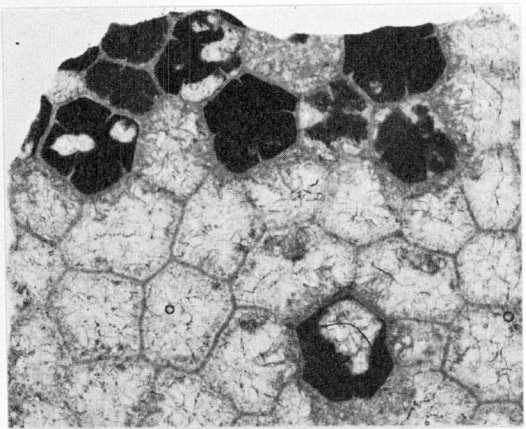
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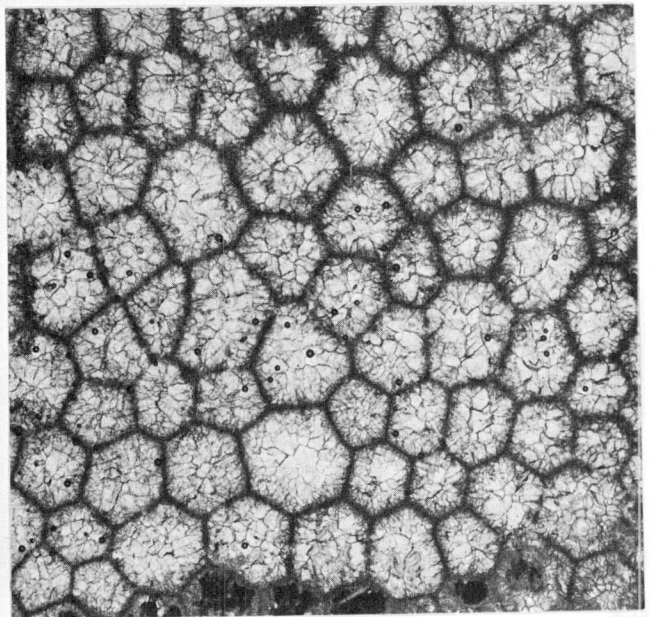
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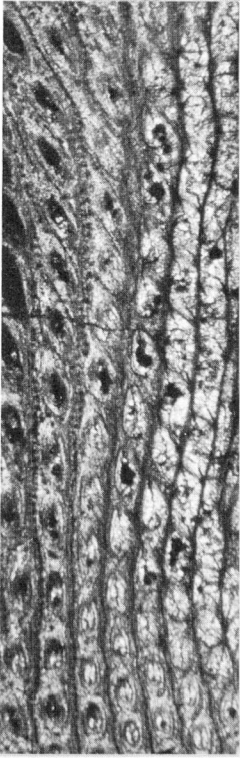
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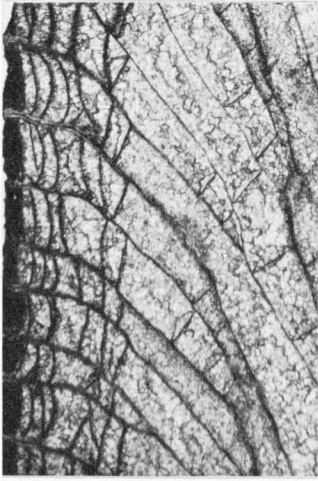
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PLATE XXI

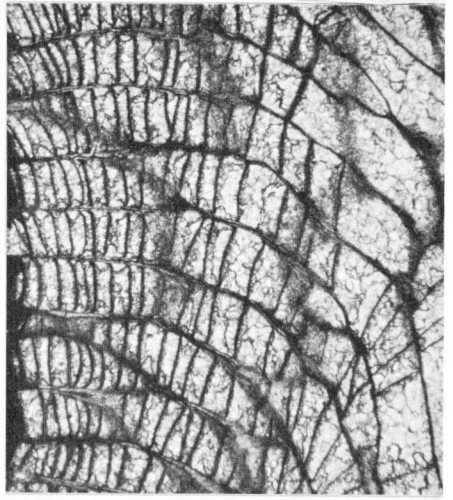
- Figures 1, 9, 10 *Stictopora* sp. (Page 42)  
1. Slightly oblique tangential section showing longitudinal arrangement of elongate zooecial openings and linear series of acanthopores in zooecial walls (x20). Fig. spec., GSC No. 22625b.  
