THE BRACHIOPOD FAUNA OF THE ARISAIG SERIES (SILURIAN-LOWER DEVONIAN) OF NOVA SCOTIA

Thesis by

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Abstract

The Arisaig series comprises a very fossiliferous, fairly continuous sequence of strata of early Llandovery to Gedinnian age. The brachiopod species of the Arisaig series are described, identified generically, and compared with related species. Forty-five genera and eighty-two species are recognized. Seven new species, three new genera, and three new subgenera are proposed.

A phylogeny is proposed for each of the following groups: the Rhipidomellidae, plagiorhynchids, leptostrophids, douvillinids, and the Pholidostrophiinae.

Idiorthis is considered to be related to a proposed new genus of Silurian platyorthids. Shaleria(Telaeoshaleria) Williams is considered to be a pholidostrophid and is rejected as a subgenus of Shaleria Caster. Mclearnites Caster is considered to be closely related to Mesodouvillina Williams and not closely related to Shaleria. Pholidostrophia(Mesopholidostrophia) Williams and Lissostrophia(Mesolissostrophia) Williams are considered to be identical. Protochonetes Muir-Wood and Strophochonetes Muir-Wood are considered to be closely related, if not congeneric. Spirifer(Quadrifarius) Fuchs is redefined as a subgenus of Delthyris Dalman.

The lowest formation in the Arisaig series, the Beechhill Cove Formation is considered to be of early Llandovery age, as is the Glencoe Brook Formation in Pictou Co., N.S. The three members of the Ross Brook

which overlies it are middle Llandovery (or high early Llandovery), late Llandovery(C_3-C_5), and late Llandovery (C_6) or low Wenlock in age respectively. The overlying French River Formation is considered to be late Llandovery(C_6) or low Wenlock in age. The lower two members of the overlying McAdam Formation are considered to be Wenlock or Ludlow in age, the upper two, Ludlow in age. The overlying Moydart Formation is considered to be Ludlow in age, and the highest formation in the series, the Stonehouse Formation, is considered to be Gedinnian and possibly, in part, Skala in age.

Many brachiopod groups which are common and widespread in beds of equivalent age elsewhere in the world are absent or virtually absent in the Arisaig series; the genera which are present are not endemic-most of them are common and widespread in beds of equivalent age elsewhere. This very possibly resulted from the presence of a barrier which prevented the larvae of some, but not all, groups from entering the area of Arisaig rocks; but the possibility that it resulted from certain factors in the depositional environment being unfavorable to the missing groups cannot be ruled out.

Photographic materials on pp. 319-429 are essential and will not reproduce clearly on Xerox copies. Photographic copies should be ordered.

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Introduction and Statement of Purpose

The Arisaig Series comprises a very fossiliferous, fairly continuous marine sequence of limy mudstones, siltstones and fine grained sandstones spanning earliest Silurian (lower Llandovery to earliest Devonian (Gedinnian) age. Brachiopods are, by far, the most abundant fossils in the Arisaig Series.

Hall (1860), Dawson (1880, 1881) and Ami (1894) described a few of the brachiopod species of the Arisaig series, but the only published description of the brachiopod fauna as a whole is that made about 40 years ago by McLearn (1918, 1924). McLearn's work on the brachiopods was pioneering in that he pointed out the occurrence in the Arisaig series of a number of Silurian forms. However, his descriptions and illustrations are confined mainly to the external morphology of the shells studied, owing to his lack of access to modern techniques of fossil preparation, and most of his generic assignments are now out of date.

A collection consisting of about ten tons of fossiliferous blocks from the Arisaig series was made by Dr. Boucot, now of C.I.T., and others during the summers of 1956-61. In 1961, the author and Dr. Boucot, his advisor, both became convinced that a monographic study of the brachiopods in the Arisaig series, based on this collection, would contribute significantly to our knowledge of

brachiopod evolution and the sequence of brachiopod faunas.

It appeared to be a particularly good idea to undertake such a study at that time as a number of recent advances had been made in the mapping of the Arisaig series. Preliminary detailed maps of the Arisaig series in Antigonish Co. were made by Boucot, Griffin, Hickox, McKerrow, Ziegler and students at the M.I.T. Geology Summer Field Camp at Crystal Cliffs in the summers of 1958-61. Maehl (1961) mapped the Arisaig series and correlative strata in Pictou Co.

The present investigation was begun in the Summer of 1961, as a study of the brachiopods in the above mentioned collection. Dr. McKerrow of Oxford University has subsequently done additional mapping in the Arisaig area and provided additional collections. Dr. D. G. Kelly of the Geological Survey of Canada, who is engaged in mapping in the Cobequid Mountains, Nova Scotia, very kindly provided the author with a large collection from the Arisaig series in the Cobequid Mountains. The author has also studied the collections of brachiopods from the Arisaig series in the Geological Survey of Canada and in the Peabody Museum of Yale University.

The present investigation is a systematic study of the brachiopod species of the Arisaig series. Its purpose is to identify and to determine the phylogenetic relationships of these species, and to correlate the units of the

Arisaig Series on the basis of the known stratigraphic distribution of the groups to which these species belong.

Location of Outcrop Areas of the Arisaig Series

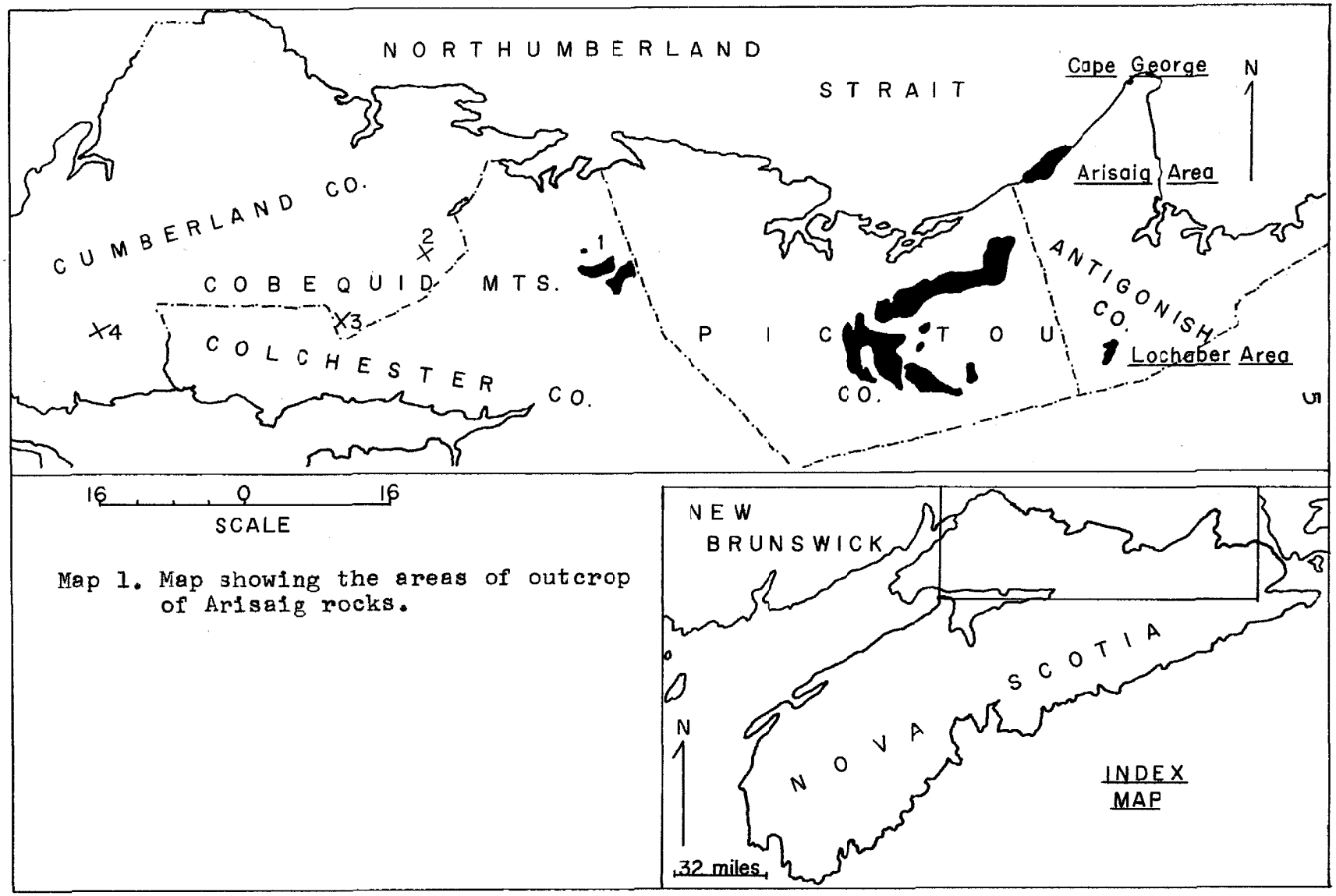
The areas of outcrop of the Arisaig Series (and correlative strata in S. E. Pictou Co.) are shown in figure 1.

Previous Work

A large number of geologists have investigated the rocks of the Arisaig series in Antigonish Co. and Pictou Co. during the past 130 years (see McLearn, 1924, pp. 3-7, and Maehl, 1961, pp. 12-13).

Hall (1860) described 9 species of brachiopods from the Arisaig district: Discina subplana, Crania acadiensis, Chonetes tenuistriatus (=Protochonetes tenuistriatus'), Chonetes novascoticus (=Protochonetes novascoticus'), Rhynchonella saffordi (=Sphaerirhynchia saffordi'), Spirifer rugaecosta (=Spirifer (Quadrifarius) rugaecosta'), Spirifer subsulcatus (=Spirifer (Quadrifarius) rugaecosta'), Trematospira acadiae (=Rhynchospirina acadiae'), and Rhynchospira sinuata (=Rhynchospirina sinuata'). Dawson (1880, 1881) described two species: Stricklandia billingsi (=Meristina billingsi') and Brachyprion gilpini (=Shaleria gilpeni'). Ami (1894) described Discina novascotica. McLearn (1918, 1924) described 48 species of brachiopods inaddition to those listed above. These are listed in table 1 and the classification of these species used in this report is also given.

' names in parentheses are those used in this report.



Map 1. Map showing the areas of outcrop of Arisaig rocks.

Table I. Brachiopod species described by McLearn (1918, 1924)

The species described by McLearn are given in column A and the genus and species to which the holotype (or plesiotype(s) of each is assigned in this report is given in column B. (In some cases the holotype and one or more of the paratypes of one of McLearn's species belong to different species. The classifications given in column B refer only to the holotypes (or plesiotypes) designated by McLearn.)

A	B
Dalmanella conservatrix	Salopina conservatrix
Dalmanella elegantula mut. primitiva	Dalmanella ? primitiva
Dalmanella elegantula var. submedia	Salopina submedia
Dalmanella elegantula var. transversaria	Salopina submedia
Dalmanella wisbyensis var. nana	Visbyella nana
Dalmanella lunata (Sowerby)	Isorthis fornicatimcurvata
Dalmanella orbicularis (Sowerby)	Salopina submedia
Idiorthis avita	indet. dalmanellid
Idiorthis matura	Idiorthis matura
Schizophorella arisaigensis	Mendacella arisaigensis
Leptaena rhomboidalis (Wilckens)	Leptaena cf. L. depressa
Rafinesquina beechhillensis	Eoleptostrophia beechhillensis
Brachyprion mertoni	Mclearnites mertoni
Brachyprion gilpeni (Dawson)	Shaleria gilpeni
Brachyprion ? honeymani	Shaleria honeymani
Amphistrophia arisaigensis	Shaleria honeymani
Schuchertella pecten (Linnaeus)	indet. orthotetacid
Chonetes tenuistriatus (Hall)	Protochonetes tenuistriatus
Chonetes novascoticus (Hall)	Protochonetes novascoticus
Camarotoechia bimesiornata	"C." bimesiornata
Camarotoechia nucula var. planorugosa	"C." planorugosa
Camarotoechia nucula var. moydartensis	"C." moydartensis
Camarotoechia llandoveriana var. rossonia	"C." rossonia
Camarotoechia glomerosa	"C." glomerosa

Camarotoechia marklandensis	"C." glomerosa
Camarotoechia squamifera	"C." squamifera
Pectorhyncha antiqua	Sphaerirhynchia antigua
Pectorhyncha obtusiplicata (Hall)	Sphaerirhynchia sp.
Eatonioides westoni	"C." westoni
Wilsonia wilsoni var. saffordi (Hall)	Sphaerirhynchia saffordi
Wilsonia wilsoni mut. stonehousensis	Sphaerirhynchia saffordi
Plagiorhyncha decemplicata (Sowerby)	Plagiorhyncha aff. P. glassi
Plagiorhyncha plastica	Plagiorhyncha plastica
Plagiorhyncha glassi (Davidson)	Plagiorhyncha aff. P. glassi
Atrypa reticularis (Linnaeus)	Atrypa cf. A. gedinniana
Delthyris crispa (Hisinger)	Howellella moydartensis
Delthyris crispa mut moydartensis	Howella moydartensis
Delthyris rugaecosta (Hall	Delthyris (Quadrifarius) rugaecosta
Delthyris rugaecosta mut. prima	Delthyris (Quadrifarius) rugaecosta
Delthyris rugaecosta var subsulcata (Hall)	Delthyris (Quadrifarius) rugaecosta
Eospirifer stonehousensis	Striispirifer stonehousensis
Rhynchospira salteri var. acadiae (Hall)	Rhynchospirina acadiae
Rhynchospira sinuata (Hall)	Rhynchospirina sinuata
Whitfieldella ? crassa var. beechhillensis	Cryptothyrella beechhillensis
Whitfieldella ? northumberlandensis	Hyattidina northumberlandensis
Whitfieldella ? angustifrons (McCoy)	Cryptothyrella beechhillensis
Meristina tumida (Dalman)	Hyattidina northumberlandensis
Meristina billingsi (Dawson)	Meristina billingsi
Coelospira hemisphaerica (Sowerby)	Eocoelia aff. E. hemisphaerica

Stratigraphy

The Arisaig series was defined by Williams (1910). Williams (1910) and McLearn (1924) recognized five formations in the series. They are, in ascending order, the Beechhill Cove Formation, the Ross Brook Formation, the McAdam Formation, the Moydart Formation, and the Stonehouse Formation. Maehl (1961, pp. 34-35, 51-54) added another unit to the series - the French River Formation-which occurs stratigraphically between the Ross Brook Formation and the McAdam Formation in Pictou Co. Maehl (1961, p.35) states that the French River Formation is not definitely known in the Arisaig area although it is believed to occur there as McLearn found Eospirifer stonehousensis (McLearn, 1924) - a characteristic fossil of the French River Formation - in a boulder in the area. The French River Formation has subsequently been recognized in the Arisaig area on Doctor's Brook, Ross Brook and on a small brook 150 feet west of Smith Brook (see section on fossil localities).

Maehl (1961, p. 43) pointed out that the Ross Brook Formation could be subdivided lithologically into three members which he referred to as the lower, middle and upper members. These members are recognized in this report.

Boucot (personal communication) states that the McAdam Formation can be subdivided lithologically into four members. Member 1 consists of quartzites and an iron ore bed and is exposed on Arisaig Brook in the Arisaig area. Member 2

consists of grey calcareous mudstones and is exposed along the Arisaig coast from the mouth of Smith Brook to a point about 100 feet east of the mouth of McAdam Brook. Member 3 consists of a basal portion of black mudstones overlain by dark grey to black mudstones with septarian nodules. It rests with a knife edge contact on member 2 and is exposed along the Arisaig coast from about 100 feet east of the mouth of McAdam Brook to a point about 1000 feet west of McAdam Brook. Member 4 consists of green siltstone without septarian nodules and is exposed on the Arisaig coast from a point about 1000 feet west of McAdam Brook to a point about 1250 feet west of McAdam Brook. These members can also be recognized in the McAdam of Pictou Co. Maehl mapped the lower two members as the "lower member" of the McAdam Formation and the upper two members as the "upper member" of the McAdam Formation. The four members defined by Boucot are recognized in this report.

Maehl (1961, p. 35) divided the Moydart Formation into two members: a lower member (corresponding to Zone a of McLearn (1924, p. 12) of greenish-grey fossiliferous marine mudstones, siltstones and limestones and an upper member, the "red stratum", (corresponding to Zone b, the "red band", of McLearn (1924, p. 13) that contains fish fragments.

The stratigraphic sequence of the Arisaig series in Antigonish Co., in N. E. Pictou Co. and in the Cobequid Mountains is shown in table 2. The Arisaig series consists

of 3000 to 4000 feet of conformable, marine calcareous mudstones, calcareous shales, argillaceous and calcareous siltstones and shales, limestones and some quartzites. It overlies the Browns Mountain Group disconformably and is overlain conformably by the Knoydart Formation.

The Beechhill Cove Formation consists of sandstones, siltstones and mudstones. It is about 150 to 200 feet thick in the Arisaig area (Twenhofel, 1909, p. 149 and Williams, 1914, p. 63) and varies from a minimum of 50 feet to a maximum of 240 feet in N. E. Pictou Co. (Maehl, 1961, p. 38).

The Ross Brook Formation consists of mudstones and shales with interbedded siltstones and sandstones in the upper member. Twenhofel (1909, p. 148) reports a minimum thickness of 833 feet for the Ross Brook Formation in the Arisaig area. Maehl (1961, p. 43) reports a nearly complete section totalling 1200 feet in Pictou Co. Maehl (1961, p. 43) reports a thickness of about 100 feet for the lower member of the Ross Brook Formation at Beechhill Cove, a minimum thickness of about 300 feet for the middle member in Pictou Co. and at Arisaig, and a thickness of about 750 feet for the upper member in Pictou Co.

The French River Formation consists of sandstones and mudstones and have a minimum thickness of 175 feet.

The McAdam Formation consists of mudstones and sandstones. Williams (1914, p. 67) reports a minimum thickness

of 1100 feet for the formation at Arisaig. Maehl reports a minimum thickness of 660 feet for the formation in Pictou Co. (Maehl, 1962, p. 55).

The Moydart Formation consists of mudstones and siltstones. Twenhofel (1909, p. 155) reports a thickness of 379 feet for the Moydart Formation, the top 32 feet of which comprise the "red stratum" (=upper member of Maehl, 1962).

The Stonehouse Formation consists of mudstones, siltstones and sandstones. Twenhofel (1909, p. 66) reports a minimum thickness of 1075 feet for the Stonehouse Formation in the Arisaig area and Maehl (1961, p. 66) reports a thickness of about 2000 feet for the formation in Pictou Co.

In S. E. Pictou Co., Maehl recognized the sequence shown in table 2. The Glencoe Brook Formation is correlative with the Beechhill Cove Formation on the basis of the fossils contained in both. The Stonehouse Formation in S. E. Pictou Co. is correlative with the Stonehouse in N. E. Pictou Co. The Kerrowgare Formation is equivalent with the Ross Brook, French River, McAdam and Moydart Formations on the basis of its stratigraphic position.

An unnamed quartzite occurs in fault blocks in School Brook Cove in the Cape George area. This quartzite contains Scolithus-like worm tubes and unidentifiable fish fragments (Orvig, written communication referred to in Boucot, et. al., 1962). Two localities in the quartzite have yielded Hyattidina northumberlandensis, Sphaerirhynchia saffordi and "Camarotoechia" squamifera-all of which indicate a Moydart age for the unit.

Table 2.

Stratigraphy: Antigonish Co., Pictou Co. and Cobequid Mountains.

Antigonish Co., Northeast Pictou Co. and the Cobequid Mountains		Southeast Pictou Co.
Knoydart Formation		Knoydart Formation
Stonehouse Formation		Stonehouse Formation
MOYDART FORMATION	Upper Member	
	Lower Member	
MCADAM FORMATION	Member 4	
	Member 3	
	Member 2	
	Member 1	
French River Formation		Kerrowgare Formation
ROSS BROOK FORMATION	Upper Member	
	Middle Member	
	Lower Member	
Beechhill Cove Formation		Glencoe Brook Formation
Browns Mountain Group	Upper Part	Sunnybrae Formation
	Lower Part	Charcoal Formation

Methods of Preparation

Large blocks of fossiliferous rock were collected in the field. These were broken into small blocks using a rock crushing machine and blocks which contained fossils were saved.

The specimens from the Beechhill Cove Formation, Glencoe Brook Formation, Ross Brook Formation, French River Formation, member 1 of the McAdam Formation, and the Stonehouse Formation were either preserved as natural casts or as original shell material in a matrix containing an appreciable amount of insoluble material. The specimens preserved as original shell material were dissolved in hydrochloric or sulfamic acid to form casts.

The specimens from the upper three members of the McAdam Formation and the Moydart Formation were preserved as original shell material in a very limy matrix. These specimens could not be dissolved in acid to form casts as the matrix in which they are imbedded dissolves in acid at about the same rate as the shells. A number of specimens of each species preserved in these units were prepared by roasting the shells under a gas flame. This treatment calcines and softens the shells so that the shell material may be scraped away with a fine needle to form a cast.

Rubber impressions were made of several casts of each of the species studied.

Brachiopod Fauna of the Arisaig Series.

Faunal lists for each of the formations of the Arisaig Series and for the Glencoe Brook Formation are given in tables III to VIII.

Table III

Faunal lists: Beechhill Cove Formation and Glencoe Brook Formation.

Beechhill Cove Formation Faunal list:	Glencoe Brook Formation Faunal list:
Dolerorthis sp.	Dolerorthis sp.
Ptychopleurella ? sp.	
Dalmanella sp. A.	
Dalmanella ? sp.	Dalmanella sp. B
Dalmanella ? primitiva	
	Fascifera ? sp.
Mendacella arisaigensis	Mendacella arisaigensis
Isorthis prima n. sp.	
Linoporella sp.	
Eoleptostrophia beechhillensis	Eoleptostrophia beechhillensis
Leptaena sp.	
indet. leptaenid	
Fardenia ? sp.	Fardenia ? sp.
"Camarotoechia" bimesiornata	
	Megumatrypa glencoensis n. sp.
Cryptothyrella beechhillensis	Cryptothyrella beechhillensis

Table IV

Ross Brook Formation Faunal list:

Visbyella nana
Salopina conservatrix
Eoleptostrophia beechhillensis
Pholidostrophia (Mesopholidostrophia) cf. P. (M.) nitens
Pentlandina ? sp.
Leptaena sp. cf. L. depressa
Protochonetes tenuistriatus
Plagiorhyncha aff. P. glassi
Plagiorhyncha plastica
"Camarotoechia" rossonia
Sphaerirhynchia antigua
Hyattidina sp.
Eocoelia aff. E. hemisphaerica
E. cf. E. sulcata

Table V

French River Formation faunal list:

Marklandella maehli n. sp.
Salopina submedia
Leptostrophia sp.
Fardenia sp.
Leptaena sp. cf. *L. depressa*
P. cf. *P. plastica*
Striispirifer stonehousensis
Meristina billingsi

Table VI

McAdam Formation faunal list:

Resserella cf. *R. concavoconvexa*
Dalejina sp.
Marklandella mcadamica n. sp.
Idiorthis matura
Isorthis mcadamensis
Salopina submedia
Leptostrophia sp.
Amphistrophia funiculata
Amphistrophia striata
Mclearnites sp.
Leptaena sp. cf. *L. depressa*
Fardenia sp.
Plectodonta sp.
Protochonetes novascoticus
Plagiorhyncha sp. *A.*
"*Camarotoechia*" *westoni*
"*Camarotoechia*" sp. aff. "*C.*" *planorugosa*
Sphaerirhynchia sp.
Rhynchospirina sp. *A*
Rhynchospirina?sp. B
Atrypa sp. cf. *A. reticularis*
Howellella moydartensis
Striispirifer stonehousensis
Meristina billingsi
Hyattidina northumberlandensis
Nucleospira sp.

Table VII

Moydart Formation faunal list:

Salopina submedia
Shaleria gilpeni
Lissostrophia sp.
Protochonetes novascoticus
Eatonioides lamellornatus
"Camarotoechia" sp. aff. "C." planorugosa
"Camarotoechia" squamifera
"Camarotoechia" moydartensis
Sphaerirhynchia saffordi
Rhynchospirina acadiae
Hyattidina northumberlandensis
Howellella moydartensis

Table VIII

Stonehouse Formation faunal list:

Isorthis fornicatimcurvata
Schizophoria sp.
Proschizophoria sp.
Salopina submedia
Salopina stonehousensis
Shaleria gilpeni
Shaleria honeymani
Mclearnites mertoni
Leptaena sp. aff. L. rhomboidalis
indet. orthotetacid
Protochonetes novascoticus
Protochonetes stonehousensis
"Camarotoechia" planorugosa
"Camarotoechia" glomerosa
Rhynchospirina sinuata
Rhynchospirina sp. A.
Atrypa sp. cf. A. gedinniana
Protathyris ? sp.
Delthyris (Quadrifarius) rugaecosta
Podolella ? sp.

Age and Correlation of the Formations in the Arisaig Series.

Beechhill Cove Formation

The Beechhill Cove Formation is considered by the author to be early Llandovery in age. It occurs conformably beneath the lower member of the Ross Brook Formation which contains a graptolite assemblage that is highest lower Llandovery or lowest middle Llandovery in age (see section on the age of the Ross Brook Formation which follows). It contains the brachiopod Eoleptostrophia beechhillensis which belongs to a group of leptostrophids of the Leptostrophia mullochensis (Reed, 1917) type. Leptostrophids of this type are extremely common and widespread in beds of early Llandovery age, and may occur in beds of late Llandovery age, but are not known to occur in beds of Ordovician age. It must be pointed out, however, that late Ordovician rafinesquinids, a group the author considers to be the probable ancestor of leptostrophids of this type, have not been intensively studied. The author has studied specimens from the Richmond Group in the U.S.N.M. and found them to be clearly distinct from leptostrophids of the L. mullochensis in having a pair of simple teeth instead of a denticulate hinge. The other brachiopod elements do not serve to date the unit precisely. The common and widespread genera Mendacella and Cryptothryella are restricted elsewhere in the world to beds of late Ordovician to late Llandovery (C_1 - C_2) age. Linoporella is not known in beds of Ordovician age, although the

Caradocian genus Laticrura (Cooper, 1956) appears to be closely related. Linoporella is extremely rare in beds of Silurian age and possibly is not known in older beds because of its rarity. Isorthis is not known in beds of Ordovician age. The differences between Llandovery Isorthis and upper Ordovician and lower Llandovery Dalmanella are very subtle, however. Until a comprehensive review of upper Ordovician dalmanellids is made it cannot be definitely established that Isorthis does not occur in the Ordovician.

Lower Llandovery brachiopod faunas are characterized by the presence of abundant Eoleptostrophia together with abundant Mendacella and Cryptothyrella. The Beechhill Cove Formation resembles lower Llandovery faunas elsewhere in this regard.

Ross Brook Formation

As mentioned above, the lower member of the Ross Brook Formation is highest lower Llandovery or lowest middle Llandovery in age. It contains the following graptolite assemblage (identified by Dr. Berry of the Univ. of Calif. at Berkeley): Climacograptus scalaris var. normalis, Climacograptus rectangularis, Monograptus acinacas, Monograptus lobiferus, and Orthograptus bellulus, which Berry considers to be indicative of the British Silurian graptolite zone of Monograptus gregarius of Ellis and Wood. The lower member contains only a few poorly preserved brachiopods assigned to Pentlandina ?. These do not help to date the unit.

No fossils were found in the basal several hundred feet of the middle member of the Ross Brook Formation. The beds in the upper portions of the member have yielded Eocoelia aff. hemisphaerica which lack dental plates; these indicate a late Llandovery (C_3 - C_5) age for that portion of the member. The stratigraphic range of this variety of Eocoelia is well documented in many areas of North America and Britain. C_1 - C_2 age Eocoelia have dental lamellae and C_6 - low Wenlock Eocoelia are of the E. sulcata type with much finer ribs than the C_3 - C_5 variety of Eocoelia.

It is reasonable to assume that the basal portion of the middle member of the formation, which is barren of fossils, represents the interval between middle Llandovery

time, when the lower member was deposited, and late Llandovery (C_3 - C_5) time, when the upper portion of the middle member was deposited.

The upper member of the Ross Brook Formation is considered to be C_6 - low Wenlock age on the basis of the presence of Eocoelia cf. sulcata. The upper member contains a graptolite assemblage (identified by Dr. Berry, personal communication) including Monograptus clintonensis, Monograptus aff. M. dextrorsus, Monograptus marri, and Monograptus priodon which indicate a C_3 to lowest Wenlock age.

The brachiopods of the Ross Brook Formation other than Eocoelia do not serve to date the formation more precisely but are consistent with the above correlations. Salopina conservatrix is known elsewhere only in the Hemse marl of Ludlow age in Gotland. Visbyella is known elsewhere only in the lower and upper Visby Marls of upper Llandovery to low Wenlock age in Gotland. Plagiorhyncha is known in upper Llandovery to Wenlock age beds in Britain. Eoleptostrophia is known elsewhere only in beds of lower Llandovery to C_2 age and so appears to have survived longer at Arisaig than in the rest of the world.

French River Formation

The French River Formation is considered to have an age which lies somewhere in the late Llandovery (C_6) to late Wenlock interval on the basis of its stratigraphic position above the upper member of the Ross Brook Formation and below the McAdam Formation which contains lower Ludlow graptolites at the base of member 3. Marklandella is known outside of Nova Scotia only in beds of lower Llandovery to Wenlock age in Brazil and Bolivia. Plagiorhyncha is known elsewhere in beds of late Llandovery to Wenlock age in Britain. The other brachiopod elements are extremely long ranging.

McAdam Formation

Member 3 of the McAdam Formation contains a graptolite assemblage at its base which contains Monograptis vulgaris, Monograptus varians, and Monograptis wandalensis which indicate equivalence to the zone of Monograptus nilssoni of Britain which is lower Ludlow. It rests with a knife edge contact on Member 2 suggesting the presence of a disconformity between the two members.

The presence of Amphistrophia in the lower two members of the McAdam Formation indicate a Wenlock or Ludlow age for these members. The other brachiopod species in the lower two members of the McAdam Formation belong to groups which are either endemic or long ranging.

Two graptolite specimens were obtained on Doctor's Brook in the Arisaig area at locality ZS4. No other fossils were found at this locality; the few rock specimens obtained from the locality somewhat resemble those from localities in the lower member of the McAdam Formation on the brook but a positive correlation cannot be made on this basis. The locality occurs a few hundred feet upstream from beds containing fossils indicative of the Frence River Formation and a few hundred feet downstream from beds containing fossils indicative of the lower member of the McAdam Formation. (See map 2.) It is reasonable to assume that the beds at this locality belong to the lower member of the McAdam Formation but, as the structure on Doctor's Brook is extreme-

ly complex, this cannot be definitely established. Berry (personal communication) identifies the graptolites found at the locality as M. cf. M. distans. According to Berry, monograptids of this sort - ones with hooked thecae and rather slender rhabdosomes - occur most frequently and in greatest diversity in the late Llandovery but some do range into the Wenlock.

The brachiopod species found in the upper two members of the McAdam Formation belong to groups which are extremely long ranging. The upper two members are considered to be Ludlow in age as Member 3 has lower Ludlow graptolites at its base and the members lie below the Moydart Formation which is considered to be Ludlow in age.

Moydart Formation

The lower member of the Moydart Formation is considered to be Ludlow in age because it is stratigraphically above the beds with lower Ludlow graptolites in the McAdam Formation and contains Hyattidina which is restricted elsewhere to beds of Silurian age.

The upper member of the Moydart Formation contains some fish remains but these are not useful in determining its age. (Dinely, 1962).

Stonehouse Formation

The Stonehouse Formation is considered to be Gedinnian and possibly, in part, of Skala age as it contains the characteristic Gedinnian and younger elements Isorthis fornicatimcurvata, Schizophoria sp. and Proschizophoria sp. and the characteristic Gedinnian and Skala element D. (Quadrifarius) and lies stratigraphically and apparently conformably below the Knoydart Formation from which Dinely (1962) has reported upper Downtonian fish about 650 to 700 feet above the base and Dittonian fish at a higher horizon. The presence of questionable Podolella in the uppermost 50 feet of the Formation in Pictou Co. suggests a Gedinnian age for that portion of the Formation. I. fornicatimcurvata and Quadrifarius are abundant throughout the formation; Schizophoria is known only from a few specimens from about the middle of the formation; and Proschizophoria is known only from the uppermost 50 feet of the formation in Pictou Co.

Copeland (1960) correlated the Stonehouse Formation with the Beyrichia Limestone of the Baltic region on the basis of the contained ostracod fauna. The Beyrichia limestone is considered by Copeland to be possibly Downtonian in age on the basis of the ostracods it contains.

Orvig (written communication to Boucot, mentioned in Boucot, et. al. 1959, p. 1572) reports fish fragments which "seem to consist of Thelodontid scales (of the Thelodus parvidens kind) and Acanthodian spines and scales, the latter

being referable to Nostolepis sp. and "Gomphodus" sp. "from beds in the Cape George area which probably belong to the Stonehouse Formation." He states that this fauna seems to be an upper Ludlovian one.

Age and Correlation of the Glencoe Brook Formation

The Glencoe Brook Formation contains *Dolerorthis* sp., *Mendacella arisaigensis*, *Eoleptostrophia beechhillensis*, and *Cryptothyrella beechhillensis* - all of which are restricted to the Beechhill Cove Formation in the Arisaig series. The Glencoe Brook Formation is clearly the same age as the Beechhill Cove Formation.

Age and Correlation of the Kerrowgare Formation

The Kerrowgare Formation conformably overlies the Glencoe Brook Formation of early Llandovery age and is overlain by the Stonehouse Formation of Gedinnian and possibly Skala age. The upper contact of the Kerrowgare Formation is not exposed, however, the strata of the formation appear to be conformable with those of the overlying Stonehouse Formation. Fossils were found in the Kerrowgare Formation only in four small areas: (1) on the west branch of Blanchard Brook, (2) on the East branch of Holmes brook, (3) near the mouth of Sam Cameron Brook and (4) on McLellan Brook about 3/4 mile due east of Brookville. (See Maehl, 1960, fig. 14 and Appendix 1 of this report.)

The fossils from near the mouth of Sam Cameron Brook include Visbyella nana, Plagiorhyncha sp. aff. P. glassi and Eocoelia aff. E. hemisphaerica. The first two species are restricted in the Arisaig series to the upper two members of the Ross Brook Formation and the last species is restricted to the middle member of the Ross Brook Formation. Thus, the beds in this area are correlative with the middle member of the Ross Brook Formation.

The one locality on the west branch of Blanchard Brook which yielded fossils is in a iron ore bed which is very similar lithologically to the iron ore bed in member 1 of the McAdam Formation at locality C-1 in the Arisaig area. The fauna at this locality includes Salopina submedia, Atrypa

cf. A. reticularis, Leptaena sp. cf. L. depressa, Mclearnites sp. "Camarotoechia" sp. aff. C. planorugosa and Meristina billingsi. These species all occur also in the iron ore bed in the Arisaig area. Meristina billingsi and Mclearnites sp. are restricted in the Arisaig series to member 1 of the McAdam Formation. It follows that the beds at this locality are correlative with member 1 of the McAdam Formation.

Fossil localities in the Kerrowgare Formation on the East branch of Holmes Brook have yielded Salopina submedia, Protochonetes sp., Howellella sp. and an unidentified rhynchonellid. The presence of Howellella sp. suggests a correlation with the McAdam or Moydart Formations of the Arisaig series.

The one fossil locality in the Kerrowgare Formation on McLellan Brook has yielded only a few unidentifiable plant fragments.

Local Stratigraphic Distribution of Species in the Ross Brook Formation

Large collections were made in the Ross Brook Formation at several localities in the Arisaig area and at a very large number of localities in Pictou Co. *Eocoelia* aff. *E. hemisphaerica* was found to be restricted to the middle member of the formation and *E.* cf. *E. sulcata* was found to be restricted to the upper member. *Salopina conservatrix*, *Leptaena* cf. *L. depressa* and *Hyattidina sp.* are all fairly common in the upper member in the Arisaig area and Pictou Co. but are not known to occur in the middle member.

Local Stratigraphic Distribution of Species in the McAdam Formation

Arisaig area

The geologic structure in the vicinity of Doctor's Brook is very complex; the rocks in this area are badly fractured and altered and cannot be correlated lithologically with those in the Arisaig Series to the West. Therefore, the stratigraphic distribution of species in the McAdam Formation in the Arisaig area must be established on the basis of the section between MacGillivray Brook and the westernmost exposures of the unit about 1000 feet west of the mouth of McAdam Brook.

Fossils were obtained from member 1 at localities on MacGillivray Brook, Mill Brook, Ross Brook and Arisaig Brook. Fossils were obtained from member 2 at four localities - one on Smith Brook, one on the first brook west of Smith Brook and two in the shore section. Fossils were obtained from member 3 at one locality in the shore section and from member 4 at one locality in the shore section.

The distribution of species at these localities are shown in table IX. Locality C-2 occurs stratigraphically below the other three localities in member 2 and contains a different fauna; it is listed separately from the other three localities.

The following species occur in member 1 but are not found in the higher members: Resserella cf. R. concavoconvexa, Dalejina sp., Mclearnites sp., Fardenia sp., Sphaeri-

Table IX.
Local Stratigraphic Distribution of Species in the McAdam Formation

	Resserella cf. *R. concavoconvexa*	*Dalejina* sp.	*Marklandella mcadamica*	*Idiorthis matura*	*Isorthis mcadamensis*	*Salopina submedia*	*Leptostrophia* sp.	*Amphistrophia funiculata*	*Amphistrophia striata*	*Mclearnites* sp.	*Leptaena* sp. cf. *L. depressa*	*Fardenia* sp.	*Plectodonta* sp.	*Protochonetes novascoticus*	*Plagiorhyncha* sp. *A.*	"*C.*" *westoni*	"*C.*" sp. aff. "*C.*" *planorugosa*	*Sphaerirhynchia* sp.	*Rhynchospirina* sp. *A.*	*Rhynchospirina* ? sp. *B.*	*Atrypa* sp. cf. *A. reticularis*	*Howellella moydartensis*	*Strispirifer stonehousensis*	*Meristina billingsi*	*Hyattidina northumberlandensis*	*Nucleospira* sp.
Arisaig area:																										
Member 1 Localities	X	X				X	X			X	X	X		X			X	X	X		X			X		
Member 2 Locality C-2			X	X		X	X	X			X			X		X	X				X					
Member 2 Localities above C-2						X								X	X	X	X					X				
Member 3 Locality						X								X	X	X	X									
Member 4 Locality						X								X			X					X				
Pictou Co.:																										
Member 1 Localities	X	X			X	X		X	X		X	X		X		X	X	X	X			X	X		X	
Member 2 Localities			X	X	X	X		X			X					X	X	X								
Cobequid Mountains																										
Member 1 Localities	X	X						X			X	X	X			X		X		X	X	X	X	X		X

rhynchia sp., Rhynchospirina sp. A. and Meristina billingsi.

The following species are known in the Arisaig area only from locality C-2 in the lower part of member 2: Marklandella mcadamica, Idiorthis matura, and Amphistrophia funiculata. Isorthis mcadamensis is common in collections from the Arisaig shore section which are not identified as to locality, but which contain the above three species.

Leptostrophia sp., Leptaena sp. cf. L. depressa and Atrypa sp. cf. A. reticularis occur in member 1 and at locality C-2 in the lower part of member 2, but are not known from the higher horizons of the McAdam Formation.

The localities in the upper part of member 2 and those in members 3 and 4 yielded a small fauna consisting of Salopina submedia, Protochonetes novascoticus, three species of rhynchonellids and Howellella. All of these except one of the rhynchonellids, Plagiorhyncha sp. A., occur also in member 1 and the lower part of member 2.

It appears, then, that a marked faunal break occurs between the lower part and the upper part of member 2 with a relatively small number of species persisting in the McAdam Formation above the lower part of member 2. This conclusion, however, may have to be somewhat revised if additional fossil localities are found in members 2, 3, and 4; only a relatively small number of localities are known in these parts of the McAdam Formation.

Most of the localities on Doctor's Brook have yielded

species which are restricted to member 1 in the McAdam Formation in the rest of the Arisaig area; some of the localities on the brook have not yielded diagnostic species, and others have yielded species indicative of the French River Formation.

Pictou Co.

Fossils were obtained in the McAdam Formation in Pictou Co. only from members one and two (mapped together by Maehl (1961) as the "lower member" of the McAdam). All but two of the Pictou Co. localities contain several species which are found in member 1 in the Arisaig area but not in the higher members (see table IX); these may be correlated with member 1 in the Arisaig area. The remaining two localities (HAF and DT23) occur stratigraphically above member 1 localities and contain Marklandella mcadamica and Idiorthis matura which are known in the Arisaig area only from the locality in the lower part of member 2; these may be correlated with the lower part of member 2 in the Arisaig area.

Sphaerirhynchia sp. is known in the Arisaig area only in Member 1; in Pictou Co. it occurs in both member 1 and member 2. Isorthis mcadamensis and Amphistrophia funiculata are known in the Arisaig area only from member 2; in Pictou Co. they occur in both members 1 and 2.

Amphistrophia striata and Hyattidina northumberlandensis are rare in member 1 in Pictou Co.; they are not known in the McAdam Formation in the Arisaig area.

Cobequid Mountains

Four localities in the Cobequid Mountains yielded fossils indicative of member 1 of the McAdam Formation (see table IX). Two of these localities yielded also Striispirifer stonehousensis which is known in the Arisaig area and in Pictou Co. only in the French River Formation. As a large number of the species at these localities are confined to member 1 in the Arisaig area and Pictou Co., it may be concluded that S. stonehousensis occurs slightly higher in the Cobequid Mountains than in the Arisaig area and Pictou Co.

Nucleospira sp. and Plectodonta sp. are not known in the Arisaig area and Pictou Co.; they occur at one locality in member 1 in the Cobequid Mountains.

Local Stratigraphic Distribution of Species in the Stonehouse Formation

Mclearnites mertoni and *Leptaena* sp. cf. *rhomboidalis* are known in the Arisaig area only from localities in the lower part of the Stonehouse Formation; they are not known to occur in Pictou Co. *Protathyris*? sp. is known only from localitis E-2 and E-4 and is extremely rare at both. *Proschizophoria* sp. and *Podolella*? sp. are known only from two localities in the uppermost 50' of the formation in Pictou Co. *Schizophoria* sp. is known only from localities E-4 and E-5 and is rare at both. The other species present in the Arisaig area and Pictou Co. are extremely long ranging in the formation.

It is not possible to zone the Stonehouse Formation using the available locality data for the brachiopods.

Copeland (1960, p. 95) states that "the exact stratigraphic distribution of ostracods throughout the Stonehouse Formation is not known. This will constitute a separate study to be published at a later date."

Restrictive nature of the Brachiopod Fauna of the Arisaig Series

Many brachiopod groups which are common and widespread in beds of equivalent age elsewhere in the world are absent or virtually absent in the Arisaig series. The brachiopod genera which are present are not endemic to the Arisaig series; most of them are very widespread and common in beds of equivalent age elsewhere. For the purposes of this report, I am defining this occurrence of a limited number of groups in an area as a restrictive fauna. The restrictive nature of the Arisaig brachiopod fauna very possibly resulted from the presence of a barrier which prevented the larvae of some but not all groups from entering the area of Arisaig rocks. The possibility that it resulted from certain factors in the depositional environment being unfavorable to the missing groups cannot, however, be completely ruled out.

The brachiopod faunas of the Beechhill Cove and Glencoe Brook Formations are very similar in the diversity of groups present to early Llandovery faunas elsewhere in the world, although the absence of stricklandids is worth noting. However, the faunas of the rest of the Arisaig series are very restrictive. These are listed on table X. Rhipidomellinids, strophonellids, Protomegastrophia, coelospirids, cyrtiinids, and members of the Pentameroidea are extremely widespread and abundant in marine shelly beds of late Llandovery to Ludlow age elsewhere in the world and their

Table X

Brachiopod groups lacking or virtually lacking in the Arisaig series in beds younger than Beechhill Cove:

Orthids
Rhipidomellinids (absent except for a few specimens of *Dalejina* in Member 1 of the McAdam Formation)
Strophonellids
Protomegastrophids
Leptellids
Plectodontids (occur only at one locality in the Cobequid Mountains)
Triplesioids
Pentlandinids (one specimen known from the lower member of the Ross Brook Formation)
Trimerellids
Coelospirids
Plectatrypids
Septatrypinids
Lissatrypinids
Dayids
Cyrtiinids
Pentameroids

absence or virtual absence in the Ariaaig series is very puzzling. The other groups listed are also widespread and abundant in such beds elsewhere although they are somewhat less ubiquitous; their absence is also very puzzling. It is also notable that members of the suborder Spiriferoidea are completely lacking in the upper two members of the Ross Brook Formation and, yet, are common in beds of upper Llandovery (C_3-C_6) age elsewhere in the world. Corals are lacking in the Arisaig series in beds younger than Beechhill Cove.

A plausible explanation of the restrictive nature of the Arisaig fauna is that there was some sort of barrier between (1) the belt of Arisaig rocks extending from Cape George west to the western half of the Cobequid Mountains and (2) Maine, Quebec, and New Brunswick to the North and West. For example, there may have been a belt of deeper water between these two areas in which adult brachiopods could not live. Larvae of sessile invertebrates are known to vary widely in the range of temperatures they can tolerate and the length of time they remain in the plankton before becoming attached to a substrate. Those species having larval stages which could remain alive during transport across such a barrier could enter the area of the Arisaig rocks. Those having larval stages which could not remain alive during transport across such a barrier, either because they could not tolerate the conditions in the barrier

or because they could remain in the plankton for only a relatively short time before becoming attached to a substrate, could not enter the area. An oceanic current such as the Gulf Stream could similarly serve as a barrier to larval stages.

If such a barrier existed, it must have persisted throughout upper Llandovery to Gedinnian time.

A few unusual endemic elements do occur in the Arisaig fauna - Visbyella nana, Idiorthis matura, Isorthis mcadamensis, and Eatonioides lamellornatus. However, this is not peculiar, as other areas have a similar percentage of endemic species. The presence of only a small number of endemic species indicates that such a barrier, if it existed, permitted certain groups to freely enter the area, while others were excluded.

A second explanation of the restrictive nature of the fauna is that the species of the missing groups were unable to survive in the depositional environment of the Arisaig series, or, at least, were unable to persist[23] a population for very long in the area without dying out. Elton (1960, p. 149) points out that the spread of any species from one area to another involves (1) the migration of individuals of the species into the new area, (2) the establishment of these individuals, i.e., their survival in the area and (3) the establishment of the species, i.e., the successful interbreeding of these migrants to produce fertile offspring

and to establish a permanent population of the species in the area. It is possible that the species of the missing groups were able to migrate into the area of Arisaig rocks but the migrants were either unable to survive in the area, or unable to establish themselves as permanent populations of species in the area because of some factor or factors in the depositional environment.

McLearn (1918, p. 131-33) noted that the brachiopoda are poorly represented in the Arisaig series in terms of the variety of groups present and concluded that this was due to the "prevailing muddy bottoms" of the Arisaig area during the deposition of the Arisaig series. This explanation is untenable as sequences of marine strata of the same age and with very similar lithologies occur in Quebec and New Brunswick, and these by no means contain a similarly restricted brachiopod fauna.

It could be argued that depth of water was one controlling factor. However, the Arisaig series contains one 30 foot red bed with fish fragments - the upper member of the Moydart - and is conformably overlain by the Knoydart Formation which contains fish remains; both of these are generally regarded as estuarine or non-marine. This, together with the presence of linguloids at several horizons, and certain sedimentary features of the Arisaig series (see Maehl, 1961, pp. 102-3), suggest a shallow water origin for the Arisaig series. Hence, it appears unlikely that depth

of water was a major controlling factor.

Temperature probably was not a controlling factor as the faunas in nearby Quebec and New Brunswick were presumably subjected to similar ranges of temperature and, yet, are not restrictive.

Salinity may possibly have been a controlling factor. As mentioned above, the red band of the Moydart Formation and the conformably overlying Knoydart Formation are generally regarded as estuarine or non-marine. Their presence suggests the possibility that the Arisaig series may have been, at least in part, of near shore origin. It is possible that the waters inhabited by the Arisaig fauna were diluted by fresh water from rivers from a nearby land mass.

Other possible controlling factors which occur to the author are amount and type of food available and the availability of plants such as seaweed to which the brachiopods could attach themselves.

The possibility that the restrictive nature of the brachiopod fauna of the Arisaig series resulted from certain peculiar ecologic factors of the depositional environment cannot be completely ruled out. However, it seems somewhat more reasonable to conclude that the fauna was restrictive owing to the presence of a barrier to the larvae of the missing groups.

SYSTEMATIC PALEONTOLOGY

Phylum BRACHIOPODA

Class ARTICULATA

Superfamily ORTHACEA Walcott and Schuchert, 1908

Family Orthidae Woodward, 1852

Genus Dolerorthis Schuchert and Cooper, 1931
(emended Williams) 1962

Type species.--Orthis interplicata Foerste 1909, Bull. Sci. Lab. Denison Univ., vol. 14, p. 76, pl. 3, fig. 44.

Discussion.--Schuchert and Cooper (1932, pp. 88-89) defined Dolerorthis to include only orthids in which the adult specimens are convexo-concave. Williams (1962, p. 113) emended the genus to include orthids which are similar to the type except that the adult specimens are biconvex. As presently defined, the genus includes a great variety of species of Caradocian to Gedinnian age which are biconvex to convexo-concave, have an open delthyrium and notothyrium, short dental lamellae, triangular pedicle muscle field with a rounded anterior margin, flat triangular notothyrial cavity, simple cardinal process and tabular brachiophores, and which lack accessory ridges lateral to the cardinal process. These species differ considerably in their ornament and external form and could, undoubtedly, be subdivided profitably into a number of genera. However, this would necessitate a careful review of all of the species of Dolerorthis and is outside the scope of this report.

Most of the orthid specimens in the Beechhill Cove

Formation and the Glencoe Brook Formation collections are generically similar to Orthis interplicata (Foerste, 1909) in ornament and in their brachial interior (see Schuchert and Cooper 1932, plate 5, fig. 18 and Foerste 1909, plate 3, fig. 44 for illustrations of O. interplicata). No illustrations of the pedicle interior of O. interplicata are available. Owing to lack of specimens of O. interplicata for comparisons and the poor state of preservation of most of the Arisaig specimens, the Arisaig specimens cannot be identified specifically.

Dolororthis sp.

Plate I, figs. 1-5.

Description.

Exterior.--The valves are biconvex with the pedicle valve more convex than the brachial valve. The outline is subelliptical and 3/5 to 4/5 as wide as long. The hinge line is straight and slightly shorter than the greatest width which occurs slightly anterior to the hinge line. The pedicle interarea is flat, high apsacline and 1/4 to 1/5 as high as long; the brachial interarea is flat, high anacline, and about 1/6 as high as long. The delthyrium and notothyrium are triangular in outline and open. The cardinal angles are rounded. The anterior commissure is rectimarginate. The valves are marked by coarse costae which are rectangular in cross section and separated by

interplications of the same width as the costae. The costae increase in size distal to the apex and occasionally increase by bifurcation or by insertion. One specimen has fine striae on the costae. A faint sulcus may be present on the brachial valve.

Interior pedicle valve.--The teeth are stout and supported by short, erect dental plates. The muscle field is triangular in outline with a rounded anterior margin, is confined to the delthyrial cavity, and extends anteriorly 1/3 to 1/4 the length of the valve. The diductors are broad and flabellate and enclose very narrow elongate oval adductors. The muscle field is bounded anteriorly by curved ridges. The diductor scars may be marked by curved ridges which define the position of the anterior margin of the muscle field at various growth stages. The interior of the valve is marked by coarse ridges which correspond to the external ornament. These may be confined to the periphery or may extend posteriorly as far as the muscle field.

Interior brachial valve.--The notothyrial platform is flat, triangular in outline and extends antero-dorsally from the apex of the notothyrium to the anterior margin of the notothyrial cavity and then drops abruptly to the level of the floor of the valve. The lateral margins of the notothyrial cavity intersect at the apex at about a right angle. The brachiophores are tabular. The medial surfaces

of the brachiophores lie in the planes defined by the lateral margins of the notothyrial platform. The ventral margins of the brachiophores are straight and lie along the lines defined by the lateral margins of the notothyrium. The sockets are triangular in outline with their apices directed medially. They are rounded at their base, diverge antero-laterally at a high angle to the median line, and are elevated above the level of the floor of the valve. A broad rounded median ridge extends 1/4 to 1/2 the length of the valve. The muscle field is usually obscure. When impressed, the muscle field consists of two pairs of oval adductors of about the same size. The interior of the valve is marked by coarse ridges which correspond to the external ornament. These may be confined to the periphery or may extend posteriorly as far as the muscle field.

Occurrence.--*Dolerorthis* sp. occurs in the Beechhill Cove Formation of early Llandovery age at localities A-4 and AZ1 in the Arisaig area. It occurs at locality FT5 in the Glencoe Brook Formation of early Llandovery age in Pictou Co.

Subfamily Glyptorthiinae Schuchert and Cooper, 1931

Genus Ptychopleurella Schuchert and Cooper, 1931

Type species.--Orthis bouchardi Davidson, 1847, London Geol. Jour. p. 64, pl. 13, figs. 5-8.

Ptychopleurella ? sp.

Plate I, figs. 6-7.

External and internal impressions of one brachial valve and one pedicle valve of an orthid with a rugose external surface were found in the Beechhill Cove Formation. A rugose external surface is characteristic of glyptorthiinids of which three genera are known - Glyptorthis (Foerste, 1914), Eridorthis (Foerste, 1914) and Ptychopleurella. The Beechhill Cove Formation specimens have a coarser ornament than Glyptorthis and have a subpyramidal pedicle valve which differs from the relatively low pedicle valve of Glyptorthis. Eridorthis is characterized by a sulcus in the brachial valve which reverts into a fold - this is lacking in the Beechhill Cove Formation species. The Beechhill Cove Formation species resembles Ptychopleurella in having a subpyramidal pedicle valve, and a relatively convex brachial valve which bears a sulcus, and in its cardinalia and muscle fields. However, Cooper (1932, p. 92) states that Ptychopleurella is characterized by a "sulcus bounded by two costellae considerably elevated above their fellows", and the Beechhill Cove Formation species does not have costellae of this type.

Ptychopleurella has not previously been recognized in beds of early Llandovery age. Ordovician Ptychopleurella have unbranched ribs; late Llandovery and younger Ptychopleurella have branching ribs. The Beechhill Cove species has branching ribs and, thus, resembles the other Silurian species, rather than the Ordovician species in this regard.

Description.

Exterior.--The pedicle valve is subpyramidal, the brachial valve is fairly strongly convex and bears a median sulcus. The valves are semielliptical in outline, widest at the straight hinge line and about 2/3 as wide as long. The anterior commissure is crenulate and sulcate. The pedicle interarea is flat, high apsacline and about 1/4 as high as long; the notothyrium is triangular and open. The interarea is not preserved on the one brachial valve studied. The valves are marked by coarse angular costae which increase by both bifurcation and insertion and by regularly spaced lamellose growth lines.

Interior pedicle valve.--The teeth are supported by short divergent dental plates which bound the muscle field laterally. The muscle field is cordate, about as wide as long, and extends anteriorly 2/5 the valve length. The external surface is marked by the impress of the external ornament anterior and lateral to the muscle field.

Interior brachial valve.--The brachiophores are short and form the margins of the notothyrial cavity. A flat

notothyrial platform extends between the brachiophores and bears the small elongate simple cardinal process. A low myophragm extends anteriorly from the notothyrial platform to about 1/3 the valve length and divides the faintly impressed oval adductors. The periphery of the valve is marked by crenulations corresponding to the costae.

Occurrence.--Known only from locality A-4 in the Beechhill Cove Formation of early Llandovery age in the Arisaig area.

Superfamily Dalmanellacea Schuchert and Cooper, 1931

Family Dalmanellidae Schuchert, 1929

Genus Dalmanella Hall and Clarke, 1892

Type species.--Orthis testudinaria (Dalman, 1828), p. 148, pl. II, figs. 4a-d.

Dalmanella? primitiva (McLearn, 1924)

Plate I, figs. 8-17; Plate II, figs. 1a,b.

1924. Dalmanella elegantula mut. primitiva McLearn, p. 53, pl. III, fig. 7.

Type specimen.--Holotype Peabody Museum #421.

Description.

Exterior.--The valves are unequally biconvex with the pedicle valve more convex than the brachial, shield shaped in outline with rounded cardinal angles. The greatest width occurs in the posterior half of the valves. The hinge line straight and about 2/3 as long as the greatest width. The anterior commissure is crenulate and sulcate. The thickness is about 1/2 the width. The valves are marked by rounded costellae which increase by bifurcation and are separated by rounded interspaces of about the same width as the costellae.

Exterior pedicle valve.--The valve is shield shaped in outline, strongly convex, somewhat carinate, and varies from 4/5 as long to as long as wide. The interarea is apsacline, curved concave outwards and about 1/8 as high as long; the delthyrium is triangular in outline, open and

intercepts an angle of about 50° at the apex. The beak extends about 1/10 the length posterior to the hinge.

Exterior brachial valve.--The valve is shield shaped, gently convex, from 3/4 as long to as long as wide, and bears a low rounded sulcus. The interarea is flat, anacline, and about 1/25 as high as long; the notothyrium is triangular in outline and filled by the cardinal process.

Interior pedicle valve.--The teeth are stout, triangular in outline, and supported by short erect dental plates. The muscle field is oval in outline, extends anteriorly about 1/3 the valve length and is slightly longer than wide. It is not always impressed. On a few well preserved specimens it consists of two diductor scars separated by a broad, flat, parallel sided median tract which probably was the area of adductor attachment. The anterior crenulations are rounded, separated by interspaces of about equal width and may bifurcate anteriorly. They may be confined to the periphery or may extend posteriorly as far as the muscle field.

Interior brachial valve.--The muscle field extends anteriorly to about midlength, and is about 1/3 as wide as the greatest width and about as wide as long. A broad rounded median ridge which tapers slightly in width anteriorly divides the muscle field. The muscle field may be bounded laterally by low curved ridges and is often divided into a posterior pair of oval adductors and a

slightly larger anterior pair. The brachiophores are tabular, triangular in lateral profile and diverge anterolaterally at their bases. On some specimens they curve slightly laterally at their upper margins. They are erect on some specimens and on others they are convergent onto the median line. Fulcral plates extend from the brachiophores to the hinge line on most specimens; on some specimens socket pads extend from the brachiophores to the hinge. The sockets are triangular in outline and rounded at their base. One specimen shows faint ridges in one socket which may be crenulations. The cardinal process is simple and consists of a narrow shaft and an expanded oval myophore. The anterior crenulations are rounded, separated by interspaces of about equal width and may bifurcate anteriorly. They are deeply impressed along the periphery; in some cases they extend inwards as faint ridges as far as the muscle field.

Discussion.--D.? primitiva differs from typical Dalmanella in having a shield shaped outline, a simple cardinal process and brachiophores which are erect on some specimens and convergent onto the median ridge in others. Dalmanella has a subcircular outline, a bilobed cardinal process, and brachiophores which are convergent onto the median ridge.

D.? primitiva resembles Resserella (Bancroft, 1928 (emended Cooper, 1956) in outline and in having a strongly

convex pedicle valve, and may well have been ancestral to it. It differs from Resserella, however, in lacking the characteristic resserellid ornament in the median part of the brachial valve, and in lacking crenulated teeth and sockets (one specimen shows faint traces of what might be crenulations). Resserella has much stouter brachiophores than D.? primitiva and has a bilobed or trilobed cardinal process which is commonly much broader than that in D.? primitiva. The brachial muscle field of Resserella differs in outline from that of D. primitiva.

D.? primitiva resembles Dedzetina (Havlicek, 1950) in outline but differs from it in having a less strongly impressed pedicle muscle field and in having a simple cardinal process. Dedzetina has a bilobed cardinal process.

Distribution.--D.? primitiva is known only from locality A-3 of the Beechhill Cove Formation of early Llandovery age in the Arisaig area.

Dalmanella sp. A

Plate II, figs. 2-11.

Description.

Exterior.--The valves are biconvex with the pedicle valve more convex, subcircular to subelliptical in outline with rounded cardinal angles. The anterior commissure is crenulate and rectimarginate. The length varies from 3/4 the width to equal to the width; the greatest width occurs at about mid-length. The hinge line is straight and from 1/2 to 3/5 as long as the greatest width. The valves are marked by coarse costellae which increase by bifurcation and insertion and are separated by interplications of about the same width.

Exterior pedicle valve.--The valve is subcircular to subelliptical in outline and from 3/4 as long to as long as wide. The interarea is apsacline, curved concave outwards and about 1/5 as high as long; the delthyrium is triangular, open and intercepts an angle of about 50° at the apex. The beak overhangs the hinge about 1/10 the total length.

Exterior brachial valve.--The valve is subelliptical in outline, nonsulcate, and from 3/4 as long to as long as wide. The interarea is flat, anacline, and about 1/8 as high as long; the notothyrium is triangular, intercepts and angle of about 40° at the apex, and is filled at its

base by the cardinal process.

Interior pedicle valve.--The teeth are triangular in outline and supported by short, widely spaced dental plates. The pedicle muscle field is oval in outline, usually wider than long, and extends anteriorly 1/3 to 1/2 the length of the valve. It is bounded laterally by the dental plates and often by low ridges which extend anteriorly from the dental plates and curve around the anterior margin of the muscle field. The anterior crenulations are rounded and may bifurcate. They are separated by interspaces of about the same width and may be confined to the periphery or may extend inward to the muscle field. No median ridge is present. The individual adductors and diductors are not impressed.

Interior brachial valve.--The brachiophores are tabular, triangular in lateral profile, parallel at their bases, and convergent on to the median ridge. The cardinal process consists of a narrow shaft and a simple oval myophore. The sockets are triangular in outline, rounded at their base and floored by fulcral plates. A prominent rounded median ridge extends anteriorly from the cardinalia to 1/2 to 3/4 the length of the valve and tapers slightly in height anteriorly. The muscle field is about 3/4 as long as wide and is divided by the median ridge which occupies the middle 1/3 to 1/4 of the field. The adductors are oval in outline and are, in some cases, divided into

an anterior pair and a slightly smaller posterior pair. The anterior crenulations are identical to those in the pedicle valve.

Discussion.--D. sp. A and D.? primitiva differ as follows: D. sp. A has a subcircular to subelliptical outline; D.? primitiva is shild shaped in outline. D. sp. A has a more convex brachial valve, coarser ribs, a more prominent brachial median ridge, and a broader pedicle muscle field.

D. sp. A differs from Fascifera? sp. in having thicker brachiophores which are convergent on to the median ridge in contrast to the erect brachiophores of Fascifera? sp. D. sp. A has a much more prominent brachial median ridge and a broader pedicle muscle field.

Occurrence.--D. sp. A occurs in the Beechhill Cove Formation of early Llandovery age at locality A-2 in the Arisaig area.

Dalmanella sp. B

Plate II, figs. 13-18.

Description.

Exterior.--The valves are plano-convex or unequally biconvex with the brachial valve only very gently convex, and are subelliptical in outline with somewhat rounded cardinal angles. The hinge line is straight and about 2/3 as long as the greatest width. The anterior commissure is crenulate and rectimarginate or gently sulcate. The length varies from 3/4 to 4/5 the width; the greatest width occurs at about mid-length. The valves are marked by coarse somewhat angular costellae which increase by bifurcation and insertion.

Exterior pedicle valve.--The valve is subelliptical in outline uniformly convex, and 3/4 to 4/5 as long as wide. The interarea is curved, about 1/6 as high as long, and apsacline; the delthyrium is triangular and open.

Exterior brachial valve.--The valve is subelliptical in outline and 3/4 to 4/5 as long as wide. A faint sulcus may be developed. The interarea is flat, anacline and about 1/8 as high as long; the notothyrium is triangular and is filled by the cardinal process.

Interior pedicle valve.--The teeth are triangular in outline and supported by short dental lamellae which diverge from the margins of the delthyrium at about a 70°

angle to each other. The muscle field is oval in outline and confined to the posterior 1/3 of the valve. The internal surface is marked by the impress of the external ornament which extends inwards as far as the muscle field.

Interior brachial valve.--A rounded median ridge extends from the cardinalia to 1/2 to 2/3 the valve length, and may be flanked laterally by oval adductor scars. On some specimens the adductor scars are not impressed. The brachiophores are short, very stubby, convergent on to the median ridge. The bases of the brachiophores are parallel or only slightly divergent anteriorly. The sockets are rounded at their base and floored by fulcral plates. The cardinal process consists of a short shaft and a simple myophore. The internal surface is marked by the impress of the external ornament.

Discussion.--Dalmanella sp. B differs from Fascifera? sp., which also occurs in the Glencoe Brook Formation, as follows: D. sp. B has very stubby brachiophores, a flat or almost flat brachial valve which may bear a faint sulcus; Fascidera? sp. has long bladelike brachiophores, a very convex brachial valve and is nonsulcate.

D. sp. B differs from D. ? primitiva, that occurs in the Beechhill Cove Formation, which is correlative with the Glencoe Brook Formation, in having much less divergent brachiophores, coarser ribbing, and in lacking the shield shape outline characteristic of D. ? primitiva.

D. sp. B differs from D. sp. A, which occurs in the Beechhill Cove Formation, in having a much flatter brachial vlave, broader brachiophores, and a narrower pedicle muscle field.

Occurrence.--D. sp. B is known from the Glencoe Brook Formation of early Llandovery age at localities GB2, I1, TT11, MT2A, and MT2B in Pictou Co.

Dalmanella ? *sp.*

Plate II, fig. 12.

A single finely costellate, strongly convex dalmanellid pedicle valve with an elongate muscle field that lacks a median ridge was found at locality A-2 in the Arisaig area in the Beechhill Cove Formation of early Llandovery age. It differs from *Dalmanella sp. A*, which occurs at the same locality, in having finer ornament and a much more elongate muscle field. The affinities of this specimen are not clear.

Fascifera Ulrich and Cooper, 1942

Type species.--Fascifera subcarinata (Ulrich and Cooper, 1942), Journ. Paleont., vol. 16, No. 5, p. 620, pl. 90, figs. 1-5.

Fascifera? sp.

Plate II, figs. 19-21; Plate III, figs. 1-6.

Description.

Exterior.--The valves are biconvex with the pedicle valve more convex than the brachial, subcircular to transversely subelliptical in outline and widest at about mid-length. The cardinal angles are rounded. The anterior commissure is rectimarginate and crenulate. The hinge line is straight and about 3/5 as long as the greatest width. The ornament consists of more or less angular costellae which increase by bifurcation and insertion, and are separated by interspaces of about the same width. Between 25 and 50 costellae are present at a length of 5mm.

Exterior pedicle valve.--The valve is subcircular to transversely subelliptical in outline with rounded cardinal angles, uniformly convex, and from 3/5 as long to as long as wide. The interarea is apsacline, about 1/10 as high as long, and gently concave outwards; the delthyrium is triangular, open, and intercepts a 60° angle at the apex. The beak extends a short distance posterior to the hinge line but does not overhang the hinge.

Exterior brachial valve.--The valve is subcircular to

transversely subelliptical in outline with rounded cardinal angles, 3/5 to 9/10 as long as wide, and non sulcate. The interarea is anacline, flat, and 1/10 to 1/20 as high as long; the triangular notothyrium intercepts an angle of about 50° at the apex and is filled by the cardinal process.

Interior pedicle valve.--The rounded teeth are supported by short dental plates which extend anteriorly from the margins of the delthyrium and diverge anterolaterally at a 60° angle to each other at their base. The muscle field is suboval in outline, extends anteriorly to about 1/3 the lenght of the valve. On some specimens the median 1/3 of the muscle field is occupied by a faint raised area which separates the oval diductor scars and represents the area of adductor attachment. The internal surface is marked by the impress of the external ornament which extends posteriorly as far as the muscle field.

Interior brachial valve.--The muscle field extends anteriorly to midlength and is slightly wider than long. It is not always impressed. A low rounded median ridge occupies the median 1/3 of the muscle field and separates the oval adductor scars. The cardinal process is simple and consists of an elongate shaft and a slightly expanded myophore. The brachiophores are erect, bladelike, and may be parallel to the median line or may diverge anterolaterally from the apex at an angle of less than 15° to

each other. They extend anteriorly as far as the cardinal process. Prominent fulcral plates extend from the brachiophores to the hinge and bound the sockets dorsally. The sockets are triangular in outline, anterolaterally directed, and rounded at their base. The valve is marked by the impress of the external ornament which extends posteriorly as far as the muscle field.

Discussion.--This dalmanellid species from the Glencoe Brook Formation resembles Pionodema in having bladelike brachiophores which are only slightly divergent and a small cardinal process with a short erect shaft. The Glencoe Brook Formation species is unequally convex with the pedicle valve more convex than the brachial whereas Pionodema is subequally biconvex and has a brachial valve which is relatively more convex than that of the Glencoe Brook species. More important, in Pionodema the brachiophores are slightly divergent and have long supporting plates which extend anteriorly as ridges converging on the median ridge. In the Glencoe Brook species the anterior portion of each brachiophore lies in the same plane as the posterior portion. The cardinal process of Pionodema is bilobed; that of the Glencoe Brook species is simple. The pedicle diductors of Pionodema are much broaded and more flabellate than those of the Glencoe Brook species. It is in precisely these characters that the genus Fascifera, previously known only from the

Caradoc (Porterfield and Wilderness stages) of Tenn., Ala., Va., and Ga., differs from Pionodema and so the Glencoe Brook species is here questionably assigned to Fascifera. It should be pointed out, however, that specimens of Ordovician Fascifera were not available to the author for comparative purposes. The author's conception of the genus is based on the descriptions and figures in Cooper (1956).

The genera Drabovia Havlicek, 1950 and Drabovinella Havlicek 1950, in which Havlicek included Llandeilian-Caradocian species from central Bohemia, are very close to Fascifera in shape, outline, and in their cardinalia and muscle fields and are quite possibly congeneric with Fascifera. Lack of comparative material precludes positive assignment of these to Fascifera.

Comparison.--The Glencoe Brook species differs from the genotype F. subcarinata in that F. subcarinata has a sulcus in the brachial valve whereas the Glencoe Brook species lacks such a sulcus. The specimens of F. subcarinata illustrated in Cooper 1956 (pl. 152, figs. 1-11; pl. 153, figs. 1-6, 11-30; pl. 155, fig. 31) appear to be very similar to the Glencoe Brook Formation species in shape, ornament and in details of the cardinalia and muscle fields.

Occurrence.--Fascifera? sp. is known from localities NR9 and FT5 in the Glencoe Brook Formation of early

Llandovery age in Pictou Co.

Genus Visbyella (new genus)

Genotype.--Orthis visbyensis (Lindstrom, 1860) "Bidrag Till Kannedomen om Gotlands Brachiopoder", Ofers af Kong. Svenska Vetenskaps-akad. Forhandl. 17.

Species assigned-Orthis visbyensis (Lindstrom, 1860) Dalmanella wisbyensis var nana (McLearn, 1924), G.S.C. Memoir 137, p. 55, plate III, figs. 10-17.

Diagnosis.--Plano-convex to concavo-convex resserllids with a strongly incurved beak, an apical deltidium and a hypercline brachial interarea. Cardinal process expands posteriorly and has a posterodorsally directed, markedly trilobed distal face.

Visbyella nana (McLearn, 1924)

Plate III, figs. 7-15; Plate IV, figs. 1a,b.

1924. Dalmanella wisbyensis var. nana McLearn, p. 55, plate III, figs. 10-17.

Diagnosis.--Pedicle beak strongly incurved but does not overhang valve. Prominent median ridge in the brachial valve extends 7/8 the length of the valve. It increases abruptly in height at the anterior end of the muscle field, and then tapers in height anteriorly. Brachiophores strongly curved posterolaterally. Teeth more or less flat anterolateral faces; anterior margins of the dental lamellae diverge ventrolaterally from each other.

Description.

Exterior.--Plano-convex to concavo-convex; dorsally sulcate; outline semielliptical to shield shaped with sharp, obtuse cardinal angles. Lateral and anterior

commissures curved and crenulate, anterior commissure sulcate. Hinge line straight, slightly less than the greatest width which is slightly posterior to midlength. Width 3/4 the length to equal to the length; thickness about 1/2 the length. Shell multicostellate, costellae increasing by bifurcation.

Exterior pedicle valve.--The valve is strongly convex; the surface of the valve is strongly arched along the plane of symmetry and slopes off abruptly lateral to it. The beak is strongly curved, dorsally directed at the apex, and projects 1/5 the total length posterior to the hinge line. The interarea is strongly curved concave outwards, apsacline, 1/4 as high as long; the delthyrium is triangular, enclosing about 60°; the apical 1/3 of the delthyrium closed by a deltidium which is gently convex outwards and has a dorsal margin which is strongly concave towards the hinge line; the basal portion of the delthyrium is occupied by posterior end of the cardinal process. The width varies from 3/4 the length to equal to the length.

Exterior brachial valve.--The valve is flat in proximal portion and may be flat or gently concave along the periphery. A wide, deep median sulcus widens from umbo to anterior margin where it equals about 1/2 of the shell width. The interarea is flat, orthocline to hypercline, and 1/2 as high as the pedicle interarea; the notothyrium is triangular, enclosing about 110°, and is occupied

by the posterior end of the cardinal process. The median rib bifurcates in the typical resserellid pattern - in some cases only two or three bifurcations occur before a length of 5 mm is reached. In many specimens a smooth triangular area occurs between the last two branches of the median rib.

Interior pedicle valve.--The delthyrial cavity is deep; the muscle field is cordate in outline, extends 1/3 to 1/2 the length of the valve, and is 3/5 to 4/5 as wide as long. The diductor scars are triangular in outline with rounded anterior margins, and are separated by a raised median area of uniform width which is rounded in cross section, and about 1/4 as wide as the muscle field. Narrow rounded depressions of uniform width may be present on each side of the raised median area medial to the diductor scars. The raised median area, in some cases, extends anterior to the muscle field and tapers in height anteriorly. A minute linear ridge may be present in the posterior end of the delthyrial cavity. The teeth are large, blunt, triangular in outline, crenulated on their inner surface, and bear deep crural fossettes on their medial face. The dental plates are flat, diverge ventrolaterally from the teeth to the floor of the valve, and extend anteriorly about 1/4 the length of the valve. The anterior crenulations are rounded, and separated by deep rounded interspaces of about equal width.

Interior brachial valve.--The muscle field extends 2/3 the length of the valve, is 3/5 as wide as long, and is bounded by low ridges which extend parallel to the midline from the base of the brachiophores to about the midlength of the muscle field, and then extend anteromedially so as to intersect the midline at about a 45° angle. A prominent median ridge extends 7/8 the length of the valve, and is 1/5 as wide as the muscle field. It increases abruptly in height at the anterior end of the muscle field and then tapers in height anteriorly. The dorsal surface of the median ridge anterior to the muscle field is flat, oval in outline and posteroventrally directed. The muscle field is divided into an anterior pair and a posterior pair of oval adductors of about equal size by low transverse ridges which diverge anterolaterally from the median ridge. The sockets are short, crenulated, triangular in outline, and floored by socket pads with a strongly convex inner surface. The brachiophores are blunt, rounded at their distal end, diverge at about a 90° angle to each other at their bases and are strongly curved posterolaterally. Cardinal process expands posteriorly, and has a posterodorsally directed, markedly trilobed distal face. The median lobe of the distal face may be further divided into three small lobes. The anterior crenulations are rounded, may bifurcate, and are separated by deep rounded interspaces of about the same width as the crenulations.

Discussion.--Visbyella nana differs from Visbyella visbyensis in that it has a very prominent median ridge in the brachial valve which increases abruptly in height at the anterior end of the muscle field, and then tapers in height anteriorly. In Visbyella visbyensis, the brachial median ridge either terminates at the anterior end of the muscle field or extends anterior to it as a very faint low tapering ridge. The pedicle beak is less strongly incurved than in V. visbyensis. V. nana has brachiophores which are strongly curved posterolaterally whereas V. visbyensis has brachiophores which are planar or only very gently curved posterolaterally. In V. nana, the teeth have more or less flat anterolateral faces and the anterior margins of the dental lamellae diverge ventrolaterally from each other; in V. visbyensis the teeth have a groove on their anterolateral faces and the anterior margins of the dental lamellae are parallel.

Occurrence.--V. nana occurs in the middle member of the Ross Brook Formation of late Llandovery (C_3 - C_5) age at localities B1 and B2 in the Arisaig area, at localities ME14, ME50, ME29, ME67, DF60 and ES5 in Pictou Co., and at G.S.C. locality 17057 in the Cobequid Mountains. V. nana occurs in the upper member of the Ross Brook Formation of late Llandovery (C_6) or low Wenlock age at locality B4 in the Arisaig area and at localities ES1A, ES2, DF38, DF43, DF45, DF48 and DF49 in Pictou Co.

Genus Resserella Bancroft, 1928

Type species.--Orthis canalis Sowerby, 1839, in Murchison's Silurian System, pl. 13, fig. 12a.

Resserella cf. R. concavoconvexa (Twenhofel, 1928)

Plate IV, figs. 3-9.

1928. Resserella concavoconvexa, Twenhofel, G.S.C. Memoir No. 154, p. 179, pl XVI, figs. 1-3.

Description.

Exterior.--The pedicle valve is strongly convex and carinate; the brachial valve is flat to concave and may bear a faint sulcus. The valves are shield shaped in outline and widest at midlength or slightly posterior to midlength. The cardinal angles are obtuse and may be slightly rounded. The hinge line is straight and 3/4 to 9/10 as long as the greatest width. The anterior commissure is evenly curved, crenulate and rectimarginate. The pedicle beak is incurved and overhangs the hinge line about 1/5 the total valve length. The interarea of the pedicle valve is gently curved concave outwards, low apsacline, and about 1/5 as high as long; the delthyrium intercepts about a 45° angle, and is triangular and open. The brachial interarea is flat, orthocline, and about 1/10 as high as long; the notothyrium intercepts an angle of about 90° and is triangular in outline and filled by the cardinal process. The valves are marked by rounded costellae separated by interspaces of about the same width. The costellae in the lateral portions of the valves increase by bifurcation and

insertion, and are uniform in width. The median costella in both valves bifurcates rapidly anteriorly giving rise alternately to branches to the right and branches to the left which do not bifurcate. This pattern of branching is characteristic of the genus.

Interior pedicle valve.--The muscle field is broad, oval in outline, and extends anteriorly about 2/5 the valve length. The triangular diductors are separated by a flat parallel sided track which occupies the median 1/3 to 1/4 of the field and presumably was the site of adductor attachment. On some specimens a faint tapering ridge extends anteriorly from this track. The teeth are stout, triangular in outline and have flat posterior faces which are oriented about parallel to the interarea. The teeth are supported by short dental plates which bear deep crural fossettes on their medial faces. The anterior crenulations are high and rounded and are separated by deep rounded grooves; the internal surface may be marked by the impress of the external ornament anterior and lateral to the muscle field.

Interior brachial valve.--The muscle field varies from 2/3 as long as wide to as long as wide and extends anteriorly to about midlength. A broad rounded median ridge of uniform width occupies the middle 1/3 of the muscle field. The adductor scars are elongate oval in outline. The cardinal process is bilobed with a flat, triangular, posteriorly directed attachment face; it is broad and expands in width posteriorly. The brachiophores are widely

divergent at their bases and curve posteriorly upwards from their bases so as to overhang the sockets. The sockets are rounded at their base, crenulate, and floored by socket pads. The periphery of the valve is marked by high rounded anterior crenulations separated by deep rounded grooves. The internal surface may be marked by the impress of the external ornament anterior and lateral to the muscle field.

Discussion.--R. cf. R. concavoconvexa is identical in ornament and external form to R. concavoconvexa (Twenhofel, 1928) from the Jupiter Formation of late Llandovery (C_3 - C_6) age on Anticosti Island. The internal features of R. concavoconvexa are, at present, poorly known.

R. cf. R. concavoconvexa differs form Visbyella nana in having a bilobed cardinal process with a flat posteriorly directed attachment face; in having an orthocline interarea in the brachial valve; and in lacking a apical pseudodeltidium and a high median ridge in the brachial valve. Visbyella nana has a cardinal process which is nonlobate on its ventral surface and which has a markedly trilobate, posterodorsally directed attachment face; a hypercline interarea in the brachial valve; an apical pseudodeltidium; and a very prominent median ridge in the brachial valve which increases abruptly in height at the anterior end of the muscle field and then tapers in height anteriorly.

R. cf. R. concavoconvexa differs from R. elegantula (Dalman, 1828) from the Mulde marl of Wenlock age of Gotland

in having a flat or concave brachial valve and a very faint sulcus or lacking a sulcus in the brachial valve. R. elegantula has a gently convex brachial valve with a well developed sulcus.

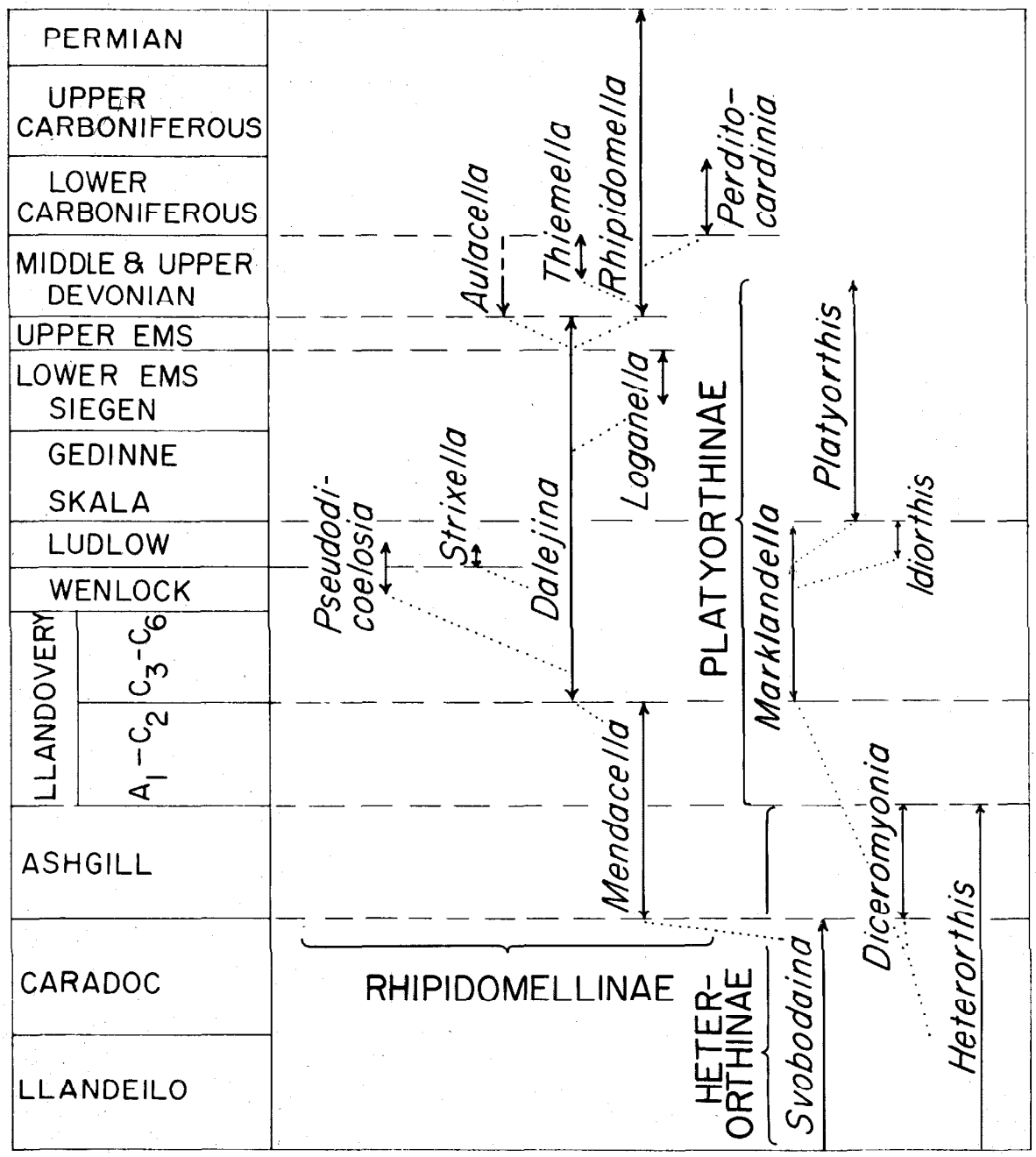
Occurrence.--R. cf. R. concavoconvexa occurs in the lower member of the McAdam Formation of Wenlock or early Ludlow age at locality RB70 in the Arisaig area and localities HA5A, HA7, DM7 and DM8 in Pictou Co. It occurs in beds correlative with the lower member of the McAdam Formation at localities KA-62-4F, KAR-63-123F and KAR-63-115F in the Cobequid Mountains.

Family Rhipidomellidae Schuchert and Cooper 1913 emended Boucot, Harper, Johnson and Walmsley 1963

The family Rhipidomellidae was emended by Boucot, Johnson, Walmsley and the author to include the subfamilies Rhipidomellinae, Heterorthinae, and a new subfamily of platyorthids which was not named. The Rhipidomellinae was emended to include Rhipidomella, Dalejina Havlíček (=Rhipidomelloides Boucot and Amsden), Mendacella, Aulacella, Thiemella, Perditocardinia, Loganella, Pseudodicoelosia, and Strixella. The new subfamily of platyorthids (herein designated the Platyorthiinae) is here defined to include Platyorthia (Skala to Eifelian age), Marklandella (upper Llandovery to Ludlow age) and Idiorthis (known only from lower McAdam fm.).

The genera of the family are considered to be related as shown in figure 1. The earliest rhipidomellinid, Mendacella, is considered to have been derived from Svobodaina in late Ordovician time. Mendacella ranges from Ashgillian to upper Llandovery (C_2) where it is succeeded by Dalejina which is considered to have been derived from it. Dalejina ranges into the lower Devonian and is considered to have given rise to Rhipidomella and Aulacella in the middle Devonian. Marklandella presumably arose from a heterorthinid of the Diceromyonia type. It is considered to have given rise to both Platyorthis and Idiorthis.

Figure 1. Inferred Phylogeny of the Rhipidomellidae.



Subfamily Rhipidomellinae
Boucot, Harper, Johnson, and Walmsley 1963

Diagnosis.--Biconvex rhipidomellids with the brachial valve usually more convex than the pedicle valve and a large pedicle muscle field consisting of commonly broad flabellate diductor impressions with scalloped margins which usually enclose the adductor impressions.

Genus Mendacella Cooper, 1930

Type species.--Orthis uberis (Billings, 1866), Cat. Sil. Foss. Anticosti, p. 42.

Mendacella arisaigensis (McLearn, 1924)

Plate IV, figs. 11-17; Plate V, figs. 1-8.

1924. Schizophorella arisaigensis McLearn, p. 58, pl. IV, figs. 9-13.

Description.

Exterior.--The valves are punctate, unequally biconvex with the brachial valve much more convex than the pedicle valve, subcircular to subelliptical in outline with the greatest width at about midlength, and have rounded cardinal angles. The anterior commissure is rectimarginate to very slightly sulcate. The hinge line is straight and 2/5 to 1/2 as long as the greatest width. The valves are marked by rounded costellae which increase by bifurcation and insertion and are separated by interspaces of about the same width. The costellae increase in size anteriorly. The costellae contain hollow tubes directed posteriorly at a low angle to the external surface of the valve. The

costellae in the central part of the valve are straight; those along the posterolateral margins curve gently concave posteriorly.

Exterior pedicle valve.--The valve is subcircular to subelliptical in outline, and varies from 3/4 as long as wide to as wide as long. The beak overhangs the hinge line 1/8 the length of the valve. The interarea is planar, apsacline, and about 1/4 as high as long; the delthyrium is triangular, open, and intercepts about a 45° angle at the apex. A very gentle sulcus is sometimes developed along the anterior margin of large specimens.

Exterior brachial valve.--The valve is subcircular to subelliptical in outline and varies from 2/3 to 9/10 as long as wide. The interarea is planar, low anacline to orthocline and about 1/5 as high as long; the notothyrium is triangular, intercepts an angle of about 50° at the apex and is occupied by the cardinal process.

Interior pedicle valve.--A low rounded median ridge extends anteriorly 1/2 to slightly greater than 1/2 the length of the valve and divides the muscle field. The muscle field is deeply impressed, consists of elongate suboval diductor scars and small elongate oval adductor scars. The adductor scars are confined to the median 1/3 of the posterior half of the muscle field and are completely enclosed by the diductor scars. The diductor scars are often marked by anterolaterally diverging straight parallel

ridges which terminate at a scalloped margin. The muscle field varies from 1/2 to 3/5 as wide as long. The lateral margins of the muscle field extend anteriorly in a straight line parallel to each other on some specimens. On other specimens, the anterior margins are broadly curved convex laterally. A prominent pedicle callist is present. The teeth are stout, triangular in outline and curve slightly posteriorly so as to overhang the hinge. They are supported by short thick dental plates. No crural fossettes are present. The internal surface is marked by closely spaced broad rounded crenulations along the anterior and lateral periphery of the valve which extend a short distance inwards and may bifurcate.

Interior brachial valve.--The muscle field extends anteriorly to midlength or slightly anterior to midlength, and is 4/5 to 5/6 as long as wide. A broad rounded median ridge of uniform width occupies the median 1/4 of the muscle field. The muscle field is further divided by curved ridges into a posterior pair of adductors which are triangular in outline and a somewhat larger anterior pair which are oval in outline. The brachiophores are stout, tear shaped in outline at their base and triangular in lateral profile. They diverge anteriorly at about a 60° angle to the median line. The sockets are triangular in outline and rounded at their base. Fulcral plates are lacking; low socket pads may be present. The cardinal

process is simple, consists of a long shaft which expands posteriorly and an expanded myophore which has a flat posteroventrally directed attachment face. A few specimens show a straight median pallial sinus and a pair of straight lateral pallial sinuses anterior to the muscle field. The internal surface is marked by crenulations as in the pedicle valve.

Discussion.--M. arisaigensis differs from the genotype, M. uberis, which is known from beds of Ashgill-C_2 or lowest C_2 age in Anticosti island, in having a more ponderous cardinal process, longer and less stubby brachiophores, a shorter hinge line and more rounded cardinal angles. It differs from Mendacella mullochiensis Davidson from beds of early Llandovery age at Mulloch Hill in Britain in lacking a prominent sulcus in the pedicle valve and fold in the brachial valve. M. arisaigensis differs from M. tugussensis Nikiforova 1955 in beds of early Llandovery to C_2 age of the Siberian platform (Nikiforova and Andreeva, 1961, p. 129, pls. 1920) in being less transverse and in having a simple cardinal process in contrast to the double cardinal process of M. tungussensis. M. arisaigensis is very similar to specimens of M. sp. in the collection of A. J. Boucot from beds of early Llandovery age in the Caparo Formation of the Merida Andes. (See Boucot, Harper, Johnson, and Walmsley, in prep.) The Venezuelan species resembles M. arisaigensis in shape,

outline, cardinalia, brachial and pedicle muscle fields and is, in all probability, conspecific with it.

McLearn incorrectly assigned M. arisaigensis to the orthid Schizophorella. Schizophorella is impunctate and has orthid cardinalia whereas M. arisaigensis is punctate and has dalmanellid cardinalia.

Occurrence.-M. arisaigensis is known from the Beechhill Cove Formation of early Llandovery age at localities A-1 and A-2 in the Arisaig area and localities FP16, UE22, WB137 and DW4 in Pictou Co. It occurs in the Glencoe Brook Formation of lower Llandovery age in Pictou Co. at locality TT1.

Genus Dalejina Havlicek, 1953

Type species.--Dalejina hanusi Havlicek, 1953, p. 5, pl. 1, fig. 10, 12-13, pl. 2, fig. 4.

Dalejina sp.

Plate V, figs. 9-10.

Description.

Exterior.--The valves are unequally biconvex with the pedicle valve more convex than the brachial valve, subelliptical in outline with straight anterior margins, and widest slightly anterior to midlength. The hinge line is straight and about 1/3 as long as the greatest width; the cardinal angles are rounded. The anterior commissure is rectimarginate and crenulate. The pedicle interarea is apsacline, gently curved concave outwards and about 1/5 as high as long; the delthyrium is triangular and open. The brachial interarea is flat, anacline and about 1/8 as high as long; the notothyrium is triangular, intercepts an angle of about 60° and is filled by the cardinal process. The valves are marked by rounded costellae which increase by bifurcation and insertion.

Interior pedicle valve.--The muscle field consists of large broad flabellate diductor scars which completely enclose the elongate oval adductor scars which are confined to the posterior half of the field; it is about 3/4 as wide as long and extends anteriorly 1/2 to 2/3 the valve length. The teeth are triangular in outline and are supported by

short dental plates which diverge anterolaterally at about a right angle to each other. The periphery is marked by low rounded anterior crenulations which may bear a median groove and which are separated by rounded interspaces. The internal surface may be marked by the faint impress of the external ornament anterior and lateral to the muscle field.

Interior brachial valve.--The muscle field is circular in outline, extends anteriorly to about midlength and is divided by a rounded median ridge which is about 1/8 as wide as the field. Transverse ridges divide the adductors into a posterior pair and a somewhat larger anterior pair. The cardinal process consists of an elongate shaft and an expanded myophore with a flat posteroventrally directed attachment surface. The brachiophores are slightly flaring blades which diverge at a 60° angle to each other and expand in width anterolaterally. The periphery is marked by low rounded anterior crenulations which may bear a median groove and which are separated by rounded interspaces. The internal surface is marked by the faint impress of the external ornament anterior and lateral to the muscle field.

Discussion.--Only 15 specimens of Dalejina sp. were found and so a specific assignment cannot be made.

Occurrence.--Dalejina sp. occurs in the lower member of the McAdam Formation of Wenlock or early Ludlow age at locality C-1 in the Arisaig area, and localities HA7 and DM7 in Pictou Co. It occurs in beds correlative with the

lower member of the McAdam Formation at locality KAR-63-123F in the Cobequid mountains.

Subfamily Platyorthiinae (new subfamily)

Diagnosis.--Usually plano-convex or concavo-convex rhipidomellids with a large broad pedicle muscle field with flabellate diductor scars that enclose the adductor impressions.

Genera assigned.--Platyorthis Schuchert and Cooper, 1931; Idiorthis McLearn, 1924; and Marklandella (new genus).

Genus Marklandella (new genus)

Type species.--Marklandella maehli (new species)

Species assigned.--
Marklandella maehli (new species)
Marklandella mcadamica (new species)
Orthis (Dalmanella) freitana Clarke, 1899 Archivos do Museu Nacional do Rio de Janeiro, Volume 10, pp. 10, 11, pl. 1, figs. 22, 23, 24.

Daignosis.--Planoconvex or concavo-convex platyorthiinids with a relatively narrow cardinal process; with erect tabular brachiophores, or with brachiophores which are erect at their base and flare laterally outwards at their distal end; and commonly with straight transverse ridges. Median ridge lacking in pedicle valve.

Discussion.--Marklandella resembles Platyorthis in outline, in convexity, and in its pedicle interior. Both genera have a large broad flabellate pedicle muscle field. However, it differs from Platyorthis in lacking a median ridge in the pedicle valve and in the nature of its cardinalia. Marklandella has erect tabular brachiophores or brachiophores which are erect at their base and flare laterally outwards at their distal end. The brachiophores

of Platyorthis are tabular and strongly convergent on to the base of the cardinal process. (Platyorthis is illustrated on plate VIII, figs. 6-9 for comparative purposes).

Marklandella is presently known from beds of early Llandovery to Wenlock or early Ludlow age.

Marklandella maehli (new species)

Plate VII, figs. 1-14.

Diagnosis.--Marklandella with a high, erect bladelike cardinal process, erect planar brachiophores, and a narrow median ridge in the brachial valve; and a muscle field in the pedicle valve which has scalloped margins. Postero-lateral costellae curve strongly posteriorly so as to intersect the hinge line at a high angle.

Description.

Exterior.--The pedicle valve is gently convex; the brachial valve is flat to gently concave. The valves are transversely subelliptical in outline, 2/3 to 3/4 as long as wide and widest at about midlength. The hinge line is straight and about 3/5 as long as the greatest width. The anterior commissure is evenly curved, crenulate and recti-marginate; the cardinal angles are rounded. The valves are marked by rounded costellae which are separated by interspaces of about the same width, and increase in number by bifurcation and insertion. The costellae are relatively straight in the central part of the valve; in the postero-lateral portions of the valve they are strongly curved concave posteriorly and intersect the hinge line at a high angle. The pedicle interarea is apsacline, curved slightly outwards and about 1/8 as high as long. It extends poster-ior to the hinge line about 1/12 the valve length. The delthyrium is triangular, open, and intercepts an angle of

about 40°. The brachial interarea is linear.

Interior pedicle valve.--The teeth are supported by curved dental plates which extend anteriorly about 1/4 the valve length and bound the muscle field at its posterior end. The muscle field is flabellate with scalloped lateral margins. It is 3/4 as wide to as wide as long and extends anteriorly about 1/2 the valve length. Low scalloped ridges extend anteriorly from the dental plates along the lateral margins of the diductors and then curve medially to bound the diductors anteriorly. The small elongate oval adductor scars are confined to the middle 1/3 of the muscle field and are completely enclosed by the adductors. The periphery of the valve is marked by rounded anterior crenulations which may bear a median groove and are separated by broad rounded interspaces. The valve is marked by the impress of the external ornament peripheral to the muscle field.

Interior brachial valve.--The muscle field is faintly impressed, about as wide as long and extends anteriorly 1/3 to 1/2 the valve length. It consists of oval adductor scars separated by a low myophragm which occupies the median 1/3 to 1/4 of the muscle field and decreases in width anteriorly. The cardinal process is simple, bladelike, erect, and fusiform in outline; it is extremely high at its posterior end and tapers in height anteriorly. The posterior margin of the cardinal process is perpendicular to the floor of

the valve. The long tabular brachiophores diverge at a right angle to each other and are oriented about perpendicular to the floor of the valve; they increase in height to about midlength and then taper in height anteriorly. The lateral margins of the brachiophores become constricted at about their midlength. The sockets are rounded at their base and open laterally. No fulcral plates or socket pads are present. The anterior crenulations and the impress of the costellae are as in the pedicle valve.

Discussion.--M. maehli may be readily distinguished from M. freitana (Clarke, 1899) from beds of early Llandovery age, Rio Trombetas, State of Para, Brazil (for locality see Clarke, 1899, pp. 2-3) and from beds of late Llandovery (C_3 - C_6) or low Wenlock age in Boliva (specimens in collection of A. J. Boucot, locality not known). The costellae of M. maehli are relatively coarser; those in the posterolateral portions of the valve are strongly curved posteriorly so as to intersect the hinge line at a high angle in contrast to the relatively straight costellae of M. freitana. The muscle field of the pedicle valve of M. maehli has scalloped margins which are lacking in M. freitana. The brachial interiors of the two species differ markedly in two respects. M. maehli has a high, erect, bladelike cardinal process; the cardinal process of M. freitana is much broader and lower and may be bilobate. The median ridge in the brachial valve of M. maehli is relatively

narrow at its posterior end; that of M. freitana is very broad at its posterior end; in both species it decreases in width anteriorly. However, the brachiophores of the two species are very similar; in both species the brachiophores become constricted at about their medlength. (Marklandella freitana is illustrated for comparative purposes on Plate VIII, figures 1-5).

Occurrence.--M. maehli occurs in the French River Formation of late Llandovery (C_6) or Wenlock age at localities DF13, DF15, DF16 and DF17 in Pictou Co.

Holotype.--Specimen #161.

Marklandella mcadamica (new species)

Plate VI, figs. 4-13.

Diagnosis.--Plano-convex Marklandella with relatively low cardinal process which may be simple, bilobate, or trilobate; flaring brachiophores; and a narrow median ridge in the brachial valve; and a muscle field in the pedicle valve which lacks scalloped margins. Posterolateral costellae curve strongly posteriorly so as to intersect the hinge line at a high angle.

Description.

Exterior.--The valves are plano-convex, transversely subelliptical in outline, 2/3 to 9/10 as long as wide and widest at about midlength. The anterior commissure is evenly curved, crenulate, and rectimarginate. The hinge line is straight and about 2/3 as long as the greatest width; the cardinal angles are rounded. The pedicle interarea is apsacline, about 1/6 as high as long and slightly curved concave outwards; the delthyrium is triangular, open, and intercepts about a right angle. The brachial interarea is flat, anacline, and about 1/10 as high as long; the notothyrium intercepts an angle of about 150° at the apex and is filled by the brachiophores and the cardinal process. The valves are marked by rounded costellae which increase in number by bifurcation and insertion and are separated by interspaces of about the same width. The costellae in the posterolateral portions of

the valve are strongly curved posteriorly and intersect the hinge line at a high angle.

Interior pedicle valve.--The stout teeth are supported by long curved dental plates which bound the muscle field laterally. The muscle field is flabellate, about as wide as long, and extends anteriorly to midlength. The diductors are separated by a low myophragm which may be broad or narrow; they may bear numerous curved transverse ridges which presumably mark the position of the muscle field at different stages of growth. The oval adductors are confined to the middle 1/3 of the muscle field and are enclosed by the diductors. The internal surface is marked by the impress of the external ornament anterior to the muscle field.

Interior brachial valve.--The muscle field extends anteriorly to about midlength; it is suboval in outline with straight lateral margins, slightly wider than long and divided by a rounded median ridge of uniform width which occupies the median 1/3 of the field. The adductor scars may be divided into an anterior and a slightly larger posterior pair by low transverse ridges. The cardinal process rests on a notothyrial platform and consists of an elongate shaft and myophore which is oval in outline and may be simple, bilobate or trilobate. The brachiophores are relatively wide, triangular in lateral profile, and flare out laterally at their distal ends. The sockets are

triangular in outline, anterolaterally directed, rounded at their base, and floored by socket pads. The periphery is marked by broad rounded anterior crenulations which may bear a narrow median groove and are separated by relatively narrow grooves. The internal surface is faintly marked by the impress of the costellae lateral and anterior to the muscle field.

Discussion.--Marklandella mcadamica differs from M. freitana in having brachiophores which flare laterally outwards at their distal end, a relatively narrow median ridge of uniform width in the brachial valve. M. freitana has erect planar brachiophores and a median ridge in the brachial valve which is very wide at its posterior end and which tapers in width anteriorly.

Marklandella mcadamica differs from M. maehli in having brachiophores which flare laterally outwards and a much lower cardinal process which may be bilobate or trilobate. M. maehli has erect planar brachiophores and a high bladelike simple cardinal process. The muscle field in the pedicle valve of M. maehli has scalloped margins; these are lacking in M. mcadamica.

Occurrence.--M. mcadamica occurs in member 2 of the McAdam Formation of Wenlock or early Ludlow age at localities HAF and DT23 in Pictou Co. and locality C-2 in the Arisaig area.

Holotype.--Specimen #36432.

Genus Idiorthis McLearn 1924

Type species.--Idiorthis matura (McLearn, 1924), G.S.C. Memoir 137, p. 57, pl. III, figs. 19-24; pl. IV, figs. 1-4; pl. XXVIII, fig. 10.

Species assigned.--Idiorthis matura (McLearn, 1924).
Species rejected.--Idiorthis avita (McLearn, 1924), p. 57, pl. 3, fig. 18.

Diagnosis.--Biconvex platyorthiinids with the pedicle valve more convex than the brachial valve, with a ponderous, broad, simple cardinal process and strongly curved transverse ridges in the brachial valve. Median ridge lacking in the pedicle valve.

Discussion.--Idiorthis is clearly closely related to Marklandella. The pedicle valves of the two genera are indistinguishable. The brachial valves of the two genera differ in their cardinal processes and transverse ridges. Idiorthis has a ponderous broad cardinal process and strongly curved transverse ridges in the brachial valve; Marklandella has a much narrower and generally smaller cardinal process and has straight transverse ridges in the brachial valve. The two genera differ also in convexity. Idiorthis is biconvex; Marklandella is plano-convex or concavo-convex.

Idiorthis differs from Platyorthis in having erect brachiophores, a simple cardinal process which is oval in outline, curved transverse ridges in the brachial valve, and in lacking a median ridge in the brachial valve. Platyorthis has brachiophores which are convergent on to

the base of the cardinal process, a posteriorly expanding cardinal process which is bilobate on its ventral face and may be bilobate or trilobate on its posterior face, straight transverse ridges in the brachial valve and a median ridge in the pedicle valve.

The convex brachial valve, ponderous broad oval cardinal process and curved transverse ridges of Idiorthis clearly set it apart from other rhipidomellinids. It is best regarded as a specialized stock derived from Markland-ella and not directly related to Platyorthis.

Williams and Wright (1063, p. 27) consider Idiorthis "to be founded on a few gerontic specimens of a species of Dalmanella". As small Idiorthis have been found which show the essential characters of the genus, and true Dalmanella has not been recognized above the lower Llandovery and certainly is not known in the McAdam Formation,the statement of Williams and Wright is incorrect.

Idiorthis avita (McLearn, 1924) is here rejected from Idiorthis. The holotype of I. avita is a poorly preserved dalmanellid brachial valve exterior from the Beechhill Cove Formation, Arisaig shore section,which is not identifiable generically but which does not bear any particular resemblance to Idiorthis. No specimens of Idiorthis were found in any of the large collections from the Beechhill Cove Formation studied by the author.

Idiorthis matura (McLearn, 1924)

Plate V, figs. 11-13; Plate VI, figs. 1-3.

1924. Idiorthis matura McLearn, G.S.C. Memoir 137, p. 57, pl. III, figures 19-24; pl. IV, figs. 1-4; pl. XXVIII, fig. 10.

Description.

Exterior.--The valves are biconvex with the pedicle valve more convex than the brachial, transversely subelliptical in outline and 2/3 to 9/10 as long as wide. The brachial valve may bear a gentle sulcus. The hinge line is straight and 1/2 to 2/3 as long as the greatest width which occurs at midlength. The anterior commissure is crenulate and rectimarginate or gently sulcate. The pedicle valve interarea is apsacline, curved, and about 1/6 as high as long; the delthyrium is triangular, open, and intercepts an angle of about 90°. The brachial interarea is flat, anacline, and about 1/12 as high as long; the notothyrium intercepts an angle of about 150° at the apex and is filled by the brachiophores and the cardinal process. The rounded costellae are separated by interspaces of about the same width and increase in number by bifurcation and insertion. The costellae in the posterolateral portions of the valve are strongly curved posteriorly and intersect the hinge line at a high angle.

Interior pedicle valve.--The stout teeth are supported by long prominent dental plates which extend to about midlength and may be straight or may curve medially. The

dental plates bound the muscle field laterally. The muscle field is flabellate, about as wide as long. The diductor scars are divided by a broad flat median track and are often marked by curved ridges which parallel the anterior margin and presumably mark the position of the muscle field at different stages of growth. The valve is marked by the impress of the costellae anterior and lateral to the muscle field.

Interior brachial valve.--The muscle field is oval in outline, 3/5 to 4/5 as wide as long, and extends slightly anterior to midlength. It is divided by a rounded median ridge of uniform width which occupies the median 1/4 of the field. Strongly curved transverse ridges divide the adductors into a posterior pair and a somewhat larger anterior pair. The cardinal process is simple, oval in outline and ponderous in size. The brachiophores are erect, tabular and triangular in lateral profile; they taper gradually in height at their anterior end. The sockets are anterolaterally directed, triangular in outline, rounded at their base, and floored by socket pads. The anterior crenulations are broad, rounded and separated by relatively narrow rounded grooves. The internal surface is faintly marked by the impress of the external ornament anterior to the muscle field.

Occurrence.--Idiorthis matura occurs in member 2 of the McAdam Formation of Wenlock or early Ludlow age at

locality C-2 in the Arisaig area and locality HAF in Pictou Co.

Discussion.--*Idiorthis matura* differs from *Marklandella mcadamica*, which often occurs at the same localities, in convexity and in having a broad cardinal process; erect brachiophores which taper gradually in height anteriorly, and curved transverse ridges in the brachial valve. *Marklandella mcadamica* has a relatively narrow and low cardinal process, brachiophores which flare outwards from their base and which taper abruptly in height at their posterior end, and straight transverse ridges.

Family Schizophoriidae Schuchert and LeVene, 1929

Subfamily Isorthinae Schuchert and Cooper, 1931

Genus Isorthis Kozlowski, 1929

Type species.--Dalmanella (Isorthis) szajnochai (Kozlowski, 1929), Palaeontologia Polonica T. I, pp. 75-29, pl. II, figs. 24-41.

Isorthis prima (new species)

Plate IX, figs. 11-14.

Diagnosis.--Unequally biconvex with the pedicle valve more convex than the brachial, brachial valve sulcate, outline subcircular to subelliptical. Pedicle valve with elongate parallel diductors extending 1/4 - 1/2 the length of the valve, and usually separated by a low broad flat median ridge. Cardinal process simple; brachiophores stubby, triangular in outline, erect, and widely divergent. Brachial valve muscle field about 4/5 as long as wide and extends to slightly anterior to midlength; oval adductors separated by narrow median ridge which tapers anteriorly.

Description.

Exterior.--The valves are unequally biconvex with the pedicle valve more convex than the brachial and subcircular to subelliptical in outline with rounded cardinal angles. The hinge line is straight and about 2/3 as long as the greatest width. The anterior commissure is crenulate and sulcate. The length varies from 3/4 the width to about equal to the width; the greatest width occurs at about mid-

length. The valves are marked by rounded costellae which increase by bifurcation and insertion and are separated by rounded interspaces of about the same width.

Exterior pedicle valve.--The valve is subcircular to subelliptical in outline with rounded cardinal angles, and varies from 3/4 as wide as long to as wide as long. The valve may be uniformly convex or may be slightly arched about the midline. The beak overhangs the hinge about 1/8 the length of the valve. The interarea is curved, apsacline, and about 1/5 as high as long; the delthyrium is open, triangular and intercepts an angle of about 60°.

Exterior brachial valve.--The valve is subelliptical in outline with rounded cardinal angles and varies from 2/3 as wide as long to slightly less than as wide as long. A prominent sulcus is developed. The interarea is about 1/10 as high as long, anacline and planar; the notothyrium is triangular and filled by the cardinal process.

Interior pedicle valve.--The elongate parallel diductors extend anteriorly 1/4 to 1/2 the length of the valve and are usually separated by a low broad flat median ridge. The adductor scars are rarely impressed; when present, they are confined to the posterior half of the muscle field. The teeth are triangular in outline and supported by dental plates which diverge anterolaterally at about a 60° angle to each other. The periphery is marked by rounded anterior crenulations separated by interspaces of

about the same width as the crenulations.

Interior brachial valve.--The muscle field consists of two oval adductors separated by a narrow median ridge which tapers in width anteriorly. It is about 4/5 as long as wide, extends to slightly anterior to midlength, and bounded laterally by low curved ridges. The brachiophores are stubby, triangular in outline, erect and lateral profile and curve slightly posteriorly. They diverge at about a 60° angle to each other. The sockets are triangular in outline, rounded at their base, and floored by socket pads. The cardinal process is simple and consists of a short shaft and an oval myophore. Anterior crenulations rim the periphery as in the pedicle valve.

Discussion.--I. prima is considered to be a primitive Isorthis as it has elongate parallel pedicle diductors which are usually separated by a median ridge. Isorthis is considered to have been derived from Dalmanella as the Llandovery Isorthis are very similar to upper Ordovician Dalmanella and differ from them primarily in having such a median ridge in the pedicle valve.

Isorthis prima differs from Dalmanella? primitiva, which also occurs in the Beechhill Cove Formation, in having a median ridge in the pedicle valve and in its subcircular to semielliptical outline which contrasts with the shield shaped outline of D.? primitiva.

I. prima differs from Dalmanella sp. A from the

Beechhill Cove Formation in having a median ridge in the pedicle valve, a much narrower pedicle muscle field and much finer costellae. The brachiophores of I. prima are erect and widely divergent; those of Dalmanella sp. A are convergent on the median ridge and are not divergent anteriorly.

I. prima differs from Dalmanella sp. B from the Glencoe Brook Formation, of equivalent age to the Beechhill Cove Formation, in having a median ridge in the pedicle valve, much finer ornament, brachiophores which are markedly more divergent anteriorly, and a more convex brachial valve.