9. Longitudinal section showing superior hemisepta (x5). Fig. spec., GSC No. 22629a.  
10. Broad bifoliate expansion with low monticules of the *Eurydictya* type (x1). Fig. spec., GSC No. 22623.
- Figures 2, 3, 8. *Monotrypella* sp. (Page 42)  
2, 8. Part of longitudinal section showing sparse diaphragms in axial region and concentration in short peripheral region, and tangential section showing polygonal zooecial openings (x20). Fig. spec., GSC Nos. 22633a, b.  
3. Part of longitudinal section showing longer peripheral region and corresponding increase in number of diaphragms (x20). Fig. spec., GSC No. 22634a.
- Figures 4-6. "*Aulopora*" *wilsonae* Sinclair (Page 40)  
4. Side view of corallum (x1). Hypotype, GSC No. 22558.  
5, 6. Longitudinal section showing rare tabulae, and transverse section showing both halysitoid and cerioid growth habit and lack of septa (x10). Hypotype, GSC Nos. 22560a, b.
- Figure 7. *Nicholsonella* sp. cf. *N. wilsonae* Fritz (Page 42)  
Tangential section near zoarial surface showing large acanthopores in the thick zooecial walls and petaloid appearance of zooecial openings (x20). Hypotype, GSC No. 22559b.



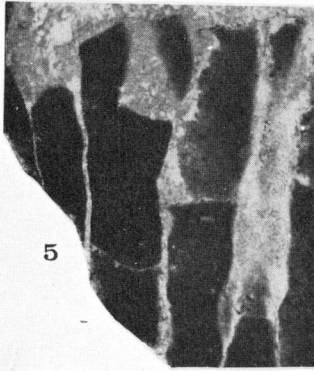
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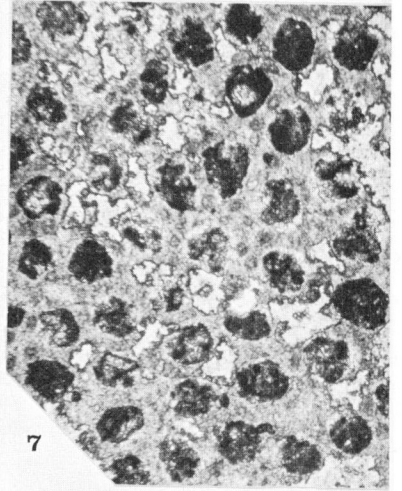
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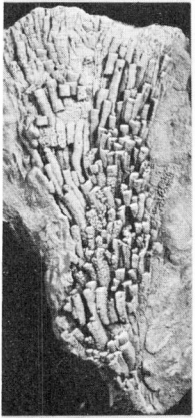
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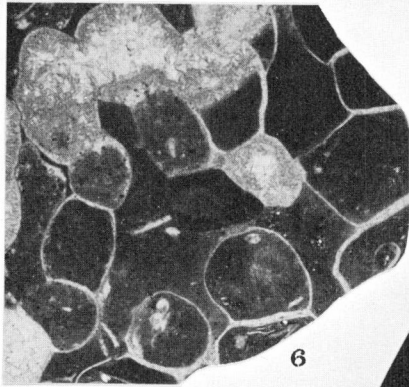