I. prima differs from Fascifera? sp. from the Glencoe Brook Formation in having a median ridge in the pedicle valve, a sulcus in the brachial valve and in having brachiophores which are much thicker and markedly more divergent anteriorly. Fascifera? sp. has fulcral plates whereas I. prima has socket pads.

Occurrence.--I. prima is known to occur in Nova Scotia only at locality A2 in the Beechhill Cove Formation of early Llandovery age in the Arisaig area.

Specimens from the Mulloch Hill Sandstone of early Llandovery age from a quarry about 1 1/2 miles NNE of New Bailly, and about 120 yds. WSW of Rough Neuk Farm (A. J. Boucot locality 56GB137) in Britain are considered to belong to I. prima. Specimens from the Upper Cabano

Formation of early Llandovery age at a locality 2 1/2 miles NW of Notre Dame, Quebec (Greiner locality G-34 (in the collection of A. J. Boucot) are assigned to I. prima. Specimens from Ayrton locality T29-OF in beds of early Llandovery age in Gaspe, Quebec are also assigned to I. prima (specimens are in the collections of A. J. Boucot).

Holotype.--Specimen #2.

Isorthis mcadamensis (new species)

Plate X, figs. 1-10.

Diagnosis.--Unequally biconvex to almost plano-convex, pedicle valve more convex than brachial, usually sulcate, subcircular to transversely subelliptical in outline. Pedicle valve with a narrow rounded median ridge of uniform width which extends 1/2 the length of the valve and gradually tapers in height at its anterior end; diductor field triangular in outline, extends to mid-length or slightly anterior to midlength and has steep straight lateral walls which are oriented about perpendicular to the plane of commissure. Diductor tracks and median ridge rest on a delthyrial platform which is raised above the floor of the valve. Teeth bear crural fossettes on their inner face; dental plates tabular with flattened anterior margins. Brachial valve adductor muscle field well empressed, extends 3/5 to 3/4 the length of the valve is 4/5 as wide to as wide as long, and is distinctly quadripartite with the anterior pair of adductors about twice the size of the posterior pair. It is bounded laterally by ridges which extend anteriorly parallel to the median line to about 2/3 the length of the muscle field, and then extend anteromedially. A broad median ridge about uniform in width separates the adductor scars. Brachiophores stubby, divergent, planar to slightly flaring blades.

Cardinal process simple.

Description.

Exterior.--The valves are unequally biconvex to almost plano-convex with the pedicle valve more convex than the brachial, and are subcircular to transversely subelliptical in outline with well rounded cardinal angles. The lateral and anterior commissures are evenly curved and crenulate, and the anterior commissure is slightly sulcate to rectimarginate. The hinge line straight, and equal in length to 2/3 the greatest width which is at midlength. The width is equal to or slightly greater than the length; the thickness is equal to about 1/2 the length. The shell is multicostellate, and the costellae increase by bifurcation. At a length of 5 mm, 60 - 70 costellae are developed. In the median area of the brachial valve at a length of 5 mm a median pair of primaries I are developed which have given off secondaries medially.

Exterior pedicle valve.--The valve is subcircular to transversely subelliptical in outline, varies from 9/10 as long to as long as wide, and is evenly convex. The distinct beak projects - 1/7 the total length posterior to hinge line. The interarea is apsacline, strongly curved concave outwards, and 1/4 as high as wide. It has rounded lateral margins. The delthyrium is triangular, open, and encloses about a 50° angle at the apex.

Exterior brachial valve.--The valve is transversely

subelliptical in outline, and from 4/5 to 9/10 as long as wide. It is evenly convex to almost flat, and usually bears a shallow median sulcus which widens from umbo to the anterior margin where it equals about 1/3 of the shell width. The interarea is anacline, flat, and 1/3 to 1/4 as high as pedicle interarea; the notothyrium is triangular, enclosing about 90°, and is partially filled by the cardinal process.

Interior pedicle valve.--A narrow low rounded median ridge of uniform width extends from the posterior end of the delthyrial cavity to midlength or slightly anterior to midlength where it fades gradually. The diductor field extends to midlength or slightly anterior to midlength, and is triangular in outline and 1/2 to 2/3 as wide at its anterior end as it is long. The diductor field has steep straight lateral walls which are oriented about perpendicular to the plane of commissure. The diductor tracks and the median ridge rest on a delthyrial platform which is raised above the floor of the valve. The diductor tracks are bounded laterally by low ridges which extend anteriorly from the bases of the dental lamellae and have rounded anterior margins which extend a short distance anterior to the median ridge. The teeth are stubby, triangular in outline, supported by short tabular dental plates with flattened anterior margins, and bear deep crural fossettes on their internal face. The anterior

crenulations are low, rounded, evenly spaced and may bifurcate. On some specimens vascular grooves diverge anteromedially from the anterior margins of the diductor tracks and fade out anteriorly.

Interior brachial valve.--The adductor muscle field is well impressed, extends anteriorly 3/5 to 3/4 the distance to the anterior margin and varies from 4/5 to as wide as long. It is bounded laterally by ridges which extend anteriorly parallel to the median line from the brachiophores to about 2/3 the length of the muscle field and then extend anteromedially toward the median ridge. A low broad median ridge about 1/4 as wide as the muscle field divides the muscle field and may be uniform in width or taper slightly in width anteriorly. The muscle field is divided into a posterior pair and an anterior pair of adductors by low transverse ridges which are perpendicular to the median line; the anterior pair is about twice the size of the posterior pair. The brachiophores are stubby plates which diverge at about an 80° angle, vary from planar to moderately concave posterolaterally, and are triangular in lateral profile. The sockets increase in width laterally and are floored by socket pads which extend from the base of the brachiophores to the hinge line. The cardinal process is simple and consists of a short linear shaft and an elongate oval myophore. The anterior crenulations are low, rounded, evenly spaced and may

bifurcate.

Discussion.--I. mcadamensis is close to I. gwydderigensis (n. sp., Walmsley, Boucot, and Harper manuscript in preparation) in that both have a delthyrial platform on which the diductor tracks and median ridge are raised above the floor of the valve and both species have relatively thick dental lamellae with flat anterior faces. A triangular pedicle muscle field can occur in both species, however, it is always present in I. mcadamensis. I. mcadamensis differs from I. gwydderigensis in having a very low narrow rounded median ridge which is uniform in width and gradually tapers in height anteriorly. The median ridge of I. gwydderigensis is higher, expands in width anteriorly, much wider at its base, and extends abruptly in a broad slope to the valve floor at its anterior end. The brachial muscle field extends further anteriorly in I. mcadamensis than in I. gwydderigensis.

I. mcademensis differs from I. prima in having a much more deeply impressed pedicle muscle field which is triangular in outline in constrast to that of I. prima which has subparallel margins. I. mcadamensis has a delthyrial platform on which the diductor tracks and the median ridge are raised above the floor of the valve; this is lacking in I. prima. The brachial muscle field of I. mcadamensis is much more strongly impressed than that of I. prima and extends further anteriorly.

I. mcadamensis differs from I. fornicatimcurvata in having a delthyrial platform on which the diductor tracks and median ridge are raised above the floor of the valve, and in having a pedicle diductor field which is triangular in outline with steep straight lateral walls which are about perpendicular to the plane of commissure. I. fornicatimcurvata lacks a delthyrial platform and has a diductor field which is elongate oval in outline, less deeply impressed and has broadly rounded lateral walls. The dental lamellae in I. mcadamensis are flattened on their anterior face whereas in I. fornicatimcurvata they are rounded on their anterior face. The brachial muscle field in I. moydartensis extends further anteriorly than in I. fornicatimcurvata and is distinctly quadripartite. In the latter species it may be bipartite or quadripartite. I. mcadamensis is more finely ribbed and has, on the average, a less convex brachial valve than I. fornicatimcurvata.

Occurrence.--I. mcadamensis is known from the lower two members of the McAdam Formation which are Wenlock or Ludlow in age. It occurs in collections from the Arisaig shore section for which the localities are not known, but which contain a fauna indicative of member 2 of the McAdam Formation. It occurs at localities DM7, DM8, DM9, DM9A, DM9B, HA5A, HA6, HAF, DT23, HA7, and DR14A in Pictou Co. It occurs at localities KA-62-4F and KA-63-400F in the Cobequid Mountains and at locality 117 in the Lochaber area.

Holotype.--Specimen #22.

Isorthis fornicatimcurvata (Fuchs, 1919)

Plate X, figs. 11-12; Plate XI, figs. 1-25.

1919. Orthis fornicatimcurvata Fuchs, Jahrb. Preuss. Geol. Land., 39, Teil 1, Heft 1, pp. 58-61, pl. 5, figs. 1-6, 10; pl. 6, fig. 1a.

1922. Orthis (Dalmanella) lunata Barrois, Pruvost, and Dubois, non Sowerby, Me. Soc. Geol. Nord, 6, 2, pp. 77-79, pl. XI, figs. 4-12.

1924. Dalmanella lunata McLearn, non Sowerby, G.S.C. Memoir 137, p. 55, pl. IV, figs. 5, 6.

1930. Dalmanella verneuili Asselberghs pars, non De Koninck, Mem. Mus. roy. Hist. nat. Belg., 41, pl. 2, fig. 5

1942. Dalmanella orbicularis Dahmer, non Sowerby, Senckenbergiana, 25, pp. 116-117, figs. 14-16.

1952. Dalmanella orbicularis Dahmer, non Sowerby, Palaeontographica, 101, Abt. A, Lf. 1-4, pp. 91-94, T. VII, fig. 1; T. IX, figs. 20-21; T. X., fig. 6; T. XI, fig. 22; T. XII, fig. 10.

1960. Isorthis fornicatimcurvata (Fuchs), Boucot, Mem. de l'Institut Geologique de l'Universite de Louvain, Tome XXI, p. 296-8, pl. X, figs. 6-7.

Diagnosis.--Unequally biconvex with pedicle valve more convex than brachial, sulcate, subcircular to transversely subelliptical in outline. Pedicle valve with a narrow rounded median ridge which extends 1/2 the length of the valve, gradually tapers in height at its anterior end. Elongate subparallel diductor scars with rounded anterior margins extend 1/2 the length of the valve, are separated by the median ridge, and bounded laterally by straight subparallel or slightly convergent ridges. The adductor impressions, when impressed, are elongate oval in outline and extend anteriorly about 3/4 the length of the muscle

field. Brachial valve adductor muscle field well impressed, extends 1/2 to slightly greater than 1/2 the length of the valve, and is 3/5 to 4/5 as wide as long. It is bound laterally by ridges which extend anteriorly parallel to the median line from the brachiophores to about 2/3 the length of the muscle field, then extend anteromedially. Muscle field bilobate or tetralobate with subequal muscle impressions, divided by broad rounded median ridge of uniform width. Brachiophores divergent, slightly flaring blades. Cardinal process simple.

Description.

Exterior.--The valves are unequally biconvex with pedicle valve more convex than brachial valve, and subcircular to transversely elliptical in outline with well rounded cardinal angles. The lateral and anterior commissures are evenly curved and crenulate, the anterior commissure is sulcate. The hinge line is straight and equal to 2/3 the greatest width which is at midlength. The width is slightly greater than equal to the length; the thickness is about 1/2 the length. The shell is multicostellate, the costellae increase by bifurcation. At a length of 5 mm, 40 - 55 costellae are developed. In the median area of the brachial valve at a length of 5 mm a median pair of primaries I are developed which have given off secondaries medially.

Exterior pedicle valve.--The valve is subcircular to

transversely elliptical in outline, and varies from 4/5 as long as wide to slightly longer than wide. It is evenly convex and has a distinct beak projecting 1/6 the total length posterior to the hinge line. The interarea is apsacline, gently curved concave outwards, and 1/5 as high as long; the delthyrium is triangular, open, and encloses about 40°.

Exterior brachial valve.--The valve is transversely elliptical in outline, from 2/3 to 9/10 as wide as long, and less convex than the pedicle valve. It is evenly convex and bears a shallow median sulcus which widens from the umbo to the anterior margin where it equals about 1/3 of shell width. The interarea is flat, anacline, and 2/3 as high as pedicle interarea; the notothyrium is triangular, enclosing about 50°, and is partially filled with cardinal process.

Interior pedicle valve.--A rounded median ridge extends from the delthyrial cavity to mid-length where it tapers in height to the level of the floor of the valve. Subparallel diductor tracks with rounded anterior margins extend 1/2 the length of the valve and are separated by the median ridge. They are bounded laterally by straight, slightly convergent ridges which extend anteriorly from the dental lamellae and curve around the anterior margin of the muscle field to intersect the median ridge. The adductor scars when impressed are elongate oval in outline,

and extend from the delthyrial cavity to 3/4 the length of the muscle field. The teeth are triangular in outline, project normal to the hinge line, and bear crural fossettes on their inner surface. They are supported by short divergent dental lamellae. A small pedicle callist may be present. The lateral and anterior periphery is crenulated by the impress of the costellae which may extend inwards as far as the muscle field.

Interior brachial valve.--The muscle field is well impressed, extends 1/2 or slightly greater than 1/2 the length of the valve, and is 3/5 to 4/5 as wide as long. It is bounded laterally by ridges which extend anteriorly parallel to the median line from the brachiophores to about 2/3 the length of the muscle field, and then extend anteromedially so as to intersect the median ridge at about a 45° angle. The bounding ridges may be broken at about midlength, and the anterior portions offset medial to the posterior portions. A low broad rounded median ridge of uniform width, about 1/4 as wide as the muscle field, separates the adductor scars. The muscle field may be subdivided into an anterior pair and a slightly smaller posterior pair of adductor scars by low transverse ridges which are perpendicular to the median ridge. The brachiophores diverge at about an 80° angle to each other, are slightly flaring blades, triangular in lateral profile with a rounded ventral margin, and are connected to the

inner wall of the shell by socket pads which floor the dental sockets. The cardinal process consists of a narrow shaft and a simple oval myophore. Anterior crenulations are low rounded and evenly spaced.

Discussion.--The above description is based primarily on specimens from the lower Gedinnian of Germany and Belgium. A large collection from the Stonehouse Formation of Gedinnian and possibly Skala age in Nova Scotia has yielded several thousand specimens clearly assignable to I. fornicatimcurvata. The vast majority of the specimens from the Stonehouse Formation fit the above description. However, about 5% of the brachial valves in this collection are flat, and a number are less convex than the specimens from Germany and Belgium. The range of convexity of the specimens from Nova Scotia overlaps that of the specimens from Europe. Although most of the specimens from Nova Scotia are sulcate, about 5% of them lack a sulcus. A median ridge is very rarely absent in the pedicle valve, and socket pads were noted as lacking in two of the several thousand specimens studied. The collection from Nova Scotia may be best regarded as a geographic subspecies of Isorthis fornicatimcurvata.

I. fornicatimcurvata differs from I. prima in having a much more prominent median ridge in the pedicle valve, narrower and longer brachiophores and a shorter, narrower, less circular, and more deeply impressed brachial muscle

field. The outline of I. prima is more circular than that of I. fornicatimcurvata.

I. fornicatimcurvata differs from I. orbicularis (Sowerby, 1839) from the Ludlovian of Great Britain, in having a more convex brachial valve, somewhat coarser ribs, and a brachial muscle field that is more elongate, less circular in outline, and extends further anteriorly. The brachial muscle field of I. fornicatimcurvata is quadripartite or bipartite, that of I. orbicularis is quadripartite. In the pedicle valve of I. fornicatimcurvata the lateral margins of the muscle field tend to be more convergent anteriorly than in I. orbicularis.

Occurrence.--I. fornicatimcurvata occurs in the Stonehouse Formation of early Gedinnian and possible Skala age at localities E1, E2, E3, E4, E5, E6, CRED, NF14, NF15, NFA, MCK26, MCK27, MCK30, MCK39, MCK40, MCK51, MCK52, MCK53, MCK54, MCK55, MCK56, and MCK57 in the Arisaig area. It occurs at localities LR8 and LR9 in the Stonehouse Formation in Pictou Co., and at locality 81 in the Stonehouse Formation in the Lochaber area. It occurs in the Stonehouse Formation in the Cape George area at locality F-18 and in the Stonehouse Formation in the Cobequid mountains at localities 11F, KA-62-394F, KA-63-128F, and G.S.C. #44971.

Subfamily Schizophoriinae

Genus Schizophoria King, 1850

Type species.--Conchyliolithus Anomites resupinatus Martin, 1809, Petref. Derb., pl. 49, figs. 13, 14.

Discussion.--About 15 small convex brachial valves having cardinalia and a broad muscle field with oblique transverse ridges as in Schizophoria were found at two localities in the Stonehouse Formation. No pedicle valves were found. The material is not adequate for specific determination.

Schizophoria sp.

Plate IX, figs. 7-10.

Description.

Exterior brachial valve.--The valve is subcircular in outline, widest at about midlength and evenly convex. The hinge line is straight and about half the greatest width. The anterior commissure is crenulate and rectimarginate. The interarea is flat, anacline and about 1/10 as high as long; the notothyrium is triangular in outline and intercepts an angle of about 45°. The valve is marked by rounded costellae which increase by insertion and bifurcation. "Hollow costellae" are evident on some specimens.

Interior brachial valve.--The muscle field is slightly longer than wide and extends anteriorly to midlength. It is divided by a narrow median ridge of uniform width and usually by a pair of transverse ridges which diverge from the midline at about a 45° angle. The cardinal process

consists of a narrow shaft and a small myophore which appears to be nonlobate. The brachiophores are erect blades, triangular in lateral profile, which diverge at a 60° angle to each other. The sockets are triangular in outline and floored by fulcral plates. Low curved ridges extend anteriorly from the brachiophores and bound the muscle field. The periphery of the valve is marked by the impress of the external ornament.

Occurrence.--*Schizophoria* sp. is known from localities E-4 and E-5 in the Stonehouse Formation of Gedinnian and possibly Skala age in the Arisaig area.

Family Linoporellidae Schuchert and Cooper, 1931

Genus Linoporella Schuchert and Cooper, 1931

Type species.--Orthis punctata Verneuil, 1848, Bull. Soc. Geol. France (2), vol. 5, p. 343.

Linoporella sp.

Plate VI, figs. 14-17.

Description.

Exterior.--The valves are subequally biconvex, subelliptical in outline, slightly wider than long and widest at about midlength. The hinge line is straight and about 2/3 as long as the greatest width. The anterior commissure is rectimarginate and faintly crenulate. The pedicle interarea is apsacline, curved, and roughly 1/6 as high as long; the delthyrium is triangular and open. The brachial interarea is low, flat and anacline. The valves are marked by fine costellae. No trace of coarse pits on the costellae such as those found on the type species were noted on the external molds studied. This is presumably due to the relatively poor state of preservation of the specimens studied.

Interior pedicle valve.--The muscle field is oval in outline, about 3/4 as wide as long, and extends anteriorly about 1/3 the valve length. The diductor scars are divided medially by a faint parallel sided track which presumably marks the area of adductor attachment. A low narrow ridge extends anteriorly from the muscle field along the midline

to about 2/3 the valve length. The teeth are supported by parallel dental plates which extend anteriorly to about 1/3 the valve length and bound the muscle field. The dental plates are slightly curved concave medially. The periphery is marked by the faint impress of the ornament.

Interior brachial valve.--The linear cardinal process merges anteriorly with a prominent narrow median ridge which may extend anteriorly as far as the anterior margin. The brachiophores are erect and about parallel at their distal ends; they curve medially at their bases and converge to intersect the median ridge and form a cruralium. A faint ridge diverges anterolaterally from the anterior end of the cruralium on each side of the valve. The periphery is marked by the faint impress of the ornament.

Discussion.--Linoporella sp.is known from 10 incomplete specimens and so may not be identified specifically. These specimens are similar to Linoporella punctata illustrated by Schuchert and Cooper (1932, pl. 18, figs. 13, 14, 17, 18, 24 and 33); no specimens of the latter were available for study.

Occurrence.--Linoporella sp occurs in the Beechhill Cove Formation of early Llandovery age at localities ZLB6 and A-2 in the Arisaig area,and at localities DW1 and UE22 in Pictou Co.

Family assignment uncertain:

Genus Salopina Boucot, 1960

Type species.--Salopina lunata (Sowerby, 1839), The Silurian System, p. 611, pl. 5, fig. 15.

Salopina conservatrix (McLearn, 1924)

Plate XIII, figs. 15-22; Plate XIV, figs. 1-11.

1924. Dalmanella conservatrix McLearn, G.S.C. Memoir 137, p. 52, pl. II, figs. 24, 25 non 26.

Type specimens.--McLearn designated a holotype #6205 and two paratypes #6206 and #6207 all of which are in the G.S.C. type collections in Ottawa. The holotype and paratype #6206 belong to S. conservatrix. The paratype #6207 is a Visbyella.

Diagnosis.--Dorsally sulcate with transversely elliptical to subcircular outline, and fine costellae which radiate with little curvature. Posterior costellae subparallel to hinge line in brachial valve. Brachiophores thin blades, with triangular lateral profile, increase in height to about midlength and then taper anteriorly. The width of the brachiophores at their base is about equal to their maximum height. They may be oriented perpendicular to the plane of commissure or may converge medially towards the midline at a low angle to each other. Fulcral plates or socket pads are present.

Description.

Exterior.--The valves are unequally biconvex with the

pedicle valve having the greater convexity, dorsally sulcate with transversely elliptical to subcircular outline, and 3/4 to 9/10 as long as wide. The hinge line is straight and is equal to 3/5 to 4/5 the greatest width which occurs slightly anterior to midlength. The lateral and anterior margins evenly curved and crenulate; the anterior commissure is sulcate. The surface is multicostellate with hollow costellae which increase by bifurcation.

Exterior pedicle valve.--The valve is uniform in curvature and subcircular to transversely subelliptical in outline with obtuse, rounded cardinal angles. The beak projects about 1/10 the total length posterior to the hinge line. The interarea is triangular, curved, and apsacline, with sharp lateral margins; the delthyrium is open, triangular, and subtends an angle of about 40° at the apex.

Exterior brachial valve.--The valve is subcircular to subelliptical in outline, less convex than the pedicle valve and bears a shallow sulcus which is about 1/4 as wide as the greatest width at the anterior commissure. The cardinal angles are obtuse and rounded. The interarea is plane, anacline and about 1/2 as high as the pedicle interarea. The notothyrium is triangular in outline and occupied by the cardinal process.

Interior pedicle valve.--The muscle field extends

3/10 to 1/2 the length of the valve and is slightly longer than wide. It is usually undivided, cordate in outline, and is bounded by curved dental lamellae and by low curved ridges which extend anteriorly from the anterior end of the dental lamellae and then curve inwards so as to bound the muscle field anteriorly. A narrow rounded median ridge is rarely developed. The teeth are small, triangular in outline and project normal to the hinge line. The anterior crenulations are flat, closely spaced, may or may not bifurcate, and are separated by rounded interspaces.

Interior brachial valve.--The muscle field extends 1/2 the length of the valve, is about 1/3 as wide as the greatest shell width, and is divided by median ridge which is about 1/3 as wide as the muscle field. The median ridge is uniform in width and may be rounded or angular in cross section. The adductor impressions are bounded laterally by raised margins which are sub-parallel to the median ridge and may be slightly concave towards it. These margins curve sharply medially to the base of the brachiophores at their posterior end. At their anterior end they either terminate at about midlength, or bend medially at about 2/3 the length of the muscle field, and intersect the median ridge at about a 45° angle. The muscle field may be divided into anterior and posterior adductor impressions of equal width separated by low transverse ridges perpendicular to the median ridge. The brachio-

phores are thin and bladelike with a triangular lateral profile. They diverge at about a 30° angle to each other and may be perpendicular to the plane of commissure or may converge medially towards the base of the cardinal process at a low angle to each other. The width of the brachiophores at their base is about equal to their maximum height. Curved fulcral plates or socket pads extend from the proximal end of the brachiophores to the hinge line and floor the sockets. The simple cardinal process consists of a faint shaft and an elongate oval myophore. The anterior crenulations are flat, closely speced, separated by rounded interspaces, and may bifurcate anteriorly.

Discussion.--Salopina conservatrix differs from S. lunata in that it is smaller in size, and has brachiophores which are triangular in lateral profile, increase in height to about midlength and then taper anteriorly, and which may be perpendicular to the plane of commissure or may converge medially towards the midline at a low angle to each other. The width of the brachiophores at their base is about equal to their maximum height. S. lunata has long pointed brachiophores which overhang the surface of the valve anteriorly, and which are perpendicular to the plane of the commissure. The width of the brachiophores at their base is much less than their maximum height.

Occurrence.--S. conservatrix is known from the upper member of the Ross Brook Formation of late Llandovery (C_6)

or low Wenlock age at localities B4, B5, and B6 in the Arisaig area and localities DF8, DF9 and DF43 in Pictou Co. It occurs in a collection made by A. J. Boucot from the Hemse Group of Gotland, Sweden at a locality along shore 270 m. N.E. of the southernmost point in the inlet at Djupriks flge., Kraklingbo parish.

Salopina submedia (McLearn, 1924)

Plate XII, figs. 1-26; Plate XIII, figs. 1-3.

1924. Dalmanella elegantula var. submedia McLearn, p. 53, pl. III, figs. 3, 4 non 5, 6; pl. IV, fig. 8.
1960. Salopina lunata Boucot, non Sowerby, 1839, pl. 1, figs. 6-12.

Type specimens.--McLearn designated a holotype #6208 - which is in the G.S.C. type collections in Ottawa - and paratypes #419, 420, and 428 which are in the Peabody Museum of Yale University. Paratype #428 belongs to S. submedia; paratypes #419 and #420 belong to Isorthis fornicatimcurvata (Fuchs, 1919).

Diagnosis.--Plano-convex to biconvex with the pedicle valve moderately convex and the brachial valve almost flat; gently to strongly sulcate; subcircular to transversely subelliptical in outline. Costellae coarse, radiate and laterally curve so that posterior ribs intersect hinge line at a considerable angle. Costellae rounded in outline. Brachiophores thick, tabular. Socket pads are present.

Description.

Exterior.--Plano-convex to biconvex with the pedicle valve moderately convex and the brachial valve almost flat, gently to strongly sulcate, subcircular to transversely subelliptical in outline. Hinge line straight and 3/4 as wide as the greatest width which is at midlength. Lateral and anterior margins evenly curved and crenulate, anterior

margin sulcate, cardinal angles well rounded, obtuse. Shell costellate, costellae hollow, rounded in cross section and increase by bifurcation.

Exterior pedicle valve.--Curvature uniform, outline subcircular to transversely subelliptical with obtuse, rounded cardinal angles. Beak projects 1/6 total length beyond hinge line. Interarea apsacline, strongly concave outwards, and about 1/8 as high as long; delthyrium open, intercepts an angle of about 40° at the apex.

Exterior brachial valve.--Flat to very gently convex, sulcate, subcircular to semielliptical in outline, cardinal angles obtuse, rounded. Interarea anacline, planar, about 2/3 as high as the pedicle interarea; notothyrium triangular in outline, occupied by the base of the cardinal process. Multicostellate, costellae radiate and curve laterally and posteriorly; posterior costellae intersect the hinge line at a considerable angle.

Interior pedicle valve.--Muscle field extends 3/10 to 2/5 the length of the valve and is slightly longer than wide, cordate in outline; narrow rounded median ridge may divide the muscle field. It is bounded by curved dental lamellae and by low curved ridges which extend anteriorly from the anterior end of the dental lamellae and then curve inwards so as to bound the muscle field anteriorly. The teeth are small, triangular in outline and project normal to the hinge line. The anterior crenulations are

wide, flat, and may bifurcate. They are separated by narrow rounded interspaces.

Interior brachial valve.--Muscle field extends 1/2 the length of the valve and is about 1/3 as wide as the greatest shell width, divided by broad rounded median ridge of uniform width which is 1/3 as wide as the muscle field. The adductor impressions are bounded laterally by raised margins which are parallel or diverge at a low angle to the median ridge, and which curve sharply medially to the base of the brachiophores at their posterior end. The muscle field is often divided into an anterior pair and a posterior pair of adductors of equal width by low narrow tra nsverse ridges. The brachiophores are thick, tabular, triangular in outline, and diverge at a low angle to each other. Sockets triangular in outline, floored by socket pads with a concave ventral surface. The cardinal process is simple, oval in outline, and elongate parallel to the median line. The anterior crenulations are wide, flat, and may bifurcate. They are separated by narrow rounded interspaces.

Discussion.--Salopina submedia may be distinguished from S. lunata (Sowerby, 1839) by its less convex brachial valve, thicker and less pointed brachiophores, and costellae which curve laterally so that the posterior costellae intersect the hinge line at a high angle. The costellae of S. lunata radiate with little or no curvature.

S. submedia may be distinguished from S. conservatrix by its thicker brachiophores and coarser costellae which radiate and curve laterally. The costellae of S. conservatrix radiate with little or no curvature as in S. lunata.

S. submedia is considered by the author to be conspecific with Salopina lunata Boucot, 1960, non Sowerby, 1839 (Boucot, 1960, pl. 1, figs. 6-12) from the Jones Creek Formation of New Brunswick (MacKenzie, 1951 a, b,) of possible Ludlow age.

Occurrence.--S. submedia is known from the French River Formation of late Llandovery or Wenlock age at localities MCK4 and MCK6 in the arisaig area and at localities DF13, DF15, DF16, DF17 and FR22 in Pictou Co. It is known from all four members of the McAdam Formation of Ludlow and possibly, in part, Wenlock age. It occurs at localities C1, C2, C3, C4, C5, MCK13, MCK32, BB-F, BB-I, and ZS2 in the McAdam Formation in the Arisaig area, and at localities I06, DM7, DM9, DT23, and HAF in the McAdam Formation in Pictou Co. It is known from the Moydart Formation of Ludlow age at localities D1, D2, D3, SB2, SB4, SB5 and SB6 in the Arisaig area and at localities DS43 and DS53 in Pictou Co. It occurs in the Stonehouse Formation of Gedinnian and possibly Skala age at locality MCK39 in the Arisaig area and in collections from the shore section in the Arisaig area for which the localities are unknown. It occurs in the Stonehouse Formation in the Cobequid

Mountains at locality KA-62-394F. It occurs in the Kerrowgare Formation of upper Llandovery - Ludlow age at localities HB83, HB85 and HB91.

Salopina stonehousensis (new species)

Plate XIII, figs. 4-14.

Diagnosis.--Usually nonsulcate, subcircular to subelliptical in outline, finely costellate. Costellae radiate with little curvature; posterior costellae subparallel to hinge line in the brachial valve. Brachiophores thin, bladelike and triangular in lateral profile.

Description.

Exterior.--The valves are unequally biconvex, with pedicle valve more convex than brachial, and subcircular to transversely subelliptical in outline. A sulcus generally lacking, but is sometimes very faintly developed. The hinge line straight and equal to 3/5 the greatest width which occurs at midlength. The length varies from 4/5 to equal to the width. The anterior and lateral margins are rectimarginate, crenulate and evenly curved. The valves are multicostellate with hollow costellae which increase by bifurcation.

Exterior pedicle valve.--The valve is evenly convex, subcircular to subelliptical in outline with anterior margins which are parallel to the hinge line, and lateral margins which are evenly rounded. The cardinal angles are well rounded and obtuse. The beak projects 1/8 the total length posterior to hinge line. The interarea is 1/6 as high as long, apsacline, curved concave outwards,

and has sharp lateral margins. Delthyrium open, triangular, subtending an angle of about 40° at the apex.

Exterior brachial valve.--The valve is evenly convex, subelliptical in outline, with the anterior margin parallel to the hinge line and the lateral margins evenly rounded. The cardinal angles are well rounded and obtuse. The interarea is 1/10 as high as long, anacline, and planar; the notothyrium is triangular, and filled at its base by the cardinal process.

Interior pedicle valve.--The muscle field is oval in outline, extends 1/3 the length of the valve, and is about 1/4 as wide as the greatest width. In some cases, the diductor scars are impressed on their inner margins and are separated by a flat median area about 1/3 as wide as the muscle field. The muscle field is bounded laterally by the curved dental lamellae and laterally and anteriorly by low ridges which extend anteriorly from the dental lamellae and curve medially. The teeth are small and triangular in outline. The anterior crenulations are flat, closely spaced and may bifurcate anteriorly. They extend inwards about as far as the muscle field.

Interior brachial valve.--The adductor muscle field extends 1/2 the length of the valve and is 1/3 as wide as the greatest shell width. It is divided by a rounded median ridge which varies from 1/3 to 1/6 as wide as the muscle field. The adductor impressions are bounded

laterally by raised margins which may be subparallel to the median ridge or may diverge at a low angle to it, and which may be straight or slightly concave inwards. These margins fade out anteriorly at about midlength and curve sharply medially to the base of the brachiophores at their posterior end. The adductor impressions are not subdivided into an anterior and a posterior pair. The brachiophores are thin, bladelike, triangular in lateral profile, and diverge at a 30° angle to each other. They are oriented perpendicular to the plane of commissure. Fulcral plates extend from the proximal end of the brachiophores to the hinge line and floor the socket. The cardinal process is simple and elongate oval in outline. The anterior crenulations are flat, closely spaced, extend inwards as far as the muscle field, and may bifurcate anteriorly.

Discussion.--S. stonehousensis differs from S. lunata and S. conservatrix in that it is generally nonsulcate, whereas, the latter two species have a well developed sulcus. It differs from S. lunata in having less pointed brachiophores.

S. stonehousensis differs from S. submedia in having thicker brachiophores and costellae which are straight or only very slightly curved in contrast to the strongly curved costellae of S. submedia.

Occurrence.--S. stonehousensis occurs in the Stonehouse

Formation of early Gedinnian and possibly Skala age at localities E4, E5, E7, E8, C-RED, NF14, NF15, NFA, MCK27, MCK40 and MCK41 in the Arisaig area and localities LR1, DT1 and NR3 in Pictou Co.

Holotype.--Specimen number 98.

Genus Proschizophoria Maillieux, 1911

Type species.--Orthis personata Zeiler 1857, Verh. Nat. Hist. Ver. Bonn, vol. 14, p. 48, pl. 4, figs. 9-11.

Proschizophoria sp.

Plate IX, figs. 1-6.

Description.

Exterior.--The valves are subequally biconvex, subcircular to subelliptical in outline with rounded cardinal margins, and vary from slightly wider than long to slightly longer than wide. The hinge line is about 1/3 as long as the greatest width which occurs at about midlength. The pedicle interarea is about 1/5 as high as long and apsacline. The brachial interarea is about 1/6 as high as long, flat and anacline; the notothyrium intercepts about a 40° angle and is filled by the cardinal process. The valves are marked by rounded costellae which increase by insertion and bifurcation.

Interior pedicle valve.--The teeth are supported by dental lamellae which bound the muscle field laterally. The muscle field is oval in outline, slightly longer than wide and extends anteriorly almost to midlength. The muscle field is not divided. The adductor scars are not impressed. The internal surface is marked by the impress of the external ornament anterior and lateral to the muscle field.

Interior brachial valve.--The muscle field is oval in

outline, about as wide as long and extends anteriorly 1/3 to 1/2 the valve length; it is divided by a narrow median ridge. The cardinal process is narrow, bladelike, and apparently simple. The brachiophores are erect blades, triangular in lateral profile which diverge at about a 60° angle to each other. The sockets are triangular in outline, rounded at their base, and floored by fulcral plates. The valve is marked by the impress of the external ornament anterior and lateral to the muscle field.

Occurrence.--*Proschizophoria sp.* occurs in the Stonehouse Formation of Gedinnian and possibly Skala age at localities LR4A and G.S.C. 45432 in Pictou Co. These localities are from the uppermost 50 feet of the Stonehouse Formation in Pictou Co. which is quite possibly Gedinnian age as the conformably overlying Knoydart Formation contains upper Downtonian fish 650 feet above the Stonehouse-Knoydart contact (Dinely, 1962).

Suborder Strophomenoidea Maillieux, 1932
emend Opik 1934, emend Williams, 1953

Superfamily Strophomenacea Schuchert, 1896.

Family Stropheodontidae Caster, 1939

Genus Leptostrophia Hall and Clarke, 1892

Type species.--Leptostrophia magnifica Hall, 1857, 10th Rept. N. Y. State Cab., p. 54.

Diagnosis.--Plano-convex to gently concavo-convex strophedontids with a triangular muscle field in the pedicle valve usually bounded by ridges and with socket plates.

Discussion.--Unequally parvicostellate leptostrophids which differ from contemporaneous and later Leptostrophia in having prominent dental plates are common and widespread in beds of early Llandovery age and occur in beds of C_6 or low Wenlock age in the Arisaig area. These have the essential characters of the genus - gently convex pedicle valve, flat or gently concave brachial valve, triangular muscle field in the pedicle valve, and socket plates. A new subgenus - Eoleptostrophia is erected below to include these leptostrophids.

A second group of Leptostrophia, comprised of species with unequally parvicostellate ornament which lack dental plates, occur in beds of early Llandovery to middle Devonian (Hamilton) age. The author proposes to erect a new, and, as yet, unnamed, subgenus of Leptostrophia based on L. tenuis (Williams, 1951, p. 126, pl. VIII, figs. 7-9) to include the species belonging to this group.

A third group of Leptostrophia, comprised of species which are ornamented by closely spaced costellae of uniform width and which lack dental plates, occur in beds of Wenlock

to Siegenian age. These include L. magnifica, the type species of Leptostrophia, and are here considered as comprising Leptostrophia (Leptostrophia) Hall, 1892.

The earliest known representatives of the genus are L. (Eoleptostrophia) occurring in beds of early Llandovery age; and L. tenuis antecedens (Williams, 1951, p. 125-6, pl. VIII, figs. 5, 6) from the Gasworks Mudstone of early Llandovery age in Wales, which belongs to the new unnamed subgenus that has unequally parvicostellate ornament and lacks dental plates. Both of these are considered to have been derived from a Rafinesquina similar to R. planulata (Cooper, 1956, p. 886-7, pl. 266, figs. 1-4) from the Oranda Formation in Virginia of Trenton age. R. planulata closely resembles these early representatives of Leptostrophia in convexity, outline, ornament and in its cardinalia, dental plates and pedicle muscle field. It differs from them in having simple teeth, in contrast to the denticles of the early Leptostrophia, and in having a shorter pedicle muscle field.

Eostropheodonta (Williams, 1951) based on Eostropheodonta hirnantensis (M'Coy, 1851, Ann. Mag. Nat. Hist., 2nd. Ser., Vol. 8, p. 395) from the Hirnant Limestone of early Llandovery age in the Bala District, Wales, is here restricted to include stropheodontids with fasciculate costellae, a few denticles on each side of the delthyrium, dental plates, a posteroventrally directed bilobed cardinal

process, socket plates, and obscure muscle fields in both valves. So restricted, the genus includes only the type species and Eostropheodonta siluriana Davidson, 1871 from the Ashgill Shales of Yorkshire, England. It differs from Eoleptostrophia in ornament and in having obscure muscle scars in both valves. It differs from the new unnamed subgenus of unequally parvicostellate Leptostrophia which lack dental plates in ornament and in having dental plates. The relationship of Eostropheodonta to Leptostrophia is not clear; it is very possible that they were derived independently from two distinct stocks of Rafinesquina.

The new unnamed genus of unequally parvicostellate Leptostrophia which lack dental plates is considered to have given rise to Leptostrophia (Leptostrophia) in the upper Llandovery. Leptostrophia (Leptostrophia) is considered to have given rise to Protoleptostrophia Caster, 1939 in the lower Devonian. The latter genus differs from L. (Leptostrophia) only in lacking socket plates.

The proposed relationships of the groups discussed above is shown in figure 2.

Subgenus Eoleptostrophia (new subgenus)

Type species.--Rafinesquina beechhillensis McLearn, 1924, G.S.C. Memoir 137, p. 60, pl. 4, fig. 15.
Species assigned.
Leptostrophia filosa var. mullochensis Reed, 1917, Transactions of the Royal Society of Edinburgh, Vol. LI, part. V, no. 26, pp. 894-5, pl. XVII, figs. 4-8.
Rafinisquina beechhillensis McLearn, 1924.
Eostropheodonta sp. Boucot and Johnson, Brachiopods of the Ede Quartzite (Lower Llandovery) of Norderon, Jemtland, Sweden (in press).

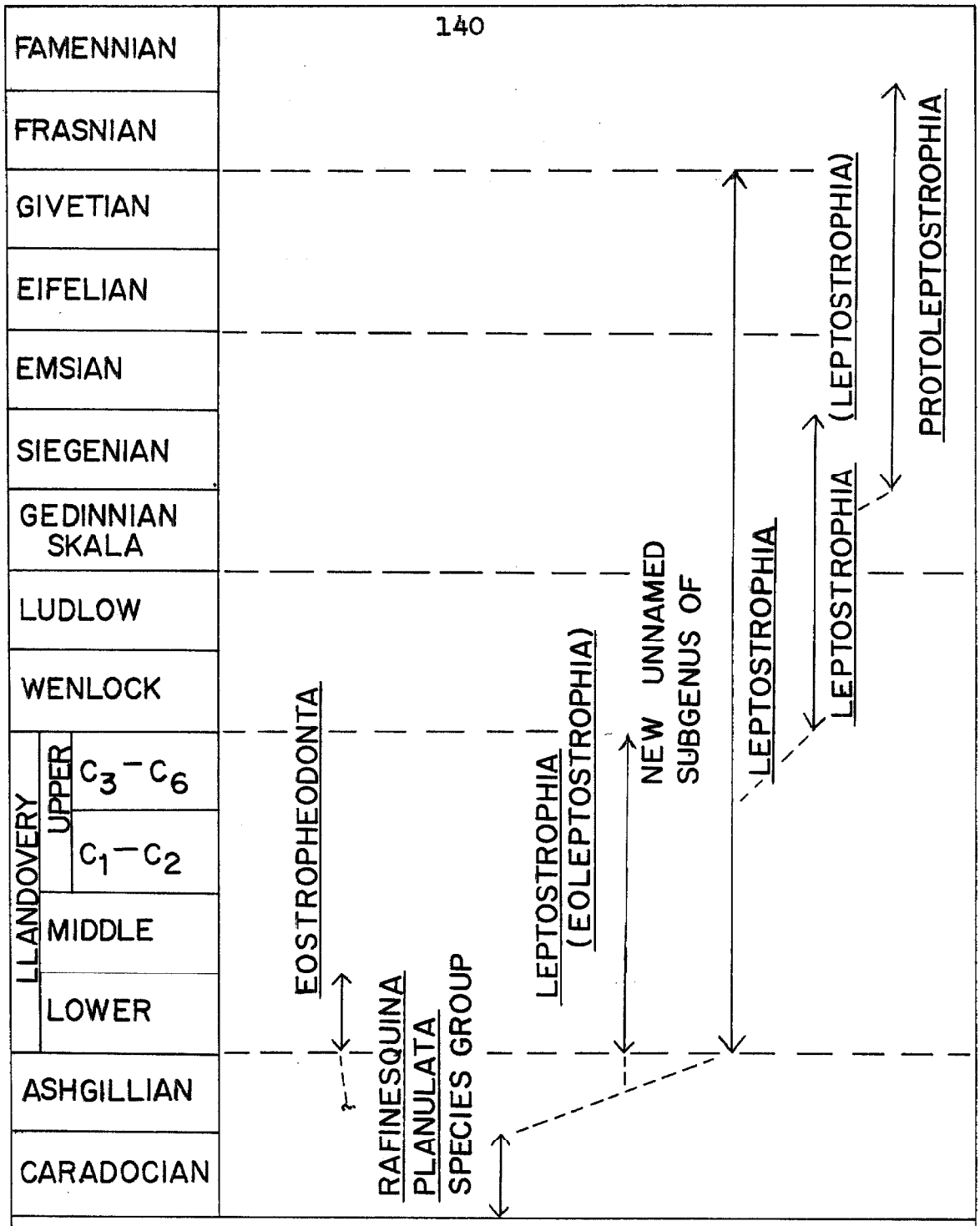


Figure 2 . Inferred Phylogeny of the leptostrophids.

Eoleptostrophia sp. in collections of A. J. Boucot from beds of early Llandovery age in the Merida Andes, Venezuela (at localities AR2207, AR2079, AR2081, 80748, SME1583). Eoleptostrophia sp. in collections of A. J. Boucot from beds of early Llandovery age in Quebec (at localities G-80 (Cabano Formation, Lake Temisqouata area, 1/2 mi. S.W. of Pointe aux Trembles); G-34, (2 1/2 mi. N.W. of Notre Dame); Ff (Pointe aux Trembles Formation, Rimouski-Matapedia area), T-23-7F (Gaspe), and T-12-2F Clemville Formation, Gaspe), 57-L-83 (Pointe aux Trembles).

Diagnosis.--Plano-convex to gently concavo-convex, unequally parvicostellate leptostrophids with a prominent convex chilidium and often a small apical pseudodeltidium. Pedicle valve with dental plates, a triangular muscle field, a few denticles along the hinge line on each side of the delthyrium. Brachial valve with postero-ventrally directed cardinal process lobes, socket plates, semi-oval or obscure adductor scars. Socket plates are crenulate along their posterior face; sockets may bear a few denticles.

Discussion.--Leptostrophia (Eoptostrophia) mullochensis (Reed, 1917) from the Mulloch Hill Group of early Llandovery age in the Girvan district, Scotland; L. (E.) beechhillensis (McLearn, 1924) from the Beechhill Cove Formation and Glencoe Brook Formation of early Llandovery age and the middle and upper members of the Ross Brook Formation of late Llandovery and possibly early Wenlock age; L. (E.) sp. from the Ede Quartzite of early Llandovery age of Norderon, Jemtland, Sweden; L. (E.) sp. from beds of early Llandovery age in Quebec; and L. (E.) sp. from beds of early Llandovery age in the Merida Andes, Venezuela

all closely resemble each other in outline, convexity, ornament, in their cardinalia, and in the extent of their pedicle muscle fields and dental plates. All of these are probably best regarded as belonging ot L. (E.) mullochensis, however, a positive assignment cannot be made until specimens of L. (E.) mullochensis are studied.

Leptostrophia tenuis antecedens (Williams, 1951) from the Gasworks Mudstone of the lower Llandovery of Wales does not belong to Eoleptostrophia as it lacks dental plates. It is the earliest known species belonging to the proposed new subgenus of unequally parvicostellate Leptostrophia without dental plates.

Eoleptostrophia beechhillensis (McLearn, 1924)

Plate XV, Figures 1-6.

1924. Rafinesquina beechhillensis McLearn, ref. cit.

Description.

Exterior.--The pedicle valve is very gently convex; the brachial valve is flat to gently concave. The valves are semi-elliptical in outline, from 2/3 as long to as long as wide, alate, and widest at the straight hinge line. The pedicle interarea is flat, apsacline and about 1/25 as high as long; the triangular interarea intercepts about a right angle and is apparently open. The brachial interarea is flat, high anacline to orthocline, and less than half as high as pedicle interarea; the notothyrium is filled by a chilidium which is convex outwards. The valves are

unequally parvicostellate.

Interior pedicle valve.--Short ridges bearing 3 to 6 denticles extend along the hinge line on each side of the delthyrium. Dental plates diverge anterolaterally from the delthyrium at a 75° - 90° angle to each other to 1/10 to 1/ 5 the valve length, and bound the triangular muscle field posteriorly. The muscle field extends anteriorly 1/3 to 1/2 the valve length. The adductor scars, when impressed, are confined to the posterior half of the muscle field. A small rounded ventral process is present. The internal surface is marked by the impress of the external ornament which extends posteriorly as far as the muscle field.

Interior brachial valve.--The cardinalia consist of a bilobed posteroventrally directed cardinal process and socket ridges which diverge anterolaterally at a 120° angle to each other. The socket plates bear 3 to 6 crenulations on their posterior face which correspond to the denticles of the pedicle valve. A low rounded myophragm extends anteriorly to about 1/4 the valve length and separates the faintly impressed semi-elliptical adductor scars. The internal surface is marked by the impress of the external ornament which extends posteriorly as far as the muscle field.

Occurrence.--L. (E.) beechhillensis occurs in the Beechhill Cove Formation of early Llandovery age at

localities A-1, A-2 and A-3 in the Arisaig area; and at localities DW1, UE22, A11, and MH2 in Pictou Co. It occurs in the Glencoe Brook Formation of early Llandovery age at locality FT5. It occurs in the middle member of the Ross Brook Formation of late Llandovery (C_3-C_5) age at locality ME 29 in Pictou Co., and in the upper member of the Ross Brook Formation of late Llandovery (C_6) or Low Wenlock age at locality FR45 in Pictou Co.

Subgenus Leptostrophia Hall and Clarke, 1892

Type species.--Leptostrophia magnifica Hall, 1857, op. cit.

Diagnosis.--Leptostrophia which lack dental plates and have an ornament of closely spaced uniform costellae.

Leptostrophia sp.

Plate XV, figs. 7a,b.

Description.

Exterior pedicle valve.--The valve is gently convex, semi-elliptical in outline, and widest at the straight hinge line. The interarea is flat, apsacline and about 1/20 as high as long; the delthyrium is triangular, open, and intercepts an angle of about 60°. The valve is marked by fine rounded costellae of about uniform width separated by slightly wider, rounded interspaces. The costellae increase by insertion.

Interior pedicle valve.--Ridges bearing a small number of denticles extend along the hinge on each side of the delthyrium. The muscle field is triangular in outline, bounded laterally by low ridges, and bisected by a narrow median ridge. The lateral margins of the muscle field diverge at about a 75° angle to each other. The muscle field extends anteriorly slightly less than 1/2 the valve length and is open anteriorly. The internal surface is marked by the impress of the external ornament anterior and lateral to the muscle field, and is pustulose lateral to the muscle field.

Discussion.--No brachial valves of this species were found; hence, it is not known whether it had socket plates as in Leptostrophia or lacked socket plates as in Protoleptostrophia. However, as Protoleptostrophia is not known in beds older than Siegenian (Becraft-Oriskany) age, the species, in all probability, had socket plates.

Occurrence.--This species is known from the French River Formation of late Llandovery (C_6) or Wenlock age at localities DF13 and DF15 in Pictou Co.; from member 1 of the McAdam Formation of Wenlock or early Ludlow age at locality C-1 and from member 2 of the McAdam Formation of Wenlock or early Ludlow age at locality C-2.

Genus Amphistrophia Hall and Clarke, 1892

Type species.--Strophonella striata Hall, 1843, p. 104, fig. 3

Amphistrophia funiculata (M'Coy, 1846)

Plate XVI, figs. 1-7.

1846. Orthis funiculata M'Coy, Sil. Foss. Ireland, p. 30, pl. 3, fig. 11.

Description.

Exterior.--The valves vary from 1/2 as wide as long to slightly less than as wide as long, and are semi-elliptical in outline, widest at the straight hinge line and alate. The pedicle valve is initially gently convex, the brachial valve is initially flat or very gently concave; the valves become resupinate and sharply geniculate at a length between 8 to 14 mm from the apex. The geniculate margins of the valves are inclined at a 70° - 80° angle to the central portions of the valves. The commissure may be smooth or crenulate, the anterior commissure is rectimarginate. The pedicle interarea is apsacline, planar, and about 1/20 as high as long; the brachial interarea is linear. The pedicle interarea is marked by alternating grooves and ridges in the median 1/3 of the valve which mark the former position of the denticles. The delthyrium intercepts an angle of about 60° at the apex. A minute apical pseudodeltitium is present. The valves are marked by rounded costellae that increase by

insertion. The inserted costellae are initially much finer than the primary costellae but increase in width and height distal to the apex so as to become equal in width to the primary costellae. In a given small area on the surface the ornament consists of uniform coarse costellae separated by interspaces of about the same width which may bear a single relatively fine costellae of higher order. The valves are pseudo-punctate. The body cavity is very narrow.

Interior pedicle valve.--The hinge line of adult shells bears denticles along 1/3 to 1/2 of its length. The process pits are low; the ventral process is low and hourglass shaped. The muscle field is semi-oval to oval in outline, extends anteriorly 1/2 to 4/5 the length of the valve, and varies from 2/3 as wide as long to as wide as long, and is divided by a median ridge. It is bounded laterally by curved ridges which are convex outwards, and originate a short distance anterior to the hinge line. The bounding ridges may (1) terminate in the posterior half of the muscle field or (2) terminate at the anterior margin of the muscle field or (3) curve medially and then posteriorly at their anterior ends so as to intersect at the median line and completely enclose the muscle field. On specimens in which the muscle field is not bounded anteriorly by ridges, it may be closed or may be open anteriorly. The adductor scars are elongate, oval in

outline and confined to the posterior half of the muscle field. The muscle field may be widest at its mid-length or at a point posterior to its mid-length. The bounding ridges may be evenly curved or may be relatively straight at their posterior end and relatively strongly curved at their anterior end. The internal surface may be marked by the impress of the external ornament in the peripheral portion of the valve.

Interior brachial valve.--The cardinal process lobes are postero-ventrally directed, tear shaped in cross section, and have flat, striated attachment faces. They are separated by a rounded groove that may bear a minute median ridge. The socket ridges diverge antero-laterally at about 120° angle to each other and extend anteriorly as far as the cardinal process lobes. A low, rounded median ridge which is wide at its posterior end and decreases in width anteriorly extends from the cardinalia to 1/3 to 1/2 the length of the valve. The muscle field consists of a pair of semi-oval adductors which extend anteriorly 1/3 to 1/2 the length of the valve and are open anteriorly. Each adductor may be divided into equal parts by a low ridge which extends antero-laterally at a low angle to the median line. The internal surface is pustulose and may be marked by the impress of the external ornament in the peripheral part of the valve.

Discussion.--A. funiculata differs from A. striata

(Hall, 1843) in having sharply geniculate anterior and lateral margins in contrast to the margins of A. striata which are gently deflected ventrally.

A. funiculata differs from Amphistrophia loeblichi (Amsden, 1951) in having ornament consisting of uniform coarse costellae separated by interspaces of about the same width which may bear a single relatively fine costellae of higher order. A. loeblichi is parvicostellate.

Occurrence.--This species is widely distributed in beds of Wenlock-Ludlow age in North America and Europe. It occurs in Nova Scotia in the lower two members of the McAdam Formation of Wenlock or Ludlow age, at localities C2 and MGB1 in the Arisaig area, at localities HAT, DT12, DT23, and HAF in Pictou Co., and at localities KA-62-4F, KA-62-400F, KA-63-115F and KA-63-123F in the Cobequid mountains.

Amphistrophia cf. A. striata (Hall, 1843)

Plate XV, figs. 9-10.

Exterior.--The valves are semi-elliptical in outline, widest at the hinge straight line, alate, resupinate, finely costellate to parvicostellate, and 3/5 to 4/5 as long as wide. The pedicle valve is initially gently convex, the brachial valve is initially flat or gently concave; both valves become gently deflected ventrally. The anterior commissure is crenulate and rectimarginate. The pedicle interarea is flat, high apsacline, and about 1/25 as high as long; the brachial interarea is linear. The delthyrium is apparently open. It is not clear from the available specimens whether or not an apical pseudodeltidium was present. The nature of the notothyrium is not clear from the available specimens. The valves are pseudopunctate, the body cavity is narrow.

Interior pedicle valve.--The muscle field is semi-oval in outline, open anteriorly, bounded by curved ridges, and divided by a low median ridge. It extends anteriorly about 1/3 - 1/2 the length of the valve and is about as wide as long. The ventral process, adductor scars, and denticles are not preserved on the available specimens. Anterior and lateral to the muscle field, the internal surface is marked by the impress of the external ornament.

Interior brachial valve.--The cardinal process lobes

are oval in outline, postero-ventrally directed, and separated by a rounded groove which bears a minute median ridge. The socket ridges diverge antero-laterally at a 120° angle to each other. The muscle field consists of semi-oval adductors separated by a low myophragm which is wide at its posterior end and decreases in width anteriorly. The muscle field extends anteriorly about 1/3 the length of the valve. The internal surface is marked by the impress of the external ornament anterior and lateral to the muscle field.

Discussion.--A. cf. A. striata closely resembles A. striata in shape, ornament, cardinalia and muscle fields. However, as the extent of the denticles along the hinge and the nature of the ventral process and adductor scars are not evident on the available specimens, a positive assignment cannot be made. Only 15 fragmental specimens of A. cf. A. striata were available for study.

Occurrence.--This species occurs at localities HA7, DM7 and DM8 in Pictou Co., in the lower member of the McAdam Formation of Wenlock or Ludlow age.

Genus Shaleria Caster, 1939

Type species.--Strophomena gilpeni Dawson, 1861, Can. Nat. n. ser. 9, p. 341.

Diagnosis.--Gently concavo-convex strophedontids with a muscle field in the pedicle valve consisting of narrow, elongate parallel-sided diductor tracks in some cases flanked laterally by a pair of shorter, parallel-sided accessory diductor tracks. The diductor tracks and accessory diductor tracks are bounded laterally by low ridges. The diductor tracks are divided by a median ridge which bifurcates at its anterior end. Brachial valve with two pairs of straight ridges anterior to the muscle field - a medial pair which are parallel or diverge slightly anteriorly and a lateral pair which diverge slightly anteriorly.

Discussion.--Williams (1950, p. 281) defined Telaeoshaleria based on Telaeoshaleria sulcata (Williams, 1950) as a subgenus of Shaleria. However, Telaeoshaleria closely resembles the Pholidostrophia lepis (Bronn, 1835) species group in its external shape and outline, and in certain features of its brachial interior; and is considered by the author to be related to this group. The P. lepis species group are clearly pholidostrophids and are considered by the author to belong to a new unnamed genus of the subfamily Pholidostrophiinae Stainbrook, 1943. Thus, Telaeoshaleria is also considered by the author to belong to the Pholidostrophiinae. (See Harper and Boucot, 1963, p. 74 and the discussion of the subfamily Pholidostrophiinae on

page 171 of this report.)

Williams (1953, p. 46) placed Mclearnites Caster, 1939 in synonomy with Shaleria, but Mclearnites has a broad semi-elliptical muscle field in the pedicle valve with widely spaced lateral margins; this differs markedly from the narrow elongate parallel sided diductor tracks of Shaleria. Shaleria has a bifurcating median ridge in the pedicle valve and the two pairs of ridges anterior to the muscle field in the brachial valve; these structures are lacking in Mclearnites. Hence, Shaleria and Mclearnites are clearly distinct genera. The author considers them to be unrelated at the subfamily level.

Shaleria gilpeni (Dawson, 1881)

Plate XVII, figs. 6-7; Plate XVIII, figs. 1-7.

1881. Strophomena gilpeni Dawson, Can. Nat., n. ser. 9, p. 341.
1924. Brachyprion gilpeni (Dawson) McLearn, G.S.C. Mem. 137, p. 61, pl. 5, figs. 28-29.
1953. Shaleria gilpeni (Dawson) Williams, G.S.A. Mem. 56, pl. 12, figs. 9-13.

Description.

Exterior.--The valves are gently concavo-convex, semi-elliptical in outline, alate, widest at the straight hinge line, and vary from 1/2 as long as wide to as long as wide. The pedicle interarea is flat, apsacline and about 1/25 as high as long; the delthyrium is triangular, intercepts an angle of about 60°, and bears an apical pseudodeltidium. The brachial interarea is linear. A prominent chilidium which is strongly convex outwards extends upward into the

delthyrium. The valves are marked by rounded costellae that attain a uniform width separated by interspaces of about the same width which may bear a single fine inserted costellae. The costellae increase by insertion; the inserted costellae are very fine at their point of origin and increase in width distally to reach the width of the lower order costellae between which they are inserted. The costellae are evenly curved laterally on some specimens; on others they may follow a somewhat irregular undulating course. The valves are marked by fine, evenly curved concentric growth lines.

Interior pedicle valve.--The muscle field consists of a pair of narrow elongate parallel sided diductor tracks which are parallel at their posterior end, and may be parallel or slightly divergent at their anterior end, usually flanked laterally by a narrower and somewhat shorter pair of parallel sided accessory diductor tracks. The diductor tracks are divided by a prominent median ridge which bifurcates at its anterior end. Both the diductor tracks and the accessory diductor tracks are bounded laterally by prominent ridges; the ridges bounding the accessory diductor tracks may curve medially at their anterior end to enclose the tracks. The diductor tracks extend anteriorly to about midlength. The accessory diductor tracks vary in width from specimen to specimen; they may be 2/3 as wide as the diductor tracks or may be extremely narrow and almost

linear. They are absent on some specimens. The ventral process is constricted in width at its midlength. Numerous denticles are present along the hinge line; the denticles occur from the delthyrium to about 1/2 the distance to the cardinal angles on each side. The internal surface is marked by the impress of the external ornament peripheral to the muscle field.

Interior brachial valve.--The bilobed cardinal process is posteroventrally directed to posteriorly directed. The prominent straight socket plates diverge at a 120° angle to each other. The muscle field consists of a pair of short, semi-elliptical adductor scars which are divided by a broad, rounded median ridge which tapers in width anteriorly and bounded laterally by a pair of parallel rounded ridges which are wide at their posterior end and taper in width anteriorly. On small specimens the adductor scars are not always impressed and the median ridge is not always present. Two pairs of narrow ridges occur anterior to the muscle field: a medial pair which are parallel or very slightly divergent anteriorly, and are situated close to the midline; and a higher lateral pair which diverge anteriorly at a 15° to 30° angle to each other. The lateral pair of ridges commonly extend posteriorly as low ridges to divide the adductor scars. In some cases the lateral pair of ridges merge at their posterior end with the tapering muscle bounding ridges situated posterior to them. The adductor scars are

confined to the posterior 1/5 of the valve. The two pair of narrow ridges extend anteriorly to 1/4 to 1/2 the valve length. The internal surface is pustulose in the central part of the posterior half of the valve peripheral to the muscle field. The periphery may be marked by widely spaced radial grooves or may be marked by the impress of the external ornament.

Discussion.--Shaleria gilpeni differs from Shaleria ornatella Davidson, 1871 from the Ludlow of Wales and the Welsh borderland in having a uniformly costellate ornament with evenly curved growth lines and in usually having a prominent pair of accessory diductor tracks in the pedicle valve. Shaleria ornatella has a unequally parvicostellate radial ornament crossed by "zig-zagging" growth lines and either lacks accessory diductor tracks in the pedicle valve or has them only incipiently developed.

Shaleria rigida (De Koninck, 1876) from the lower Gedinnian of Germany and Belgium closely resembles Shaleria ornatella in its ornament and internal features. Boucot (1960, p. 303) states that the ornament in S. rigida is more deeply impressed than that of S. ornatella.

Occurrence.--Shaleria gilpeni occurs in the Moydart Formation of Ludlow age at locality D-3 in the Arisaig area. It occurs in the Stonehouse Formation of Gedinnian and possibly Skala age at localities E2, E5, E7, E8, MCK26, MCK39, MCK40, MCK41, MCK27, MCK50, MCK54, MCK55, MCK56,

and MCK57 in the Arisaig area; locality LR8 in Pictou Co.; localities 11F, KA-62-394F, GSC 44971, and KAR-63-377F in the Cobequid Mountains; and localities F-2, F-9 and F-18 in the Cape George area.

Shaleria honeymani McLearn, 1924

Plate XVIII, Fig. 8.

1924. Brachyprion (?) honeymani McLearn, p. 62, pl. V, fig. 30.
1924. Amphistrophia arisaigensis McLearn, p. 63, fig. 31.

Only three pedicle valves of this species are known. The interiors of these specimens are not exposed. On one specimen, the holotype (Peabody Museum #426), a median ridge and closely spaced parallel muscle bounding ridges of the Shaleria type may be seen through the shell surface.

Description.--The pedicle valve is initially gently convex and becomes strongly geniculate. It is wider than long, alate, and widest at the straight hinge line. The ornament consists of widely spaced coarse costellae between which a single fine costellae may be inserted and of "zig-zagging" growth lines. A median ridge and closely spaced parallel muscle bounding ridges extend anteriorly almost to midlength.

Comparison.--S. honeymani differs from S. gilpeni in having a geniculate margin in the pedicle valve and an ornament of widely spaced costellae and "zig-zagging" growth lines. In S. gilpeni the pedicle valve is not geniculate, the costellae are more closely spaced and the growth lines are evenly curved. S. honeymani resembles S. ornatella in ornament.

Amphistrophia arisaigensis (McLearn, 1924) is based on a single specimen of a brachial valve exterior shown on

plate XVIII, fig. 8. This brachial valve is concave outwards and, hence, does not belong to Amphistrophia. It It closely resembles the holotype of S. honeymani in ornament and is here assigned to that species.

Occurrence.--This species is known only from specimens in the Peabody Museum of Natural History which are labeled as coming from the coast section, Arisaig; Stonehouse Formation.

Genus Mclearnites Caster, 1945

1939. Mclearnia Caster, Bull. Am. Paleont., vol. XXIV, no. 83, pp. 33-4.
1945. Mclearnites Caster, Jour. Paleont., vol. 19, no. 3, p. 319. (in place of Mclearnia preoccupied.)

Type species.--Brachyprion mertoni McLearn, 1924, p. 61, pl. IV, figs. 16-18; pl. XXVIII, fig. 12.

Diagnosis.--Plano-convex or gently concavo-convex stropheodontids; with a pedicle muscle field that is semi-elliptical in outline, and bounded laterally by curved ridges which originate slightly anterior to the hinge line; with a brachial muscle field of elongate oval adductor scars usually bounded laterally by parallel ridges which taper in width anteriorly, and usually separated by a tapering median ridge. Brace plates lacking.

Diagnosis.--Mclearnites is known from beds of Wenlock to Emsian age.

It differs from Mesodouvillina Williams, 1950 of lower Gedinnian to Emsian age primarily in that it is plano-convex or gently concavo-convex whereas the latter genus is strongly concavo-convex. Kozlowski (1929, p. 97) illustrates the type species of Mesodouvillina, Stropheodonta subinterstrialis (Kozlowski, 1929), as having low pustulose ridges in the brachial valve on each side of the median line which diverge at a low angle to the median ridge; these are probably homologous to the brace plates of later douvillinids which occur in the same position. Similar structures are seen on Mesodouvillina birmanica from beds

of Eifelian age in the Northern Shan States, Burma, illustrated by F. R. Cowper Reed (1908, pl. 15, figs. 11-13, pl. 16, figs. 1-6; localities given on pp. 2, 3); and on Mesodouvillina sp. from the Windmill Limestone of Gedinnian age in Nevada (Johnson, manuscript in preparation). These are the only species of Mesodouvillina known to the author in which the brachial interiors are known. It appears then, that Mesodouvillina may well be characterized as having such ridges. However, as such ridges also occur on Mclearnites sp. from the "Spirifer" pinyonensis zone of Emsian age in Nevada (Johnson, manuscript in preparation), they do not serve to separate Mesodouvillina from Mclearnites.

Mclearnites differs from the "Douvillina" inequistriata (Conrad, 1842) group of douvillinid stropheodontids of middle Devonian (Onondaga-Hamilton) age in having less convex valves and in lacking brace plates which are characteristic of the latter group.

Mclearnites differs from Douvillina Oehlert, 1887 sensu strictu from beds of late Devonian (Frasnian) age in being less convex, in lacking the ponderous brace plates characteristic of the latter, and in having a pedicle muscle field which is not elevated above the floor of the valve on a platform as is that of the latter.

Douvillinella Spriesterbach, 1926 which occurs in beds of middle and upper Devonian (Frasnian) age, differs from

Mclearnites in being resupinate and in having brace plates.

Douvillinaria Stainbrook, 1945 from the Independence shale of Iowa of late Devonian (Frasnian) age differs from Mclearnites in its abberant shape and outline, and in having brace plates.

Mclearnites differs from Leptostrophia in having a muscle field in the pedicle valve which is semi-elliptical in outline in contrast to that of Leptostrophia which is triangular in outline.

Mclearnites and the Wenlock-Ludlow genus Amphistrophia Hall and Clarke, 1892 have identical pedicle muscle fields and cardinalia and are considered to be closely related. They differ primarily in that Mclearnites is plano-convex to concavo-convex and non-geniculate whereas Amphistrophia is resupinate and may have a geniculate margin.

The relationships of the above genera are considered to be as shown on figure 3. Mclearnites and Amphistrophia are considered to have arisen from Leptostrophia at some time in the late Llandovery. Mclearnites is considered to have given rise to Mesodouvillina in the late Silurian or Gedinnian. Mesodouvillina is considered, in turn, to have given rise to the "Douvillina" inequistriata group of stropheodontids for which the author proposes to erect a new, as yet unnamed, genus. The "Douvillina" inequistriata group of brachiopods is considered to have given rise to Douvillina sensu strictu, Douvillinella and Douvillinaria.

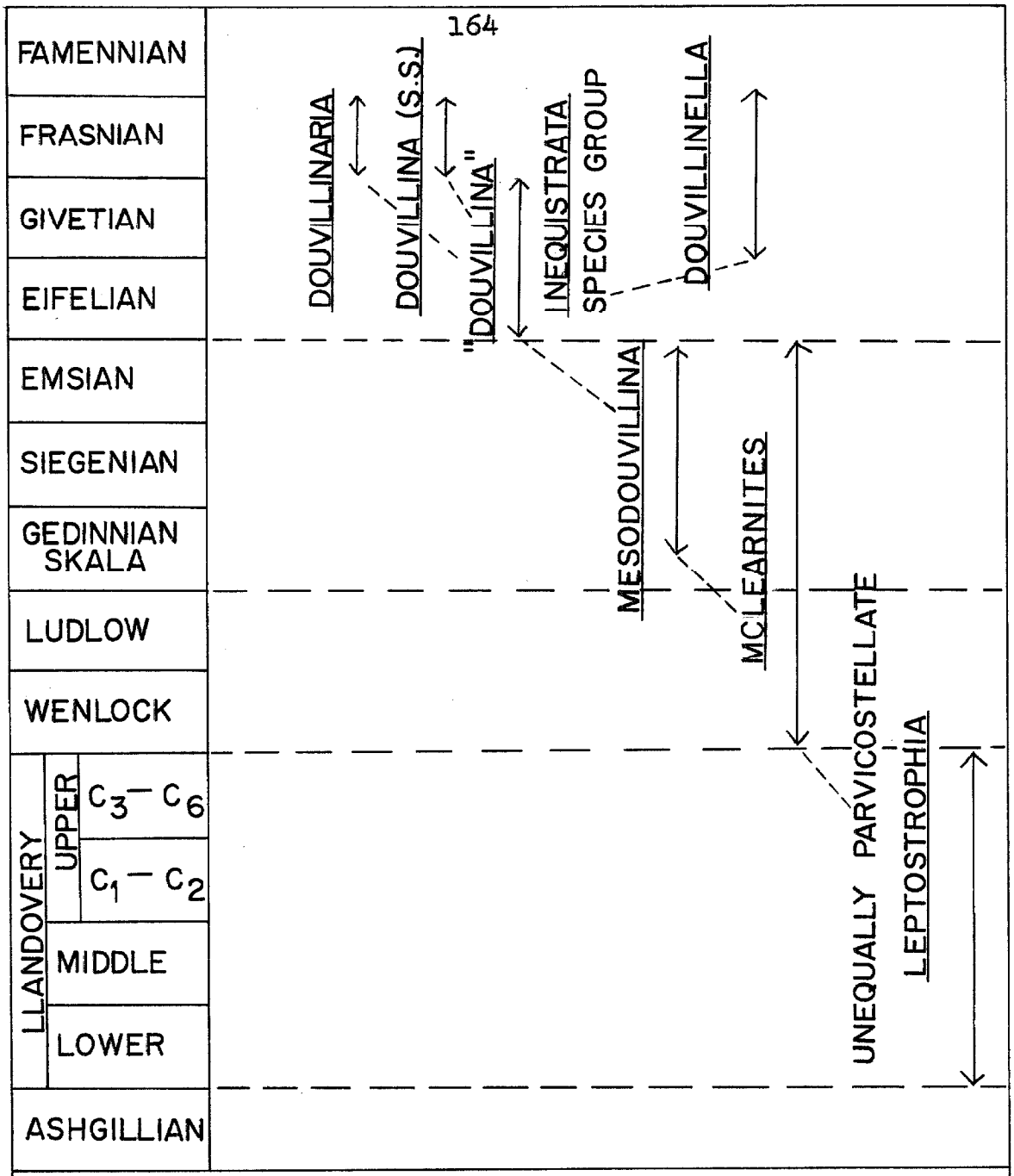


Figure 3. Inferred Phylogeny of the douvillinids.

Mclearnites sp.

Plate XVI, Figs. 8-9.

Description.

Exterior.--The valves are gently concavo-convex, semi-elliptical in outline, from 1/2 as long as wide to as long as wide, alate and widest at the straight hinge line. The pedicle interarea is low, apsacline, and marked by the trace of the denticles. The brachial interarea is linear. The pseudodeltidium and chilidium are not preserved in any of the available specimens. The valves are unequally parvicostellate; the costellae may be bent laterally at their anterior ends.

Interior pedicle valve.--The muscle field is semi-elliptical in outline, about as wide as long, and extends anteriorly 1/4 to 1/3 the valve length. It is bounded laterally by curved ridges and is open anteriorly. A low median ridge divides the muscle field. Numerous denticles occur along the middle 1/3 of the hinge. The valve is marked by the impress of the ornament distal to the muscle field.

Interior brachial valve.--Only two fragments of the posterior end of brachial valves were available for study. The cardinal process lobes are narrow and posteroventrally directed. A minute ridge occurs between the cardinal process lobes. The socket ridges are straight and widely divergent.

Occurrence.--M. sp. occurs in member 1 of the McAdam Formation of Wenlock or early Ludlow age at locality C-1 in the Arisaig agea and locality IO-6 in Pictou Co.

Mclearnites mertoni McLearn, 1924

Plate XVI, Figs. 10-13; Plate XVII, Figs. 1-5.

1924. Brachyprion mertoni McLearn, G.S.C. Memoir 137, p. 61, pl. IV., figs. 16-18; pl. XXVIII, fig. 12.

Description.

Exterior.--The valves are plano-convex to gently concavo-convex; semi-elliptical in outline, alate, widest at the straight hinge line, and vary from slightly wider than long to about as wide as long. The hinge line is denticulate along 1/2 of its length. The pedicle interarea is flat, apsacline, about 1/20 as high as long, and marked by ridges which mark the trace of the denticles; the delthyrium is triangular and filled by an apical pseudodeltidium. The brachial interarea is linear. A prominent convex chilidium, bearing a median groove extends upwards into the delthyrium. The valves are marked by rounded costellae of more or less uniform width separated by interspaces which are as wide or somewhat wider than the costellae. The costellae increase by insertion; the inserted costellae are very narrow at their point of origin and increase in width distally to reach that of the primary costellae. The costellae commonly bend abruptly laterally at their anterior ends.

Interior pedicle valve.--The ventral process is narrow. The muscle field is semi-elliptical in outline; it extends anteriorly 1/3 to slightly less than 1/2 the valve length and slightly longer than wide. The muscle field is divided

by a low myophragm and bounded laterally by curved ridges which originate slightly anterior to the hinge line. The elongate oval adductor scars are confined to the posterior half of the muscle field and are completely enclosed by the diductor scars. The internal surface is marked by the impress of the external ornament lateral and anterior to the muscle field. Numerous denticles are present along the hinge line on each side of the delthyrium; the hinge is denticulate along 1/2 of its length. Short flat plates extend from the margins of the delthyrium at about a 150° angle to each other.

Interior brachial valve.--The cardinal process is bilobed and posteroventrally directed; each of the lobes bears a median groove. A minute ridge occurs between the cardinal process lobes. The straight socket plates diverge at about a 120° angle to each other. The muscle field consists of a pair of semi-elliptical adductors which are usually separated by a low median ridge which tapers in width anteriorly. The muscle field is bounded laterally by prominent rounded ridges which taper in width anteriorly and is open at its anterior end; it extends anteriorly about 1/3 the valve length and is longer than wide. The hinge line bears denticles along the middle 1/2 of its length. The internal surface is marked by the impress of the external ornament lateral and anterior to the muscle field.

Discussion.--M. mertoni differs from M. sp. from the "Spirifer" pinyonensis zone of Emsian age in Nevada (Johnson, manuscript in preparation) in lacking the low pustulose ridges which diverge anteriorly at a low angle to the median ridge that are found in the latter.

M. mertoni differs from M. newsomensis (Foerste, 1909) from the Waldron shale of Wenlock age in Tennessee in having tapering ridges in the brachial valve which bound the muscle field laterally and in having a uniformly costellate ornament. M. newsomensis lacks such ridges in the brachial valve and has an unequally parvicostellate ornament.

M. mertoni differs from M. sp. from the lower member of the McAdam Formation in ornament and in having short plates which extend anterolaterally from the margins of the delthyrium. M. sp. has unequally parvicostellate ornament and lacks such plates.

Occurrence.--M. mertoni occurs in the Stonehouse Formation of Gedinnian and possibly Skala age at localities E1, E2 and E4 in the Arisaig area; locality KAR-63-128F in the Cobequid Mountains; and Sakrison and Saunders locality B in the Lochaber area.

Genus *Lissostrophia* Amsden, 1949

Plate XIX, Figs. 3a,b.

Type species.--*Lissostrophia cooperi* Amsden, 1949, p. 202.

Lissostrophia sp.

External and internal molds of a single specimen of a pedicle valve were found in the Moydart Formation of Ludlow age at locality D-2 in the Arisaig area.

Exterior pedicle valve.--The valve is small, strongly convex, smooth, semi-elliptical in outline and widest at the straight hinge line.

Interior pedicle valve.--The muscle field is semi-elliptical in outline and divided by a low myophragm; it extends anteriorly a little less than 1/2 the valve length.

Subfamily Pholidostrophiinae Stainbrook, 1943

Harper and Boucot (1963, p. 74) revised the subfamily Pholidostrophiinae Stainbrook 1943 to include (1) a new undescribed genus of ribbed pholidostrophid of early Llandovery to late Llandovery age based on Stropheodonta sefinensis (Williams, 1951) from the C_1 substage of the upper Llandovery of the Llandovery district; (2) Pholidostrophia (Mesopholidostrophia) (Williams, 1950, emended Harper and Boucot 1963) of Llandovery to Givetian age; (3) Pholidostrophia (Pholidostrophia) (Hall and Clarke, 1892) of Siegenian to Frasnian age; (4) Telaeoshaleria (Williams, 1950) of Eifelian age; (5) a new undescribed genus of Emsian-Eifelian age pholidostrophids of the P. lepis (Bronn, 1835) species group and (6) another new undescribed genus of Emsian age pholidostrophids related to it.

Lissostrophia (Mesolissostrophia) (Williams, 1950) is considered by the authors to be synonomous with Pholidostrophia (Mesopholidostrophia) (Williams, 1950). The types of both subgenera in the U. S. National Museum, which are from the same locality, are identical in morphology and differ only in that specimens assigned by Williams to Mesopholidostrophia have a nacreous luster and those assigned by Williams to Mesolissostrophia lack a nacreous luster. Several of the U. S. National Museum collections from the Hamilton Formation contain both

individuals with a nacreous luster and individuals that lack a nacreous luster. This change in luster is considered to be due to weathering.

The relationships of these genera are considered to be as shown in fig. 4. The new early Llandovery to late Llandovery pholidostrophid is considered to be ancestral to P. (Mesopholidostrophia) which, in turn, gave rise to P. (Pholidostrophia). P.(Pholidostrophia) is considered to have given rise to the two new pholidostrophid genera of Emsian-Eifelian age and to Telaeoshaleria.

As emended, the Pholidostrophiinae constitute a group of concavo-convex stropheodontids which are wider than long, and usually have a smooth nacreous shell. They became distinct from the rest of the stropheodontids by early Llandovery time.

Genus Pholidostrophia Hall and Clarke, 1892

Subgenus Mesopholidostrophia Williams, 1950

Mesopholidostrophia Williams, 1950, Journal of the Wash. Acad. of Sciences, Vol. 40, no. 9, pp. 278, 280.

Mesolissostrophia Williams, 1950, op. cit., p. 280.

Mesopholidostrophia Williams, 1953, G.S.A. Memoir 56, p. 36.

Mesolissostrophia Williams, 1953, G.S.A. Memoir 56, p. 38.

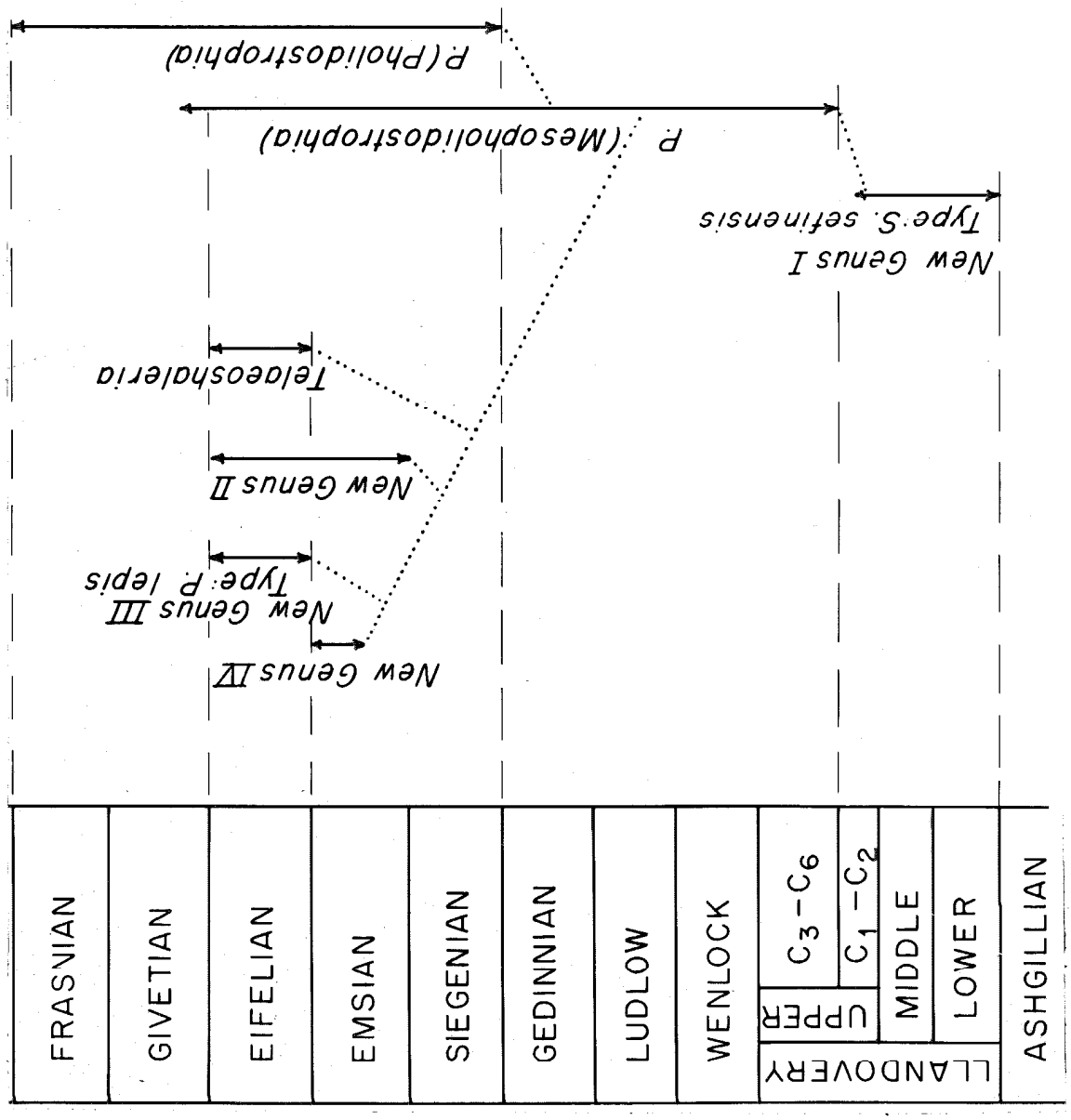
P. (Mesopholidostrophia) cf. P. (M.) nitens (Williams)

Plate XVIII, figs. 11-15; Plate XIX, figs. 1-2.

Description.

Exterior.--The valves are smooth or very faintly

Figure 4. Inferred Phylogeny of the Pholidostrophiinae.



parvicostellate, moderately concavo-convex, closely spaced and wider than long. The length varies from 2/3 to 4/5 the width, the greatest width occurs at about midlength or slightly posterior to it. The pedicle interarea is planar, high apsacline to orthocline, 1/10 as high as long and about 4/5 as long as the greatest width. The delthyrium is triangular in outline, intercepts an angle of about 60° at the apex. No pseudodeltidium is evident on any of the specimens. The brachial interarea is planar, hypercline, about 1/2 as high as the pedicle interarea. The notothyrium is filled by a chilidium which is convex outwards and extends upwards into the delthyrium. The hinge line is equal to about 4/5 the width and is denticulate along 1/4 to 1/2 of its length. The interareas are marked by the trace of the denticles.

Interior pedicle valve.--The muscle field is triangular in outline and extends anteriorly 1/3 to 1/2 the length of the valve. It may be open anteriorly or broadly rounded along its anterior margin, and is not bounded by ridges. The adductor scars are oval in outline and situated in the posterior half of the muscle field. The diductor scars, when impressed, are oval in outline and situated in the posterior 2/3 of the muscle field. Denticles are present along 1/4 to 1/2 the length of the hinge. The internal surface of the valve lateral to the muscle field is pustulose.

Interior brachial valve.--The cardinalia consist of postero-ventrally directed elongate cardinal process lobes which diverge anterolaterally at about a 60° angle to each other and straight narrow socket ridges which extend anterlaterally at about a 120° angle to each other. The muscle field consists of two pairs of adductors - a medial pair which is semi-elliptical in outline and separated by a low, narrow median ridge and directed anteriorly and a lateral pair which are semi-elliptical in outline, directed anterolaterally and bounded laterally by low ridges. The two pair of adductors extend anteriorly slightly less than 1/2 the length of the valve.

Discussion.--The Ross Brook Formation species P. (M.) cf. nitens closely resembles P. (M.) nitens from the Mulde Marl of Wenlock age in Gotland, Sweden, and may be conspecific with it. However, P. (M.) cf. nitens has a median ridge in the brachial muscle field and such a ridge appears to be only very faintly developed in the brachial valve of P. (M.) nitens illustrated by Williams (1950, plate 1, fig. 10). No other brachial valves of P. (M.) nitens were available for study. The specific value of this character may be determined only after the amount of variation in the development of the median ridge in the brachial valve of P. (M.) nitens is known. Unaltered shells of P. (M.) nitens have a nacreous luster as do the unaltered shells of other Pholidostrophia. It is reasonable to assume that

the shell of P. (M.) cf. nitens also had a nacreous luster, but, as the specimens of this species are preserved as casts and molds of the original shells, this may not be definitely established. It is not known whether or not the shells of the new genus of ribbed pholidostrophid, which is considered to have given rise to Mesopholidostrophia in the late Llandovery, were nacreous as the original shells are not preserved in the available specimens of the genus.

The Ross Brook Formation species differs from the type species of P. (Pholidostrophia) Hall and Clarke, 1892 - P. nacrea - in having socket plates, a convex chilidium and posteroventrally directed cardinal process lobes which lack a medial groove. P. nacrea lacks socket plates, has a flat chilidium, posteriorly directed cardinal process lobes each of which bears a medial groove. The two species also differ in that P. nacrea has 3 ridges situated anterior to the muscle field in the brachial valve, and these are lacking in the Ross Brook species.

Occurrence.--P. (M.) cf. nitens is known from locality ME29 in the middle Ross Brook Formation of late Llandovery (C_3 - C_5) age in Pictou Co. and from locality B4 in the upper Ross Brook Formation of late Llandovery (C_6) or early Wenlock age in the Arisaig area.

Family Strophomenidae King, 1846

Genus Pentlandina Lamont, 1949

Type species.--Strophomena (Pentlandina) parva Lamont, 1949 p. 13, fig. 9 (see also Williams, 1951, p. 118, pl. VII, fig. 8-10).

Pentlandina ? sp.

Plate XIX, figs. 4-5.

Eight poorly preserved specimens resembling Pentlandina parva were found in the lower member of the Ross Brook Formation. These are provisionally assigned to Pentlandina as the material is not adequate for positive identification.

Exterior.--The pedicle valve is initially gently convex and becomes gently resupinate; the brachial valve is initially flat and becomes gently concave. The valves are semi-elliptical in outline, slightly wider than long and widest at the straight hinge line. The pedicle interarea is low, flat and apsacline. The brachial interarea is not preserved on the available specimens. The ornament is unequally parvicostellate.

Interior pedicle valve.--A low pedicle callist is present. The flabellate pedicle muscle field is confined to the posterior 1/4 of the valve and is divided by a rounded myophragm.

Interior brachial valve.--Only one brachial interior was available. This was prepared by burning and scraping and, as the specimens of this species are preserved in a coarsely crystalline limestone nodule, most of the details

of the interior are obscure. The cardinal process consists of two narrow lobes which diverge at about a right angle to each other. The brachiophores are linear and diverge at about a 150° angle to each other.

Discussion.--P. ? sp. appears to differ from P. parva in lacking zig-zag rugae found in the latter species.

Occurrence.--P. ? sp. is known only from locality LRB1 in the lower member of the Ross Brook Formation of late Llandovery or middle Llandovery age.

Family Leptaenidae Hall and Clarke, 1895

Genus *Leptaena* Dalman, 1828

Type species.--*Leptaena rugosa* Dalman, 1828, Kongl. Vet. Akad. Handl., ;. 137, pl. 1, fig. 1. (Lectotype selected by Xing (1846).)

Spjeldnaes (1957, p. 172) restudied the type material of the genotype *L. rugosa* and found that the types were not from the Silurian of Gotland, as generally supposed, but were from the Upper Ordovician Dalmanitina Beds of Vastergotland, Sweden. *L. rugosa*, as described by Spjeldnaes, appears to differ from Silurian *Leptaena* in having a relatively broader pedicle muscle field. Spjeldnaes (1957, p. 173) suggests that *Leptagonia* McCoy, 1844, might be used as a subgenus embracing the Silurian and younger *Leptaena*. Schuchert and LeVene (1929, p. 69) designate *Producta analoga* Phillips, 1836, from the Silurian of Britain as the lectotype of *Leptagonia*. The proportions of the pedicle muscle field of *L. rugosa* and those of Silurian species of *Leptaena* are somewhat variable. The present author will defer making a decision as to whether or not *Leptagonia* should be retained as a subgenus of *Leptaena* until after the type material of *L. rugosa* in the Paleozool. avd., Riksmuseet, Stockholm, Sweden, has been restudied.

Leptaena sp.

Plate XIX, figs. 7-8.

1924. Leptaena rhomboidalis (Wilckens, 1769), McLearn, p. 59, pl. IV, fig. 14.

Seven fragmental specimens of Leptaena were found in the Beechhill Cove Formation at localities A-3 and A-4 (Arisaig Area) and DW1 (Pictou Co.). The specimens are too poorly preserved for specific identification.

Exterior.--The valves are subquadrate to semi-elliptical in outline, about twice as wide as long, widest at the straight hinge line or slightly anterior to it, and may or may not be alate. The pedicle valve is initially convex, the brachial valve is initially flat; both valves become sharply geniculate ventrally at a length between 7 and 20 mm. The pedicle interarea is high apsacline. The delthyrium is not preserved on any of the available specimens. The brachial interarea is high anacline. The notothyrium is filled by a chilidium which is strongly convex outwards. The valves are marked by coarse rugae which are more or less evenly spaced at intervals which vary from 1/2 mm to 2 mm and by rounded costellae which are separated by interspaces of the same width and increase by insertion.

Pedicle valve interior.--The one pedicle valve available has short dental plates which diverge at about a 120° angle to each other, and a very faintly impressed, oval muscle field which is bounded by faint ridges. The internal

surface is marked by the impress of the costellae and rugae anterior and lateral to the muscle field.

Interior brachial valve.--Two fragmental brachial valve interiors were available. One specimen (1.8 cm. long) has a bilobed cardinal process and triangular sockets which are open laterally and bounded anteriorly by straight socket ridges which diverge at a 120° angle to each other. The muscle field is confined to the posterior 1/4 of the valve and is about 1/3 as long as wide. It consists of two semi-oval adductor scars divided by a low rounded myophragm and flanked laterally by a second pair of semi-oval adductor scars. A median ridge and a pair of lateral ridges parallel to it lie anterior to the muscle field. The specimen is geniculate. No peripheral ridge is present in the interior. The other specimen (7 mm long) has a muscle field which is 4/5 as wide as long, extends 1/2 the valve length and consists of a pair of elongate adductors which taper in width anteriorly. It is more deeply impressed than that of the first specimen. The specimen is geniculate and a peripheral ridge is present along the geniculate margin. These two specimens possibly belong to distinct species but this cannot be demonstrated as additional specimens which show the interiors are not available.

Occurrence.--Localities A-3 and A-4 in the Arisaig area and DW1 in Pictou Co., in the Beechhill Cove Formation

of early Llandovery age.

Leptaena cf. L. depressa (Sowerby, 1825)

Plate XIX, figs. 9-16.

Exterior.--The valves are pseudopunctate, subquadrate to semi-oval in outline, alate, 1/2 to 3/5 as wide as long, and widest at the straight hinge line. The valves are plano-convex in young specimens and become sharply geniculate along their lateral and anterior margins upon reaching a length of 1.9 - 2.3 cm. The geniculate portion of the valve is oriented about perpendicular to the central portion of the valve and may reach a length along the midline equal to the length of the non-geniculate portion of the valve. A broad rounded knob may be present in the median portion of the anterior edge of the non-geniculate portion of the valve. The geniculate portion of the pedicle valve may bear a narrow rounded median fold and the geniculate portion of the brachial valve may bear a corresponding sulcus. The pedicle interarea is planar, high apsacline and 1/12 - 1/20 as high as long. The delthyrium is trapezoidal in outline and possibly open. (No pseudodeltidium was observed in any of the many specimens studied.) The brachial interarea is planar, high anacline, and 1/12 - 1/20 as high as long. The notothyrium is filled by a prominent chilidium which is convex outwards and bears a median groove. The valves are usually marked by rugae; they are marked by fine rounded uniform costellae which

are separated by interspaces of about the same width as the costellae. The costellae increase slightly in height and width distal to the apex and increase in number by bifurcation and insertion. 90 - 130 costellae are present along the periphery at a length of 1 cm.

Interior pedicle valve.--The teeth are stout and supported by short dental plates which diverge at about a 90° angle to each other. A small pedicle callist is present in some specimens. The muscle field is oval in outline, 2/3 - 9/10 as wide as long and extends anteriorly 1/2 - 2/3 the length of the valve. Curved ridges extend anteriorly from the dental plates and enclose the muscle along its lateral and anterior margins. The adductor scars are elongate oval in outline and confined to the median 1/2 - 2/3 of the muscle field. The diductor scars are semi-oval in outline and bear numerous parallel ridges that extend antero-laterally at a low angle to the median line. The diductors do not enclose the adductors along their anterior margin. A low platform usually lies between the diductors and anterior to the adductors. The platform bears a low median ridge and may be raised as a high knob at its posterior end. On some specimens, a depression occupies the position of the platform. On some specimens, the antero-medial margins of the diductors extend anteriorly as rounded lobes. The internal surface anterior and lateral to the muscle field is pustulose and is marked by the impress of the rugae and the costellae.

Interior brachial valve.--The cardinal process is bilobed; the lobes are oval in outline and have flat, longitudinally striated, postero-ventrally directed attachment faces. The lobes are separated by a rounded groove which is triangular in outline and may bear a minute median ridge at its posterior end. The cardinal process is in contact with the chilidium. The sockets are triangular in outline, laterally directed, open laterally and rounded at their base. They are bounded posteriorly by the interarea and anteriorly by straight socket ridges which diverge antero-laterally at a 120° angle to each other. The muscle field extends anteriorly 1/3 to 1/2 the length of the valve and varies from 3/4 as long to as long as wide. On large specimens the muscle field is raised above the level of the surface of the valve. It is divided by a rounded myophragm which is very wide at its posterior end and decreases in width anteriorly, and consists of two pairs of oval adductors - one pair at the posterior end of the field and another pair situated anterior and medial to the first pair. A median ridge and a pair of lateral ridges are situated in the anterior half of the valve anterior to the muscle field. The lateral ridges diverge antero-laterally at about a 20° angle to the mid-line. A rounded peripheral ridge rims the valve along the geniculate margin. Lateral and anterior to the muscle field the internal surface is

pustulose and is marked by the impress of the rugae and the costellae.

Discussion.--L. cf. L. depressa resembles L. depressa in having relatively fine rugae, a prominent convex chilidium with a median groove, and in its cardinalia and muscle fields. Both species become geniculate at about the same stage of development. However, L. depressa has a small pseudodeltidium and an adjacent apical foramen and in the specimens of L. cf. L. depressa studied the delthyrium is open ventral to the chilidium. It is possible that a pseudodeltidium was present in these specimens but was not preserved.

Both L. cf. L. depressa and L. depressa differ from L. rhomboidalis (Wilkens, 1769) as described by Poulsen (1943, p. 18 - 21) in having much finer rugae. As the original specimens described by Wilckens were from Stargard, Pommerania, Germany presumably from glacial erratics and the specimens described by Poulsen were from the Silurian of Gotland, it is not completely certain that the specimens described by Poulsen as L. rhomboidalis are actually conspecific with the typs of the species.

Leptaena cf. L. depressa differs from L. sp. from the Beechhill Cove Formation in having finer rugae.

Occurrence.--L. cf. L. depressa occurs in the upper member of the Ross Brook Formation of late Llandovery (C_6) or early Wenlock age at locality B-5 in the Arisaig area

and at locality DF36 in Pictou Co. It occurs in the French River Formation of late Llandovery (C_6) or Wenlock age at localities DF13 and DF16 in Pictou Co. It occurs in the lower two members of the McAdam Formation of Wenlock or early Ludlow age at localities C1, C2, and MCK13 in the Arisaig area, localities HAT, DM8, DT12, NR16, I06 and HA8 in Pictou Co., and localities KA-62-4F, KA-63-115F and KA-63-123F in the Cobequid Mountains.

Leptaena aff. L. rhomboidalis (Wahlenberg, 1821, p. 65)

Plate XIX, figs. 17-18; Plate XX, fig. 1.

Description.

Exterior.--The valves are subquadrate to semi-oval in outline, alate, 1/2 to 2/3 as long as wide, and widest at the straight hinge line. The valves are plano-convex in young specimens and become sharply geniculate dorsally along their lateral and anterior margins upon reaching a length of .8 to 1.4 cm. The pedicle interarea is flat, high apsacline and about 1/10 as high as long; the delthyrium bears an apical deltidium. The brachial interarea is flat, orthocline and about 1/20 as high as long; the notothyrium is filled by a prominent convex chilidium. The valves are marked by rounded costellae which increase by bifurcation and insertion and by coarse, regularly spaced rugae.

Interior pedicle valve.--The stout teeth are supported by short widely divergent dental plates. The muscle field is circular or oval in outline, and as wide as long or slightly wider than long; it extends anteriorly to about 2/5 the valve length. The diductor scars are bounded laterally by curved ridges which are continuous with the dental plates. The elongate oval adductor scars are enclosed by the diductors. A small median pit may be present at the anterior end of the muscle field. The internal surface is marked by the impress of the external ornament

lateral and anterior to the muscle field.

Interior brachial valve.--The cardinal process is bilobed and posteroventrally directed. The straight brachiophores diverge at about a 100° angle to each other. The muscle field is only faintly impressed; it consists of semi-oval adductors which are divided by a low myophragm and extend to about 1/3 the valve length. A linear median ridge and a pair of linear, slightly diverging lateral ridges are present anterior to the muscle field. The internal surface is marked by the impress of the ornament as in the pedicle valve.

Discussion.--L. aff. L. rhomboidalis resembles L. rhomboidalis illustrated by Poulsen (1943, text plate figures 5C, 6B, 7A-D) in its external ornament, chilidium and pseudodeltidium; and both species become geniculate at about the same size. However, as mentioned above, it is not completely clear whether or not Poulsen's specimens actually belong to L. rhomboidalis.

L. aff. L. rhomboidalis differs from L. cf. L. depressa described above in having much coarser rugae and in becoming geniculate at a smaller size than that at which the latter species becomes geniculate.

Occurrence.--L. aff. L. rhomboidalis occurs at localities E-1 and E-2 in the Stonehouse Formation of Gedinnian and possibly Skala age in the Arisaig area.

indet. leptaenid

Plate XIX, Fig. 6

Three fragmental pedicle valves of a leptaenid other than Leptaena were found in the Beechhill Cove Formation. These may not be identified generically.

Description.

Exterior.--The valves are wider than long, alate, and widest at the straight hinge line. The pedicle valve is convex and geniculate. The pedicle interarea is catacline. The three specimens studied appear to lack radial ornament; however, this preservation is not adequate to definitely establish whether or not the specimens had radial ornament.

Interior pedicle valve.--The teeth are stout and supported by short dental plates. The muscle field consists of a pair of flabellate diductor scars divided by a broad myophragm.

Occurrence.--Beechhill Cove Formation, Arisaig area, locality ZLBC.

Superfamily Orthotetacea Williams, 1953

Genus Fardenia Lamont, 1935

Type species.--Fardenia scotica Lamont, 1935, Trans. Geol. Soc. of Glasgow, Vol. XIX, part II, pp. 311-2, pl. VII, figs. 1-7.

Fardenia ? sp.

Plate XX, figs. 2, 3, 5.

Three small specimens of an orthotetacid were found in the Beechhill Cove Formation and one was found in the Glencoe Brook Formation. These are assigned questionably to Fardenia as it is not clear from the available specimens whether the species has a chilidium as in Coolinia Bancroft, 1949 (=Chilidiopsis Boucot, 1959) or discrete chilidial plates as in Fardenia. As Coolinia is not known in beds older than late Llandovery, and Fardenia is common in beds of lower Llandovery age, the Arisaig specimens are assigned questionably to Fardenia.

Description.

Exterior.--The valves are gently biconvex, semielliptical in outline, widest slightly anterior to the straight hinge line, and about 2/3 as long as wide. The pedicle interarea is flat, apsacline and about 1/10 as high as long; the delthyrium is trapezoidal with lateral margins that diverge at about a right angle, and is open. The brachial interarea is linear. The cardinal angles are obtuse. The anterior commissure is crenulate and rectimarginate. The valves bear straight rounded costellae which increase by both bifurcation and insertion.

Interior pedicle valve.--The teeth are supported by short dental plates which diverge at about a right angle to each other. The muscle field is triangular, extends anteriorly about 1/3 the valve length and bears faint radial grooves. The periphery of the valve is marked by coarse plications corresponding to the external ornament.

Interior brachial valve.--The cardinal process is bilobed and posteriorly directed. The brachiophores are tabular and diverge at about a 150° angle to each other. The faintly impressed semi-elliptical adductor scars are separated by a broad flat myophragm and extend anteriorly about 1/3 the valve length. The periphery of the valve is marked by coarse plications corresponding to the external ornament.

Occurrence.--Fardenia ? sp. occurs at localities A-2 and A-3 in the Beechhill Cove Formation of early Llandovery age in the Arisaig area and locality FT5 in the Glencoe Brook Formation of early Llandovery age in Pictou Co.

Fardenia sp.

Plate XX, figs. 4a-c, 6-12.

Description.

Exterior.--The valves are semi-elliptical in outline, up to 3 mm long, 3/5 to 9/10 as long as wide and widest at the hinge or slightly anterior to it. The hinge line is straight and about equal to the greatest width. The commissure is crenulate and rectimarginate. The pedicle valve is initially gently convex and becomes resupinate at a length of 1 - 1.5 cm; the ventrally deflected portion of the valve may be gently or strongly concave; the brachial valve is initially gently convex - almost flat - and may remain gently convex or become strongly convex. The pedicle interarea is flat, high apsacline and 1/6 to 1/12 as high as long. The delthyrium is triangular, intercepts an angle of about 60° at the apex and is partially filled by a deltidium which is concave outwards, bears a median groove and extends from the apex to about 1/4 the length of the delthyrium. The brachial interarea is flat, 1/20 - 1/25 as high as long, and high anacline. The notothyrium intercepts an angle of about 90° at the apex. Small chilidial plates which are slightly convex outwards and may be conjunct at the apex of the valve extend inwards a short distance from the margins of the notothyrium so as to partially close it. The ornament consists of straight

to slightly irregular, coarse, rather angular costae and growth lamellae. The costae increase by insertion. Second order and higher order costae are very fine at their point of origin and gradually increase in width distal to their point of origin until they attain the width of the primary costellae. At a given growth line coarse costellae are separated by angular interspaces of roughly the same width which may bear one or more higher order costellae.

Pedicle valve interior.--The teeth are stout and supported by long dental plates which diverge antero-laterally from the margins of the delthyrial cavity at a 90° - 120° angle to each other. The deltidium projects a short distance into the delthyrial cavity. The muscle field is 3/4 as wide to as wide as long and extends anteriorly to about mid-length. The lateral margins of the muscle field extend antero-laterally from the dental plates to the middle 1/3 of the muscle field where they curve anteriorly and then medially to intersect at the median line. The diductor scars may bear parallel, antero-laterally diverging ridges and the lateral margins of the diductor scars may be scalloped between adjacent ridges. The adductor scars are elongate and elliptical in outline, completely enclosed by the diductors and confined to the median portion of the muscle field. The internal surface is marked by the impress of the external ornament which

may be confined to the periphery or may extend almost to the apex of the valve.

Interior brachial valve.--The cardinal process is bilobed; the lobes are triangular in outline, postero-ventrally directed and separated by a deep groove which bears a median ridge. Short chilidial plates, which may be fused at the apex on large specimens, flank the cardinal process. Massive tabular brachiophores extend antero-laterally from the cardinalia at a 90° angle to each other. The sockets are triangular in outline and open along their lateral margins. A broad rounded myophragm extends anteriorly from the cardinalia to 1/3 to 1/2 the length of the valve. The myophragm is uniform in width. The surface is marked by the impress of the external ornament as in the pedicle valve.

Discussion.--Fardenia sp. closely resembles Fardenia scotica from the Drummuck Group, Girvan, Scotland of Ashgillian age in ornament and outline and in its cardinalia and brachial muscle field. It differs from Fardenia scotica in having adult specimens which are much larger than those of F. scotica (specimens of F. sp studied by the author were up to 3 cm long, specimens of F. scotica studied were up to 1.2 cm long). Fardenia sp. is initially convex and becomes resupinate at a length of 1 to 1.5 cm; the pedicle valve of F. scotica is convex and may have flattened margins but is not resupinate. However, as all

of the specimens of F. scotica studied by the author were less than 1.2 cm long, and the pedicle valve of F. sp. usually did not become resupinate until it attained greater length, the presence or absence of resupinate pedicle valves may not be used to distinguish the two species. The pedicle muscle field of the specimens of F. sp. studied appear to be more deeply impressed than those of F. scotica studied. This difference is quite possibly not significant as the specimens of F. sp. pedicle valves studied were in all cases larger than the largest specimen of F. scotica pedicle valve studied.

F. sp. differs from Fardenia geoffreyi (Williams, 1951) from the Gasworks Mudstone of early Llandovery age at Haverfordwest in Wales in having a relatively uniform costellate ornament in contrast to the parvicostellate ornament of the latter species.

Occurrence.--Fardenia sp. occurs in the French River Formation of late Llandovery (C6) or Wenlock age at localities DF13 and DF16 and in the lower member of the McAdam Formation of Wenlock or early Ludlow age at localities MGB1 and RB70 in the Arisaig area; localities HAT, DM7, DM8, DM9, DT12 and I06 in Pictou Co.; and localities KA-62-4F, KA-62-400F, and KA-63-123F in the Cobequid mountains.

indet. orthotetacid

Plate XX, Figs. 13-15.

1924. Schuchertella pecten McLearn, non Linnaeus (?), p. 63-4, pl. V, fig. 32.

A single slab (G.S.C. specimen #5423) containing several specimens of an unidentifiable orthotetacid is in the type collections of the G.S.C. in Ottawa. This slab is listed as coming from the Stonehouse Formation, shore section, Arisaig.

Exterior.--The valves are resupinate, somewhat wider than long, and widest at the straight hinge line. The ornament consists of straight costellae which increase by insertion.

Interior.-- not known.

Superfamily Plectambonitacea Cooper and Williams, 1952

Family Plectambonitidae Kozlowski, 1929

Genus Plectodonta Kozlowski, 1929

Type species.--Plectodonta Mariae Kozlowski, 1929, Paleontologia Polonica, T. 1, pp. 114-7, pl. III, figs. 30-32.

Plectodonta sp.

Plate XXI, Figures 1a, b, 2a-d.

Exterior.--The valves are concavo-convex, semi-elliptical in outline, wider than long, and widest at the straight hinge line. The pedicle interarea is flat, roughly 1/10 as high as long and marked by grooves corresponding to the trace of denticles which occur along the hinge line; the delthyrium is triangular; the pseudodeltidium is not preserved on any of the specimens studied. The brachial interarea is low; the notothyrium is filled by the large cardinal prodess and a pair of large chilidial plates occurring lateral to the cardinal process. The valves are marked by fine costellae which are separated by interspaces of about the same width and increase in number by insertion. Some specimens are unequally parvicostellate, others have costellae of uniform size.

Interior pedicle valve.--Rounded teeth occur adjacent to the delthyrium and small rounded denticles occur along the middle half of the hinge line lateral to the teeth. The size of the denticles decreases laterally. Curved ridges extend anteriorly from the delthyrial cavity to about 1/2

the valve length and bound the muscle field. A median ridge extends from the delthyrial cavity to about 1/2 the valve length and bifurcates anteriorly so as to divide the muscle field and partially enclose the diductors anteriorly. The muscle field extends to about 1/3 the valve length. The elongate oval adductor scars are confined to the posterior half of the muscle field and are completely enclosed by the broad oval diductor scars. A pair of linear tracts extend anteriorly from the muscle field parallel to the median line to about 2/3 the valve length, and are bounded by the lateral ridges and the branches of the median ridge. The periphery of the valve is marked by radial ridges.

Interior brachial valve.--The simple cardinal process is flanked laterally by prominent chilidial plates. The cardinal process and chilidial plates extend outwards from the notothyrium and are posterodorsally directed. A deep pit occurs anterior and adjacent to the cardinal process and chilidial plates. The rounded sockets occur lateral to the chilidial plates and are bounded anteriorly by short low socket plates which extend parallel to the hinge line. The muscle field extends anteriorly to about 2/3 the valve length and is about as wide as long. It is divided by two pair of brachial septae and a low median ridge, and is bounded laterally by a third pair of brachial septae. The brachial septae and the median ridge extend to the anterior end of the muscle field. The medial pair of brachial

septae curve laterally outwards from their bases; they are highest at their posterior end and taper in height anteriorly. A somewhat lower second pair of brachial septae occur a short distance lateral to the medial pair. They curve slightly medially from their bases, are highest at their anterior end and taper in height anteriorly. The bases of the medial pair and of the second pair of brachial septae diverge slightly anteriorly. The third pair of brachial septae, which bounds the muscle field, is much lower than the medial two pair of septae. It is widely separated from the medial two pair at its posterior end and converges anteriorly so as to lie adjacent to the medial two pair at the anterior end of the muscle field. The internal surface is pustulose and is marked by the impress of the costellae along the periphery.

Occurrence.--A dozen specimens of Plectodonta sp. were found at locality KA-63-123F in the Cobequid Mountains in beds correlative with member 1 of the McAdam Formation of Wenlock or early Ludlow age.

Suborder Chonetoidea Muir-Wood, 1955

Superfamily Chonetacea Waagen, 1884
(nom. transl. Shrock and Twenhofel, 1953 (ex Chonetinae Waagen, 1884)

Family Chonetidae Waagen, 1884
(nom. transl. Hall and Clarke, 1895 (ex Chonetinae Waagen, 1884)

Genus Protochonetes Muir-Wood, 1962 emended

Type species.-- Protochonetes ludloviensis Muir-Wood, 1962, p. 51, pl. 3, figs. 1-5.

Diagnosis.--Transverse, concavo-convex chonetids, with a radial ornament of numerous costellae that increase by insertion or bifurcation, with or without a median enlarged costellae, with spines that extend postero-laterally outwards from the interarea, with a median septum in the pedicle valve that may or may not bifurcate posteriorly, with a cardinal process that is bilobed at its base and may be bilobed or quadrilobate on its distal face, with socket ridges that may unite to form a platform, with a median septum and a pair of short, posteriorly located lateral septae in the brachial valve.

Discussion.--Protochonetes is here emended to include forms with a median costellae that is larger than the rest of the costellae, to include forms with a median septum in the pedicle valve that does not bifurcate posteriorly, and to include forms which have a cardinal process that is quadrilobate on its distal face.