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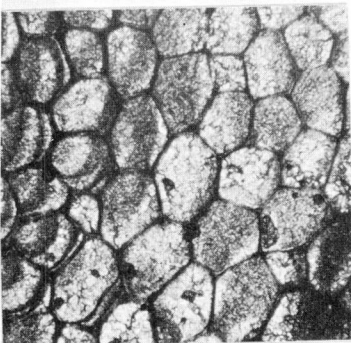
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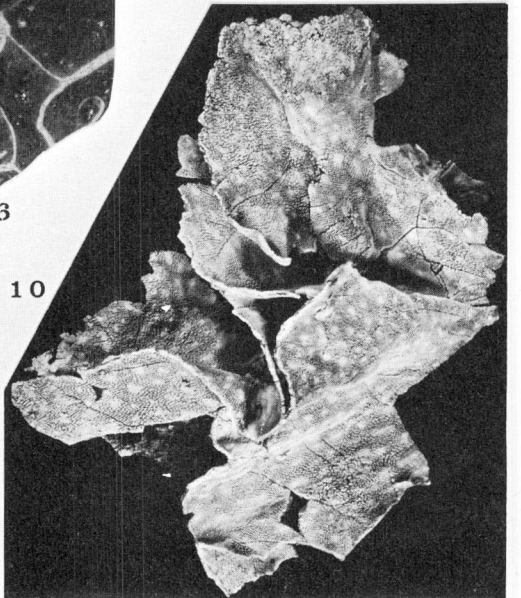
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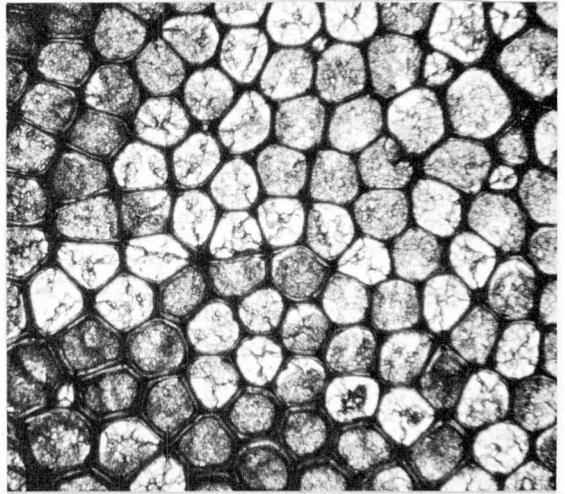
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PLATE XXII

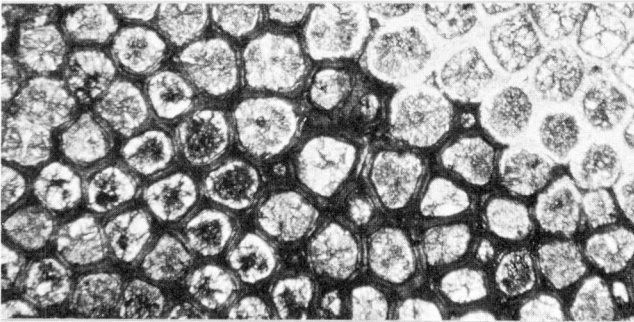
- Figures 1-3, 5. *Heterotrypa* sp. (Page 42)  
1, 3. Transverse and longitudinal sections showing rare mesopore and thick, locally integrate, zooecial walls with rare large megacanthopores at corners and small acanthopores between corners (x20). Fig. spec., GSC Nos. 22630c, b.  
2. Tangential section showing local integrate wall structure and rare acanthopore (x20). Fig. spec., GSC No. 22631b.  
5. Tangential section showing integrate zooecial walls and local development of large acanthopores both in and between corners to produce petaloid zooecial openings (x20). Fig. spec., GSC No. 22632b.
- Figures 4, 6. *Dekayia* sp. cf. *D. typica* Fritz (Page 42)  
Longitudinal section showing undulating to weakly crenulated, thin zooecial walls in axial region and concentration of diaphragms in subperipheral region; tangential section showing angular zooecia and rare mesopore, random distribution of acanthopores, and both amalgamate and integrate zooecial walls (x20). Hypotype, GSC Nos. 22635a, b.