Muir-Wood (1962, p. 41) considers that Strophochonetes Muir-Wood, 1962 differs from Protochonetes in its smaller

dimension, finer costellae, presence of a median enlarged costella, less numerous spines which extend at a high angle to the hinge and in lacking a posteriorly bifurcating median septum. However, consideration of P. novascoticus Hall,1860 from the Arisaig series shows that all of these characters, except possibly the angle of emergence of the spines, are extremely variable within a single species and thus do not serve to distinguish the two genera. P. novascoticus has costellae which are extremely variable in width and the median costella in this species is enlarged in some specimens and the same size as the rest of the costellae in other specimens. The median septum in the pedicle valve of P. novascoticus bifurcates posteriorly in some specimens but not in others. These variations are exhibited in each of the collections from a number of localities. Muir-Wood describes the type species of Strophochonetes as having 3 - 4 spines on each side of the hinge and describes the type species of Protochonetes as having 4 - 5 spines on each side of the hinge. Protochonetes novascoticus has 3 - 5 spines on each side of the hinge. It appears, then, that Protochonetes and Strophochonetes may be distinguished only on the basis of the angle of emergence of the spines. The brachial interior of S. cingulatus Lindstrom 1860 - the type species of Strophochonetes - is not known and may possibly differ from that of Protochonetes. It is possible that the type

species of the two genera are not significantly distinct, and are best regarded as being congeneric, but this cannot be determined until the brachial interior, and the variation in the angle of emergence of the spines in S. cingulatus is known.

The chonetid species in the Arisaig series are assigned to Protochonetes rather than to Strophochonetes on the basis of the angle of emergence of the spines.

Protochonetes tenuistriatus (Hall, 1860)

Plate XXI, figs. 5-9.

1860. Chonetes tenuistriata Hall, Can. Nat. Geol., 5, p. 145, fig. 3
1924. Chonetes tenuistriatus McLearn, G.S.C. memoir 137, p. 64, pl. V, figs. 33, 34.

Diagnosis.--Small, finely costellate, relatively strongly concavo-convex Protochonetes with a median septum in the pedicle valve that does not bifurcate posteriorly, and with a bilobed cardinal process.

Description.

Exterior.--The valves are small (up to 1 cm. wide), closely spaced, transversely semi-elliptical in outline with the cardinal angles slightly rounded. The length varies from 3/5 to 4/5 the width, the greatest width is at the hinge line or between the hinge line and mid-length. The hinge line is straight and as long or almost as long as the greatest width. The pedicle valve is relatively strongly convex and uniform in convexity except along the

postero-lateral margins which may be slightly flattened; the brachial valve varies from gently to moderately convex and is uniform in convexity. The anterior commissure is crenulate and rectimarginate. The valves are marked by rounded, slightly undulating, costellae which are separated by rounded interspaces of about equal width. The costellae increase by insertion and occasionally by bifurcation and widen slightly away from the apex. 60 - 80 costellae cross a growth line which is 5 mm from the apex at the mid-line. Spines are rarely preserved. When present, the spines diverge postero-laterally from the pedicle interarea at a high angle to the interarea. The pedicle interarea is planar, high apsacline and about 1/20 as high as long. The delthyrium is triangular and open. The brachial interarea is linear and its inclination could not be determined.

Interior pedicle valve.--The small, rounded teeth are situated directly lateral to the margins of the delthyrium. The median ridge extends 1/4 to 1/2 the length of the valve and tapers in height anteriorly. The muscle field is triangular in outline and extends anteriorly 1/4 to 1/2 the length of the valve. The lateral margins of the diductors are straight or very slightly curved convex postero-laterally and diverge at about a 100° angle to each other. The adductor scars are elongate oval in outline and confined to the posterior 1/2 of the muscle field.

The interior is pustulose and marked by the impress of the costellae.

Interior brachial valve.--The cardinal process is bilobed, directed posteriorly and bordered laterally on each side by short chilidial plates. The sockets are straight, rounded at their base, and diverge antero-laterally from the base of the chilidial plates. Socket ridges bound the sockets anteriorly. A pair of short lateral septae diverge at about a 40° angle to each other and are confined to the posterior 1/3 of the valve. A median septum extends anteriorly from the cardinalia to about mid-length. The adductor scars, when impressed, are semi-oval in outline and confined to the posterior 1/3 of the valve. The interior is pustulose and marked by the impress of the costellae.

Discussion.--Protochonetes tenuistriatus differs from P. ludloviensis (Muir-Wood, 1962) in being smaller, more strongly concavo-convex, and in having a median ridge in the pedicle valve which does not bifurcate posteriorly.

Occurrence.--P. tenuistriatus occurs in the middle member of the Ross Brook Formation of late Llandovery (C_3 - C_5) age in Pictou Co. at locality ME60. It occurs in the upper member of the Ross Brook Formation of late Llandovery (C_6) or early Wenlock age at localities B4, B5, and B6 in the Arisaig area at localities DF9 and DF38.

Protochonetes novascoticus (Hall, 1860)

Plate XXI, figs. 10-16.

1860. *Chonetes novascoticus*, Hall, Can. Nat. Geol, 5, p. 144, fig. 2.
1924. *Chonetes novascoticus* (Hall), McLearn, G.S.C. Memoir 137, p. 65, pl. V., figs. 35, 36; pl. VI, fig. 1.
1924. *Chonetes novascoticus crassistriatus*, McLearn, op. cit., p. 66, pl V, fig. 37.

Diagnosis.--Large, finely to coarsely costellate, gently to moderately concavo-convex *Protochonetes*, with a median septum in the pedicle valve that may or may not bifurcate posteriorly, and with a cardinal process that is bilobed at its base and quadrilobate on its distal face.

Exterior.--The valves are relatively large (up to 4 mm wide), transverse, 1/2 to 2/3 as long as wide, semi-elliptical in outline with the greatest width about at midlength. The cardinal angles are somewhat rounded. The hinge line is straight, and about 4/5 as long as the greatest width. The pedicle valve is gently to moderately convex and the brachial valve is flat to gently concave. A gentle sulcus is rarely developed in the pedicle valve and a gentle fold is rarely developed in the brachial valve. The postero-lateral margins of the pedicle valve are slightly flattened. The pedicle interarea is planar, apsacline, oriented at a high angle to the plane of commissure and about 1/15 as high as long. The delthyrium is triangular in outline and open. The brachial interarea

is planar, high anacline or oriented perpendicular to the plane of commissure, and about half as high as the pedicle interarea. The notothyrium is triangular. Small chilidial plates occupy the lateral margins of the notothyrium. The valves are marked by slightly undulating rounded costellae, separated by rounded interspaces of about the same width as the costellae. The costellae increase in number by insertion and bifurcation and increase slightly in width and height anteriorly. The median costellae is coarser than the other costellae on some specimens and the same weight as the other costellae on others. 35 - 70 costellae cross a growth line which is 5 mm from the apex at the midline. Three to five spines occur on each side of the interarea. They extend postero-laterally at a 40° - 80° angle to the interarea. Hollow tubes extend antero-laterally from the base of the spines at the upper edge of the interarea to the spine apertures along the hinge on the internal surface of the valve. The hollow tubes may be curved concave posteriorly.

Interior pedicle valve.--The teeth are small, rounded in outline, The median septum extends 1/4 to 1/3 the length of the valve and may or may not bifurcate posteriorly. It tapers in height anteriorly. The muscle field is triangular in outline, divided by the median ridge. The lateral margins of the muscle field diverge at a 100°- 120° angle to each other and extend anteriorly about 1/4 the length

of the valve. The adductor scars are semi-oval in outline and confined to the posterior half of the muscle field. The internal surface is marked by the impress of the costellae.

Interior brachial valve.--The socket ridges are fused medially to form a platform on which the cardinal process and the chilidial plates rest. This platform is divided medially by a low median groove. The cardinal process is bilobed at its base and quadrilobate on its distal face. It is directed posteriorly and flanked laterally by small erect chilidial plates that are triangular in lateral profile and separated from the cardinal process by a narrow groove. The sockets are anterolaterally directed, rounded at their base, and bounded anteriorly and medially by the platform formed by the socket ridges. On some specimens low rounded ridges extend lateral to the sockets and parallel to the hinge line to about 3/4 the distance from the median line to its lateral margin. A low rounded median septum extends anteriorly from the platform to 1/2 to 2/3 the length of the valve and decreases in height and width anteriorly. A pair of short lateral septae diverge antero-laterally at a 35° angle to each other and are confined to the posterior 1/4 of the valve. The adductor scars are semi-oval in outline and usually only very faintly impressed. The internal surface is marked by the impress of the costellae.

Discussion.--*Protochonetes novascoticus* closely resembles *P. ludloviensis* Muir-Wood, 1962 in convexity, outline, ornament, pedicle valve internal features and in the number and arrangement of septae in the brachial valve. The socket ridges in both species fuse medially to form a platform on which the cardinal process and the chilidial plates rest. They differ in that (1) the above mentioned platform is much more prominent in *P. novascoticus* than in *P. ludloviensis* and (2) the cardinal process is quadrilobate on its distal face in *P. novascoticus* and bilobate on its distal face in *P. ludloviensis*.

P. novascoticus differs from *P. tenuistriatus* in its larger size, in being much less strongly concavo-convex. *P. novascoticus* has a cardinal process that is quadrilobate on its distal face, and a median septum in the pedicle valve that may bifurcate posteriorly. In *P. tenuistriatus* the cardinal process is bilobate, and the median septum does not bifurcate posteriorly.

Occurrence.--*Protochonetes novascoticus* occurs in all four members of the McAdam Formation of Ludlow and possibly Wenlock age at localities C1, C2, C4, C5, MCK13 in the Arisaig area; localities I06 and HAF in Pictou Co.; and locality KAR-63-115F in the Cobequid mountains. It occurs in the Moydart Formation of Ludlow age at localities MCK33, MCK59, D1, D2, D3, SB2, SB5, and SB6 in the Arisaig area; and localities DS45, and DS53 in Pictou Co. It

occurs in the Stonehouse Formation of Gedinnian and possibly Skala age at localities MCK40, MCK41, MCK42, MCK26, MCK29, MCK30, MCK27, MCK50, MCK53, MCK54, MCK55, MCK56, E1, E2, E3, E4, E5, E6, E7, E8, and CRED in the Arisaig area; localities LR1, LR2, LR3, LR4A, LR9, and DT1 in Pictou Co.; localities SSB and 358 in the Lochaber area; localities F1, F18, F8, F9 in the Cape George area; and localities 11F, KA-62-383F, KAR-63-377F, KAR-63-128F, and KAR-63-135F in the cobequid mountains.

Protochonetes stonehousensis (new species)

Plate XXI, figs. 3-4.

Diagnosis.--Small (less than 8 mm wide), strongly concavo-convex, coarsely costellate Protochonetes with a median septum in the pedicle valve that does not bifurcate posteriorly and with a bilobed cardinal process.

Exterior.--The valves are small (less than 8 mm wide,) transverse, and semi-elliptical in outline. They are 1/2 to 2/3 as long as wide, and the greatest width is at mid-length. The hinge line is straight and slightly shorter than the greatest width. The cardinal angles are somewhat rounded. The valves are strongly concavo-convex. A gentle sulcus is sometimes developed in the pedicle valve; no corresponding fold was observed in any of the brachial valves studied. The pedicle interarea is planar and apsacline; the brachial interarea is planar and anacline. Small chilidial plates occupy the margins of the noto-thyrium; no pseudodeltidium was observed. The valves are marked by slightly undulating rounded costellae, separated by rounded interspaces of about the same width as the costellae. The costellae increase by bifurcation and by insertion. About 40 - 50 costellae cross a growth line which is 5 mm from the apex at the midline. The spines are rarely preserved. One or two spines were observed on each side of the interarea on a few specimens. They

diverged postero-laterally at about a 60° angle to the interarea.

Interior pedi valve.--The median septum extends about 1/4 the length of the valve. The teeth are small and oval in outline. The muscle field is triangular in outline, open anteriorly, and divided by the median ridge. It extends anteriorly about 1/4 the length of the valve. The adductor scars were not observed. The internal surface is marked by the impress of the costellae.

Interior brachial valve.--The cardinal process is bilobed and posteriorly directed. Small chilidial plates lie on each side of the cardinal process. The sockets are rounded at their base and postero-laterally directed. A median septum which extends anteriorly about 1/2 the length of the valve and a pair of short, posteriorly situated lateral septae are present. The internal surface is marked by the impress of the costellae.

Discussion.--P. stonehousensis differs from P. novascoticus in that it is smaller and more strongly concavo-convex. P. stonehousensis has a median septum in the pedicle valve which does not bifurcate posteriorly and a bilobed cardinal process. In P. novascoticus the median septum in the pedicle valve may bifurcate posteriorly and the cardinal process is quadrilobate on its distal face.

P. stonehousensis differs from P. tenuistriatus in having coarser costellae.

Occurrence.--P. stonehousensis in known from localities E1, E4, and E8 in the Arisaig area in the Stonehouse Formation of Gedinnian and possibly Skala age.

Holotype.--Specimen 464116.

Suborder Rhynchonelloidea Moore, 1952

Genus Plagiorhyncha McLearn, 1918

Type species.-- Rhynchonella glassi Davidson, 1884, A Monograph of the British Fossil Brachiopoda, Vol. V, Silurian and Devonian Supplements, p. 155, pl. 10, figs. 22, 22a. (=Atrypa depressa Sowerby, 1839 (nomen nudum), in Murchison, The Silurian System, part II, p. 629, pl. 13, fig. 6).

Species assigned.--
Rhynchonella glassi Davidson, 1884, ref. cit.
Atrypa analoga Wieniukow, 1899, Fauna siluriyskih otlozheniy Podolskoy gubernii, Mater. Geol. Russlands, 21, p. 120-122, pl. I, fig. 16; pl. VII, figs. 13, 17.
Atrypa analoga (Wieniukow) Nikiforova, 1954, Stratigraphic Scheme of the Silurian of Podolia, Mater. VSEGEI, p. 119-121, pl. XIII, figs. 6-9.
Terebratula thisbe, Barrande, 1847, Uber die Brachiopoden der silurischen Schichten von Bohmen, I., Naturwissenschaftliche Abhandlungen, Band 1, p. 63, pl. XVL, fig. 4.
Plagiorhyncha decemplicata McLearn, 1924 non Sowerby 1839, G.S.C. Mem. 137, pp. 77, 78, pl. VIII, figs. 1-4.
Plagiorhyncha plastica McLearn, 1924, op. cit., p. 78, pl. VIII, figs. 6-7, non 5, 33; pl. XXVIII, fig. 11.
Plagiorhyncha plastica var. media McLearn, 1924, op. cit, p. 78, 79, pl. VIII, figs. 8, 9.
Plagiorhyncha glassi (Davidson), McLearn, 1924, op. cit., pp. 79, 80, pl. VIII, figs 10-17, 36; pl. XXIX, fig. 2.
Plagiorhyncha thisbe (Barrande), Havlicek, 1961, Rhynchonelloidea des bohmischen alteren Palaozoikums (Brachiopoda), pp. 54, 55, pl. V, figs. 3-7.

Species assigned questionably.--
Terebratula niobe Barrande, 1847, op. cit., p. 78, pl. XVII, fig. 9.
Plagiorhyncha niobe (Barrande), Havlicek, 1961, op. cit., pp. 55-7, pl. V. figs. 1, 2.

Species rejected.--
Terebratula decemplicata Sowerby, 1839, in Murchison, The Silurian System, p. 641, pl. 21, fig. 17.
Terebrautula monaca Barrande, 1847, op. cit., p. 94, pl. XVII, fig. 4.
Plagiorhyncha monaca (Barrande), Havlicek, 1961, op. cit., pp. 57-8, pl. V, fig. 8.

Description.--The valves are equally biconvex or unequally biconvex with the brachial valve the more convex; and subcircular in outline, or pentagonal in outline with

rounded margins. The margins of the pedicle valve are commonly deflected ventrally. There is a sulcus in the pedicle valve and a corresponding fold in the brachial valve. The sulcus usually bears one to three rounded plications (generally only one) and the fold usually bears two to four corresponding plications. The fold and sulcus may lack plications. The valves may be marked by one to five plications on each side of the fold and sulcus, or may lack plications lateral to the fold and sulcus. The valves may be marked by fine costellae in addition to the plications. The teeth are small and unsupported by dental plates. The well impressed pedicle muscle field is pentagonal in outline commonly with scalloped margins; the diductors completely enclose the small adductors. The cardinalia consist of a pair of hinge plates separated by a median groove, and supported by a very low median ridge; a pair of curved socket ridges which flank the hinge plates laterally and floor the sockets; crura which originate at the anteromedial margins of the hinge plates; and, usually, a small bilobed cardinal process. The low median ridge in the brachial valve extends anteriorly 1/2 to 3/4 the valve length and tapers in height anteriorly. The brachial muscle field consists of an anterior pair of adductors which are elongate oval or triangular in outline and a larger posterior pair of adductors which are elongate oval in outline.

Discussion.--*Plagiorhyncha* closely resembles the related early Devonian North American genera *Costellirostra* (Cooper, 1942) and *Eatonia* (Hall, 1857) in its shape, outline, pedicle muscle field and brachial muscle field, and in lacking dental plates. *Costellirostra* has finely striate ornament similar to that in certain species of *Plagiorhyncha*. However, both *Costellirostra* and *Eatonia* have a ponderous bilobed cardinal process, and *Plagiorhyncha* has a minute cardinal process or lacks a cardinal process. The two Devonian genera have a prominent median septum in both valves; *Plagiorhyncha* has a median ridge in the brachial valve which is much lower than the septa in the Devonian genera and has only a faint myophragm in the pedical valve. *Plagiorhyncha* is considered by the author to be the probable ancestor of *Costellirostra* and *Eatonia*.

It is possible that "*Rhynchonella*" *pila* (Schnur, 1853) from the Emsian of Germany is related to *Plagiorhyncha*, which it resembles in ornament. In shape, outline, and internal features, however, the species resembles *Uncinulus*, Bayle, 1878 and the author tends to agree with Havlicek (1961, p. 140) in assigning "*R.*" *pila* to *Uncinulus*.

It is not clear from the illustrations in Havlicek (1961, pl. V, figs. 1, 2) whether or not *Terebratula niobe* (Barrande, 1847) from the Liten beds of Silurian age in Bohemia is a *Plagiorhyncha*. Barrande's original reference to the species was not available for study.

McLearn assigned Terebratula decemplicata (Sowerby, 1839) from the upper Llandovery of the Malvern Hills, England to Plagiorhyncha and included some of the Arisaig forms in this species. The author has studied topotype material of this species and finds that it is a camarotoechid with dental plates which is very similar to "Camarotoechia" bimesiornata (McLearn, 1924).

Havlicek assigned Terebratula monaca (Barrande, 1847), from beds of Silurian age belonging either to the Liten beds or the Kopanina beds in Bohemia, to Plagiorhyncha. The author rejects this species from Plagiorhyncha because it has a subtriangular outline which strongly contrasts with the subpentagonal to subcircular outline of Plagiorhyncha.

Plagiorhyncha aff. P. glassi (Davidson, 1884)

Plate XXII, figs. 1-15.

1924. Plagiorhyncha decemplicata McLearn, 1924 non Sowerby, 1839, G.S.C. Mem. 137, pp. 77, 78, pl. VIII, figs. 1-4.

1924. Plagiorhyncha glassi (Davidson), McLearn, 1924, op. cit. p. 79, 80, pl. VIII, figs. 10-17, 36; pl. XXIX, fig. 2.

Diagnosis.--Plagiorhyncha with moderately deeply impressed pedicle muscle field; a single rounded plication in the sulcus of the pedicle valve; two rounded plications separated by a rounded interplication of about the same width in the fold of the brachial valve; and flanks of the valves lateral to the fold and sulcus which may be smooth, or may bear from one to five plications on each side.

Description.

Exterior.--The pedicle valve is gently convex, the brachial valve varies from gently convex to strongly convex, and is almost always more strongly convex than the pedicle valve. The valves are subpentagonal in outline with rounded margins. The greatest width occurring at midlength or slightly posterior to it. The lateral margins of the pedicle valve are commonly deflected ventrally. The posterolateral margins of many of the brachial valves are flattened and curve concave dorsally. The hinge line is equal to about 1/3 the width. The length varies from 4/5 the width to slightly greater than

the width. The lateral and anterior commissures may be crenulate or smooth; the anterior commissure is strongly sulcate. The pedicle interarea extends anterolaterally from the apex to about midlength on each side of the valve and tapers in height anteriorly. Each half of the interarea lateral to the median line is flat and apsacline. The delthyrium is triangular, broadly rounded at the apex and intercepts an angle of about 150°. No interarea is developed in the brachial valve. The pedicle valve has a broad sulcus which intercepts an angle of 20° - 35° at the apex and which bears a single rounded median plication. The brachial valve has a corresponding fold which bears two rounded plications separated by a rounded interplication of about the same width. Both the fold and sulcus increase in height anteriorly and are rounded to subrectangular in cross section. The valves of some specimens bear 1 - 5 lateral plications on either side of the fold and sulcus; other specimens have valves which are completely smooth lateral to the fold and sulcus. The lateral plications, when present, are rounded in cross section, and are separated by interplications which are rounded in cross section and equal in width to the plications. The lateral plications vary from very coarse to very faint. All intergrades are present between specimens with coarse plications lateral to the fold and sulcus, and specimens which have valves that are smooth lateral to the fold and

sulcus.

Interior pedicle valve.--The teeth are minute, circular in outline, and situated at the base of the delthyrium. They are unsupported by dental plates. The delthyrial cavity is occupied by a low pedicle callist. The muscle field is well impressed, pentagonal in outline, and extends anteriorly slightly less than 1/2 the valve length. The diductor scars are curved at their posterior end and completely enclose the small elongate oval adductor scars which are confined to the posterior half of the muscle field. On some specimens a small pit occurs adjacent and anterior to the adductor scars. The diductor scars commonly bear ridges which extend anterolaterally. The margins of the muscle fields bearing such ridges are scalloped. On specimens bearing lateral plications, the internal surface is marked by the impress of the external ornament which extends inwards as far as the muscle field. On a few of the specimens studied, two pair of pallial marks extend anterolaterally from the anterior margin of the muscle field for a short distance.

Interior brachial valve.--The cardinalia consist of a pair of hinge plates separated by a median groove, and supported by a very low median ridge; a pair of curved socket ridges which flank the hinge plates laterally; crura; and, in some cases, a cardinal process. The median ridge extends anteriorly 1/2 to 3/4 the length of the

valve and tapers in height anteriorly. The crura originate at the anteromedial margins of the hinge plates. The cardinal process, when present, consists of two minute oval lobes, one on each side of the median groove, with ventrally directed attachment faces. The sockets are triangular in outline, rounded at their base, bounded medially by the hinge plates, and bounded dorsally by the curved socket ridges. The muscle field consists of two pair of adductors - a posterior pair which are triangular to oval in outline, and an anterior pair which are elongate oval in outline and larger than the posterior pair. On specimens which bear lateral plications, the internal surface is marked by the impress of the external ornament which extends posteriorly to the muscle field.

Discussion.--P. aff. P. glassi appears to differ from P. glassi in external ornament. Sowerby (1839, pl. 13, fig. 6) and Davidson (1884, pl. 10, figs. 22, 22a) illustrate P. glassi as having ornament consisting of fine costellae and P. aff. P. glassi lacks fine costellae. However, as no specimens of P. glassi were available, the author could not establish whether or not P. glassi actually has fine costellae.

P. aff. P. glassi differs from both P. thisbe from the Kopanina beds of Silurian age in Bohemia and P. analoga from the Kitaygorod Formation of late Llandovery age of Podolia in having a single plication in the sulcus

and two plications on the fold. P. thisbe may have as many as 4 plications in the sulcus. P. analoga may have as many as 2 plications in the sulcus.

Occurrence.--P. aff. P. glassi occurs in the middle member of the Ross Brook Formation of late Llandovery (C_3 - C_5) age at localities MCK7, B1 and B2 in the Arisaig area; at localities A20, 040, and ES5 in Pictou Co.; and at localities GSC17057 and GSC44968 in the Cobequid mountains. It occurs in the upper member of the Ross Brook Formation of late Llandovery (C_6) or low Wenlock age at localities B3, B4, and B6 in the Arisaig area; and at localities UE5, F16, ES1A, DF38, DF45, DF46, DF48, DF49, and DF50 in Pictou Co.

Plagiorhyncha plastica (McLearn, 1924)

1924. Plagiorhyncha plastica, McLearn, G.S.C. Memoir 137, p. 78, pl. VIII, figs. 6, 7 non 5, 33; pl. XXVIII, fig. 11.

1924. Plagiorhyncha plastica var. media, McLearn, op. cit., p. 78, 79, pl. VIII, figs. 8, 9.

Description.--Only four specimens (Peabody Museum spec. #453, 454, 455 and 456) were available for study. Specimens 453, 454, and 456 are badly compressed and broken. They show a fold in the brachial valve and a sulcus in the pedicle valve and an ornament of both plications and fine costellae. Specimen 455, a brachial valve, is not badly distorted and shows a pentagonal outline with rounded margins.

Occurrence.--McLearn reports this species only from the Arisaig shore section at the mouth of Arisaig Brook. It is not clear whether McLearn's specimens come from the middle member of the Ross Brook Formation of late Llandovery (C_3 - C_5) age or the upper member of this formation of late Llandovery (C_6) or Wenlock age.

Plagiorhyncha cf. P. plastica (McLearn, 1924)

Plate XXII, figs. 16-20.

Diagnosis.--Plagiorhyncha with very deeply impressed pedicle muscle field; usually with a single rounded plication in the sulcus of the pedicle valve, and two rounded plications separated by a rounded interplication of about the same width in the fold of the brachial valve; and commonly with two to five plications on each side of the fold and sulcus. The plications tend to die out anteriorly. The valves are marked by costellae which are much finer than the plications.

Description.

Exterior.--The valves are equally biconvex, or unequally biconvex with the pedicle valve more convex than the brachial valve; subpentagonal in outline with rounded margins; 1/2 to 9/10 as long as wide and widest at midlength or slightly anterior to midlength. The lateral margins of the pedicle valve are deflected ventrally in most specimens. The posterolateral margins of the brachial valve are commonly flattened and curve concave outwards. The pedicle valve bears a broad low rounded sulcus, and the brachial valve bears a corresponding fold. Both valves are marked by fine rounded costellae which are separated by rounded interspaces of about the same width. The sulcus usually bears a single median plication; the

fold usually bears two plications separated by a median interplication corresponding to the plication on the sulcus; and the valves are commonly marked by two to five plications on each side of the fold and sulcus. These plications are much coarser than the costellae and tend to die out along the periphery of large specimens. They are separated by interplications of about the same width. Some specimens lack plications on the fold and sulcus; others lack plications lateral to the fold and sulcus; and a few lack plications entirely. The costellae are invariably present, however. The pedicle interarea extends anterolaterally on each side of the valve from the apex to about midlength and decreases in height anteriorly. The interarea is flat and apsacline on each side of the median line. The delthyrium is triangular, broadly rounded at the apex, and intercepts an angle of about 150°. No interarea is developed in the brachial valve.

Interior pedicle valve.--The teeth are minute, circular in outline, situated at the bases of the lateral margins of the delthyrium, and are unsupported by dental plates. The delthyrial cavity is floored by a broad pedicle callist. The muscle field is very deeply impressed, and pentagonal in outline with scalloped margins. It extends anteriorly to about midlength, and may be bounded laterally and anteriorly by a low ridge. The diductor

scars bear numerous anterolaterally diverging ridges; they are rounded at their anterior end and completely enclose the well impressed oval adductors which are situated in the median 1/3 of the muscle field. The internal surface is marked by the impress of the plications which extend posteriorly to the muscle field.

Interior brachial valve.--The cardinalia consist of a pair of hinge plates separated by a median groove, and supported by a very low median ridge, a bilobed cardinal process, crura, and a pair of curved socket ridges which extend laterally from the hinge plates to the valve margins. The median ridge extends anteriorly 1/2 to 3/4 the length of the valve and tapers in height anteriorly. The cardinal process lobes are oval in outline with flat, ventrally directed attachment faces. The crura originate from the anteromedial margins of the hinge plates. The sockets are bounded medially by the hinge plates and dorsally by the curved socket ridges. They are rounded at their base and triangular in outline. The median ridge is flanked laterally by two pairs of adductors. One pair is triangular to elongate oval in outline and confined to the posterior half of the valve. The second pair is situated anterior and adjacent to the first pair and elongate oval in outline and somewhat larger than the first pair. The internal surface is marked by the impress of the plications which may extend posteriorly as far as

the posterior 1/4 of the valve.

Discussion.--P. cf. P. plastica may be conspecific with P. plastica but, since no specimens of the latter which show the internal structures are available, this cannot be established. It is identical to P. plastica in ornament. P. cf. P. plastica may possibly be related to P. glassi but this cannot be established either, as no specimens of P. glassi are available.

P. cf. P. plastica differs from P. aff. P. glassi in having an ornament consisting of plications which tend to die out anteriorly and costellae; and in having a much more deeply impressed pedicle muscle field. P. aff. P. glassi has plications which increase in height anteriorly and lacks costellae.

P. cf. P. plastica differs from both P. thisbe from the Kopanina beds of Silurian age in Bohemia and P. analoga from the Kitaygorod Formation of late Llandovery age of Podolia in having an ornament consisting of costellae and plications which tend to die out anteriorly. The latter two genera have plications which increase in height anteriorly and lack costellae. P. cf. P. plastica either has one plication in the fold and two in the sulcus or lacks plications in the fold and sulcus. P. thisbe may have as many as four plications in the sulcus. P. analoga may have as many as two plications in the sulcus.

Occurrence.--P. cf. P. plastica is known from the

French River Formation of late Llandovery (C_6) or low Wenlock age at localities FR22, DF13, DF15, DF16, and DF17 in Pictou Co.; and localities MCK4, MCK6, MCK60, SZ3, and Z40 in Pictou Co.

Plagiorhyncha sp. A

Diagnosis.--Plagiorhyncha ornamented by coarse costellae which increase by bifurcation and insertion.

Description.

Exterior.--The valves unequally biconvex with the brachial valve more convex than the pedicle valve, subpentagonal in outline with rounded margins. The length varies from 4/5 the width to slightly greater than the width. The pedicle valve bears a faint sulcus and the brachial valve bears a faint fold. The lateral margins of the pedicle valve are deflected ventrally on large specimens. The valves are marked by rounded coarse costellae which increase by bifurcation or insertion, and are separated by rounded interspaces of about the same width. Twenty to eighty costellae are present along the periphery at a length of one cm. On some specimens, the costellae die out at the periphery and are replaced by fine striae.

Interior pedicle valve.--Only one poorly preserved pedicle interior was available for study. It has a faintly impressed, flabellate muscle field which extends anteriorly 2/5 the length of the valve. The diductors completely enclose the adductors. The teeth are small, separated by a distance equal to 1/3 the maximum width, and unsupported by dental plates.

Interior brachial valve.--The brachial cardinalia and muscle field were not preserved on any of the specimens studied. A low median ridge extends anteriorly from the apex 1/2 to 3/4 the valve length.

Discussion.--Plagiorhyncha sp. A differs from the other species assigned to Plagiorhyncha in having an ornament consisting of coarse costellae, which increase by bifurcation and insertion. P. plastica and P. cf. P. plastica have an ornament consisting of both coarse unbranching plications and costellae; the costellae of these species are much finer than that of P. sp. A. P. cf. glassi, P. thisbe and P. analoga all have an ornament of coarse unbranched plications; the costellae of P. sp. A are much finer than the plications in these species.

Distribution.--P. sp. A is known only from the McAdam Formation in member 3 of Ludlow age at locality C4, and in member 2 of Wenlock or Ludlow age at locality MCK32.

Genus Eatonioides McLearn, 1918

Type species.--Eatonioides lamellornatus McLearn, 1918 Am. Jour. Sci. 45, p. 138.

Species assigned.--E. lamellornatus McLearn, 1918.
Species rejected.--Eatonioides westoni McLearn, 1924, G.S.C. Mem. 137, p. 74.

Discussion.--Eatonioides grossly resembles Eatonia Hall, 1857, from beds of New Scotland to Oriskany age of eastern North America, in its external form. However, Eatonia lacks the lamellose growth lines of Eatonioides and is ornamented by both plications and very fine costellae. Internally Eatonia has a median septum in the pedicle valve; and a ponderous bilobed cardinal process, and a well impressed muscle field in the brachial valve. These features are lacking in Eatonioides. As mentioned above, the author considers that both Eatonia and the closely related genus Costellirostra Cooper, 1942 were probably derived from Plagiorhyncha McLearn, 1918. Eatonioides differs markedly from Plagiorhyncha and is clearly not closely related to it. Hence, it appears that Eatonia and Eatonioides are best regarded as external homeomorphs.

"Eatonioides" westoni McLearn, 1924 does not belong to Eatonioides as the holotype has dental plates and lacks a median septum.

Eatonioides lamellornatus (McLearn, 1918)

Plate XXVI, figs. 1-7.

1918. Eatonioides lamellornatus McLearn, Am. Jour. Sci. 45, p. 138.
1924. Eatonioides lamellornatus McLearn, G.S.C. Mem. 137, p. 75, pl. VII, figs. 22-31; pl. VIII, figs. 34-35; pl. XXX, fig. 1.

Description.

Exterior.--The valves are large (up to 3 cm. wide), pentagonal in outline with rounded lateral margins and the greatest width at midlength or in the posterior half of the valve. The valves vary from 2/3 as long as wide to as long as wide. The pedicle valve is very gently convex and bears a deep, wide sulcus; the sulcus is rectangular in cross-section with rounded margins and originates at a point 5 to 10 mm. from the apex. The brachial valve is deeply convex and bears a fold corresponding to the brachial sulcus. The anterior commissure is crenulate and deeply sulcate. The cardinal margins are flat and divided by a triangular open delthyrium. The valves are marked by 8 to 12 angular unbranched plications and by lamellose growth lines. The plications are separated by angular interplications of about the same width. The sulcus bears three plications and the fold bears four plications; two to four plications occur on each side of the fold and sulcus.

Interior pedicle valve.--The muscle field is deeply impressed, circular to elongate oval in outline, as wide as long to slightly longer than wide; it extends anteriorly

to 1/2 to 3/4 the valve length. The diductor scars, when impressed, are elongate oval in outline, confined to the posterior half of the field, divided by a narrow myophragm, and completely enclosed by the diductor scars. The teeth are stout, rounded, and unsupported by dental lamellae. A low pedicle callist occupies the delthyrial cavity. The internal surface is marked by the impress of the plications and the growth lamellae peripheral to the muscle field; in some cases, the muscle field is also marked by the impress of the plications.

Interior brachial valve.--The cardinalia consists of a pair of discrete hinge plates which are supported medially by a septalium. The hinge plates are triangular in outline and slightly concave on their ventral surface. The crura originate from the anteromedial edge of the hinge plates and extend anteriorly about in the plane of commissure. The sockets are deep, rounded at their base, and anterolaterally divergent. They are bounded medially by the hinge plates and laterally by the margin of the valve. The median septum is thickened at its posterior end and tapers in width and height anteriorly; it extends anteriorly 1/3 to 1/2 the valve length. The muscle field is not impressed. The internal surface is marked by the impress of the plications along most of their extent and by the impress of the growth lamellae.

Occurrence.--E. lamellornatus occurs in the Moydart

Formation of Ludlow age at locality D-3 in the Arisaig area; at locality F-3 in the Cape George area; localities 74 and 3A in the Lochaber area; and localities DT1 and DT20 in Pictou Co.

Genus Camarotoechia Hall and Clarke, 1893

Type species.--Atrypa congregata Conrad, 1841, Ann. Rept. Geol. Surv. N. Y., v. 5, p. 55.

Discussion.--Silurian and Devonian rhynchonellids are very poorly known. A number of genera have been proposed but the relationships of these genera to each other are not well understood. For this reason, it is difficult to decide what characters of the proposed genera should be considered diagnostic. The rhynchonellid species of the Arisaig series which are assigned to "Camarotoechia" (sensu lato) in this report will, undoubtably, have to be reassigned to other genera when the rhynchonellids are better understood at the generic level.

"Camarotoechia" bimesiornata (McLearn, 1924)

Plate XXIII, Figs. 3-10.

1924. Camarotoechia bimesiornata, McLearn, G.S.C. Memoir 137, p. 69, pl. V, figs. 1-5; pl. XXX, fig. 9.

Description.

Exterior.--The valves are subequally biconvex, subrectangular to oval in outline, and may be transverse or elongate. The anterior commissure is crenulate and rectimarginate. The pedicle valve has a prominent rounded sulcus which bears a single median plication; the brachial valve has a corresponding fold which bears two plications separated by a narrow interplication. Three to six low rounded plications separated by interplications of about the same width occur on each side of the fold and sulcus. The

plications on the fold in the brachial valve are wider than those on the flanks. The plications which bound the sulcus in the pedicle valve are wider than the median plication and wider than the plications on the flanks. The valves are marked by fine growth lines.

Interior pedicle valve.--The small teeth are supported by short dental plates. The delthyrial cavity bears a low pedicle callist. The muscle field is only rarely impressed; when present it is narrow, triangular in outline and confined to the anterior half of the valve. The internal surface is marked by the impress of the costellae along most of their extent.

Interior brachial valve.--The cardinalia consist of flat discrete hinge plates which are triangular in outline and separated by a narrow groove. The crura originate from the anteromedial edges of the hinge plates. The sockets are anterolaterally directed, bounded medially by the hinge plates, and bounded laterally by the valve margins. A myophragm extends anteriorly from the hinge plates to about midlength. The adductor scars are narrow and semi-oval in outline. The internal surface is marked by the impress of the external ornament as in the pedicle valve.

Discussion.--"C." bimesiornata is very similar in shape, outline, ornament and internal features to "C." decemplicata Sowerby, 1839 from the Cowleigh Park beds of upper Llandovery (C_3 or older) age in the Malvern Hills

district of the Welsh borderland. The two species differ primarily in that "C." bimesiornata has 3 to 6 plications on each side of the fold and sulcus and "C." decemplicata may have as many as 8 plications on each side.

Occurrence.--"C." bimesiornata is known from the Beechhill Cove Formation of early Llandovery age at localities A-2, A-3, and A-4 in the Arisaig area; and localities FP16, DW1, A-11 and AV1 in Pictou Co. It is known from the Glencoe Brook Formation of early Llandovery age at locality FT5.

Camarotoechia rossonia (McLearn, 1924)

Plate XXIII, Figs. 11-15, Plate XXIV, Fig. 1

1924. Camarotoechia llandoveriana var. rossonia McLearn, p. 70, pl. V, figs. 12-14; pl. X, fig. 9.

Description.

Exterior.--The valves are subequally biconvex, pentagonal in outline, widest at midlength or in the anterior half of the valve and vary from 3/4 as wide as long to 3/4 as long as wide. The pedicle valve bears a broad sulcus which originates some distance anterior to the beak and is rectangular in cross section; the brachial valve bears a corresponding fold. The valves are marked by 30 to 40 fine angular plications separated by angular interplications of about the same width. Five to eight plications are present on the fold and on the sulcus. The anterior commissure is crenulate and uniplicate.

Interior pedicle valve.--The small teeth are supported by short dental plates. The faintly impressed muscle field consists of narrow oval diductors separated by a low myophragm; it extends anteriorly 1/3 to 1/2 the valve length. The delthyrial cavity bears a low pedicle callist. The internal surface is marked by the impress of the external ornament except at the apex of the valve.

Interior brachial valve.--The cardinalia consist of flat discrete hinge plates supported medially by a septalium. The median septum extends to midlength and is flanked at its anterior end by the elongate oval adductor scars. The

sockets are narrow and diverge posterolaterally. The internal surface is marked by the impress of the external ornament as in the pedicle valve.

Discussion.--"C." rossonia is very likely conspecific with "C." llandoveriana Davidson, 1867, from the upper Llandovery of Wales and the Welsh borderland, which it resembles in shape, outline and ornament.

"C." rossonia differs from the other species of "Camarotoechia" found in the Arisaig series in having finer and more numerous plications.

Occurrence.--"C." rossonia is known from the middle member of the Ross Brook Formation of late Llandovery (C_3 - C_5) age at localities B-2 and MCK7 in the Arisaig area and locality ME60 in Pictou Co. It is known also from the upper member of the Ross Brook Formation of late Llandovery (C_6) or early Wenlock age at localities B-3, B-4 and B-5 in the Arisaig area and localities DF36 and DF38 in Pictou Co.

"Camarotoechia" westoni (McLearn, 1924)

Plate XXIV, Figs. 4-10.

1924. Eatonioides westoni McLearn, G.S.C. Memoir 137, pl. VII, figs. 16, 17, 21; pl. XXX, Figs. 4, 7.

Description.

Exterior.--The valves are subequally biconvex, subcircular to pentagonal in outline, about as wide as long and widest at midlength or slightly anterior to it. The anterior commissure is crenulate and rectimarginate. The pedicle valve bears a prominent sulcus which originates anterior to the apex; the brachial valve bears a corresponding fold. The valves are marked by 14 to 18 uniform, straight, angular plications separated by angular interplications of about the same width. Three plications occur on the sulcus and four plications occur on the fold.

Interior pedicle valve.--The teeth are supported by very short dental plates. The delthyrial cavity bears a low pedicle callist. The muscle field is oval in outline, about as wide as long, and extends almost to midlength. The oval diductor scars enclose the elongate oval adductor scars which are confined to the posterior half of the muscle field. The internal surface is marked by the impress of the external ornament peripheral to the muscle field.

Interior brachial valve.--The cardinalia consist of broad hinge plates which curve posteriorly and are supported medially by a septalium. The crura originate from the anteromedial margins of the hinge plates. The sockets are

bounded posteriorly by the margin of the valve. The median septum merges anteriorly with the median plication on the exterior of the valve. The internal surface is marked by the impress of the plications except in the central part of the posterior half of the valve.

Discussion.--McLearn assigned "C." westoni to Eatonioides. However, it lacks the imbricating growth lamellae characteristic of Eatonioides & has dental plates whereas these are lacking in Eatonioides. "C." westoni further differs from Eatonioides in its smaller size and in being subequally biconvex. Eatonioides has a relatively flat pedicle valve and a strongly convex brachial valve.

"C." westoni differs from "C." bimesiornata in having three plications on the sulcus and four on the fold which are about the same width as those on the flanks. "C." bimesiornata has one plication on the sulcus and two on the the fold which are broader than those on the flanks.

Occurrence.-- "C." westoni is known from the lower member of the McAdam Formation of Wenlock or Ludlow age at locality HA5A in Pictou Co. and locality KAR-63-115F in the Cobequid Mountains. It is known from Member 2 of the McAdam Formation at locality C-2 and C-3 in the Arisaig area and localities HAF and DT23 in Pictou Co. It occurs in member 3 of the McAdam Formation of Ludlow age at locality C-4 in the Arisaig area.

"Camarotoechia" sp. aff. "C." planorugosa (McLearn, 1924)

Plate XXIV, Figs. 11, 12; Plate XXVII, Figs. 3a-c.

Description.

Exterior.--The valves are subequally biconvex, pentagonal in outline, and widest in the posterior half of the valve. The anterior commissure is crenulate and uniplicate. The pedicle valve bears a prominent sulcus and the brachial valve bears a corresponding fold. The valves are marked by 12 to 14 angular plications separated by interplications of about the same width. Three plications occur on the sulcus and four on the fold.

Interior pedicle valve.--The teeth are supported by short, slightly divergent dental plates. The delthyrial cavity bears a low pedicle callist. The muscle field was not impressed on any of the specimens studied. The internal surface is marked by the impress of the plications except in the delthyrial cavity.

Interior brachial valve.--The discrete hinge plates are flat and supported by a septalium. The median septum extends to about midlength. The sockets are anterolaterally directed and rounded at their base. The internal surface is marked by the impress of the plications along most of their extent.

Discussion.--"C." sp. aff. "C." planorugosa closely resembles C. planorugosa in shape, ornament and internal features. The two species differ slightly in outline.

The lateral margins of "C." planorugosa extend anteromedially from the widest part of the valve; those of "C." sp. are about parallel in the anterior half of the valve.

"C." sp. aff. "C." planorugosa differs from "C." westoni in its smaller size and in having longer dental plates. The pedicle muscle field is not impressed in the former whereas it is impressed in specimens of "C." westoni of comparable size.

Occurrence.--"C." sp. aff. "C." planorugosa is known from member 1 of the McAdam Formation of Wenlock or Ludlow age at localities MCK49 and C-1 in the Arisaig area and DT12 and I06 in Pictou Co. It is known from member 2 of the McAdam Formation of Wenlock or Ludlow age at locality C-2 in the Arisaig area and locality HAF in Pictou Co. It is known from member 3 of the McAdam Formation of Ludlow age at locality C-4 in the Arisaig area.

"C." sp. aff. "C." planorugosa occurs in the Moydart Formation of Ludlow age at localities D-2, SB-4 and SB-6 in the Arisaig area and localities DM13 and SR101B in Pictou Co.

"Camarotoechia" squamifera (McLearn, 1924)

Plate XXV, Figs. 9-13.

1924. Camarotoechia squamifera McLearn, G.S.C. Mem. 137, pp. 71-2, pl. V, Figs. 23-27; pl. XXVIII, fig. 7.

Exterior.--The valves are biconvex with the brachial valve more convex than the pedicle valve. The pedicle valve is pentagonal in outline with curved lateral margins, the brachial valve is transversely oval in outline. The pedicle valve varies from 4/5 as long to as long as wide, the brachial valve varies from 3/4 as long as wide to slightly wider than long. The greatest width is about at midlength. The anterior commissure is crenulate and deeply sulcate. The pedicle valve has a sulcus that originates at about 5 to 8 mm from the apex, is rectangular and crenulate in cross section, and deepens anteriorly. The brachial valve has a corresponding fold. The pecidle beak overhangs the brachial valve and is directed posteriorly. The valves are each marked by 16 to 26 uniform plications which are rounded in cross section and separated by interplications of equal width. The plications and interplications increase in width anteriorly. The sulcus bears 3 to 5 plications, the fold bears 4 to 6 plications. The sulcus bears a plication along its midline, the fold bears an interplication along its midline. The valves are marked by numerous lamellose growth lines.

Interior pedicle valve.--The teeth are supported by

short dental plates. The delthyrial cavity bears a pedicle callist. The muscle field extends slightly anterior to midlength and is slightly longer than wide. The diductor scars are oval in outline and enclose the small oval adductor scars which are confined to the median 1/3 of the muscle field. The internal surface is marked by the impress of the external ornament peripheral to the delthyrial cavity.

Interior brachial valve.--The cardinalia consist of flat discrete hinge plates supported by a septalium. The median septum extends to about midlength. The sockets diverge anterolaterally and are rounded at their base. The internal surface is marked by the impress of the external ornament as in the pedicle valve.

Comparison.--"C." squamifera differs from the other species in the Arisaig series assigned to "Camarotoechia" in having lamellose growth lines.

Occurrence.--"C." squamifera is known from the Moydart Formation of Ludlow age at localities D-1 and D-2 in the Arisaig area. It occurs in the Cape George area in the unnamed quartzite correlative with the Moydart Formation at locality F-17.

"Camarotoechia" moydartensis (McLearn, 1924)

Plate XXVII, Figs. 1a-c.

1924. Camarotoechia nucula mut. moydartensis McLearn, G.S.C. Memoir 137, p. 70, pl. V, figs. 9-11.

Description.

Exterior.--The valves are unequally biconvex with the brachial valve more convex than the pedicle valve, about as wide as long, and globose. The anterior commissure is crenulate and uniplicate. The pedicle valve bears a low sulcus and the brachial valve a corresponding fold. The valves are marked by fourteen angular plications separated by angular interplications of about the same width. Three plications occur on the fold and four on the sulcus. The plications on the fold and sulcus are somewhat larger than those on the flanks.

Discussion.--The above description is based on the holotype, G.S.C. specimen #5429 from the Moydart Formation in the shore section in the Arisaig area. No specimens resembling the holotype were found in any of the collections from the Moydart Formation studied by the author. The holotype resembles specimens of "C." glomerosa in ornament but is somewhat more globose than the latter.

Occurrence.--McLearn (1924, p. 70) reports this species as common in the Moydart Formation. However, the present author did not find it in any of the collections of the Moydart Formation studied. The holotype is listed as coming from the Moydart Formation, shore section, Arisaig.

"Camarotoechia" planorugosa (McLearn, 1924)

Plate XXVII, Figs. 4a,b.

1924. Camarotoechia nucula var. planorugosa McLearn, G.S.C. Memoir 137, p. 69, pl. V, figs. 6-8.

Description.

Exterior.--The valves are subequally biconvex, pentagonal in outline, and widest about midlength. The anterior commissure is crenulate and uniplicate. The pedicle valve has a prominent sulcus which bears 3 angular plications; the brachial valve has a corresponding fold which bears 4 angular plications. Four to six angular plications separated by interplications of about the same width occur lateral to the fold and sulcus.

Interior pedicle valve.--The teeth are supported by short dental plates. The delthyrial cavity bears a low pedicle callist. The muscle field is elongate, oval in outline, and confined to the posterior half of the valve. The internal surface is marked by the impress of the external ornament peripheral to the delthyrial cavity.

Interior brachial valve.--The cardinalia consists of discrete, flat hinge plates supported medially by a septalium. The median septum extends anteriorly to about midlength. The internal surface is marked by the impress of the plications along most of their extent.

Occurrence.--"C." planorugosa is known from the Stonehouse Formation of Gedinnian and possibly Skala age at localities E-1, E-2, E-3, E-4, E-5, E-6, E-8, MCK22, MCK26,

MCK27, MCK37, MCK39, MCK40, MCK50, MCK51, MCK53, MCK56 and NFA in the Arisaig area; localities LR1, LR2, LR8 and LR9 in Pictou Co.; localities F-15, F-18 and F-19 in the Cape George area; localities 11F, KAR-63-377F in the Cobequid Mountains and locality 361 in the Lochaber area.

"Camarotoechia" glomerosa (McLearn, 1924)

Plate XXVII, Figs. 2a-d.

1924. Camarotoechia glomerosa McLearn, G.S.C. Memoir 137, p. 71, pl. V, Figs. 15-19.
1924. (?) Camarotoechia marklandensis McLearn, op. cit., p. 71, pl. V, figs. 21, 22, non 20.

Description.

Exterior.--The valves are equally biconvex, slightly longer than wide, subelliptical in outline and widest at about midlength. The pedicle beak is incurved. The anterior commissure is crenulate and uniplicate. A low sulcus is present at the anterior end of large specimens and the brachial valve of large specimens bears a corresponding fold. The valves are marked by 15 to 20 angular plications separated by interplications of about the same width. Three plications occur on the sulcus and four on the fold. The plications on the fold and sulcus are about the same width as those on the flanks at the posterior end of the valves and expand in width to become wider than those on the flanks at the anterior end of the valves.

Interior pedicle valve.--The teeth are supported by short slightly divergent dental plates. The muscle field was not observed on any of the specimens studied. The internal surface is marked by the impress of the plications along most of their extent.

Interior brachial valve.--The cardinalia consists of discrete hinge plates supported by a septalium. The median septum extends to about midlength. The internal

surface is marked by the impress of the plications along most of their extent.

Discussion.--"C." glomerosa differs from "C." planorugosa in having plications in the fold and sulcus which are wider at their anterior end than the plications on the flanks. The plications of "C." planorugosa are uniform in width.

"C." marklandensis is based on two specimens. The holotype (Peabody Museum specimen #431), a brachial valve, is larger than the specimens of "C." glomerosa studied but resembles them in having four plications on the fold which are larger than those on the flanks; it is here assigned questionably to "C." glomerosa. (This specimen is illustrated on plate XXVII, Fig. 5.) The paratype G.S.C. specimen #5432, a poorly preserved pedicle valve, possibly belongs to "C." planorugosa.

Occurrence.--"C." glomerosa occurs in the Stonehouse Formation of Gedinnian and possibly Skala age in the shore section in the Arisaig area. The localities from which the available specimens were obtained are not known.

Genus Sphaerirhynchia Cooper and Muir-Wood, 1951

Type species.--Terebratula wilsoni Sowerby, 1816, Min. Conch., vol. 2, p. 38, pl. 118, fig. 3.

Sphaerirhynchia antigua (McLearn, 1924)

Plate XXIV, Figs. 2, 3.

1924. Pectorhyncha antigua, McLearn, G.S.C. Memoir 137, pp. 72-3, pl. VII, figs. 1-12; pl. XXIX, figs. 1-5.

Description.

Exterior.--The valves are equally biconvex, pentagonal in outline and often have geniculate anterior and lateral margins. They are about as wide as long and about 1/3 as deep as wide. The pedicle valve has a low sulcus which originates anterior to the umbo; the brachial valve has a corresponding fold. The pedicle beak is curved and directed dorsally. The valves are marked by 16 to 18 low rounded plications separated by low rounded interplications of about the same width; three plications are present in the sulcus and four in the fold. The anterior commissure is crenulate and gently to deeply sulcate.

Interior pedicle valve.--The small teeth are unsupported by dental plates. A prominent pedicle callist occupies the delthyrial cavity. The muscle field extends from the delthyrial cavity to about midlength, and is triangular in outline. The width of the muscle field at its anterior end is about equal to 1/2 of its length. The triangular diductor scars enclose the elongate oval adductor scars. The internal surface is marked by the impress of the plications

along most of their extent.

Interior brachial valve.--The flat hinge plates are supported by a low septalium which extends anteriorly to about midlength. The crura originate from the anteromedial margins of the hinge plates. The internal surface is marked by the impress of the plications as in the pedicle valve.

Discussion.--Sphaerirhynchia antigua is smaller than Sphaerirhynchia wilsoni from the Wenlock and Ludlow of of Wales and the Welsh borderland and has fewer plications.

Occurrence.--S. antigua is known from the Ross Brook Formation in the shore section in the Arisaig area. The specimens studied are in the Peabody Museum of Natural History. The locality from which they were obtained is not known.

Sphaerirhynchia sp.

Plate XXIV, figs. 13-17.

1924. Pectorhyncha obtusiplicata McLearn non Hall, p. 73, pl. VII, pl. XXIX, Fig. 3, pl. XXX, figs. 5, 8.

Description.

Exterior.--The valves are circular to elongate oval in outline, as long as wide or slightly longer than wide, and globose with a thickness about equal to the width. The brachial valve is deeper than the pedicle valve. The valves have flat lateral margins and develop geniculate anterior margins. The pedicle valve may bear a faint broad sulcus at its anterior end and the brachial valve a corresponding fold. The pedicle valve extends dorsally as a long tongue in the center of its geniculate margin. The anterior commissure is crenulate and bears a deep rectangular sulcus corresponding to the tongue of the pedicle valve. The valves are marked by 15 to 20 broad flat plications separated by relatively narrow interplications. The plications may bear a narrow groove at their anterior end. Three plications occur on the sulcus and four on the fold.

Interior pedicle valve.--The minute teeth are unsupported by dental plates. A low pedicle callist occupies the pedicle cavity. The muscle field is triangular in outline and divided by a low myophragm; it extends anteriorly 1/3 to 1/2 the valve length. The internal surface is marked by the impress of the plications peripheral to the muscle field.

Interior brachial valve.--The stout hinge plates are supported medially by a septalium. The median septum extends to about midlength and is greatly thickened by a plug of secondary material at its posterior end. The sockets are rounded at their base, bounded medially by the hinge plates and laterally by the valve margins. The crura originate from the anteromedial margins of the hinge plates. Most of the internal surface is marked by the impress of the external ornament.

Discussion.--McLearn (1918, p. 137; 1924, p. 173) considered the species here described to be conspecific with Atrypa obtusiplicata Hall, 1852 from the Lockport group of probable Wenlock age in New York which he made the type species of Pectorhyncha McLearn, 1918. Hall did not illustrate the interiors of Atrypa obtusiplicata and no specimens were available to the present author for study. The specimens of A. obtusiplicata illustrated by Hall (1852, pl. 58, Figs. 2a-h) differ from the species here described in having a much deeper fold and sulcus. As the species here described closely resembles Sphaerirhynchia sp. in shape, outline and most of its internal features it is assigned to Sphaerirhynchia sp. Its relationship to Pectorhyncha obtusiplicata cannot be established until the internal morphology of the latter species is known. It is possible that Pectorhyncha will replace Sphaerirhynchia when P. obtusiplicata is better known. The presence of a

deep fold and sulcus in P. obtusiplicata, however, makes this seem unlikely.

S. sp. differs from both S. wilsoni and S. antigua in having a median septum in the brachial valve which is greatly thickened by a plug of secondary material. It differs from S. wilsoni in having fewer plications.

Occurrence.--S. sp. is known from member 1 of the McAdam Formation of Wenlock or Ludlow age at localities MCK44, MCK47, MCK48, D15, D27, C, D and H in the Arisaig area; at localities HA7, DM7, DM8, I06 in Pictou Co. and locality KAR-63-115F in the Cobequid Mountains. It is known from member 2 of the McAdam Formation at locality C-2 in the Arisaig area and HAF in Pictou Co.

Sphaerirhynchia saffordi (Hall, 1860)

Plate XXV, Figs. 1-8.

1860. Rhynchonella saffordi Hall, Can. Nat. Geol. 5, p. 146.
1924. Wilsonia wilsoni var. saffordi (Hall), McLearn, G.S.C. Memoir 137, p. 75-6, pl. VIII, figs. 25-29.
1924. Wilsonia wilsoni mut. stonehousensis McLearn, ref. cit. p. 76, pl. VIII, fig. 32.

Description.

Exterior.--The valves are biconvex with the brachial valve more convex than the pedicle valve, oval in outline, widest at about midlength and vary from 5/6 as wide as long to slightly wider than long. They are globose; the thickness varies from slightly less than to equal to the width. The pedicle beak is incurved and directed ventrally. The lateral margins of the valve are flat and about perpendicular to the plane of commissure; the anterior margin becomes strongly geniculate. A faint broad sulcus rectangular in cross section is present at the anterior end of large specimens; the brachial valve of large specimens bears a corresponding fold. The pedicle valve projects dorsally as a long tongue in the center of the geniculate margin of large specimens. The anterior commissure is crenulate and, in large specimens, bears a deep rectangular sulcus corresponding to the tongue in the pedicle valve. The valves are marked by 24 to 28 flat rounded uniform plications separated by narrow grooves; the plications often bear a narrow groove at their anterior end. The fold and sulcus bear 5 to 10 plications.

Interior pedicle valve.--The teeth are minute and unsupported dental plates. A low pedicle callist occupies the pedicle cavity. The muscle field is suboval in outline, widest at midlength or anterior to midlength, 1/3 to 9/10 as wide as long and extends anteriorly 1/3 to 3/4 the valve length. The diductor scars are divided by a narrow myophragm. The adductor scars are confined to the posterior half of the muscle field and completely enclosed by the diductor scars; they are not always impressed. The pallial impressions consist of straight tracks which branch at their anterior end and give rise to curved lateral branches at their posterior end. The curved lateral branches extend posteriorly and give rise, in turn, to additional lateral branches. The internal surface is marked by the impress of the external ornament peripheral to the muscle field.

Interior brachial valve.--The cardinalia consists of flat hinge plates supported medially by a septalium. The median septum extends to midlength or slightly anterior to midlength and tapers in height anteriorly. Narrow elongate oval adductor scars are sometimes impressed. The small sockets are rounded at their base, bounded anteriorly by the hinge plates and posteriorly by the valve margin. The internal surface is marked by the impress of the plications along most of their extent.

Discussion.--S. saffordi differs from both S. antigua and S. sp. in having a greater number of plications, and in having a pedicle muscle field which is oval in outline in

contrast to the more triangular muscle fields of the latter two species. It lacks the posteriorly thickened median septum in the brachial valve characteristic of S. sp.

S. saffordi is very similar both internally and externally to S. wilsoni from the Wenlock and Ludlow of Wales and the Welsh Borderland and is very likely conspecific with it. However, as adequate comparative material is not available, a positive assignment cannot be made.

Distribution.--S. saffordi is known from the Moydart Formation of Ludlow age at localities D-2, MCK33, and X21 in the Arisaig area; and localities SR101B and DS6 in Pictou Co. It was found in the Cape George area in an unnamed quartzite which is correlative with the Moydart Formation, at locality F-12. McLearn, (1924, p. 76) described specimens from a boulder found on the shore at Arisaig near exposures of the Stonehouse Formation as Wilsonia wilsoni mut. stonehousensis. The author has studied these specimens and found them to belong to the species here described. As Sphaerirhynchia is not known in the Stonehouse Formation, the boulder from which the specimens came was probably derived from the Moydart Formation.

Suborder Retzioidea Boucot, Johnson and Staton, 1964

Superfamily Retziacea Waagen, 1883
(nom. transl. Boucot, Johnson and Staton, 1964
(ex Retziinae Waagen, 1883, p. 486)

Genus Rhynchospirina Schuchert and LeVene, 1929

Type species.--Waldheimia formosa Hall, 1857, p. 88.

Rhynchospirina sp. A.

Plate XXVII, Figs. 6-9, 18.

Description.

Exterior.--The valves are punctate, equally biconvex, and about as wide as long. The pedicle valve is pentagonal in outline with rounded margins; the brachial valve is circular in outline. A sulcus is present on the pedicle valve. The anterior commissure is crenulate and rectimarginate to very slightly uniplicate. The pedicle valve bears a single fine median plication in the sulcus and four coarse angular plications on each side which are separated by angular to rounded interplications of about the same width. The brachial valve bears ten angular to rounded plications separated by interspaces of about the same width. The surface is marked by fine growth lines.

Interior pedicle valve.--The teeth are supported by short dental lamellae. The muscle field is oval in outline and confined to the posterior half of the valve. It is not always impressed. The internal surface is marked by the impress of the plications over most of their extent.

Interior brachial valve.--The cardinal plate is broad

and extends ventrally into the pedicle umbonal cavity. A median septum extends anteriorly from the cardinal plate to about midlength. The sockets are rounded at their base, laterally divergent, and bounded medially and anteriorly by the cardinal plate. The muscle field is not impressed. The internal surface is marked by the impress of the plications as in the pedicle valve.

Discussion.--R. sp. A. resembles R. formosa from the New Scotland (upper Gedinnian) of New York in having a weak sulcus in the pedicle valve and in lacking a fold in the brachial valve. However, R. sp. A has fewer plications which are much coarser than those of the latter species.

Occurrence.--R. sp. A. occurs in the lower member of the McAdam Formation of Wenlock or Ludlow age at locality C-1 in the Arisaig area and locality HAT in Pictou Co. A few specimens belonging to this species were found in the Stonehouse Formation of Gedinnian and possibly Skala age at locality E-2 in the Arisaig area.

Rhynchospirina ? sp. B

Plate XXVII, Figs. 10-12.

Description.

Exterior.--The valves are punctate, subequally biconvex, subelliptical in outline, and vary from slightly wider than long th slightly longer than wide. The pedicle beak is strongly incurved. The anterior commissure is crenulate and sulcate. The pedicle valve bears a sulcus which may be faint or prominent; the brachial valve bears a faint fold. The valves are marked by 18 to 20 angular plications separated by interplications of about the same width. Three plications are present on the sulcus of the pedicle valve; these are finer than those occurring on the flanks.

Interior pedicle valve.--The stubby teeth are supported by short dental plates. The muscle field is circular to pentagonal in outline and confined to the umbonal cavity. A pair of tracks which diverge anterolaterally from the muscle field are commonly present. The internal surface is marked by the impress of the plications along most of their extent.

Interior brachial valve.--The cardinalia consists of discrete flat hinge plates. A low median septum extends anteriorly from the groove between the hinge plates to about midlength. The sockets are anterolaterally directed and bounded medially by the hinge plates. The external ornament is impressed as in the pedicle valve.

Discussion.--Rhynchospirina ? sp. B differs from the other species assigned to Rhynchospirina in having a pair of discrete hinge plates instead of a cardinal plate. It closely resembles R. formosa, the type species of Rhynchospirina, however, in external form and ornament and in its other internal features. A new genus of rhynchospirinid could be erected based on R. ? sp. B. and characterized by having discrete hinge plates. However, only 24 fragmental specimens of this species are available and the author does not consider this to be an adequate sample upon which to base a new genus.

Rhynchospirina ? sp. B. differs from species assigned to Homeospira Hall and Clarke, 1893 in having discrete hinge plates, and in lacking a cardinal process. Homeospira has a cardinal plate which is conjunct posteriorly and disjunct anteriorly, and has a cardinal process.

It is clear that R. ? sp. B is not a rhynchonellid as it is punctate and has plications in the sulcus of the pedicle valve which are finer than those on the flanks.

Occurrence.--Rhynchospirina ? sp. B known only from locality KAR-63-115F in the lower member of the McAdam Formation in the Cobequid mountains.

Rhynchospirina acadiae Hall, 1860

Plate XXVII, Figs. 13a,b.

1860. Trematospira acadiae Hall, Can. Nat. Geol. 5, p. 146, fig. 4.
1924. Rhynchospirina salteri var. acadiae (Hall) McLearn, G.S.C. Mem. 137, p. 85, pl. X, figs. 1-7.

Description.

Exterior.--The valves are punctate, subequally biconvex, subelliptical in outline and transverse. The anterior commissure is crenulate and uniplicate. The cardinal margin is straight and slightly shorter than the greatest width. The pedicle beak is incurved and directed dorsally. The pedicle valve bears a low rounded sulcus; the brachial valve bears a corresponding fold. The valves are marked by 14 to 16 angular plications separated by interplications of about equal width. The sulcus of the pedicle valve bears two or three plications which are usually somewhat finer than those on the flanks.

Interior pedicle valve.--The teeth are small and unsupported by dental plates. The muscle field is not impressed on any of the specimens studied. The internal surface is marked by the impress of the plications along most of their extent.

Interior brachial valve.--The cardinal plate is broad and extends into the umbonal cavity of the pedicle valve. A low short median septum extends anterior to the cardinal plate. The internal surface is marked by the impress of the plications as in the pedicle valve.

Discussion.--Rhynchospirina acadiae may be distinguished from other Rhynchospirina in the Arisaig series by its straight cardinal margin and transverse outline. It differs from R. sp. A in bearing 14 to 16 plications on each valve in contrast to the 8 to 10 plications found on the latter species. It differs from R. ? sp. in having finer ornament and in having a cardinal plate instead of discrete hinge plates.

Hall assigned this species to Trematospira Hall, 1859. It resembles Trematospira in outline, but it does not have a quadrilobate cardinal plate as in Trematospira, and it has a median septum in the brachial valve whereas Trematospira lacks a median septum in the brachial valve.

Occurrence.--Rhynchospirina acadiae occurs in the Moydart Formation of Ludlow age at localities D-3, SB2, and SB6 in the Arisaig area.

Rhynchospirina sinuata (Hall, 1860)

Plate XXVII, Figs. 14-17.

1860. Rhynchospira sinuata Hall, Can. Nat. Geol. 5, p. 146.
1924. Rhynchospira sinuata (Hall), McLearn, G.S.C. Mem. 137, p. 86, pl. VIII, figs. 18, 19.

Description.

Exterior.--The valves are punctate, subequally biconvex. The pedicle valve is pentagonal in outline with rounded margins, widest at about midlength, slightly longer than wide, and bears a shallow sulcus which originates a short distance anterior to the beak. The brachial valve is subcircular in outline, widest at midlength or slightly posterior to it and bears a shallow fold. The valves bear 15 to 23 coarse angular plications separated by angular interplications of about the same width; three plications occur on the sulcus and four plications occur on the fold. The plications on the sulcus of the pedicle valve are finer than those on the flanks. The pedicle beak is incurved and posteriorly directed; it bears a circular foramen at its apex. The anterior commissure is crenulate and uniplicate.

Interior pedicle valve.--The teeth are small, closely spaced, and unsupported by dental plates. The muscle field is obscure on some specimens and well impressed on others; when present it is circular to pentagonal in outline, about as wide as long and extends anteriorly about 1/3 the valve length. A faint myophragm may be present. Adductor impressions were not observed. The internal surface is marked by

the impress of the ornament peripheral to the muscle field.

Interior brachial valve.--The cardinal plate is broad and curves ventrally and posteriorly so as to extend well up into the delthyrial cavity. The crura originate from the anterolateral margins of the cardinal plate. The sockets are small and laterally directed. A low median septum extends anteriorly 1/2 to 3/4 the valve length and is flanked laterally by a pair of elongate oval adductor scars. The internal surface is marked by the impress of the plications along most of their length.

Discussion.--In his original description of R. sinuata Hall (1860, p. 146) states that the species has a mesial sinus beginning a little below the beak and eight or nine plications on each side of the mesial sinus. He does not figure the species. McLearn (1924, p. 86) described a species of Rhynchospirina which is common in the Stonehouse Formation as Rhynchospira sinuata. The Stonehouse Formation species fits the description given by Hall. This description applies equally well to Rhynchospirina ? sp. B. from the lower member of the McAdam Formation in the Cobequid Mountains. R. ? sp. B is not known from the Arisaig area, whereas, the Stonehouse species described by McLearn is dommon in the Arisaig area. As Hall's specimens were from the Arisaig area, it is reasonable to assume that the specimens he referred to R. sinuata belong to the Stonehouse species.

R. sinuata differs from R. sp. A and R. acadiae in having a greater number of plications which are finer than those in the latter two species. It differs from R. acadiae also in having an elongate rather than a transverse outline. R. sp. A has a single plication in the sulcus of the pedicle valve; R. sinuata has three plications in the sulcus of the pedicle valve.

R. sinuata resembles R. ? sp. B in ornament and external form. However, it has a cardinal plate whereas the latter species has discrete hinge plates.

R. sinuata is very similar to R. formosa Hall, 1857 from the New Scotland (upper Gedinnian) of New York and may well be conspecific with it. Adequate specimens of R. formosa were not available for study.

Occurrence.--R. sinuata occurs in the Stonehouse Formation of Gedinnian and possibly Skala age at localities 1E, 2E, 3E, 7E, NF15, MCK26, MCK27, MCK40, MCK53, MCK55, and MCK56 in the Arisaig area and locality KA-63-377F in the Cobequid Mountains.

Suborder Atrypoidea Moore 1952

Superfamily Atrypacea Gill, 1871
(nom. transl. Schuchert and LeVene, 1929 (ex Atrypidae Gill, 1871)

Family Atrypidae Gill, 1871

Subfamily Atrypinae Gill 1871
(nom. transl. Waagen, 1883 (ex Atrypidae Gill, 1871)

Genus Megumatrypa (new genus)

Type species.--Magumatrypa glencoensis (new species)

Diagnosis.--Plano-convex to equally biconvex atrypids which lack a fold and sulcus and are marked by coarse, unbranched costallae. Dental plates lacking. Hinge plates separated by a rounded groove or, less frequently by a simple oval cardinal process; striated area for diductor attachment lacking; sockets not crenulate.

Discussion.--The only species referred to Megumatrypa is the type-M. glencoensis.

Megumatrypa is considered to be closely related to Protatrypa (Boucot, Johnson, and Staton, 1964), a widespread genus common in beds of early Llandovery to late Llandovery (C_2) age, and to Atrypa (Dalman, 1828). The pedicle interiors of all these genera are strikingly similar. Megumatrypa differs from Protatrypa in having ribs which do not bifurcate, in having a broader and more deeply impressed pedicle muscle field, and in lacking dental plates and a fold and sulcus. Protatrypa has bifurcating ribs, dental plates, a fold in the brachial

valve, and a sulcus in the pedicle valve.

Megumatrypa differs from Atrypa (Dalman, 1828) in lacking crenulated sockets, a striated area for diductor attachment in the brachial valve, dental plates, and bifurcating ribs - all of which are present in Atrypa.

Megumatrypa resembles Nalivkinia (Bubletschenko, 1928) in having unbranched ribs. Nalivkinia has much finer ribs, is more elongate, and has a deeply sulcate commissure in contrast to the rectimarginate commissure of Megumatrypa. The brachial valve of Nalivkinia is more convex than the pedicle valve; the brachial valve of Megumatrypa varies from planar to as convex as the pedicle valve. Nalivkinia has dental lamellae; Megumatrypa lacks them. The muscle field in the pedicle valve of Nalivkinia is less strongly impressed than that in Megumatrypa.

Megumatrypa differs from Catazyga (Hall, 1894) in having much coarser costellae, and in lacking a fold and sulcus, and in having a broader and more deeply impressed pedicle muscle field.

Megumatrypa resembles the minute genus Zygospira (Hall 1862) in ornament and outline. However, it has more widely spaced teeth and a much more deeply impressed muscle field in the pedicle valve than the latter genus. The cardinalia of Zygospira consists of a pair of simple hinge plates. Megumatrypa has a pair of simple hinge plates and, in some cases, also a cardinal process.

Megumatrypa glencoensis (new species)

Plate XXVIII, figs. 15a-d; Plate XXIX, figs. 1-10.

Description.

Exterior.--The vlaves are impunctate. The pedicle valve is moderately convex; the brachial valve varies from flat to as convex as the pedicle valve and is non-sulcate. The valves vary from 3/5 as long as wide to slightly longer than wide and are semielliptical in outline. The cardinal margin is about as long as the greatest width which occurs at midlength or in the posterior half of the valve. The cardinal margin consists of two straight segments - one on each side of the median line - which diverge posterolaterally from the apex at about a 150° angle to each other. The cardinal angles are rounded and the anterior and lateral margins are evenly rounded. The anterior commissure is crenulate and rectimarginate. 15 to 24 coarse rounded non-bifurcating costae extend from the apex to the margins of the valve and are separated by interspaces of the same width as the costae. The costae may be straight or may curve slightly concave medially. The valve is marked by growth lines. The narrow pedicle interarea extends the length of the cardinal margin, is concave outwards and rounded along its posterior margin. The triangular delthyrium has a large foramen at its apex. No interarea is developed in the brachial valve.

Pedicle valve interior.--The small, rounded teeth are widely separated - the distance between them is equal to about 1/2 the valve width. They curve postero-dorsally and unsupported by dental plates. A low pedicle callist is present in the delthyrial cavity. The muscle field occupies the median 1/3 to 1/2 of the valve length and varies from 3/5 to 4/5 as long as wide. It is semi-oval in outline, deeply impressed at its posterior end and decreases in depth anteriorly to reach the level of the floor of the valve. On the larger specimens the muscle field is divided into four lobes of about equal size - two on each side of the median line. The internal surface is marked by ridges corresponding to the external ornament which extend from the margins to the muscle field.

Brachial valve interior.--The hinge plates are triangular to rhomboidal in outline, have flat, postero-ventrally directed ventral faces and overhang the surface of the valves along their lateral margins. They are usually separated by a groove of variable depth which may be parallel sided or triangular in outline and may be broad or narrow. On a few specimens the hinge plates are separated by a simple, elongate oval cardinal process instead of a groove. The crura orginate from the antero-medial margins of the hinge plates. The sockets are bounded medially by the hinge plates, open laterally, and rounded at their base. On some specimens they extend

inwards toward the apex beneath the hinge plates. The muscle field may consist of (1) a pair of semielliptical adductors which extend anteriorly about 1/2 the length of the valve and are separated by a low rounded myophragm which tapers in height and decreases in width anteriorly, or (2) two pairs of semi-elliptical adductors - a posterior pair which is widely separated by a broad myophragm which extend anteriorly to about 1/4 the length of the valve and a second pair which is situated anterior and medial to the first pair and extends to about 1/2 the length of the valve and is separated by a very narrow myophragm. In some cases the muscle field is not impressed. The internal surface is marked by ridges which correspond to the external ornament and extend from the margins of the valve to the muscle field and cardinalia. Spires with numerous volutions are present in the interior of some articulated specimens. On one specimen, spires are exposed on a flat surface which truncates the specimen. These spires are not oriented symmetrically with the plane of symmetry and so are not in place. The cones of these spires diverge at an angle of 30° in the plane of the truncating surface, and hence, must intercept an angle of 30° or greater. The spires have not been observed in place.

Occurrence.--M. glencoensis occurs in the Glencoe Brook Formation of early Llandovery age in Pictou Co. at localities GB5, NR6, NR6a, TT11, GB2, I1, MT2A, MT2B,

and FT5.

Holotype.--Specimen # 26439.

Genus Atrypa Dalman, 1828

Type species.--Anomia reticularis Linnaeus, 1758, Syst. Nat., 10th ed., p. 702.

Atrypa cf. A. reticularis (Linnaeus, 1758)

Plate XXIX, figs. 11-14.

Description.

Exterior.--The valves are equally biconvex, or unequally biconvex with the brachial valve more convex than the pedicle valve; circular in outline; and 4/5 to 1 1/4 as long as wide. The thickness varies from 1/2 to 2/3 the width. The hinge line is equal to about 2/3 the length. A fold and sulcus are lacking. The anterior commissure is crenulate and rectimarginate. Interareas are lacking. The pedicle beak is incurved. The valves are marked by rounded costellae separated by interspaces of about the same width as the costellae, and by closely spaced, often lamellose, growth lines. The costellae increase in number by bifurcation and insertion; 30 - 35 costellae are present at a length of 10 mm.

Interior pedicle valve.--The teeth are stout, triangular in outline, crenulate, and supported by minute dental plates. The delthyrial cavity bears a low pedicle callist. The muscle field is 1/2 to 3/5 as long as wide, extends to about midlength, and is usually divided by low rounded parallel ridges into a median lobe, about 1/3 as wide as the entire muscle field, and a pair of lateral

lobes. The lobes have rounded posterior margins and may be marked by 1 - 4 faint ridges. The median lobe extends posteriorly further than the lateral lobes. The diductors completely enclose the oval adductors which are situated in the posterior half of the muscle field. The internal surface is pustulose and often marked by the impress of the costellae along the periphery.

Interior brachial valve.--The muscle field consists of oval adductors separated by a broad rounded myophragm which extends anteriorly as a narrow ridge; it is somewhat wider than long and extends anteriorly 1/3 to 1/2 the valve length. The adductor scars may be divided by faint transverse ridges into an anterior pair and a slightly larger posterior pair. The hinge plates are widely divergent and separated by a flat faintly striated area for diductor attachment. The sockets are triangular in outline, rounded at their base and crenulate. The crural bases extend from the anteroventral margins of the hinge plates. The internal surface is pustulose and may be marked along the periphery by the impress of the costellae. The spires are directed dorsally.

Discussion.--A. cf. A. reticularis differs from topotypes of A. reticularis from the Mulde marl in having a pedicle muscle field which is usually markedly trilobate. The pedicle muscle field of A. reticularis is either non-lobate or is only faintly differentiated into three lobes.

Occurrence.--A. cf. A. reticularis occurs in the middle member of the Ross Brook Formation of late Llandovery (C_3 - C_5) age at locality ME29 in Pictou Co. It occurs in the upper member of the Ross Brook Formation of late Llandovery (C_6) or Wenlock age at locality B4 in the Arisaig area and locality DF6 in Pictou Co. It occurs in the lower two members of the McAdam Formation of Wenlock and possibly Ludlow age at localities HA5A and I06 in Pictou Co.; localities C1, C2, and RB70 in the Arisaig area; and locality KA-62-4F in the Cobequid mountains.

Atrypa cf. A. gedinniana (Fuchs, 1934)

Plate XXIX, figs. 15,16; Plate XXX, fig. 1.

1934. Atrypa gedinniana Fuchs, Zeit. Deut. Geol. Ges., 86, p. 404.
1960. Atrypa gedinniana (Fuchs) Boucot, Mem. de L'Institut Geologique de L'Universite de Louvain, T. XXI, p. 310, 311, pl. XVI, figs. 3-6.

Description.

Exterior.--The valves are unequally biconvex with the brachial valve the more convex; subcircular to subelliptical in outline; and about as wide as long. The hinge line is straight and slightly shorter than the greatest width which occurs in the posterior part of the valve. The interarea of the pedicle valve extends anterolaterally from the apex on each side of the valve. The interarea on each side of the valve is flat, apsacline and tapers in height anteriorly. No interarea is developed in the brachial valve. The valves are marked by lamellose growth lines and by coarse rounded costellae which are separated by interspaces of about the same width as the costellae, and increase in number by bifurcation and insertion. Ten to twenty costellae are present along the periphery at a length of 10 mm. The valves are nonsulcate. The anterior commissure is crenulate and rectimarginate.

Interior pedicle valve.--The teeth are stout, triangular in outline, crenulate, and supported by minute dental plates. The delthyrial cavity bears a low pedicle callist. The muscle field is flabellate, extends anteriorly 3/5 to 3/4 the valve length and is about as wide as

long. The diductor scars are divided by a low rounded myophragm, marked by numerous low radial ridges, and completely enclose the oval adductors which are situated in the posterior half of the muscle field. The internal surface is pustulose and marked by the impress of the costellae along the periphery.

Interior brachial valve.--The hinge plates are tabular, widely divergent, and separated by a flat, faintly striated area for diductor attachment. The sockets are anterolaterally divergent, triangular in outline, and crenulate. The crural bases extend from the anteroventral margins of the hinge plates. The muscle field is about 3/5 as long as wide, extends anteriorly 1/3 to 1/2 the length of the valve, and is divided by a rounded myophragm which tapers in height and width anteriorly. The adductor scars are longitudinally striate. The internal surface is pustulose and may be marked by the impress of the external ornament along the periphery.

Discussion.--Atrypa cf. gedinniana differs from Atrypa reticularis from Gotland, and A. cf. A. reticularis described above, in having coarser costellae. It differs from A. cf. A. reticularis in having a pedicle muscle field which is not divided into three lobes.

Occurrence.--A. cf. gedinniana occurs in the Stonehouse Formation of Gedinnian and possibly Skala age at locality LR8 in Pictou Co., and at localities MCK40, E4, and E7 in

the Arisaig area.

Superfamily Dayiacea Waagen, 1883
(nom. transl. Rzhonsniskaya, 1960 (ex Dayiinae Waagen, 1883)

Family Leptocoeliidae Boucot and Gill, 1956

Genus Eocoelia Nikiforova, 1961

Type species.--Atrypa hemisphaerica J. de C. Sowerby, 1839, in Murchison, Silurian System, vol. II, p. 637, pl. 20, fig. 7.

Eocoelia aff. E. hemisphaerica Sowerby, 1839

Plate XXVIII, figs. 1-5.

1924. Coelospira hemisphaerica McLearn, non Sowerby, 1839 p. 90, pl. X, figs. 20, 21.

Description.

Exterior.--The pedicle valve is moderately to strongly convex and carinate; the brachial valve is usually flat but may be concave and bears a low rounded sulcus. The valves are subcircular to transversely subelliptical in outline, and vary from 3/4 as long as wide to slightly longer than wide. The greatest width occurs at midlength or slightly posterior to it. The anterior and lateral commissures are crenulate and the anterior commissure is sulcate. The valves are marked by 13-17 coarse, rounded, uniform plications which are separated by interplications of about the same width; and by concentric growth lamellae. The plications do not bifurcate. A median plication occurs along the midline in the pedicle valve and a corresponding interplication occurs along the midline in the brachial valve. The sulcus bears two to five plications.

Interior pedicle valve.--The teeth are stout, triangular in outline, and extend anteroloterally from the apex. Each tooth has a deep groove which received the lateral face of the crural plate. Dental plates are usually lacking, but a few of the small specimens studied have minute dental plates which extend anteriorly a short distance from the base of the teeth. The delthyrial cavity is floored by a low pedicle callist. A low rounded median ridge extends anteriorly from the delthyrial cavity to 1/3 to 1/2 the length of the valve. The muscle field is usually not impressed but a few specimens show oval adductor scars which flank the median ridge. The internal surface is marked by plications corresponding to the external ornament; these extend from the apex to the periphery.

Interior brachial valve.--Discrete crural plates extend anterolaterally outward and are separated by a flat notothyrial platform which may bear a simple oval cardinal process. A broad median septum of uniform width extends anteriorly from the notothyrial platform 1/2 to 3/4 the valve length, and may be flanked laterally by elongate oval adductor scars. The adductor scars are not impressed on many specimens. The sockets are rounded at their base and bounded medially by the crural plates. The internal surface is marked by plications corresponding to the external ornament which extend from the cardinalia to the periphery.

Discussion.--E. aff. hemisphaerica and E. hemisphaerica sefinensis (Williams, 1951) from the C_1 substage of the Upper Llandovery differ in that the latter has well developed dental lamellae whereas dental lamellae are lacking in E. aff. hemisphaerica except in very small individuals where they are rarely present. Dr. A. M. Zeigler (personal communication) has informed the author that the type specimen of E. hemisphaerica, Sowerby belongs to E. hemisphaerica sefinensis.

Distribution.--E. aff. E. hemisphaerica occurs in the middle member Ross Brook Formation of late Llandovery (C_3-C_5) age at locality B1 in the Arisaig area; at localities ME14, ME28, ME29, ME50, ME60, ME64, ME65, ME67, ME68, ME69, LE33, LE70, LE78, FR80, DF60, A20, ES5, FP18, FP19, FR114, FR130, MH1, and 040 in Pictou Co.; and at localities 44963 and 17057 in the Cobequid mountains.

Eocoelia cf. E. sulcata Prouty, 1923

Plate XXVIII, figs. 6-14.

1923 Eocoelia sulcata, Prouty, Geol. Surv. Md., Silurian, p. 466, pl. 27, figs. 6-8.

Description.

Exterior.--The valves are subcircular to transversely subelliptical in outline and vary from 3/4 as long as wide to as long as wide; the greatest width occurs at about midlength. The pedicle valve is strongly convex and carinate; the brachial valve is usually flat but may be very gently convex or very gently concave and bears a low sulcus. The anterior commissure is sulcate; the lateral and anterior commissures may be weakly crenulate or non-crenulate. The valves are marked by 7-13 faint, rounded, uniform plications which are separated by interplications of about the same width; and by concentric growth lamellae. The plications die out distally on the larger specimens and may be absent along the periphery. A single enlarged median plication occurs along the midline of the pedicle valve and a corresponding enlarged interplication occurs along the midline of the brachial valve. Three plications occur on the sulcus. The valves may be marked by fine radial striae addition to the plications.

Interior pedicle valve.--The teeth are stout, triangular in outline and extend anterolaterally from the apex. A deep groove which received the lateral face of

the crural plate is present on the medial face of each tooth. The delthyrial cavity is floored by a low pedicle callist. A low rounded median ridge extends anteriorly from the delthyrial cavity 1/3 to 1/2 the valve length. The muscle field is usually not impressed, but a few specimens show oval adductor scars which flank the median ridge. The internal surface of the valve is marked by the impress of the plications which extend the length of the plications.

Interior brachial valve.--Discrete crural plates extend anterolaterally outward from the notothyrial cavity, and are separated by a flat notothyrial platform which bears a simple oval cardinal process. The sockets are rounded at their base and bounded medially by the crural plates. A broad median septum of uniform width extends anteriorly from the base of the notothyrial platform 3/4 to 9/10 the valve length. The muscle field is usually not impressed; on a few specimens, elongate oval adductor scars flank the median ridge and are confined to the posterior half of the valve. The internal surface is marked by the impress of the plications in the same manner as the pedicle valve.

Discussion.--E. cf. E. sulcata closely resembles E. sulcata Prouty, 1923 from beds of late Llandovery (C_6) or low Wenlock age in Maryland in shape and ornament, and is very likely conspecific with it.

E. cf. E. sulcata differs from E. aff. E. hemisphaerica in ornament having fewer plications which tend to die out distally; an enlarged median plication on the pedical valve, and a corresponding enlarged interplication on the brachial valve; and, in some cases, fine radial striae. E. aff. E. hemisphaerica has plications which do not die out anteriorly and a median plication in the pedicle valve which is not enlarged, and lacks radial striae.

Hall (1860, p. 147-8, fig. 5) erected a species Leptocoelia intermedia n. sp. based on specimens which he lists as occurring in the shales of the lower member of the Arisaig series as defined by Dawson (1860, p. 136). These shales belong to the Ross Brook Formation. Hall describes Leptocoelia intermedia as concavo-convex and having a pedicle valve with a strong median plication and 6 or 7 smaller ones on each side. It is clear from this description that Hall's specimens belong to either E. cf. sulcata or to E. aff. hemisphaerica. The median enlarged plication in the pedicle valve he refers to strongly suggests that his specimens belong to E. cf. E. sulcata. However, Hall does not state that the plications in his species are faint and tend to die out anteriorly and the plications are drawn as strong in his illustration of the species. It is not likely that Hall's specimens belong to E. aff. E. hemisphaerica as this species does not have a

median enlarged plication.

Occurrence.--E. cf. E. sulcata occurs in the Ross Brook Formation in the upper member of late Llandovery (C_6) or early Wenlock age at localities B4, B5, and B6 in the Arisaig area; and in localities DF6, DF8, DF9, DF18, DF30, DF38, DF43, UEA, UEA4, UEA12, ES1A, ES2, F16 and F24 in Pictou Co.

Suborder Athyrididoidea Boucot, Johnson & Staton, 1964
Superfamily Athyridacea M'Coy, 1844
(nom. transl. Williams, 1956 (ex Athyridae M'Coy, 1844)

Family Meristellidae Waagen, 1883
(nom. transl. Hall and Clarke, 1895 (ex Meristellinae, Waagen, 1883)

Subfamily Meristellinae Waagen, 1883

Genus Cryptothyrella Cooper, 1942
Type species.--Whitfieldella quadrangularis Foerste, 1906 Kentucky Geol. Surv. Bull. 7: 327, pl. 1, figs. 4a-c.

Cryptothyrella beechhillensis (McLearn, 1924)

Plate XXX, figs. 2-7.

1924. Whitfieldella ? crassa var. beechhillensis, McLearn, G.S.C. Mem. 137, p. 87, pl. 10, figs. 14-16.
1924. Whitfieldella cf. angustifrons (McCoy), McLearn, op. cit., p. 88, pl. 10, figs. 22-24.

Description.

Exterior.--The valves are smooth, unequally biconvex with the pedicle valve the more convex, transversely elliptical to elongately elliptical in outline, 3/4 as wide as long to 3/4 as long as wide, and circular to elliptical in cross section. The anterior commissure is rectimarginate. The pedicle beak is strongly incurved. The cardinal margin of the pedicle valve is rounded. The delthyrium is triangular, open, rounded at the apex, and intercepts an angle of 50° - 90°.

Interior pedicle valve.--The small teeth are supported by long dental lamellae which extend anteriorly to about midlength and bound the muscle field laterally. The delthyrial cavity is triangular to broadly rounded in cross-

section. The muscle field is triangular in outline, extends anteriorly 1/2 to 2/3 the valve length, and is longitudinally striate. It is deeply impressed at its posterior end and tapers in height to the level of the floor of the valve. The adductor scars are usually not impressed; when present they are elongate oval in outline and confined to the posterior half of the muscle field. Anterior to the delthyrial cavity, the dental lamellae converge medially to form an elongate trough which extends from the delthyrial cavity to the muscle field, and is raised above the level of the floor of the valve. The umbonal chambers commonly bear numerous low ridges which curve concave medially.

Interior brachial valve.--The small widely divergent sockets are bounded laterally by the posterior margin of the valve and bounded medially by discrete hinge plates. The hinge plates are flat, triangular in outline and are supported medially by a sessile septalium or by a pair of minute plates which extend from the hinge plates to the floor of the valve and converge medially. The muscle field consists of a pair of narrow, elongate oval adductors which extend anteriorly to 1/2 to 3/4 the valve length as very narrow parallel tracts, and are separated by low myophragm.

Discussion.--Cryptothyrella beechhillensis resembles Cryptothyrella quadrangularis (Foerste, 1906) from the Brassfield Limestone of middle Llandovery or late Llandovery (C_1 - C_2) age in Adams Co., Ohio, in its internal features.

The latter species attains a much larger size and adult specimens of the species are roughtly quadrangular in outline with long straight lateral margins in contrast to adult specimens of C. beechhillensis which are elliptical in outline. Small specimens of C. quadrangularis in the size range of the Arisaig species correspond to the Arisaig species in outline.

McLearn referred specimens of C. beechhillensis to Whitfieldella cf. angustifrons (McCoy). Hemithyris angustifrons (McCoy, 1891, Ann. mag. Nat. Hist., sec. 2, 8; p. 391) may belong to Hyattidina (Schuchert, 1913) or to the poorly known genus Glassina (Hall and Clarke, 1893).

Occurrence.--C. beechhillensis occurs in the Beechhill Cove Formation of early Llandovery age at locality A-2 in the Arisaig area and localities FP17, FP21, and All in Pictou Co. It occurs in the Glencoe Brook Formation of early Llandovery age at locality FT5 in Pictou Co.

Genus Meristina Hall, 1867

Type species.--Meristella maria Hall, 1863, p. 212.

Meristina billingsi (Dawson, 1880)

Plate XXX, figs. 8-15; Plate XXXI, figs. 1a-c.

1880 Stricklandia billingsi Dawson, Can. Nat. Ser. 2, 9, p. 341.

Description.

Exterior.--The valves are smooth, subequally biconvex, elliptical in outline, and vary from 1/2 as long as wide to 3/4 as wide as long. They are widest at midlength or slightly anterior to midlength. The anterior commissure is rectimarginate to sulcate. The cardinal margin of the pedicle valve is rounded. The delthyrium is open, triangular in outline, rounded at the apex, and intercepts an angle of 50° -90°. The pedicle valve commonly bears a low rounded sulcus at its anterior end and the brachial valve commonly bears a corresponding fold. The valves may lack a fold and sulcus. The valves are marked by faint growth lines.

Interior pedicle valve.--The teeth are supported by dental lamellae which are very variable in length; the dental lamellae may be confined to the delthyrial cavity or may extend along the lateral margins of the muscle field to the anterior end of the muscle field. All intergrades are present between these two extremes. The delthyrial cavity is triangular in outline and triangular or rectangular in

cross-section. The muscle field is triangular in outline with a rounded posterior margin, extends anteriorly 1/2 to 9/10 the valve length, and is longitudinally striate. The lateral margins of the muscle field diverge at an angle of between 30° and 75°. A rounded trough with parallel or slightly divergent lateral margins extends from the delthyrial cavity to the muscle field. The trough is depressed below the level of the floor of the valve and is bounded laterally by the dental lamellae on specimens in which the dental lamellae extend anterior to the delthyrial cavity. The length of the trough is variable.

Interior brachial valve.--The sockets are small, widely divergent and are bounded posteriorly by the margin of the valve and anteriorly by large flat hinge plates. The hinge plates lie about in the plane of commissure and are supported by a septalium formed by a median septum and a pair of plates which extend from the inner margins of the hinge plates and converge medially to join the median septum above the floor of the valve. The median septum extends anteriorly 1/2 to 2/3 the valve length and tapers in height anteriorly. The muscle field is usually not impressed; a few specimens show oval adductor scars flanking the median ridge in the posterior half of the valve.

Discussion.--M. billingsi differs from C. beechhillensis in having a median septum in the brachial valve in contrast to the faint myophragm of the latter species and

of other species belonging to Cryptothyrella. M. billingsi is a much larger and a much less convex species than C. beechhillensis, and commonly has a fold and sulcus which are lacking in C. beechhillensis. The trough extending from the delthyrial cavity to the muscle field in the pedicle valve of M. billingsi is depressed below the level of the floor of the valve; the corresponding trough in C. beechhillensis is raised above the floor of the valve.

M. billingsi differs from M. maria Hall from the Niagara group of Illinois and Indiana in being on the average more transverse and less convex than the latter species.

Occurrence.--M. billingsi occurs in the French River Formation of late Llandovery (C_6) or Wenlock age at locality MCK4 in the Arisaig area and at localities DF16 and DF17 in Pictou Co. It occurs in the lower member of the McAdam Formation of Wenlock or early Ludlow age at localities C1, MGB1, MCK3, MCK13, MCK14, MCK17, MCK19, MCK31, MCK45, MCK49, RB70, D11, D27, D28, I, and ZS5 in the Arisaig area; at localities DM7, DM8, DM9, DM9A, DM9B, HA6, HA7, HA8, NR16, and I06 in Pictou Co.; and localities KA-62-4F and KA-62-123F in the Cobequid mountains.

Subfamily Hindellinae Schuchert, 1894

Genus Hyattidina Schuchert, 1913

Type species.--Atrypa congesta Conrad, 1842, p. 265.

Hyattidina sp.

Plate XXXI, figs. 2-11.

Exterior.--The valves bear fine growth lines but are otherwise smooth. They are very small (less than 8 mm long) and subequally biconvex. The anterior commissure is rectimarginate to very gently sulcate. The pedicle valve is subpentagonal to elongately subelliptical in outline, from 3/4 as wide as long to about as wide as long, and commonly bears a shallow sulcus; the brachial valve is transversely elliptical in outline, from 4/5 as long as wide to about as long as wide, and is uniformly convex. The delthyrium is triangular and open.

Interior pedicle valve.--The teeth are small and are supported by very short erect dental plates which are confined to the delthyrial cavity. The delthyrial cavity is rounded in cross section. Narrow diductor tracks diverge anterolaterally from the delthyrial cavity at a 30° - 75° angle to each other and extend anteriorly from slightly less than 1/2 to 4/5 the valve length. They completely enclose the elongate oval adductor scars which are confined to the posterior end of the muscle field. Faint pallial marks commonly extend anterolaterally from the diductor tracks. The umbonal chambers occasionally bear faint

crescentic ridges.

Interior brachial valve.--The cardinalia consists of a pair of flat triangular hinge plates separated by a deep narrow groove. The sockets are anterolaterally directed and rounded at their base. Narrow elongate adductor scars extend anteriorly to about midlength and are separated by a linear myophragm. Shallow grooves bound the muscle field laterally at its posterior end. The crura originate from the medial margins of the hinge plates.

Discussion.--Hyattidina sp. and H. congesta from the Clinton group of N. Y. of late Llandovery (C_3 -C_5) age closely resemble each other in outline and in the details of the cardinalia, dental plates, and muscle fields. Both species have a pair of grooves which bound the muscle field of the brachial valve at its posterior end. However, H. congesta has a deep sulcus in the pedicle valve and a corresponding fold in the brachial valve, and H. sp. has a relatively faint sulcus, or none at all, and lacks a fold in the brachial valve.

Distribution.--Hyattidina sp. occurs in the upper member of the Ross Brook Formation of late Llandovery (C_6) or early Wenlock age at localities B4 and B5 in the Arisaig area and at localities FR18 and DF9 in Pictou Co.

Hyattidina northumberlandensis (McLearn, 1924)

Plate XXXI, Figs. 12-21.

1924. Whitfieldella northumberlandensis McLearn, G.S.C. Memoir 137, p. 87, pl. 10, fig. 8.
1924. Meristina tumida? McLearn (non Sowerby, 1828), op. cit., p. 89, pl. IX, figs. 6, 7.

Description.

Exterior.--The valves are smooth; strongly convex with about the same convexity; and pentagonal in outline with laterally divergent posterior margins, parallel or slightly convergent anterolateral margins and a straight anterior margin. The anterior commissure is rectimarginate. The cardinal margins are low and flat and are divided by a triangular delthyrium at the apex of which is a circular foramen. Both valves usually bear a narrow rounded sulcus.

Interior pedicle valve.--The small teeth are supported by very short dental plates which bound the delthyrial cavity. The delthyrial cavity is rounded at its base and has a straight anterior margin. The straight slightly divergent diductor tracks extend from the delthyrial cavity to 1/2 to 2/3 the valve length. The adductor scars, when impressed, are elongate oval in outline and confined to the posterior end of the muscle field.

Interior brachial valve.--The cardinalia consist of a pair of triangular unsupported hinge plates which bound the narrow rounded sockets medially. A very low narrow myophragm extends from the posterior end of the valve to

about 2/3 the valve length and divides the narrow elongate oval adductor scars.

Discussion.--Hyattidina northumberlandensis differs from H. sp. from the Ross Brook Formation in that it is bisulcate and attains a larger size. The latter species may have a faint sulcus on the pedicle valve but lacks a sulcus on the brachial valve. The two species are similar internally.

Hyattidina northumberlandensis differs from Hyattidina congesta Conrad, 1842, in having a sulcus in both valves. H. congesta has a well developed sulcus in the pedicle valve and a well developed fold in the brachial valve. Internally, the two species do not differ significantly.

Occurrence.--H. northumberlandensis occurs in the Moydart Formation of Ludlow age at localities D-1, D-2, SB4 and SB5 in the Arisaig area. It occurs in the unnamed quartcite correlative with the Moydart Formation at localities F-12 and F-17 in the Cape George area. One small strongly sulcate pedicle valve presumably belonging to this species was found at locality HAT in the lower member of the McAdam Formation of Wenlock or early Ludlow age in Pictou Co. (this specimen is illustrated on plate XXXI, fig. 12.)

McLearn (1924, p. 89) described a few shells from "a boulder on the shore near the middle zones of the Stonehouse Formation, Arisaig area" as "Meristina tumida ?". These shells belong to H. northumberlandensis. They occur on a

slab together with Sphaerirhynchia saffordi which is restricted to the Moydart Formation, so the boulder which contained them clearly was derived from the Moydart Formation.

Family Nucleospiridae Davidson, 1881

Genus Nucleospira Hall, 1859

Type species.--Spirifer ventricosa Hall, 1857, p. 57.

Nucleospira sp.

Plate XXXII, figs. 1a-e.

External and internal molds of a single brachial valve of Nucleospira were found in beds in the Cobequid mountains correlative with member 1 of the McAdam Formation.

Exterior.--The brachial valve is circular in outline, lenticular in lateral profile and has a narrow median groove in its posterior half and a very faint fold in its anterior half.

Interior brachial valve.--The prominent cardinal plate extends upwards well above the plane of commissure and curves posteriorly. It is flanked laterally by minute oval sockets. A myophragm extends anteriorly to about midlength and separates the narrow oval adductor scars.

Occurrence.--N. sp. occurs at locality KAR-63-123F in the Cobequid Mountains in beds correlative with member 1 of the McAdam Formation of Wenlock or early Ludlow age.

Family Athyrididae M'Coy, 1844
(emended Davidson, 1881)

Genus Protathyris Koxlowski, 1929

Type species.--Protathyris praecursor Kozlowski, 1929, p. 224.

Protathyris ? sp.

Plate XXXI, Figs. 22-24.

A dozen specimens of a very small rostrospiroid were found in the Stonehouse Formation. The delthyrial cavity in each of the two available pedicle interiors is much lower than that in Hyattidina, and the pedicle diductor tracks of Hyattidina are usually more divergent than those found in these two specimens. The Arisaig specimens resemble Protathyris in shape, outline, and pedicle internal features. However, the one available brachial interior appears to have discrete hinge plates and Protathyris has hinge plates which are conjunct posteriorly. As the nature of the hinge plates cannot be positively determined on the one available brachial interior, the Arisaig specimens are assigned provisionally to Protathyris.

Exterior.--The valves are smooth, subequally biconvex, and pentagonal in outline.

Interior pedicle valve.--The teeth are supported by short, slightly divergent dental plates. The delthyrial cavity is low. The diductor tracks are narrow, slightly divergent and enclose the small adductors.

Interior brachial valve.--The hinge plates appear to

be discrete but this may not be positively determined in the one available brachial valve interior. A narrow myophragm extends to about midlength and encloses the narrow, elongate oval adductor scars.

Occurrence.--P. ? sp. is known from the Stonehouse Formation of Gedinnian and possibly Skala age at localities NFA and 4E in the Arisaig area.

Suborder Spiriferoidea Allan, 1940

Superfamily Delthyriacea Phillips, 1841
(nom. transl. Ivanova, 1960 (ex Delthyridae Phillips, 1841)

Family Eospiriferidae Schuchert and LeVene, 1929
(nom. transl. Boucot, 1963 (ex Eospiriferinae Schuchert and LeVene, 1929)

Subfamily Eospiriferinae Schuchert and LeVene, 1929
(emended Boucot, 1963)

Genus Striispirifer Cooper and Muir-Wood, 1951

Type species.--Delthyris niagarensis Conrad, 1842, J. Acad. Nat. Sci. Philadelphia, 8, p. 261.

Striispirifer stonehousensis (McLearn, 1924)

Plate XXXII, figs. 2-5.

1924. Eospirifer stonehousensis McLearn, G.S.C. Mem. 137, p. 84, pl. IX, fig. 8.

Description.

Exterior.--The valves are subequally biconvex, transversely semielliptical in outline, and 1/2 to 3/5 as long as wide. The hinge line is straight and about 9/10 as long as the greatest width which occurs slightly anterior to the hinge line. The cardinal angles are rounded, and the anterior commissure is sulcate, plicate and crenulate. The pedicle valve bears a broad rounded sulcus and the brachial valve bears a corresponding fold. The valves are marked by 8 to 10 rounded costae on each side of the fold and sulcus. The costae are separated by rounded interspaces which are about the same width as adjacent costae; the size of the costae decreases lateral to the fold and sulcus. The valves bear a fine ornament of numerous fila which increase by

insertion and fine growth lines. The pedicle beak is incurved. The interarea of the pedicle valve is apsacline, strongly curved concave outwards and from 1/10 to 1/16 as high as long; that of the brachial valve is anacline, gently curved concave outwards and about 1/12 as high as long. The interareas are marked by fine growth lines which parallel the hinge line. The delthyrium is triangular, and intercepts an angle of about 40° at the apex; narrow deltidial plates are present along the margins of the delthyrium on a few specimens but are not preserved on most of the specimens studied. The notothyrium is triangular, and intercepts an angle of about 150°; no chilidial plates were observed in the specimens studied.

Interior pedicle valve.--The small stubby teeth are supported by bladelike dental lamellae which diverge anterolaterally at about a 45° angle to each other, and taper in height anteriorly. The dental lamellae extend anteriorly 1/4 the valve length or less. The umbonal cavities become thickened by the deposition of secondary material. The delthyrial cavity is narrow and triangular in outline; the floor of the delthyrial cavity may be V-shaped in cross-section or may be flat and bear a median groove. The muscle field is triangular in outline usually wider than long and divided by a low myophragm. It is deeply impressed at its posterior end, tapers in height anteriorly, and extends anteriorly 1/4 to 1/2 the valve length. The diductors are

longitudinally striate. The adductors are only rarely impressed; when present, they are confined to the posterior end of the muscle field. The internal surface bears the impress of the costae along most of their length and, in some cases, the impress of the fila. The internal surface is pustulose lateral to the dental lamellae.

Interior brachial valve.--The cardinalia consists of discrete, medially convergent hinge plates separated by a narrow groove V-shaped in cross section and supported by erect crural plates which are about parallel to the median line. The sockets are anterolaterally diverging, rounded at their base and floored by plates which extend from the hinge plates to the margins of the notothyrium. A narrow myophragm extends anteriorly to about midlength. The muscle field was not impressed on any of the specimens studied. The internal surface bears the impress of the costae along most of their length and, in some cases, the impress of the fila.

Discussion.--Striispirifer stonehousensis closely resembles Striispirifer niagarensis (Conrad, 1842) from the Irondequoit Limestone (late Llandovery C_5 - C_6) to Rochester Shale and Herkimer Sandstone (Wenlock) of New York illustrated by Hall (1854, pl. 54, figs. 5a-5t) and Boucot (1963, pl. 100, figs. 6, 7, 9-13). However, as adequate specimens of the latter species were not available for study the species cannot be unequivocably placed into

synonomy.

Occurrence.--Striispirifer stonehousensis occurs in the French River Formation of late Llandovery (C_6) or early Wenlock age at localities MCK6, D26-100, and Z40 in the Arisaig area and localities DF13, DF15, DF16, and DF17. It occurs in beds in the Cobequid Mountains correlative with member 1 of the McAdam Formation of Wenlock or early Ludlow age at localities KAR-63-115F and KAR-63-123F.

Family Delthyridae Phillips, 1841

Subfamily Delthyrinae Phillips, 1841
(nom. transl. Waagen, 1883 (ex Delthyridae Phillips, 1841)

Genus Howellella Kozlowski, 1946

Type species.--Delthyris elegans Muir-Wood, 1925.

Howellella moydartensis (McLearn, 1924)

Plate XXXII, figs. 6-8, 9a-e.

1924. Delthyris crispa McLearn non Hisinger, G.S.C. Mem. 137, p. 81, pl. 8, fig. 18.
1924. Delthyris crispa mut. moydartensis McLearn, op. cit., p. 82, pl. 8, figs. 19-24.

Description.

Exterior.--The valves are unequally biconvex with the pedicle valve more convex than the brachial valve; semi-elliptical in outline with rounded cardinal angles and widest a short distance anterior to the straight hinge line which is almost as long as the greatest width. The pedicle valve is from 3/4 to 9/10 as long as wide; the brachial valve is from about 3/5 to 3/4 as long as wide. The anterior commissure is crenulate and uniplicate. The pedicle beak is strongly incurved. The interarea of the pedicle valve is anacline, about 1/4 as high as long, and strongly curved posteriorly; the delthyrium is triangular, open and intercepts an angle of about 30°. The interarea of the brachial valve is flat, orthocline to low anacline, and about 1/10 as high as long. The pedicle valve bears a prominent rounded sulcus and the brachial valve bears a corresponding fold. Three to five rounded plications occur

on each side of the fold and sulcus; the plications are separated by interplications of about the same width.

Interior pedicle valve.--The teeth are supported by dental plates which diverge at about a 30° angle to each other at their bases. The dental plates extend from the margins of the delthyrium anteriorly to about 1/4 the valve length. A faint myophragm extends anteriorly to about midlength. The muscle scars are not impressed. The internal surface is marked by the impress of the plications along most of their extent.

Interior brachial valve.--The hinge plates are curved and extend laterally from the notothyrial cavity to bound the sockets anteriorly. The sockets are rounded at their base and are bounded posteriorly by the valve margin. Short parallel crural plates support the hinge plates medially. The notothyrial cavity bears a striated area for diductor attachment. A low myophragm extends anteriorly to about midlength. The adductor scars are only rarely impressed; when present they are elongate oval in outline. The internal surface is marked by the impress of the plications along most of their extent.

Discussion.--A very large number of species have been assigned to the genus Howellella and many of these are only very poorly illustrated. It is possible that H. moydartensis will be found to be synonomous with an earlier defined species of Howellella when a thorough review of the species

belonging to the genus is made. However, such a review is beyond the scope of this report.

Occurrence.--Howellella moydartensis occurs in the lower member of the McAdam Formation of Wenlock or early Ludlow age at localities DM7, DM9 and HAT in Pictou Co.; it occurs in beds correlative with the lower member of the McAdam Formation in the Cobequid Mountains at locality KA-62-4F. It occurs in member 4 of the McAdam Formation of Ludlow age at locality C-5 in the Arisaig area. It occurs in the Moydart Formation of Ludlow age at localities MCK32, MCK33, D-1, D-2, and SB6 in the Arisaig area and at locality 117 in the Lochaber area.

Genus Delthyris Dalman, 1828

Type species.--Delthyris elevata Dalman, 1828, Kongl. Vet.-Akad. Handl., p. 120, pl. 3, fig. 3.

Subgenus Quadrifarius Fuchs, 1923 emended

Type species.--Spirifer (Quadrifarius) loculatus Fuchs, 1923, Jb. Preuss. Geol. Landesanst., 50, pp. 195-6, figs. 1-4. (According to Boucot (1957, p. 312) this species is an objective synonym of Spirifer dumontianus De Koninck, 1876, Systems gedinnien, p. 39, pl. 1, fig. 9. Both species are based on specimens from the Gres de Gdoumont=Weismes Schichten.)

Species assigned.--
Spirifer rugaecosta Hall, 1860, Can. Nat. Geol. 5, p. 145.
Spirifer dumontianus De Koninck 1876, Systeme gedinnien; 39, pl. 1, fig. 9.
Spirifer (Quadrifarius) loculatus Fuchs, 1923, ref. cit.
Quadrifarius loculatus var. crassifissa Fuchs, 1929, Jb. preuss. geol. Landesanst, 50, p. 196, pl. 12, fig. 5; pl. 13, figs. 6-9.
Spirifer (Delthyris) magnus Kozlowski, 1929, Les brachioposes gothlandiens de la Podolie polonaise, Palaeontologia Polonica, 1, pp. 188-9, text fig. 62, pl. 10, figs. 4-9.

Species rejected.--
Spirifer trisectus Kayser, 1883, pl. 14, fig. 2.

Diagnosis.--Delthyris which bear a groove on the fold and may bear a single median plication on the s ulcus.