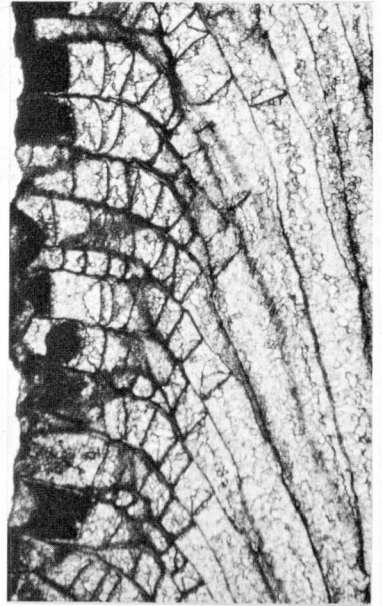
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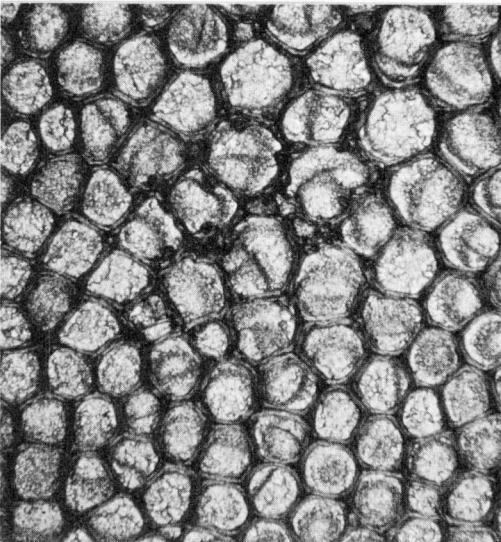
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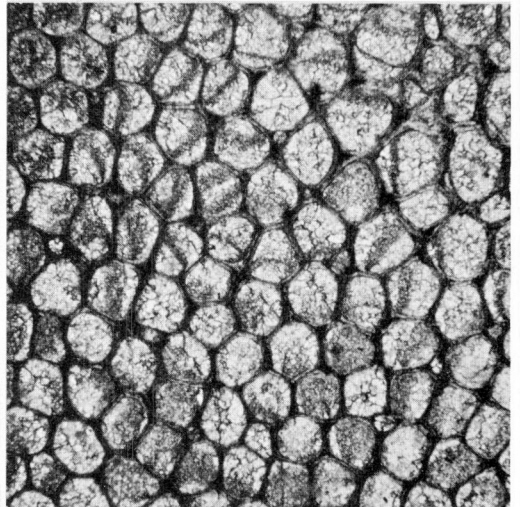
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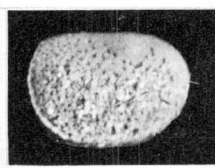
- Figure 1. *Bythocypris? cylindrica* (Hall)  
Right lateral view (x30). Hypotype, GSC No. 22221.
- Figure 2. *Cryptophyllus oboloides* (Ulrich and Bassler)  
Right lateral view (x30). Hypotype, GSC No. 22222.
- Figures 3, 4. *Byrsolopsina planilateralis* (Kay)  
Right lateral views (x30). Hypotypes, GSC Nos. 22223,  
22224.
- Figures 5-7. *Sacclatia arreata* (Ulrich)  
5. Right lateral view (x15). Hypotype, GSC No. 22225.  
6, 7. Left and right lateral views (x30). Hypotypes,  
GSC Nos. 22226, 22227.
- Figure 8. *Diplopsis* sp. cf. *D. frequens* (Steusloff)  
Left lateral view (x15). Hypotype, GSC No. 22228.
- Figure 9. *Krausella arcuata* Ulrich.  
Right lateral view (x15). Hypotype, GSC No. 22229.
- Figures 10-13. *Krausella calvini* (Kay)  
Two right and two left lateral views (x15). Hypotypes,  
GSC Nos. 22230-22233.
- Figure 14. *Bythocypris? granti* Ulrich  
Right lateral view (x30). Hypotype, GSC No. 22234.
- Figure 15. *Apatochilina?* sp.  
Left lateral view of incomplete specimen (x15). Fig. spec.,  
GSC No. 22235.
- Figures 16, 17. *Punctaparchites rugosus* (Jones).  
Left and right lateral views (x30). Hypotypes, GSC  
Nos. 22236, 22237.
- Figure 18. *Hallatia particylindrica* Kay.  
Left lateral view of deformed carapace (x30). Hypotype,  
GSC No. 22238.
- Figures 19, 20. *Tetradella ulrichi* Kay  
Left lateral views (x30). Hypotypes, GSC Nos. 22239, 22240.
- Figures 21, 22. *Levisulculus michiganensis* Kesling.  
Left and right lateral views (x30). Hypotypes, GSC  
Nos. 22241, 22242.
- Figures 23, 24. *Schmidtella affinis* Ulrich  
Dorsal and right lateral views (x30). Hypotypes, GSC  
Nos. 22243, 22244.
- Figure 25. *Leperditella* sp. cf. *L. tumida* (Ulrich)  
Left lateral view (x15). Hypotype, GSC No. 22245.
- Figures 26, 27. *Dicranella bicornis* Ulrich  
Dorsal and right lateral views (x15). Hypotypes, GSC  
Nos. 22246, 22247.
- Figure 28. *Macronotella* sp.  
Left lateral view (x15). Fig. spec., GSC No. 22248.
- Figures 29-31. *Eurychilina subradiata* Ulrich  
Left and two right lateral views (x15). Hypotypes,  
GSC Nos. 22249-22251.



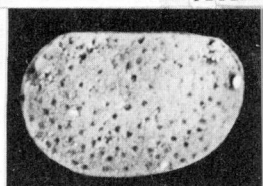
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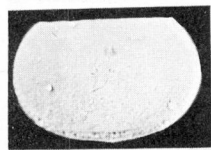
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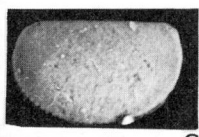
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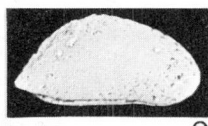
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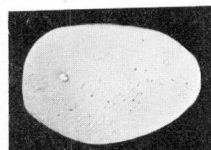
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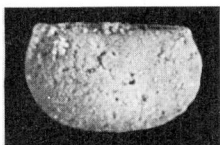
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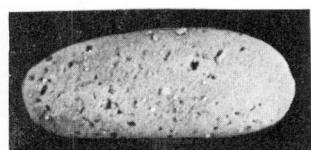
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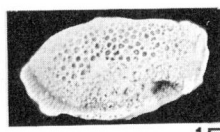
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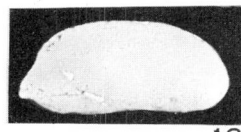
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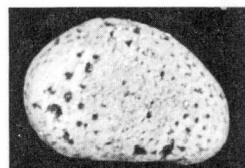
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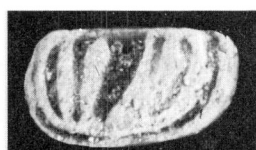
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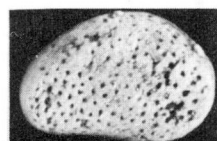
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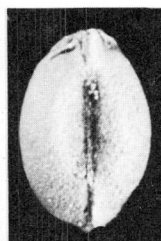
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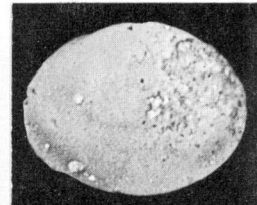
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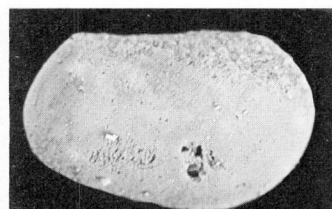
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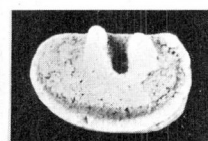
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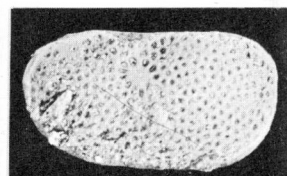
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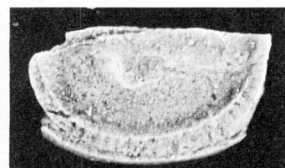
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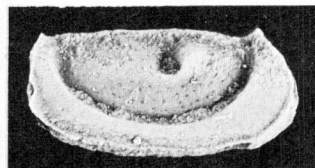
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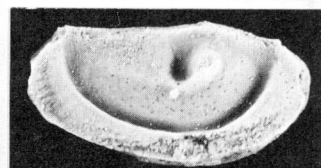
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### Geological Survey of Canada

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- 180 Stratigraphy and structure of the "Keno Hill Quartzite" in Tombstone River—Upper Klondike River map-areas, Yukon Territory, *by* D. J. Tempelman-Kluit, \$3.00 (M42-180)
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- 189 Precambrian fossils, pseudofossils, and problematica in Canada, *by* H. J. Hofmann, \$3.00 (M42-189)
- 190 Surficial geology of Rosetown map-area, Sask., *by* J. S. Scott, \$2.00 (M42-190)
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- 200 Part I: Biostratigraphy of some Early Middle Silurian Ostracoda, eastern Canada; Part II: Additional Silurian Arthropoda from arctic and eastern Canada, *by* M. J. Copeland, \$1.50 (M42-200)
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