Discussion.--Fuchs (1929, p. 195) assigned three species to Quadrifarius: Spirifer loculatus (the type species), Spirifer dumonianus, and Spirifer trisectus. The latter species has been shown by Boucot (1957, p. 312) to be a reticulariid spirifer. Boucot (1962, p. 416) assigned this species to Quadrithyris Havlicek, 1957. According to Boucot (1957, p. 312) the first two species are synonomous (both are based on specimens from the Gres de Gdoumont=Weismes Schichten).

As here defined, the subgenus Quadrifarius includes three species; D. (Q.) dumontianus (=D. (Q.) loculatus from the lower Gedinnian of Belgium and Germany, and from the Kobbinghauser Schichten of possible Skala age in Germany; D. (Q.) magnus from the Skala Formation of Podolia; and D. (Q.) rugaecosta from the Stonehouse Formation of Gedinnian and possibly Skala age in Nova Scotia. These species have the diagnostic characters of Delthyris - a prominent median septum and prominent dental lamellae in the pedicle valve, crural plates and a striated area for diductor attachment in the brachial valve, and a fine ornament of non-frilly growth lamellae crossed by fine radial ridges which project slightly anterior to the growth lamellae. However, they differ from the Silurian representatives of Delthyris, including the type species, D. elevata, in having a groove on the fold. Typical Delthyris which lack a groove on the fold are here considered as belonging to Delthyris (Delthyris); they are not known in beds of post Ludlow age.

Boucot (1957, p. 314) considered Quadrifarius synonomous with Delthyris. However, in view of its straitigraphic significance, the author believes it should be retained as a subgenus of Delthyris.

Delthyris (Quadrifarius) rugaecosta Hall, 1960

Plate XXXIII, Figs. 1-9.

1860. Spirifer rugaecosta Hall, Can. Nat. Geol. 5, p. 145.

1860. (?) Spirifer subsulcata Hall, Can. Nat. Geol. 5, p. 145.
1924. Delthyris rugaecosta (Hall), McLearn, G.S.C. Mem. 137, p. 82, pl. VIII, fig. 31; pl. IX, figs. 1-3.
1924. Delthyris rugaecosta mut prima McLearn, op. cit., pp. 83-4, pl. VIII, fig. 30.
1924. (?) Delthyris rugaecosta var. subsulcata (Hall) McLearn, op. cit., p. 85.

Description.

Exterior.--The valves are biconvex with the pedicle valve more convex than the brachial, transversely semi-elliptical in outline, 1/2 to 2/3 as long as wide and widest at the straight hinge line or slightly anterior to it. The anterior commissure is crenulate and uniplicate. The pedicle interarea is catacline, curved slightly concave outwards, and 1/3 to 2/5 as high as long; the delthyrium is triangular, open and intercepts an angle of about 30° at the apex. The brachial interarea is low anacline to orthocline, flat or slightly concave outwards and 1/12 to 1/20 as high as long. The notothyrium is triangular and encloses an angle of about 150°. The pedicle valve bears a prominent rounded sulcus which may be rounded or somewhat flattened in cross section; the brachial valve bears a corresponding fold. The valves are marked by 3 to 8 rounded plications lateral to the fold and sulcus; these are separated by interplications of about the same width. The plications may be straight or may curve somewhat anteriorly. The brachial fold bears a median groove which may originate at the apex or may originate several mm anterior to the

apex; the pedicle sulcus only rarely bears a corresponding medial plication. Closely spaced imbricating growth lamellae crossed by minute radial ridges that project slightly anterior to the margins of the growth lamellae mark the entire surface of both valves.

Interior pedicle valve.--The small, rounded teeth are supported by prominent dental plates which extend from the margins of the delthyrial cavity to the middle of the interplications which flank the sulcus. The dental plates extend anteriorly to about midlength and are curved concave laterally. A prominent median septum extends to 2/3 to 3/4 the valve length; it is high at its posterior end and tapers in height anteriorly. A pair of small horizontal plates extend from the median septum to the dental plates at the posterior end of the valve; in large specimens the space beneath these plates may be filled in with secondary shell deposits. The internal surface is marked by the impress of the costellae along their entire length and may be marked by the impress of the imbricating growth lamellae.

Interior brachial valve.--The notothyrial cavity contains a striated area for diductor attachment and is bounded laterally by the long, curved, laterally divergent sockets. The hinge plates border the sockets medially and dorsally, and are supported by short crural plates. A narrow myophragm extends from the notothyrial cavity to about midlength. The muscle scars are not impressed. The

internal surface is marked by the impress of the plications along their entire length and may be marked by the impress of the growth lamellae. The groove on the fold may or may not be impressed on the internal surface.

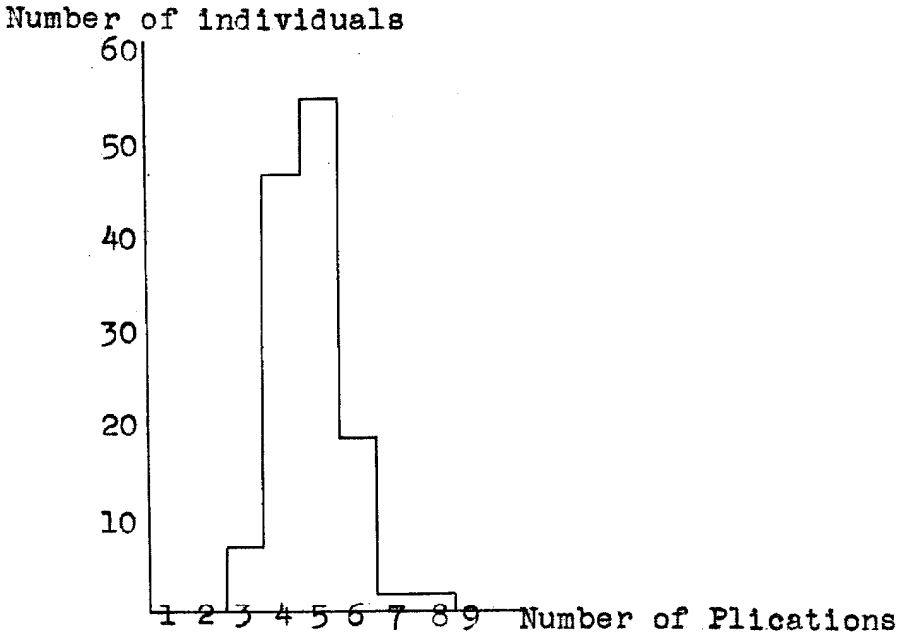
Discussion.--Hall (1860, p. 145) defined two spiriferids from the upper part of the Arisaig series - Spirifer rugaecosta and Spirifer subculcata. Neither of these species were illustrated. Hall describes S. rugaecosta as having a sulcus in the ventral valve and a fold in the dorsal valve which is depressed along the center. From this description it is clear that the specimens upon which Hall based this species belong to the species of D. (Quadrifarius) which occurs in the Stonehouse Formation. The identity of S. subsulcata is not clear. Hall's description of the species which states, among other things, that it has a somewhat flattened or very slightly rounded fold on the dorsal valve applies equally well to both some small specimens of D. (Q.) rugaecosta and to Howellella moydartensis. McLearn (1924, p. 85) considered S. subsulcata to be a variety of D. rugaecosta, but did not figure any of Hall's specimens. The present author places S. sulcata questionably in synonomy with D. (Q.) rugaecosta pending restudy of Hall's specimens in the Am. Mus. of Nat. History.

McLearn (1924, pp. 83-4) defined a variety D. rugaecosta mut. prima which he considered to be restricted to the lower part of the Stonehouse Formation, and to differ from D.

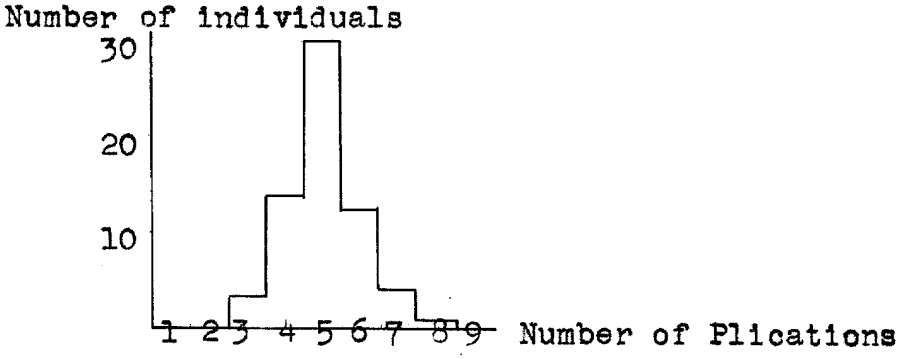
rugaecosta in the upper part of the formation in having "3 to 4 plications on either side of the fold and sulcus instead of the normal 5 to 7". The author has studied several hundred specimens of D. (Quadrifarius) from a number of localities and finds that the number of plications is actually quite variable in both the lower part and the upper part of the formation. The number of plications lateral to the fold and sulcus were counted on 130 specimens from locality E-2 and 64 specimens from locality E-4. The results are shown in figure 5. The number of plications varies from 3 to 8 in both samples and both have a frequency distribution with a maximum at 5 plications. It appears that this character is of no use in zoning the Stonehouse Formation.

D. (Quadrifarius) rugaecosta closely resembles both D. (Quadrifarius) magnus (Kozlowski, 1929) from the Skala Formation of Podolia and D. (Quadrifarius) dumontianus (De Koninck, 1876) from the Gedinnian of Belgium and Germany and from the Kobbinghauser Schichten of possible Skala age in Germany. It is possible that these species are conspecific.

Occurrence.--D. (Quadrifarius) rugaecosta occurs in the Stonehouse Formation of Gedinnian and possibly Skala age at localities E1, E2, E3, E4, E5, E6, E7, E8, CRED, MCK26, MCK27, MCK30, MCK39, MCK40, MCK42, MCK50, MCK51, MCK52, MCK53, MCK54, MCK55, and MCK56 in the Arisaig area;



Histogram showing the frequency distribution of the number of plications lateral to the fold (or sulcus) on 130 specimens from locality E-2.



Histogram showing the frequency distribution of the number of plications lateral to the fold (or sulcus) on 64 specimens from locality E-4.

Figure 5 . Histograms. Delthyris(Quadrifarius) rugae-costa.

LR1, LR2, LR3, and LR9 in Pictou Co.; F-9 in the Cape George area; Sakrison and Saunders B, 361, 3A in the Lochaber area; 11F, KA-62-394F, KA-63-377F, KA-63-128F, and G.S.C. 44971 in the Cobequid Mountains.

A few small specimens of Delthyris were found at locality D-3 a few feet below the base of the bed band in the Moydart Formation. These probably belong to D. (Quadrifarius) rugaecosta. However, only one small brachial valve was available and it does not show a groove in the fold.

Suborder Terebratuloidea Muir-Wood, 1955

Superfamily Terebratulacea Waagen, 1883

Family Dielasmatidae Schuchert and LeVene, 1929

Subfamily Mutationellinae Cloud, 1942

Genus Podolella Kozlowski, 1929

Type species.--Podolella rensselaeroides Kozlowski, 1929, p. 233-6, pl. XII, figs. 1-6.

Podolella ? sp.

Plate XXXI, Figs. 25a,b.

1960. Podolella sp. Maehl, The Silurian of Pictou Co., Nova Scotia (PhD thesis), p. 77 (in list of fossils from the Stonehouse Formation), P. 155 (in list of fossils from loc. LR4).
1961. Podolella sp. Maehl, Nova Scotia Department of Mines Memoir 4, p. 69 (in list of fossils from the Stonehouse Formation).

Ten minute, badly deformed specimens which resemble Podolella were found in the Stonehouse Formation. It is possible that these belong to Protathyris ? sp. which also occurs in the Stonehouse Formation. However, the pedicle muscle field is not impressed in these specimens and it is in the two available pedicle interiors of Protathyris ? sp. which are of comparable size.

Description.--The valves are smooth, biconvex, elliptical in outline, and elongate. The teeth are supported by short dental plates. The hinge plates appear to be discrete. A narrow myophragm extends to about mid-length.

Occurrence.--This species is known from the uppermost

50 feet of the Stonehouse Formation in Pictou Co. at localities LR4 and LR4A.

PLATES

Plate I

Figures 1 - 5 *Dolerorthis* sp.

Figures 1a-d, 3 and 5 Glencoe Brook Formation, Pictou Co., Locality FT5; Figures 2, 4a-b. Beechhill Cove Formation, Arisaig area, Locality A-4.

1a Mold of interior of brachial valve (X1). Specimen #2642.

1b Rubber impression of specimen in figure 1a (X1).

1c Mold of exterior of brachial valve; counterpart of specimen in figure 1a (X1). Specimen #2641.

1d Rubber impression of specimen in figure 1a (X1).

2 Mold of interior of pedicle valve (X1). Specimen #2645.

3 Mold of interior of pedicle valve (X1). Specimen #2643.

4a Mold of interior of brachial valve (X1½). Specimen #2646.

4b Rubber impression of specimen in figure 4a (X1½).

5 Mold of interior of pedicle valve (X1). Specimen #2644.

Figures 6 - 7 *Ptychopleurella* ? sp.

Beechhill Cove Formation, Arisaig area, Locality A-4.

6a Mold of interior of pedicle valve (X2). Specimen #36442.

6b Mold of exterior of pedicle valve; counterpart of specimen in figure 6a (X2). Specimen #36442A.

7 Mold of interior of brachial valve (X2). Specimen #36443.

Figures 8 - 17 Dalmanella ? primitiva (McLearn, 1924).

Beechhill Cove Formation, Arisaig area, Locality A-3.

8a Mold of interior of brachial valve (X4). Specimen #257.

8b,c Rubber impression of specimen in figure 8, top view and anterior view (X4).

9a Mold of interior of brachial valve (X4). Specimen #255.

9b Rubber impression of specimen in figure 9a (X4).

10 Mold of interior of brachial valve (X5). Specimen #10.

11a Mold of interior of brachial valve (X4). Specimen #2501.

11b Rubber impression of specimen in figure 11a (X4).

12a,b Rubber impression of specimen #252, posterior view and top view (X4).

13 Mold of interior of brachial valve (X4). Specimen #251.

14 Mold of exterior of pedicle valve (X4). Specimen #2502.

15 Mold of exterior of brachial valve (X4). Specimen #2522.

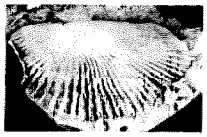
16 Mold of exterior of brachial valve (X4). Specimen #253.

17 Mold of interior of pedicle valve (X4). Specimen #256.

1a

1b

1c



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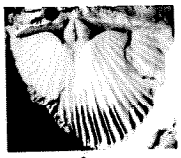

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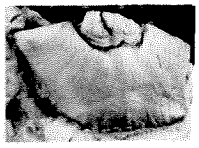

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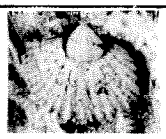

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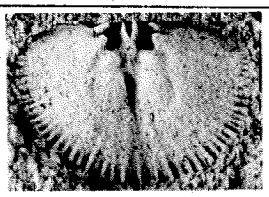

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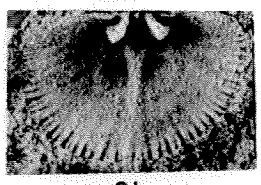

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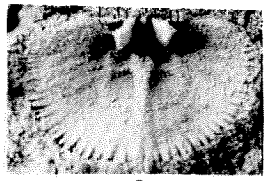

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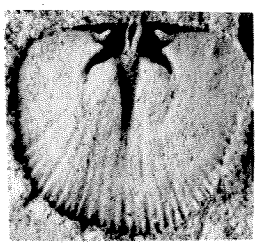

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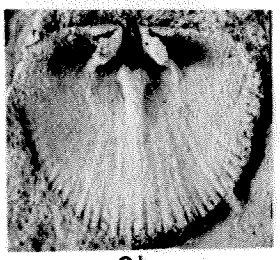

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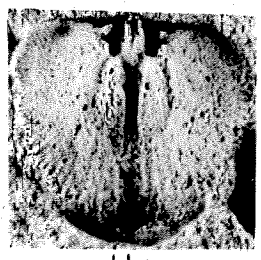

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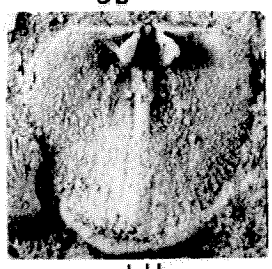

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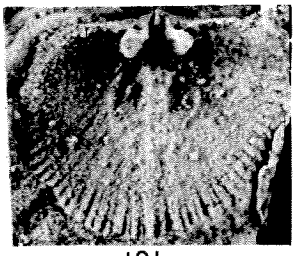

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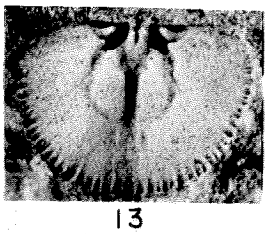

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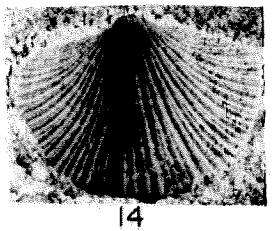

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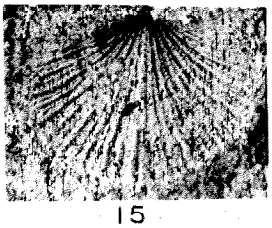

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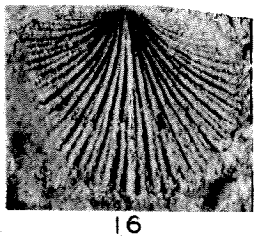

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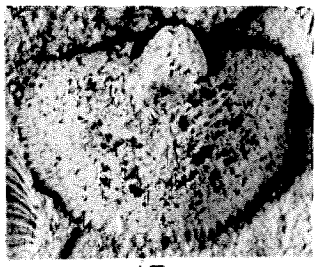


17

Plate II

Figures 1a - b — *Dalmanella primitiva* (McLearn, 1924).

Beechhill Cove Formation, Arisaig area, Locality A-3.

1a — Mold of Interior of pedical valve (X4). Specimen #254.

1b — Rubber impression of specimen in figure 1a (X4).

Figures 2 - 11 — *Dalmanella sp. A.*

Beechhill Cove Formation, Arisaig area, Locality A-2.

2 — Mold of exterior of pedical valve (X4). Specimen #259.

3a — Mold of exterior of brachial valve (X2). Specimen #36425.

3b — Rubber impression of specimen in figure 3a (X2).

4a — Mold of interior of pedicle valve (X4). Specimen #260.

4b — Rubber impression of specimen in figure 4a (X4).

5 — Mold of interior of pedicle valve (X3). Specimen #36426.

6 — Rubber impression of specimen in figure 2. (X2).

7 — Mold of interior of pedicle valve (X3). Specimen #36424.

8 — Mold of interior of pedicle valve (X4). Specimen #261.

9 — Mold of interior of brachial valve (X4). Specimen #265.

10 — Mold of interior of brachial valve (X4). Specimen #256.

11a Mold of interior of brachial valve (X3). Specimen #36427.

11b,c Rubber impression of specimen in figure 11a, Top view and anterior view (X3).

Figure 12 Dalmanella ? sp.

Beechhill Cove Formation, Arisaig area, Locality A-2. (X3) Specimen #263.

Figure 13 - 18 Dalmanella sp. B.

Glencoe Brook Formation, Pictou Co. Figures 13a, b, 16a, b, 17 Locality MT2A; Figures 14a, b, 18a, b Locality MT2A; Figure 15 Locality TT11

13a Mold of interior of pedicle valve (X2). Specimen #3642.

13b Rubber impression of specimen in figure 13a (X2).

14a Mold of exterior of pedicle valve (X2). Specimen #3641.

14b Rubber impression of specimen in figure 14a (X2).

15 Mold of interior of brachial valve (X2). Specimen #3646.

16a Mold of interior of brachial valve (X2). Specimen #3643

16b Rubber impression of specimen in figure 16a (X2).

17 Mold of interior of brachial valve (X2). Specimen #3644.

18a Mold of exterior of brachial valve (X2). Specimen #3645.

18b Rubber impression of specimen in figure 18a (X2).

Figures 14 - 21 Fascifera ? sp.

Glencoe Brook Formation, Pictou Co. Locality NR9.

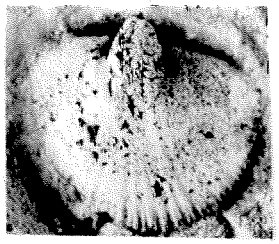
19a Mold of exterior of brachial valve (X2). Specimen #36415.

19b Rubber impression of specimen in figure 19a (X2).

20a Mold of exterior of pedicle valve Specimen #36416.

20b Rubber impression of specimen in figure 20a.

21 Mold of interior of pedicle valve Specimen #36410.



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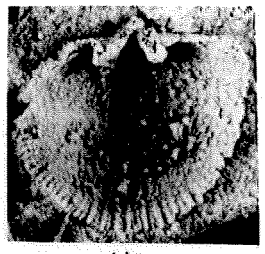

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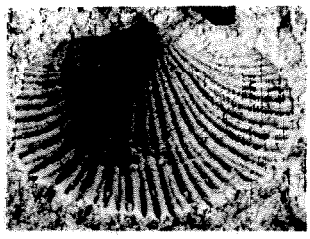

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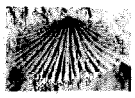

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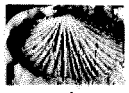

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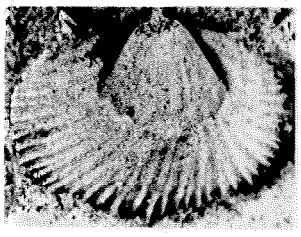

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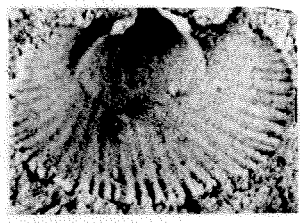

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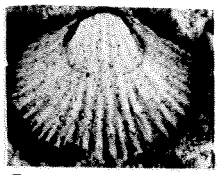

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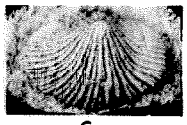

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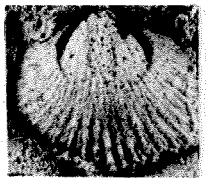

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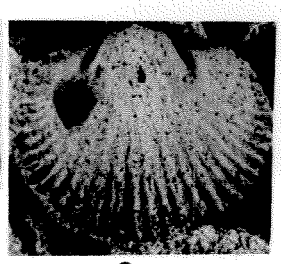

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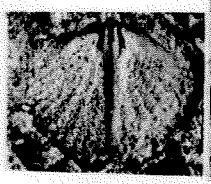

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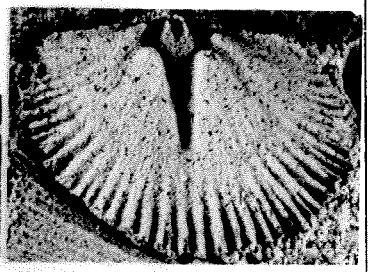

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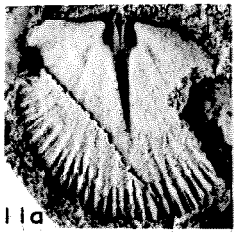

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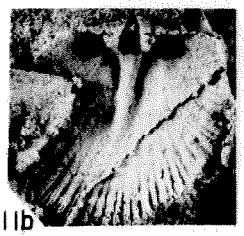

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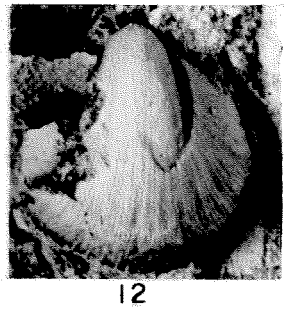

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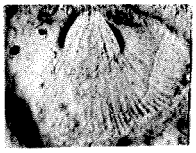

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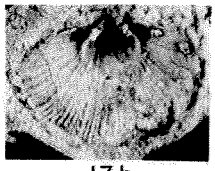

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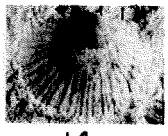

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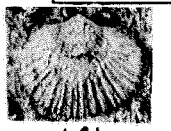

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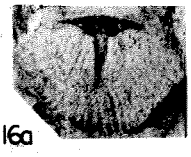

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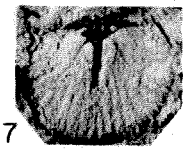

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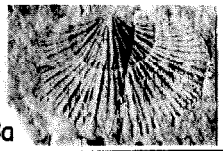

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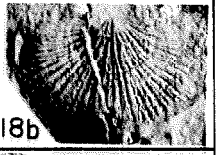

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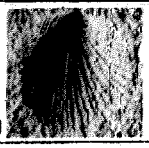

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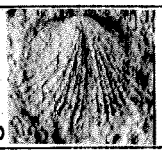

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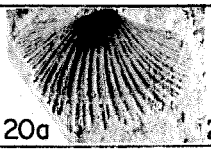

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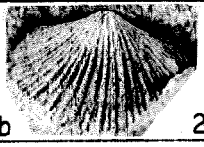

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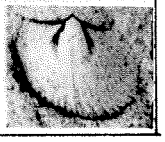


21

Plate III

Figures 1 - 6 *Fascifera* ? *sp.*

Glencoe Brook Formation, Pictou Co., Locality NR9.

1a Mold of interior of pedicle valve (X2). Specimen #3648.

1b Rubber impression of specimen in figure 1a (X2).

2 Mold of interior of pedicle valve (X2). Specimen #3649.

3 Mold of interior of brachial valve (X2). Specimen #36411.

4a Mold of interior of brachial valve (X2). Specimen #36413.

4b Rubber impression of specimen in figure 4a (X2).

5 Mold of interior of brachial valve (X2). Specimen #36414.

6 Mold of interior of brachial valve (X2). Specimen #36412.

Figures 7 - 15 *Visbyella nana* (McLearn, 1924)

Figures 7a, b, 11a, b Ross Brook Formation, Arisaig Shore Section; figures 8a, b, 9a-d, 10, and 14a-c Upper member Ross Brook Formation, Pictou Co., Locality DF49; Figures 12a, b Upper member Ross Brook Formation, Pictou Co., Locality DF48; Figures 13a-d Middle member Ross Brook Formation, Arisaig area, Locality B-2.

7a, b Ventral and dorsal views (X3) of Holotype. Peabody Museum Specimen #424.

8a-c Rubber impression of specimen #107 (Mold of anterior of articulated shell). Posterior, dorsal and side views (X4).

9a-d Rubber impression of specimen #105

(mold of exterior of articulated shell). Ventral, side, dorsal and posterior views (X4).

10 Rubber impression of specimen #106 (mold of exterior of articulated shell). Dorsal view (X4).

11a,b Ventral and dorsal views (X3) of Steinkern paratype, Peabody Museum Specimen #425.

12a,b Mold of interior of brachial valve Dorsal and anterior views (X4). Specimen #103.

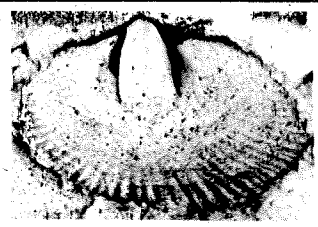
13a Mold of interior of brachial valve (X4). Specimen #110.

13b-d Rubber impression of specimen in figure 13a. Dorsal, posterior and side views (X4).

14a Mold of interior of pedicle valve (X4) Specimen #101.

14b,c Rubber impression of specimen in figure 13a. Top view and anterior view (X4).

15 Mold of exterior of brachial valve (X2) Specimen # G.S.C. 6207 (paratype D. conservatrix).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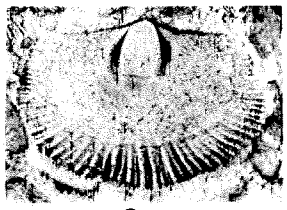
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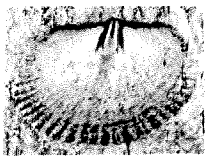
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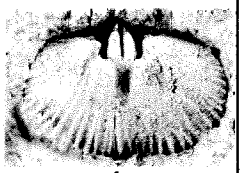
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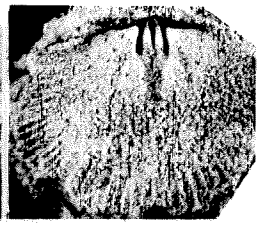
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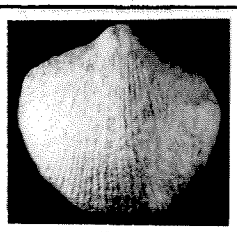
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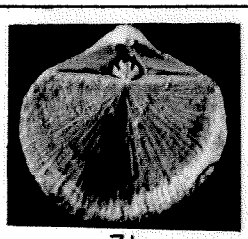
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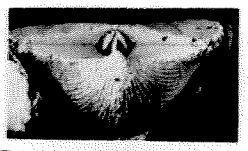
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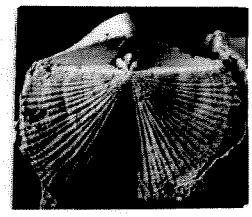
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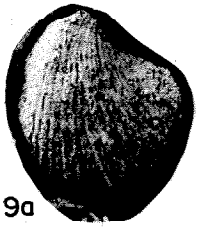
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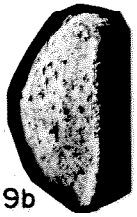
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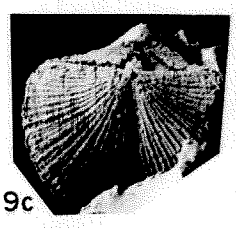
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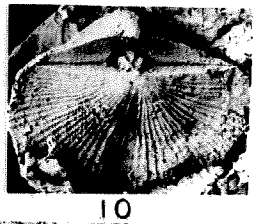
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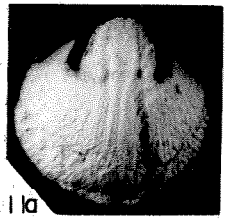
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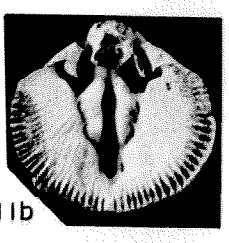
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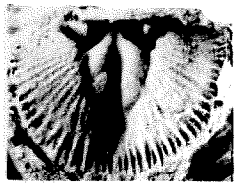
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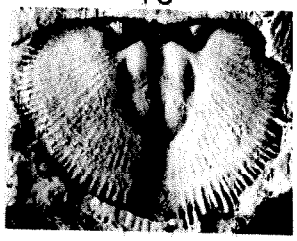
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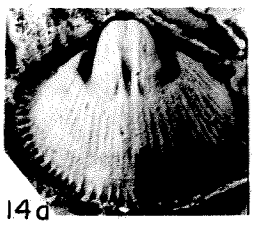
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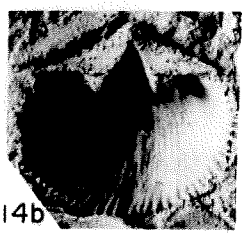
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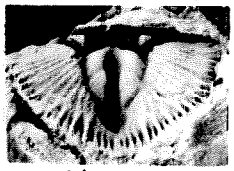
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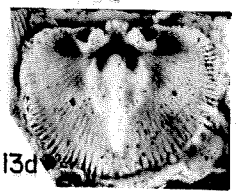
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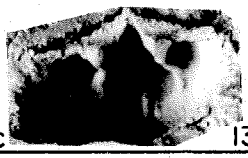

14c


13b


13c


15

Plate IV

Figures 1a,b — *Visbyella nana* (McLearn, 1924)

Middle member Ross Brook Formation, Arisaig area, Locality B-2.

1a — Mold of interior of brachial valve (X4). Specimen #112.

1b — Rubber impression of specimen in figure 1a (X4).

Figures 2 - 9 — *Resserella* cf. *R. concavoconvexa* (Twenhofel, 1927)

Figures 2a,b, 5a,b, 6, 7a,b, 9a,b, Lower member of McAdam Formation, Cobequid Mountains, Locality KA-62-4F; Figures 3a-c, 4 Lower member of McAdam Formation, Pictou Co., Locality HA5a; Figure 8, Lower member of the McAdam Formation, Arisaig area, Locality RB70.

2a — Mold of exterior of pedicle valve (X3). Specimen #36320.

2b — Rubber impression of specimen in figure 1a (X3).

3a — Mold of interior of pedicle valve (X3). Specimen #36317.

3b,c — Rubber impression of specimen in figure 3a (X3).

4 — Mold of interior of pedicle valve (X3). Specimen #36318.

5a — Mold of exterior of brachial valve (X3). Specimen #36321.

5b — Rubber impression of specimen in figure 5a (X3).

6 — Mold of interior of pedicle valve. (X3) Specimen #36319.

7a — Mold of interior of brachial valve (X3) Specimen #36323.

7b Rubber impression of specimen in figure 7a.

8 Mold of interior of brachial valve (X2). Specimen #363202.

9a Mold of interior of brachial valve Specimen #36322.

9b Rubber impression of specimen in figure 9a.

Figures 10 - 17 Mendacella arisaigensis (McLearn, 1924)

Figures 10, 11, 16a,b Beechhill Cove Formation, Arisaig area, Locality A2; Figure 12 Beechhill Cove Formation, Arisaig area, Locality A1; Figures 13, 15 Beechhill Cove Formation, Pictou Co., Locality UB22; Figure 14 Beechhill Cove Formation, Pictou Co., Locality FP16.

10 Mold of exterior of pedicle valve (X2) Specimen #281.

11 Mold of interior of pedicle valve (X4) Specimen #284.

12 Mold of interior of pedicle valve (X3) Specimen #288.

13 Mold of interior of pedicle valve (X2) Specimen #286.

14 Mold of interior of pedicle valve (X2) Specimen #283.

15 Mold of interior of pedicle valve (X2) Specimen #291.

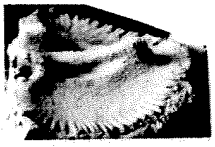
16a Mold of interior of pedicle valve (X2) Specimen 287.

16b Rubber imperssion of specimen in figure 16a (X2).

17a Mold of interior of pedicle valve (X1½) Holotype (Peabody Museum Specimen #303).

17b Rubber impression of specimen in figure 17a (X1½).


1a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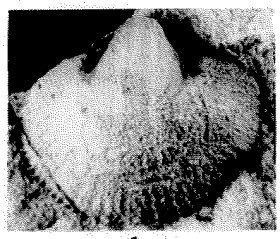
2a


2b


3a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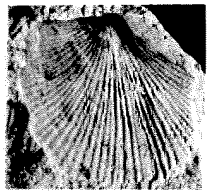
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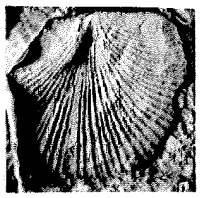
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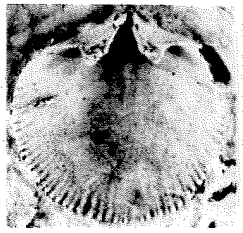
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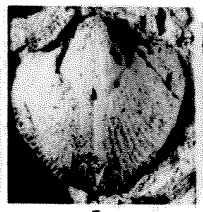
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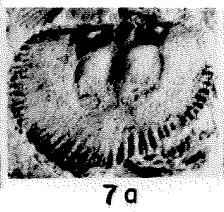
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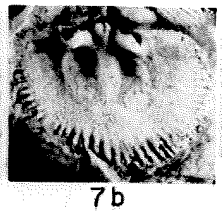
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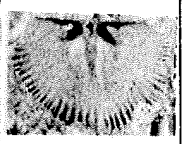
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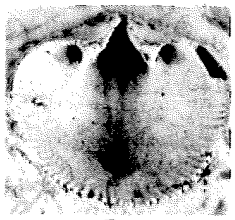
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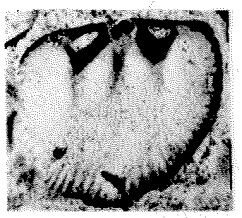
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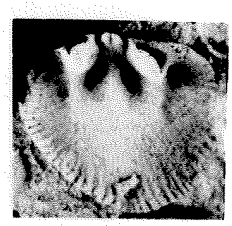
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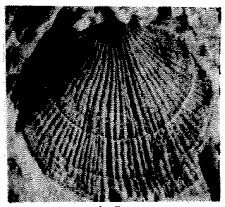
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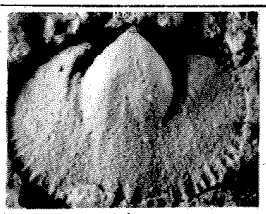
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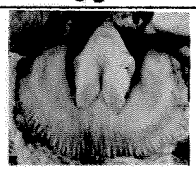
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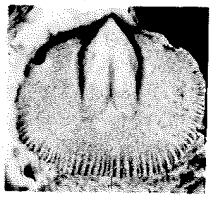
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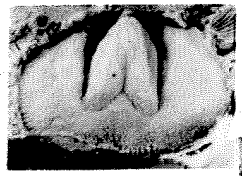
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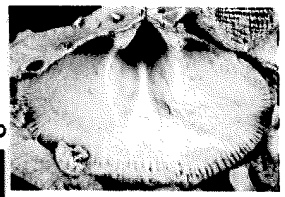
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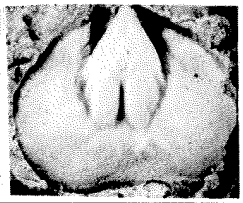
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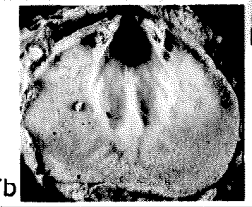
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Plate V

Figures 1 - 8 — *Mendacella arisaigensis* (McLearn, 1924)

Beechhill Cove Formation; Figures 1, 2 and 4, Locality UE22, Pictou Co.; Figures 3, 8a, b, Locality FP16, Pictou Co.; Figure 5a,b, Locality A-2, Arisaig area; Figure 6a,b, Locality A-1, Arisaig area; Figure 7 Arisaig Shore Section.

1 — Mold of interior of pedicle valve (X2) Specimen #2912.

2 — Mold of interior of pedicle valve (X2) Specimen #289.

3 — Mold of interior of brachial valve (X5) Specimen #293.

4 — Mold of interior of brachial valve (X4) Specimen #295.

5a — Mold of interior of brachial valve (X3) Specimen #298.

5b — Rubber impression of specimen in figure 5a (X3).

6a — Mold of interior of brachial valve (X1½)

6b — Rubber impression of specimen in figure 6a (X1½).

7 — Mold of interior of brachial valve paratype #G.S.C. 5412.

8a — Mold of interior of brachial valve (X1½) Specimen #301

8b — Rubber impression of specimen in figure 8a (X1½)

Figures 9 - 10 — *Dalejina* sp.

Lower member of McAdam Formation. Figures 9a,b, Locality HA7, Pictou Co; Figures 10a,b, Locality C-1, Arisaig area.

9a — Mold of interior of pedicle valve (X3)

9b Rubber impression of specimen in figure 9a (X3).

10a Mold of interior of brachial valve (X1)

10b Rubber impression of specimen in figure 10a (X1).

Figures 11 - 13 Idiorthis matura (McLearn, 1924)

McAdam Formation, Arisaig Shore Section (exact locality unknown)

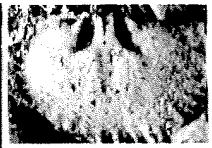
11a,b,c Ventral, dorsal and side views of Holotype (Peabody Museum Specimen #23686) (X1½).

12a,b Ventral and dorsal views of Steinkern. (X1½). Paratype (Peabody Museum Specimen #23688).

13a,b Ventral and dorsal views of Steinkern (X1½). Paratype (Peabody Museum Specimen #23687).


1


2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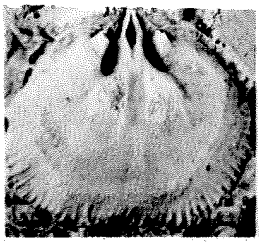
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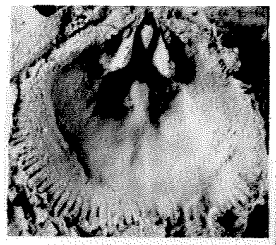
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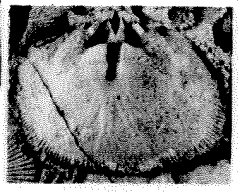
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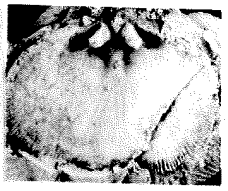
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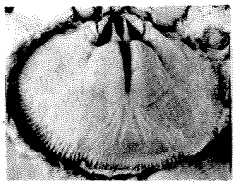
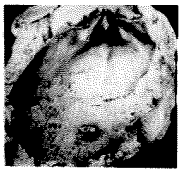

6a


6b


10a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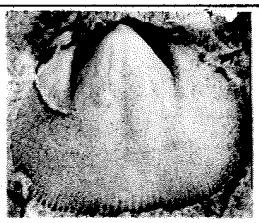
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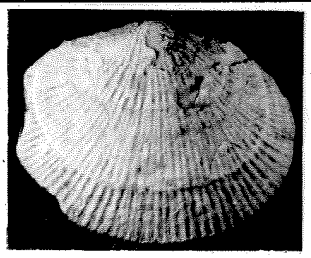
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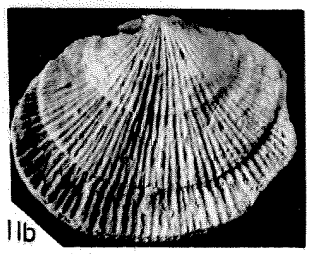
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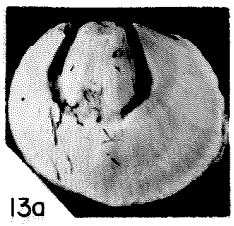
11c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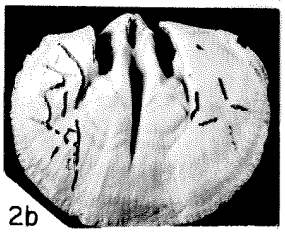
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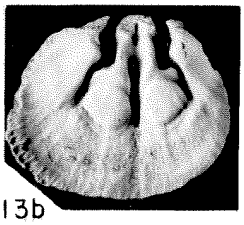

13b

Plate VI

Figures 1 - 3 — Idiorthis matura (McLearn, 1924)

Member 2, McAdam Formation, Locality C2, Arisaig area.

1a Mold of interior of brachial valve (X1½) Specimen #36431.

1b Rubber impression of specimen in figure 1a (X1½).

2a Mold of interior of brachial valve (X1½) Specimen #36430.

2b Rubber impression of specimen in figure 2a (X1½).

3a Mold of interior of brachial valve (X1½) Specimen 36429.

3b Rubber impression of specimen in figure 3a (X1½).

Figures 4 - 13 — Marklandella mcadamica (new species)

Member 2, McAdam Formation. Figures 4, 9-13, Locality HAF, Pictou Co.; Figures 5, 6, 8, Locality C2, Arisaig area; Figure 7, Locality DT23, Pictou Co.

4 Mold of interior of pedicle valve (X1½) Specimen #190.

5a Mold of interior of brachial valve (X1½) Specimen #36433.

5b Rubber impression of specimen in figure 5a (X1½).

6a Mold of interior of brachial valve (X1½)

6b Rubber impression of specimen in figure 6a (X1½).

7 Mold of interior of pedicle valve (X1½) Specimen #191.

8 Mold of interior of pedicle valve (X1½) Specimen #36428.

9a Rubber impression of specimen in figure 9b (X1½).

9b Two molds of interior of brachial valve (X1½). Specimen #183.

9c Rubber impression of specimen in figure 9b (X1½). Posterior view.

10a Mold of interior of brachial valve (X1½) Specimen #184.

10b Rubber impression of specimen in figure 10a

11a Mold of interior of brachial valve (X1½) Specimen #186.

11b Rubber impression of specimen in figure 10a.

12a Mold of exterior of brachial valve (X1½) Specimen #185.

12b Rubber impression of specimen in figure 12a.

13a Mold of interior of brachial valve (X1½) Specimen #189.

13b Rubber impression of specimen in figure 13a.

Figures 14 - 17 Linoporella sp.

Beechhill Cove Formation, Arisaig area, Figures 14-16, Locality LBC; Figure 17, Locality A-2.

14a Mold of interior of brachial valve Posterior view (X2). Specimen #464127.

14b Mold of interior of brachial valve Top view (X2). Specimen #464127.

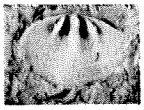
15a Mold of interior of brachial valve (X2) Specimen #464127.

15b Rubber impression of specimen in figure 15a.

16 Mold of interior of pedicle valve (X1) Specimen #464128.

17 Mold of interior of pedicle valve (X1) Specimen #464129.


1a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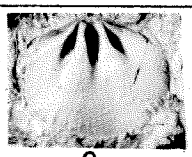
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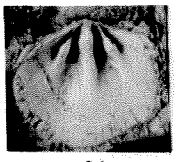
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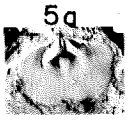
3a


3b


4


5a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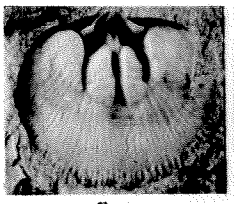
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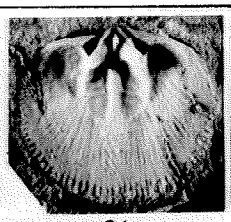
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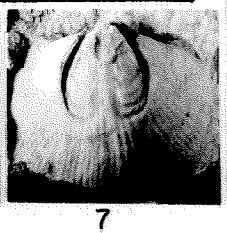
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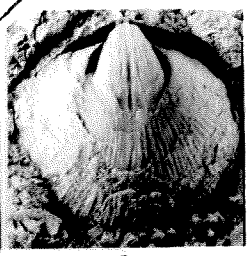
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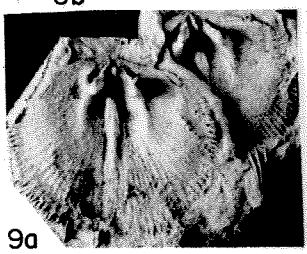
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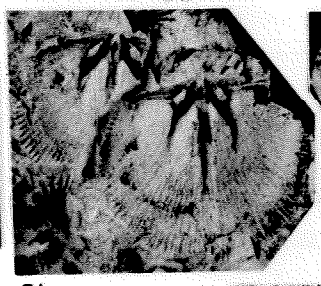
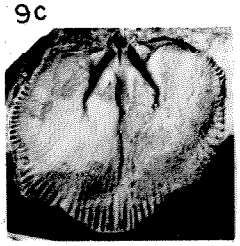

9b


10a


10b


9c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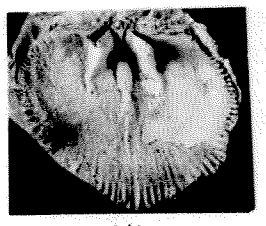
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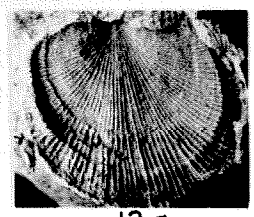
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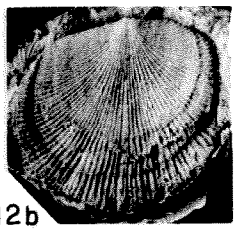
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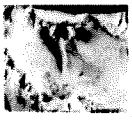
13a


13b


14a


14b


15a


15b


16


17

Plate VII

Figures 1 - 14 *Marklandella maehli* (new species)

French River Formation, Pictou Co. Figures 1, 7a,b, 8a,b, 10a,b, 12-14a,b, Locality DF15; Figures 2, 3, 5, 9a,b, 11a-e, Locality DF17; Figure 4, Locality FR22; Figure 6, Locality DF13.

1 Mold of interior of pedicle valve (X2) Specimen #154.

2 Mold of interior of pedicle valve (X1½) Specimen #153.

3 Mold of interior of pedicle valve (X1½) Specimen #160.

4 Mold of interior of pedicle valve (X1½) Specimen #151.

5 Mold of interior of pedicle valve (X1½) Specimen #152.

6 Mold of interior of pedicle valve (X1½) Specimen #159.

7a Mold of interior of pedicle valve (X1½) Specimen #157.

7b Rubber impression of specimen in figure 7a. (X1½).

8a Mold of exterior of pedicle valve (X2) Specimen #156.

9a Mold of interior of brachial valve (X2) Specimen #170.

9b Rubber impression of specimen in figure 9a (X3).

10a Rubber impression of specimen #172 (not figured) (X1½).

10b Rubber impression of specimen #172 (not figured) (X1½).

11a Rubber impression of specimen in figure 11b. Posterior view (X1½)

11b Mold of interior of brachial valve (X1½) Specimen #161.

11c-e Rubber impression of specimen in figure 11b. Side view (X1½), Top view (X1½) and oblique side view (X2).

12a Mold of exterior of brachial valve (X1½) Specimen #169.

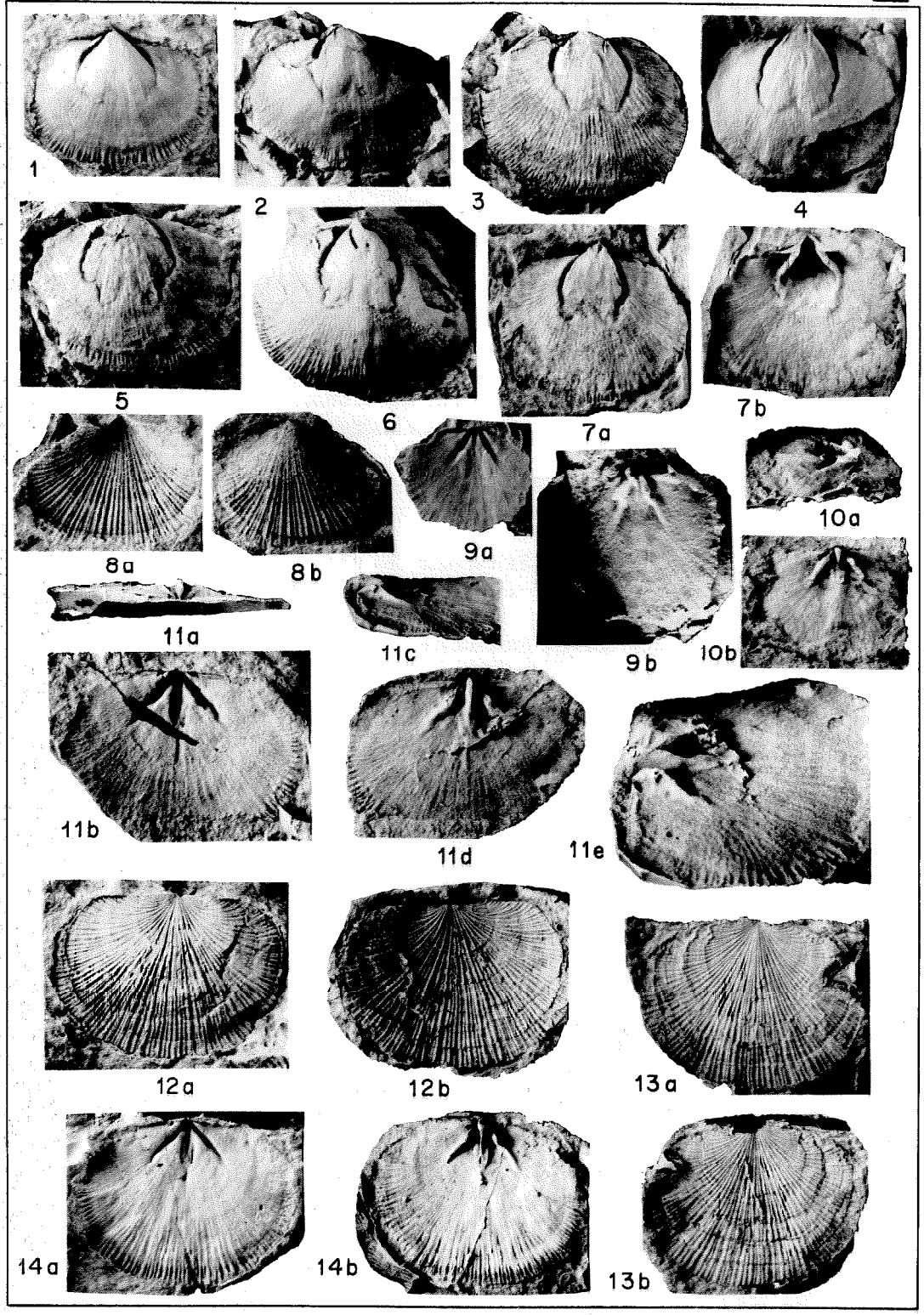
12b Rubber impression of specimen in figure 12a (X1½).

13a Mold of exterior of brachial valve (X1½) Specimen #165.

13b Rubber impression of specimen in figure 13a (X1½).

14a Mold of interior of brachial valve (X1½) Specimen #165-2. Counterpart of specimen in figure 13a.

14b Rubber impression of specimen in figure 14a.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11d
11e
12a
12b
13a
13b
14a
14b

Plate VIII

Figures 1 - 5 — Marklandella freitana (Clarke, 1899)

Specimens from beds of late Llandovery (C_3 -C_6) or Wenlock age, Bolivia, Locality unknown.

1a — Mold of interior of brachial valve (X1½) Specimen #194.

1b — Rubber impression of specimen in figure 1a (X1½).

2 — Rubber impression of specimen #198 (mold of interior of brachial valve not figured). (X1½).

3 — Mold of interior of pedical valve (X1½) Specimen #196.

4a — Mold of interior of brachial valve (X1½) Specimen #192.

4b — Rubber impression of specimen in figure 1a (X1½).

5 — Mold of interior of pedicle valve (X1½) Specimen #197.

Figures 6 - 9 — Platyorthis sp.

Torbrook Formation, Annapolis County, Nova Scotia Hickox Locality Spinney Brook #10.

6 — Mold of interior of pedicle valve (X1½) Specimen #181.

7a — Mold of interior of pedicle valve (X1½) Specimen #1812.

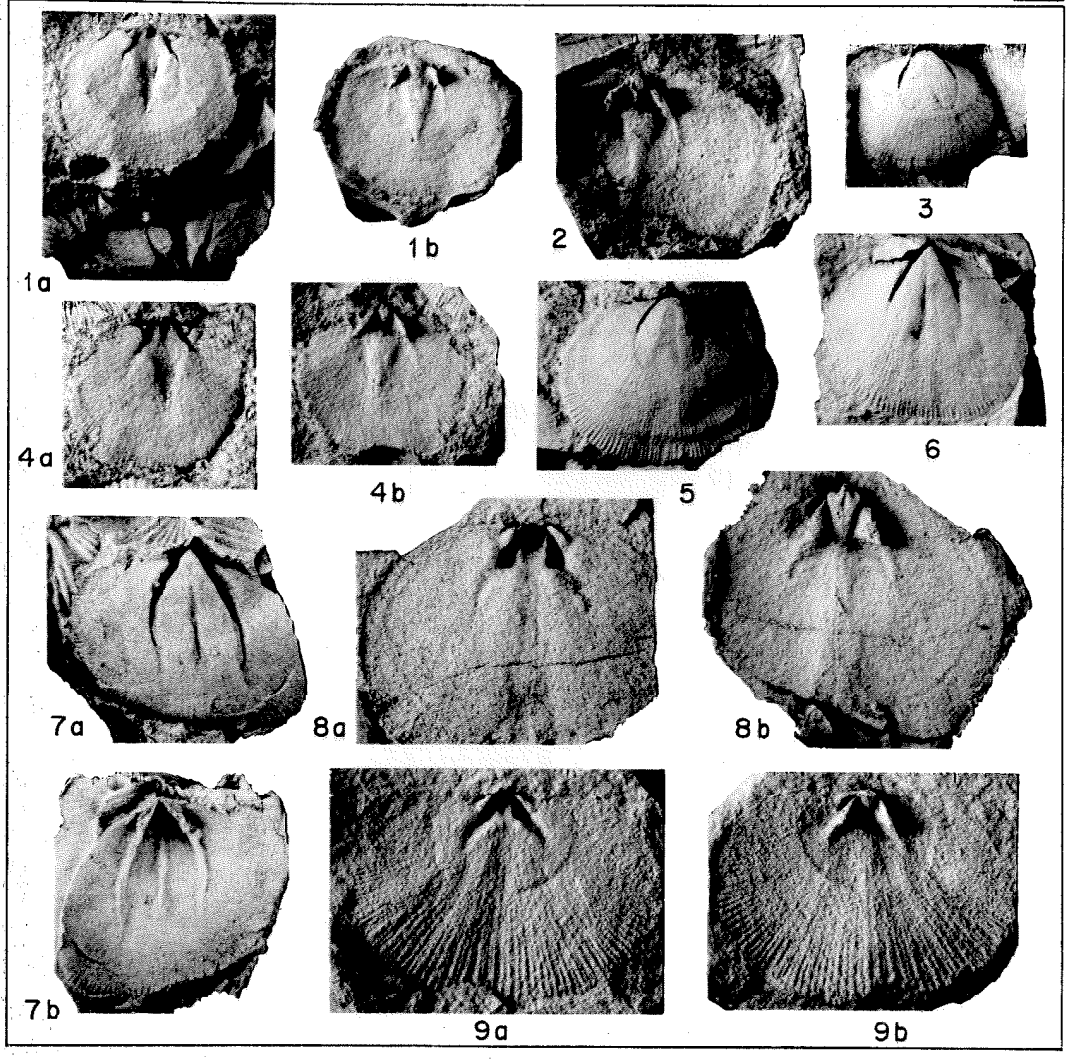
7b — Rubber impression of specimen in figure 7a (X1½).

8a — Mold of interior of brachial valve Specimen #179.

8b — Rubber impression of specimen in figure 8a.

9a Mold of interior of brachial valve Specimen #175.

9b Rubber impression of specimen in figure 9a.


1a
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7b
9a
9b

Plate IX

Figures 1 - 6 *Proschizophoria* sp.

Stonehouse Formation, Pictou Co. Figures 1, 3, 4, Locality LR4A; Figures 2, 5, 6, Locality GSC45432.

1 Mold of interior of pedicle valve (X1½). Specimen #64.

2 Mold of interior of pedicle valve (X1½). Specimen #65.

3a Mold of exterior of brachial valve (X1½). Specimen #66.

3b Rubber impression of specimen in figure 3a.

4 Mold of interior of brachial valve (X1½). Specimen #63.

5 Mold of interior of brachial valve (X1½). Specimen #62.

6a Mold of interior of brachial valve (X1½). Specimen #61.

6b Rubber impression of specimen in figure 6a.

Figures 7 - 10 *Schizophoria* sp.

Stonehouse Formation, Arisaig area, Locality E-4.

7a Mold of interior of brachial valve Specimen #46482.

7b Rubber impression of specimen in figure 7a.

8 Mold of interior of brachial valve Specimen #46481.

9 Mold of interior of brachial valve Specimen #46480.

10 Mold of exterior of brachial valve Specimen #46483.

Figures 11 - 14 *Isonthis prima* (new species)

Beechhill Cove Formation, Arisaig area, Locality A-2.

11a Mold of interior of brachial valve (X5). Specimen #2.

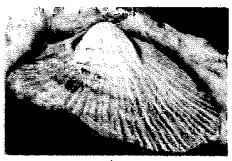
11b,c,d Rubber impression of specimen in figure 11. Top, anterior and posterior views (X5).

12a Mold of exterior of brachial valve (X2)

12b Rubber impression of specimen in figure 12a (X2).

13 Mold of interior of pedicle valve (X5). Specimen #5.

14 Mold of interior of pedicle valve (X5). Specimen #6.



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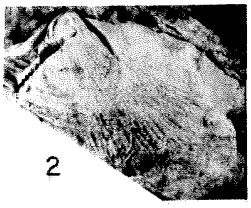

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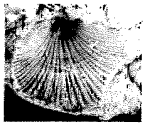

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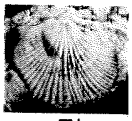

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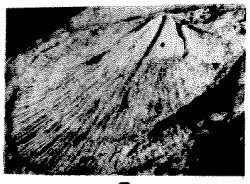

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6a

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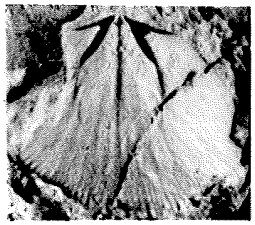

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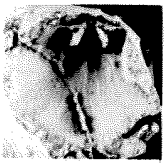

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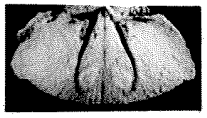

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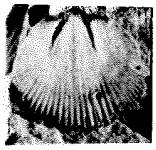

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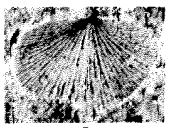

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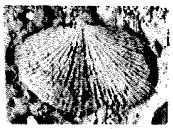

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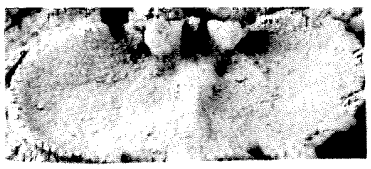

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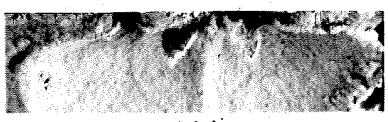

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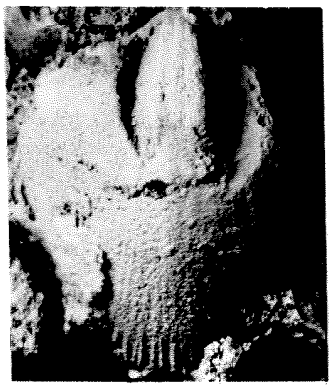

13

14

Plate X

Figures 1 - 10 *Isorthis mcadamensis* (new species)

Member 1, McAdam Formation, Pictou Co. Figures 1-5, 7-9, Locality HA7; Figures 6, 10, Locality DM7.

1a Mold of interior of brachial valve (X3). Specimen #22.

1b-d Rubber impression of specimen in figure 1a. Top, anterior and posterior views (X3).

2a Mold of exterior of brachial valve (X2½). Specimen #33.

2b Rubber impression of specimen in figure 2a (X2½).

3a Mold of interior of brachial valve (X3). Specimen #30.

3b Rubber impression of specimen in figure 3a (X3).

4a Mold of interior of brachial valve (X3). Specimen #32.

4b Rubber impression of specimen in figure 4a (X3).

5a Mold of interior of brachial valve (X3). Specimen #38.

5b Rubber impression of specimen in figure 5a (X3).

6a Mold of interior of brachial valve (X3). Specimen #40.

6b-d Rubber impression of specimen in figure 6a. Top, posterior and anterior views (X3).

7a Mold of interior of pedicle valve (X3). Specimen #29.

7b-d Rubber impression of specimen in figure 7a. Top, posterior, and anterior views (X3).

8a,b Mold of interior of pedicle valve Specimen #24.

9 Mold of interior of pedicle valve Specimen #34.

10 Mold of interior of pedicle valve Specimen #39.

Figures 11, 12 Isorthis fornicatimcurvata (Fuchs, 1919)

Flaserschiefer of Huinghauser schichten. Railroad cut, 85 paces N.E. of Huinghauser Railroad station. Map sheet Herscheid, Germany. (Boucot Locality 57-D-101)

11a Mold of interior of brachial valve (X3). Specimen #113.

11b Rubber impression of specimen in figure 11a (X3).

12 Mold of exterior of brachial valve (X3). Specimen #115. Counterpart of specimen in figure 11a.

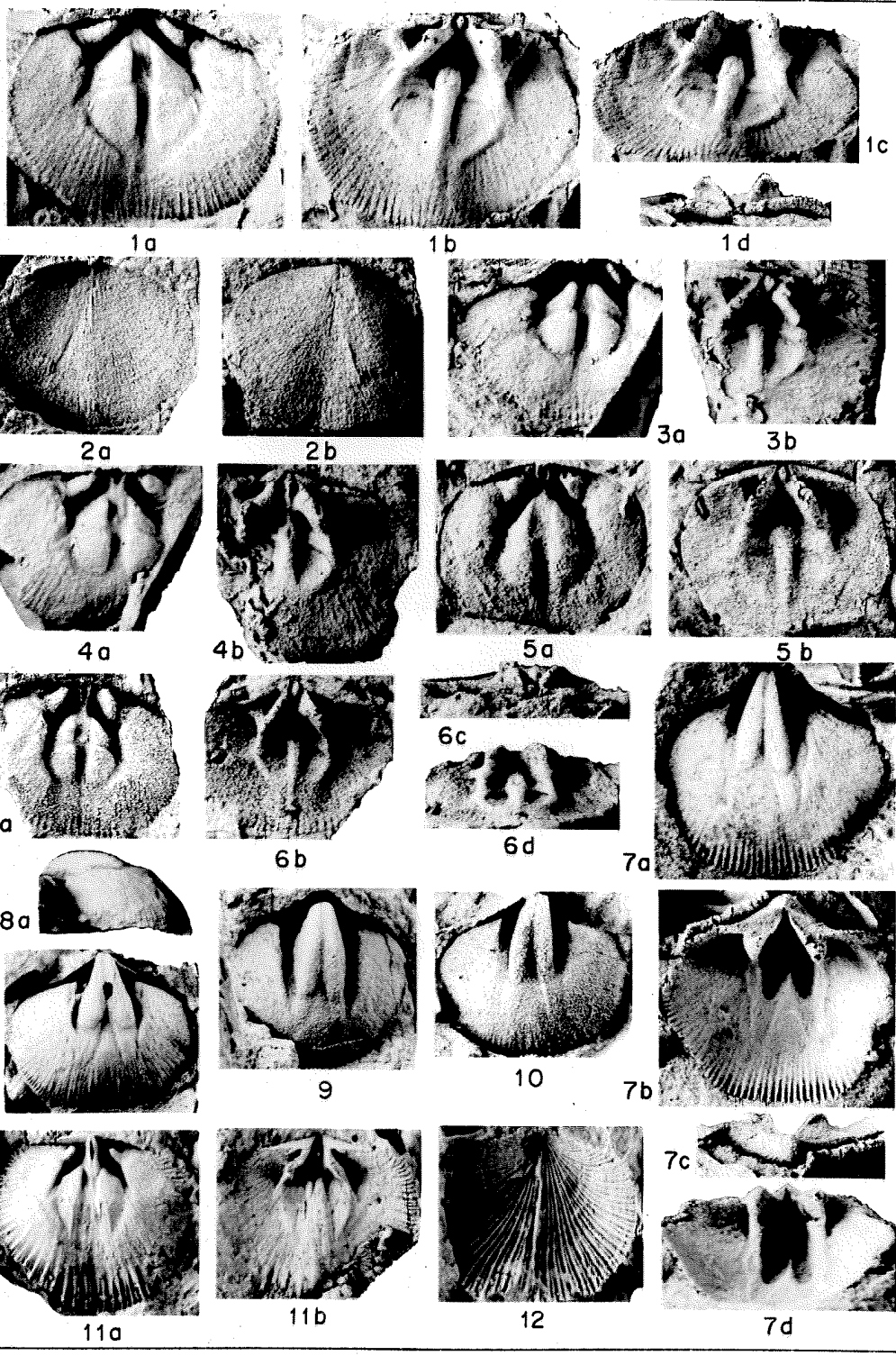
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Plate XI

Figures 1 - 25 *Isorthis fornicatimcurvata* (Fuchs, 1919)

Figures 1-7, Flasershiefer of Huinghauser Schichten. Railroad cut, 85 paces N.E. of Huinghauser railroad station. Map sheet Herscheid, Germany. (Boucot Locality 57-D-101); Figures 8-10, 15, 19, 23-25, Stonehouse Formation, Arisaig shore section; Figures 11, 12, Stonehouse Formation, Arisaig area, Locality CRED; Figures 13, 14, 16-18, 21, 22, Stonehouse Formation, Arisaig area, Locality 2E

1a Mold of interior of brachial valve (X3). Specimen #117.

1b Rubber impression of specimen in figure 1a (X3).

2 Mold of interior of pedicle valve (X2). Specimen #126.

3 Mold of interior of pedicle valve (X2). Specimen #125.

4a Mold of interior of brachial valve (X2½). Specimen #118.

4b Rubber impression of specimen in figure 4a (X2½).

5a Mold of interior of pedicle valve (X1½). Specimen #123.

5b Rubber impression of specimen in figure 5a (X1½).

6 Mold of interior of brachial valve (X2). Specimen #120.

7 Mold of interior of brachial valve (X2). Specimen #122.

8a Mold of interior of brachial valve (X2). Specimen #132.

8b Rubber impression of specimen in figure 8a (X2).

9 Mold of interior of brachial valve (X2). Specimen #130.

10 Mold of interior of brachial valve (X2). Specimen #135.

11a Mold of interior of brachial valve (X2). Specimen #137.

11b Rubber impression of specimen in figure 11a (X2).

12 Mold of interior of brachial valve (X2). Specimen #140.

13 Mold of interior of brachial valve (X3). Specimen #143.

14 Mold of interior of brachial valve (X3). Specimen #142.

15 Mold of interior of brachial valve (X1). Specimen #133.

16 Mold of interior of brachial valve (X2). Specimen #147.

17 Rubber impression of specimen #148 (mold of interior of brachial valve, not figured) (X2).

18 Mold of interior of brachial valve (X3). Specimen #149.

19 Mold of interior of pedicle valve (X2). Specimen #128.

20 Mold of interior of pedicle valve (X3). Specimen #144.

21 Mold of interior of pedicle valve (X3). Specimen #145.

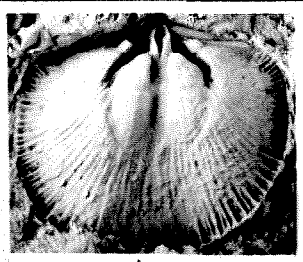
22 Mold of interior of pedicle valve (X3). Specimen #146.

23 Mold of exterior of pedicle valve (X2). Apecimen #129.

24 Mold of exterior of brachial valve (X2) Specimen #134.

25a Rubber impression of specimen in figure 25b (X2).

25b Mold of exterior of brachial valve (X2). Specimen #139.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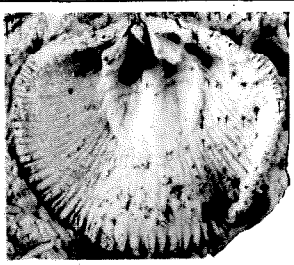
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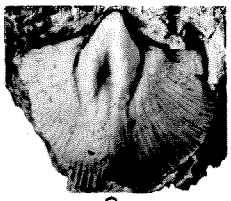
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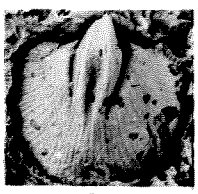
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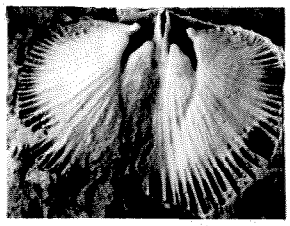
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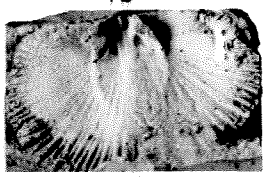
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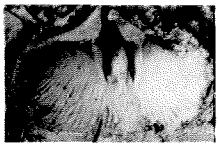
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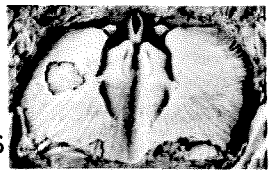
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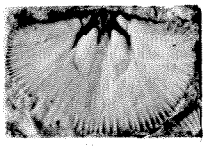
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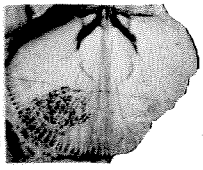
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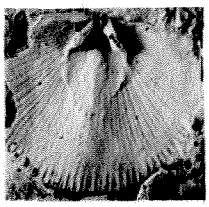
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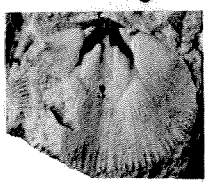
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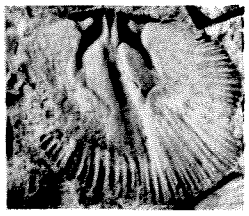
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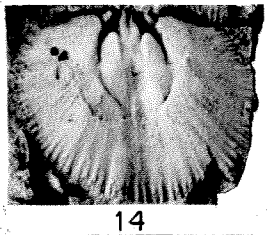
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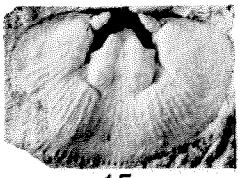
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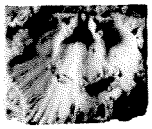
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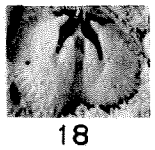
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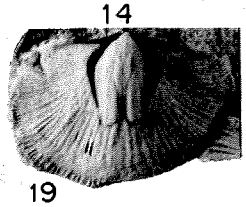
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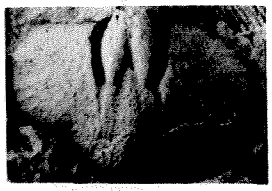
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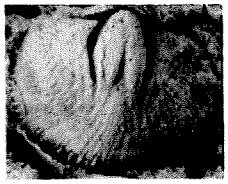
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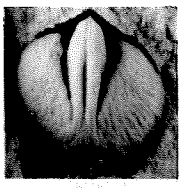
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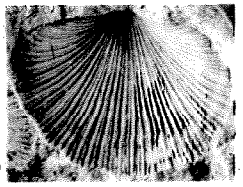
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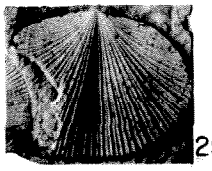
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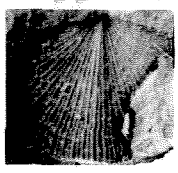
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Plate XII

Figures 1 - 26 *Salopina submedia* (McLearn, 1924)

Figures 1-3, Jones Creek Formation, Highway and Jones Creek, New Brunswick; Figures 4, 5, 7, 13, French River Formation, Locality DF15, Pictou Co.; Figures 6, 8-12, 14, French River Formation, Locality DF17, Pictou Co.; Figures 15-26, Stonehouse Formation, Arisaig shore section.

1 Rubber impression of specimen W-43. Posterior view (X3).

2a Mold of interior of brachial valve (X2). Specimen #W-9.

2b Rubber impression of specimen in figure 2a (X2).

3 Mold of interior of brachial valve Specimen #11201-14.

4 Mold of interior of pedicle valve (X3). Specimen #14

5 Mold of interior of pedicle valve (X3). Specimen #13.

6 Mold of interior of pedicle valve (X2). Specimen #16.

7 Mold of interior of brachial valve (X3). Specimen #12.

8 Mold of interior of brachial valve (X3). Specimen #15.

9 Mold of interior of brachial valve (X2). Specimen #17.

10 Mold of interior of brachial valve (X3). Specimen #18.

11 Mold of interior of brachial valve (X3). Specimen #20.

12 Mold of interior of brachial valve (X3). Specimen #19.

13 Mold of exterior of brachial valve (X3). Specimen #11.

14 Mold of exterior of brachial valve (X3). Specimen #21.

15 Mold of interior of pedicle valve (X3). Specimen #59.

16 Mold of interior of brachial valve (X3). Specimen #43.

17 Mold of interior of brachial valve (X2). Specimen #49.

18 Mold of interior of pedicle valve (X3). Specimen #60.

19 Mold of interior of pedicle valve (X3). Specimen #61.

20 Mold of exterior of brachial valve. (X3). Specimen #54.

21 Mold of interior of brachial valve (X3). Specimen #58.

22 Mold of interior of brachial valve (X2). Specimen #44.

23 Mold of interior of brachial valve (X3). Specimen #47.

24 Mold of exterior of brachial valve (X3). Specimen #472.

25a Mold of interior of brachial valve (X2½). Specimen #51.

25b Rubber impression of specimen in figure 25a (X2½).

26a Mold of interior of brachial valve (X3). Specimen #57.

26b Rubber impression of specimen in figure 26a (X3).


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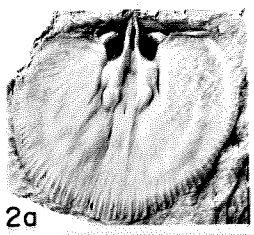
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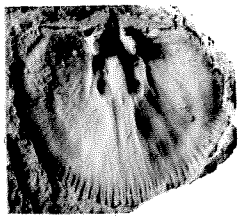
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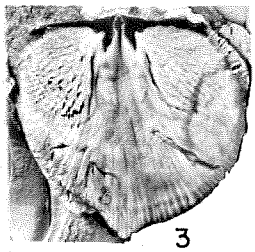
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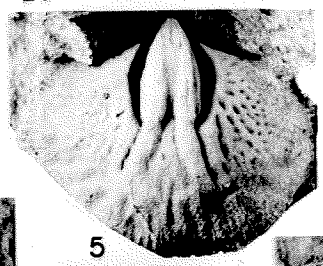
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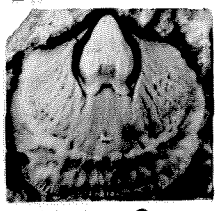
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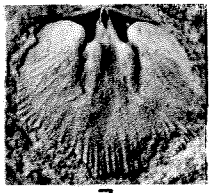
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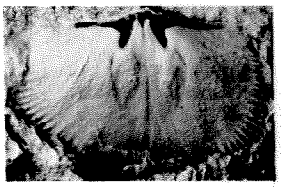
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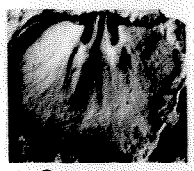
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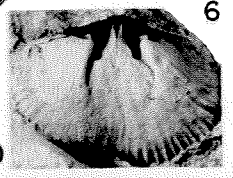
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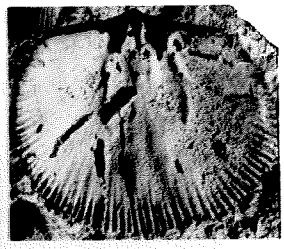
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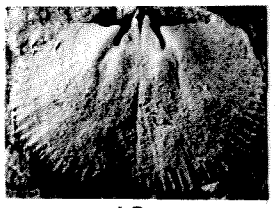
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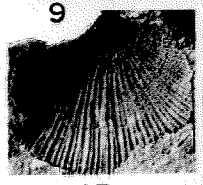
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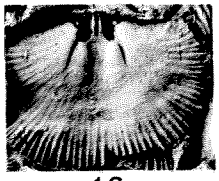
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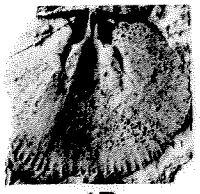
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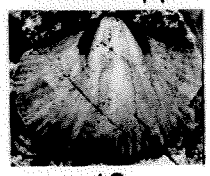
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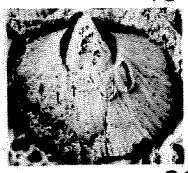
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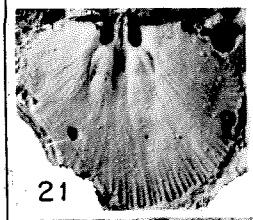
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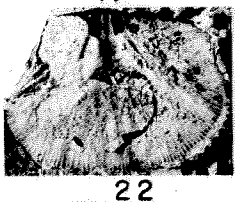
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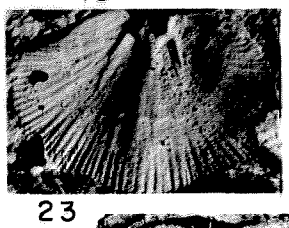
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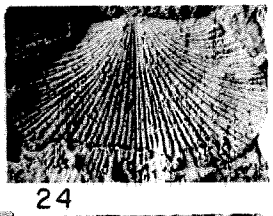
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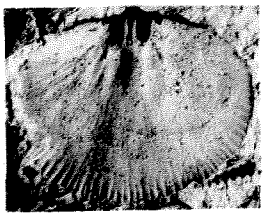
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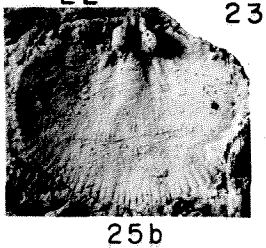
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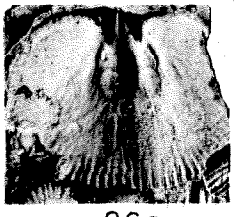
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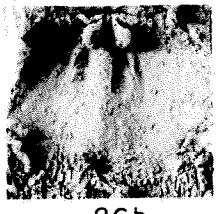
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Plate XIII

Figures 1 - 3 — Salopina submedia (McLearn, 1924)

Stonehouse Formation, Arisaig Shore Section.

1 — Mold of exterior of brachial valve (X2⅓). Specimen #52.

2 — Mold of exterior of brachial valve (X3). Specimen #55.

3 — Mold of exterior of brachial valve (X3). Specimen #50.

Figures 4 - 14 — Salopina stonehousensis (new species)

Stonehouse Formation, Arisaig area. Figures 4, 6, 8-12, 14, Locality NF15: Figures 5, 7, 13, Locality NF14.

4a-c — Rubber impression of specimen in figure 9. Top, posterior and anterior views (X4).

5 — Mold of interior of pedicle valve (X4). Specimen #100.

6 — Mold of interior of brachial valve (X4). Specimen #67.

7 — Mold of interior of pedicle valve (X4). Specimen #98.

8 — Mold of interior of brachial valve (X3). Specimen #66.

9 — Mold of interior of brachial valve (X3). Specimen #63.

10 — Mold of exterior of brachial valve (X4). Specimen #69.

11 — Rubber impression of specimen in figure 10 (X4).

12 — Rubber impression of specimen #62 (mold of exterior of brachial valve, not figured) (X3).

13 Mold of exterior of pedicle valve (X4). Specimen #99.

14 Mold of exterior of brachial valve (X3). Specimen #65.

Figures 15 - 22 Salopina conservatrix (McLearn, 1924)

Figures 15-17, Hemse Group. Locality along shore 270 m. N.E. of the southernmost point in the inlet at Djvpriks flge., Kraklingbo parish (Boucot Locality 56-G-75); Figures 18, 22, Upper member, Ross Brook Formation, Locality B-4, Arisaig area; Figures 19-21, Upper member Ross Brook Formation, Locality DF9, Pictou Co.

15 Interior brachial valve (X4) Specimen #43AR.

16 Interior brachial valve (X4) Specimen #43B.

17 Interior pedicle valve (X4) Specimen #43A.

18 Mold of interior of pedicle valve (X4). Specimen #72.

19a Mold of interior of brachial valve (X4). Specimen #92.

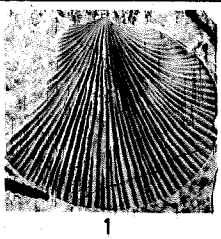
19b-d Rubber impression of specimen in figure 19a. Top, posterior and anterior views (X4).

20 Mold of interior of pedicle valve (X4). Specimen #96.

21a Mold of interior of brachial valve (X4). Specimen #91.

21b-d Rubber impression of specimen in figure 21a. Posterior, anterior and top views (X4).

22 Mold of interior of brachial valve (X4). Specimen #70.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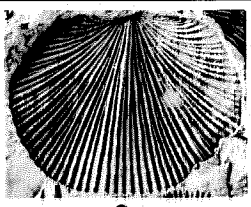
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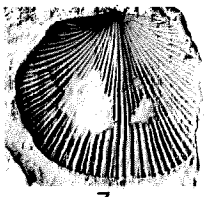
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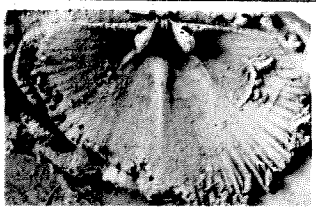
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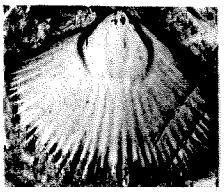
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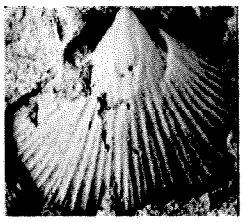
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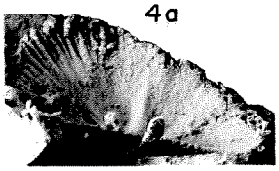
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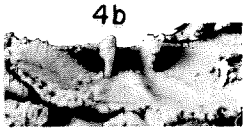
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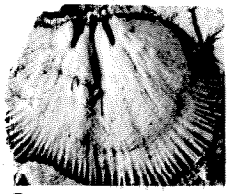
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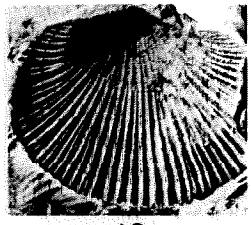
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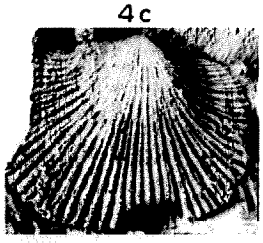
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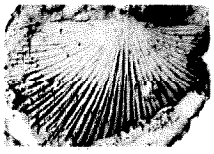
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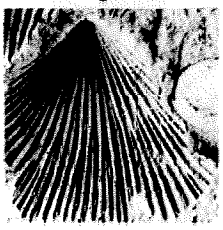
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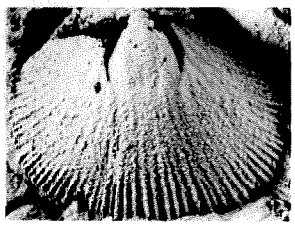
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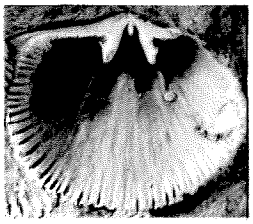
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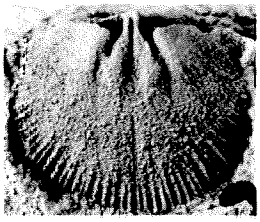
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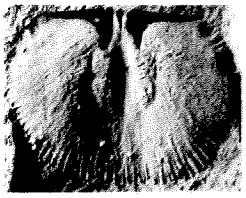
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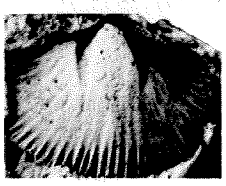
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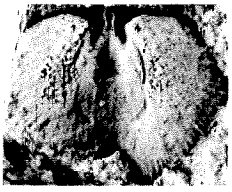
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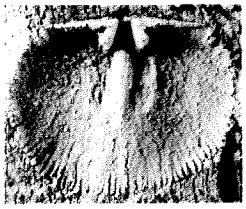
21b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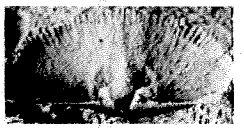
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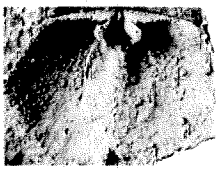
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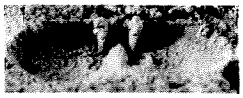

19d

Plate XIV

Figures 1 - 11 *Salopina conservatrix* (MCLearn, 1924)

Upper member Ross Brook Formation, Figures 1, 7, 9, 10, Locality B-4, Arisaig area; Figures 2-6, 8, 11, Locality DF9, Pictou Co.

1 Mold of interior of brachial valve (X4). Specimen #75.

2 Mold of interior of pedicle valve (X4). Specimen #95.

3a Mold of interior of brachial valve (X4). Specimen #82.

3b Rubber impression of specimen in figure 3a (X4).

4a Rubber impression of specimen in figure 4d (X4).

4b Rubber impression of specimen in figure 4d (X4).

4c Rubber impression of specimen in figure 4d (X4).

4d Mold of interior of brachial valve (X4). Specimen #83.

5a Mold of interior of brachial valve (X4).

5b Rubber impression of specimen in figure 5a (X4).

6

7 Mold of interior of brachial valve (X4). Specimen #78.

8a Mold of exterior of brachial valve (X4). Specimen #79.

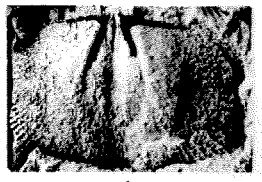
8b Rubber impression of specimen in figure 8a (X4).

9a Mold of interior of brachial valve (X3). Specimen #73.

9b Rubber impression of specimen in figure 9a (X3).

10 Rubber impression of specimen #76 (mold of exterior of brachial valve, not figured) (X3).

11 Mold of exterior of brachial valve (X4). Specimen #88.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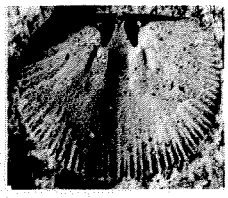
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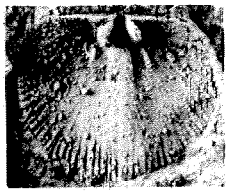
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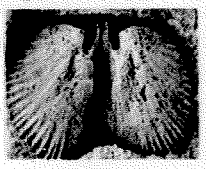
4a


4b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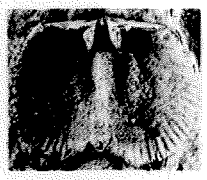
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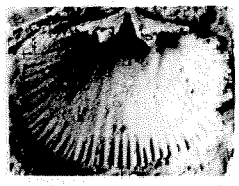
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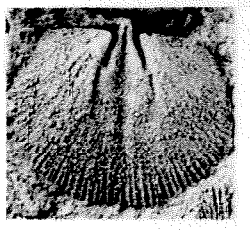
4c


4d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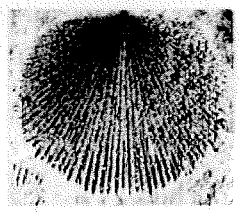
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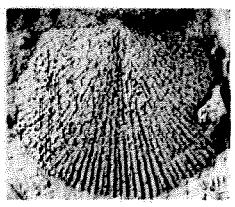
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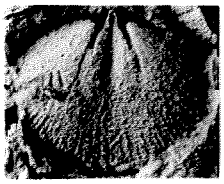
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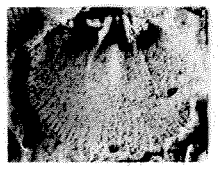
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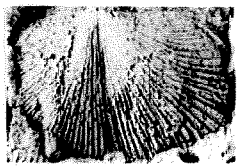
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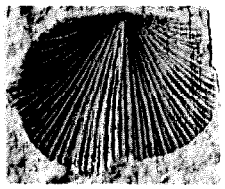
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Plate XV

Figures 1 - 6 — Loleptostrophia beechhillensis (McLearn, 1924)

Beechhill Cove Formation. Figures 1, 3, 5, Locality A-2, Arisaig area; Figures 2, 4, Locality FP1G, Pictou Co.; Figure 6, Arisaig Shore Section.

1a — Mold of interior of pedicle valve (X1½). Specimen #270.

1b — Rubber impression of specimen in figure 1a (X1).

1c — Mold of exterior of pedicle valve (X1½). Counterpart of 1a. Specimen #271

1d — Rubber impression of specimen in figure 1c (X1).

2 — Mold of interior of pedicle valve (X2). Specimen #280.

3 — Mold of interior of pedicle valve (X2). Specimen #278.

4 — Mold of interior of pedicle valve (X2). Specimen #279.

5a — Mold of interior of brachial valve (X2). Specimen #277.

5b — Rubber impression of specimen in figure 5a (X2).

6 — Mold of exterior of brachial valve (X2). Holotype GSC#5416.

Figures 7a, b — Leptostrophia sp.

French River Formation, Locality DF13, Pictou Co.

7a — Mold of interior of pedicle valve (X1½). Specimen #464100.

7b — Rubber impression of specimen in figure 7a (X1½).

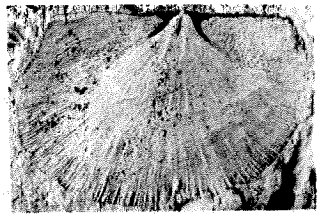
Figures 8 - 10 *Amphistrophia* cf *A. striata* (Hall, 1843)

Member 1, McAdam Formation, Locality DM7, Pictou Co.

8 Mold of exterior of pedicle valve (X2). Specimen #415643.

9 Mold of interior of pedicle valve (X2). Specimen #415642.

10 Mold of interior of brachial valve (X2). Specimen #415641.



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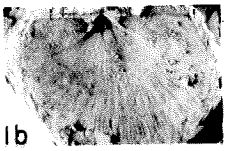

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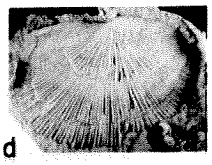

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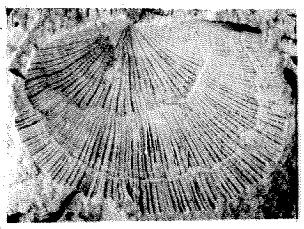
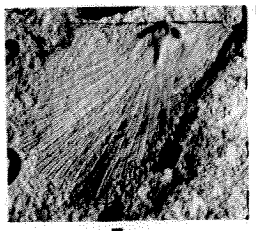


1c



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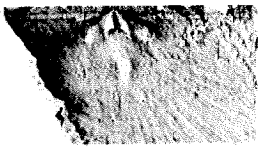

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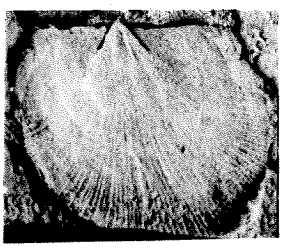

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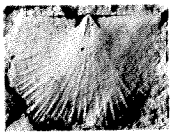

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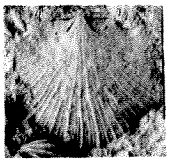

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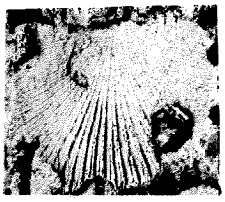

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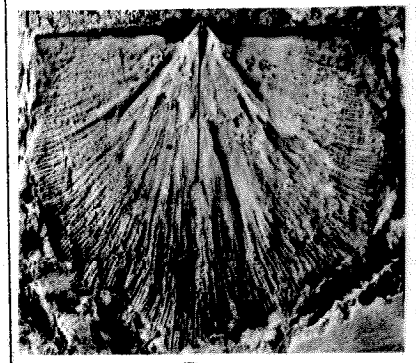
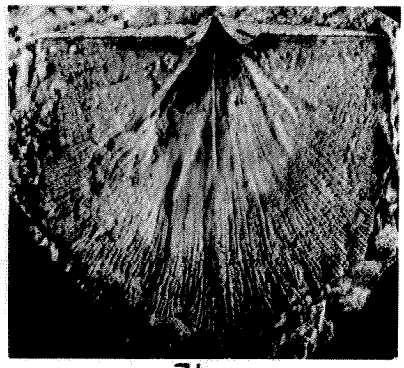


7a



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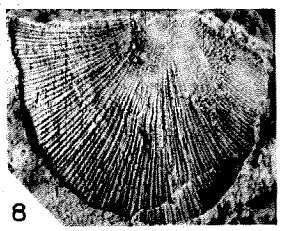

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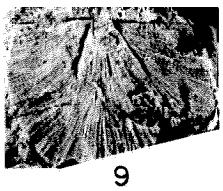

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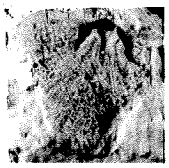


10

Plate XVI

Figures 1 - 7 — *Amphistrophia* cf *A. funiculata* (McCoy, 1846)

Figures 1, 4, 5, 7, Member 1, McAdam Formation, Locality HAT, Pictou Co.; Figures 2, 3, Member 2, McAdam Formation, Locality DT23, Pictou Co.; Figure 6 Member 2, McAdam Formation, Locality HAF, Pictou Co.

1a — Mold of interior of pedicle valve (X1½). Specimen #26415.

1b — Rubber impression of specimen in figure 1a (X1½).

2a — Mold of interior of pedicle valve (X1½). Specimen #26413.

2b — Rubber impression of specimen in figure 1a (X1½).

3a — Mold of exterior of pedicle valve (X1½). Specimen #26411.

3b — Rubber impression of specimen in figure 3a (X1½).

4 — Mold of exterior of pedicle valve (X1½). Specimen #26412.

5 — Mold of interior of pedicle valve (X1½). Specimen #26414.

6a — Mold of interior of brachial valve (X2). Specimen #26410.

6b — Rubber impression of specimen in figure 6a (X2).

6c — Mold of exterior of brachial valve (X1½). Counterpart of 6a.

7a — Mold of interior of brachial valve (X2). Specimen #2649.

7b — Rubber impression of specimen in figure 7a (X2).

Figures 8 - 9 *Mclearnites* sp.

Member 1, McAdam Formation, Locality C-1, Arisaig area.

8a Mold of interior of pedicle valve (X1). Specimen #464103

8b Rubber impression of specimen in figure 8a (X1).

9a Mold of exterior of pedicle valve (X1½). Specimen #464101A

9b Mold of interior of pedicle valve (X1½). Specimen #464101.

Figures 10 - 13 *Mclearnites mertoni* (McLearn, 1924)

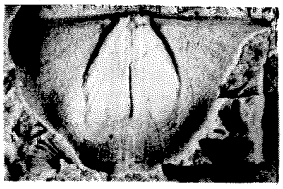
Stonehouse Formation, Arisaig area. Figures 10, 11, Shore section; Figures 12, 13, Locality E-4.

10 Mold of interior of pedicle valve (X1½). Holotype GSC #5417.

11 Mold of interior of pedicle valve (X1½). GSC #5419.

12 Mold of interior of pedicle valve (X1). Specimen #464110.

13 Mold of interior of pedicle valve (X1). Specimen #464111.



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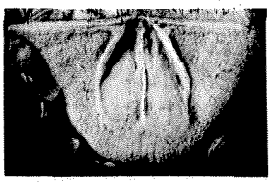

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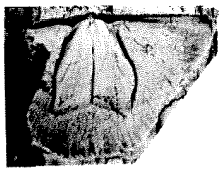

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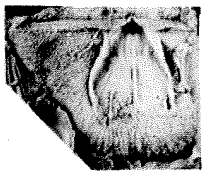

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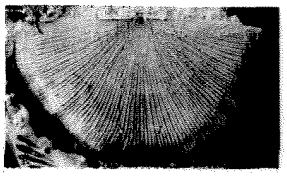

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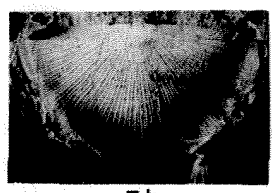

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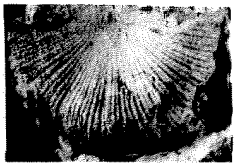

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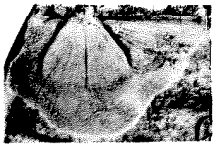

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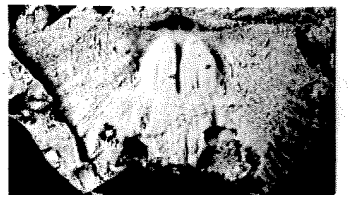

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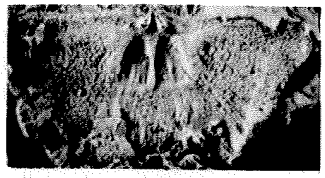

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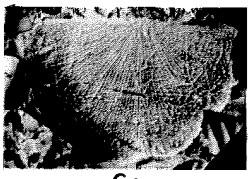

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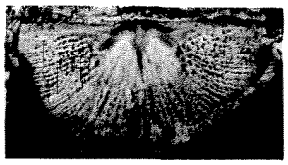

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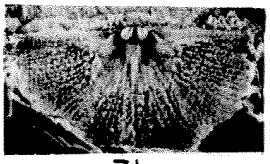

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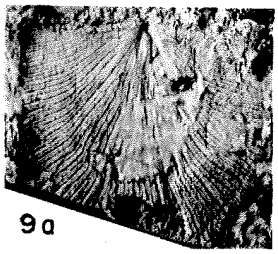

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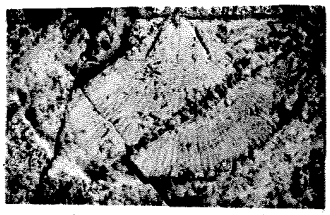

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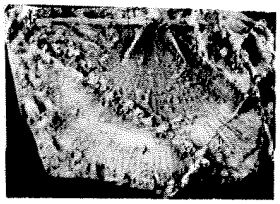

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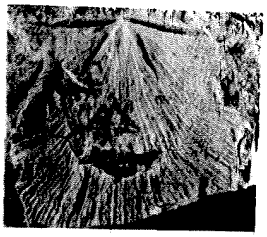

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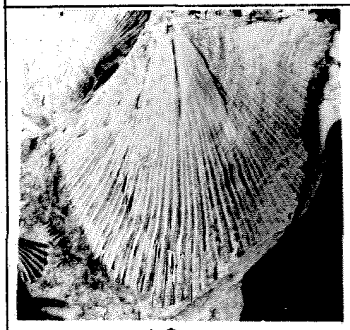

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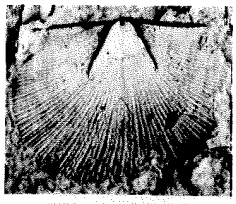

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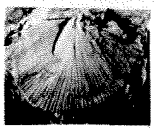


13

Plate XVII

Figures 1 - 5 — Mclearnites mertoni (McLearn, 1924)

Stonehouse Formation Locality E4, Arisaig area.

1a — Mold of interior of brachial valve (X1½). Specimen #464106.

1b — Rubber impression of specimen in figure 1a (X1½).

1c — Mold of exterior of brachial valve (X1½). Counterpart of specimen in figure 1a Specimen #464106A.

2a — Mold of interior of brachial valve (X1½). Specimen #464107.

2b — Rubber impression of specimen in figure 2a (X1½).

3 — Mold of interior of brachial valve (X1½). Specimen #464108.

4a — Mold of interior of brachial valve (X2). Specimen #464109.

4b — Rubber impression of specimen in figure 4a (X2).

4c — Mold of exterior of brachial valve (X2). Counterpart of specimen in figure 4a. Specimen #464109A.

4d — Rubber impression of specimen in figure 4c (X2).

5 — Mold of interior of brachial valve (X1½). Specimen #464105.

Figures 6 - 7 — Shaleria gilpeni (Dawson, 1881)

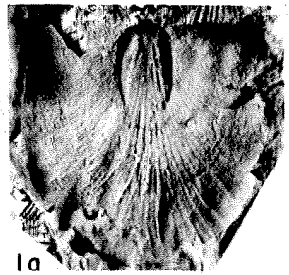
Stonehouse Formation, Arisaig area. Figure 6, Locality MCK27, Figure 7, Locality E8.

6a — Mold of interior of pedicle valve (X2). Specimen #46450.

6b Rubber impression of specimen in figure 6a.

7a Mold of interior of pedicle valve (X2). Specimen #46451.

7b Rubber impression of specimen in figure 7a.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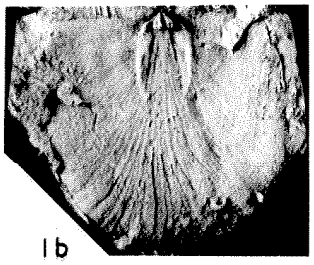
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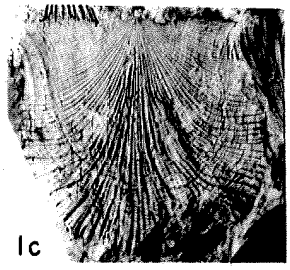
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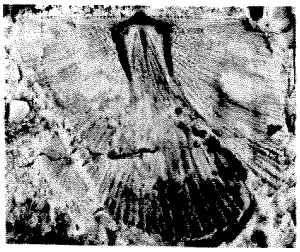
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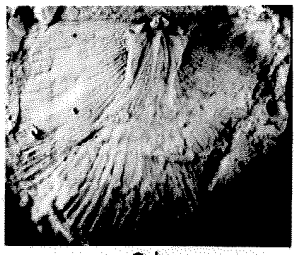
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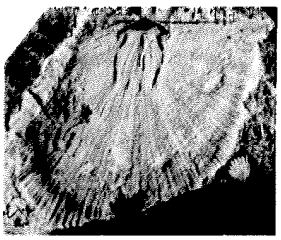
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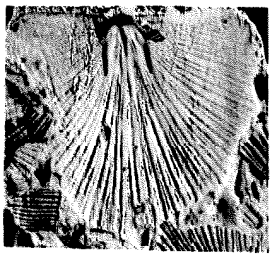
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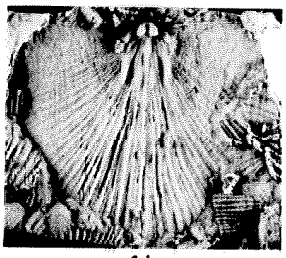
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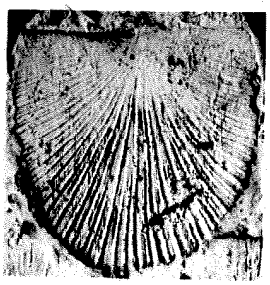
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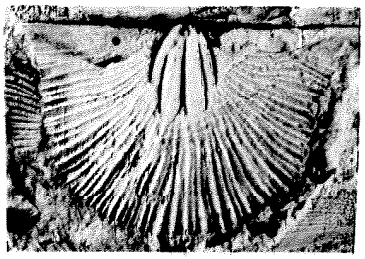
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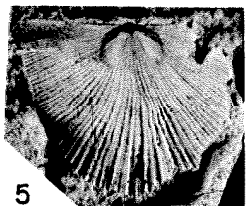
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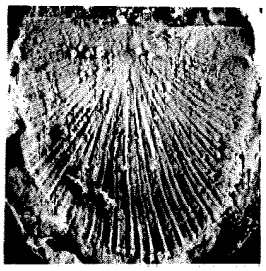
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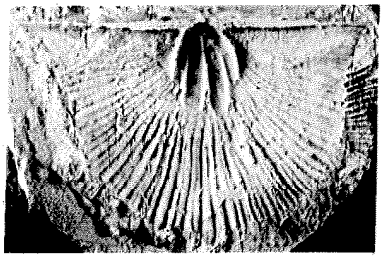
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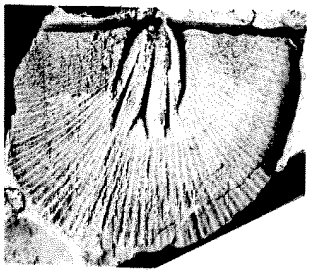
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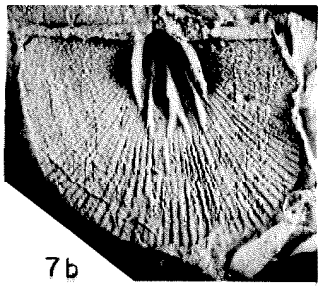
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Plate XVIII

Figures 1 - 7, 9 — Shaleria gilpeni (Dawson, 1881)

Stonehouse Formation, Arisaig area. Figures 1, 6, 7, 9, Locality E-8; Figure 2, Locality E-5; Figures 3, 5 Locality MCK40; Figure 4, Locality 2E.

1 — Mold of interior of pedicle valve (X2). Specimen #46452.

2 — Mold of interior of pedicle valve (X3). Specimen #46458.

3a — Mold of interior of brachial valve (X2). Specimen #46455.

3b — Rubber impression of specimen in figure 3a (X2).

4a — Mold of interior of brachial valve (X2). Specimen #46456.

4b — Rubber impression of specimen in figure 4a (X2).

5 — Mold of interior of brachial valve (X2). Rubber impression of specimen #46453 (mold of interior of brachial valve, not figured).

6a — Mold of interior of brachial valve (X2). Specimen #46460.

6b — Rubber impression of specimen in figure 6a (X2).

7 — Mold of interior of brachial valve (X2). Specimen #46459.

9a — Mold of exterior of brachial valve Specimen #46457.

9b — Rubber impression of specimen in figure 9a (X2).

Figure 8 — Shaleria honeymani (McLearn, 1924)

Stonehouse Formation, Arisaig Shore

section. Exterior pedicle valve (X3)
Holotype. Peabody Museum specimen #436.

Figure 10 — Shaleria ? arisaigensis (McLearn, 1924)

Stonehouse Formation, Arisaig Shore section. Exterior brachial valve (X2). Holotype. G.S.C. #5422.

Figures 11 - 15 — Pholidostrophia (mesopholidostrophia) cf. P. (M.) nitens (Williams, 1950)

Middle member, Ross Brook Formation
Locality ME29, Pictou Co.

11 Mold of interior of pedicle valve (X2). Specimen #16444.

12 Mold of interior of pedicle valve (X2). Specimen #16445.

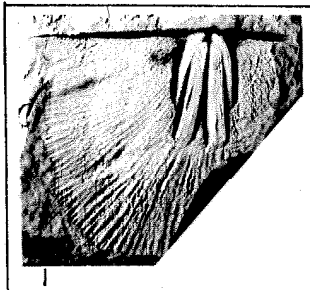
13a Mold of exterior of pedicle valve (X2). Specimen #464102.

13b Rubber impression of specimen in figure 13a (X2).

14 Mold of interior of pedicle valve (X3). Specimen #16443.

15a Mold of interior of brachial valve (X3). Specimen #16439.

15b Rubber impression of specimen in figure 15a (X2).



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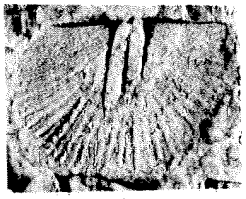

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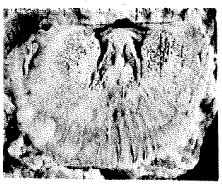

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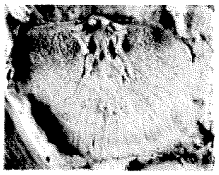

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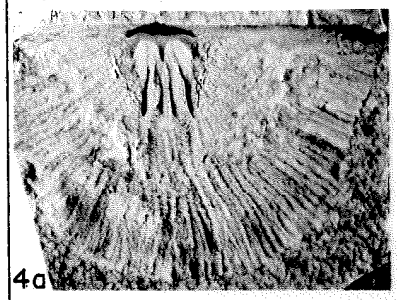

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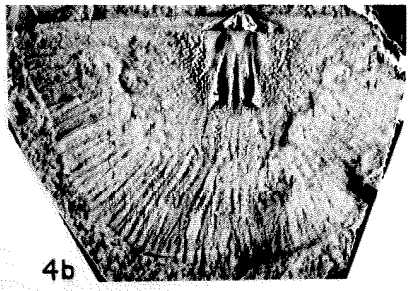

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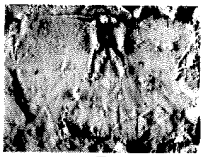

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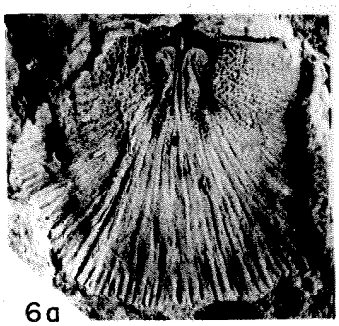

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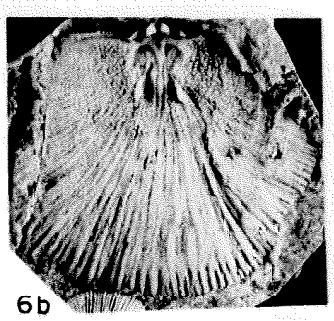

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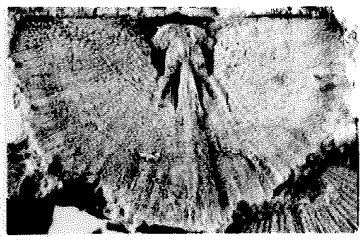

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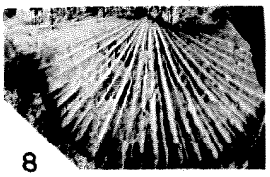

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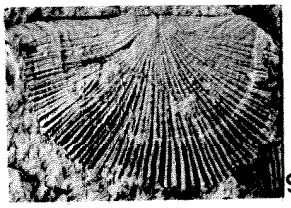

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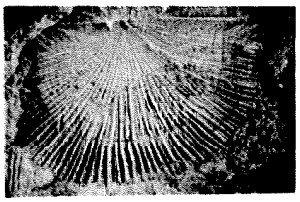

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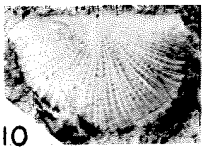

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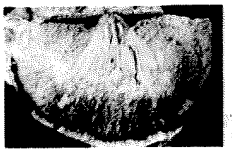

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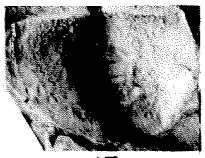

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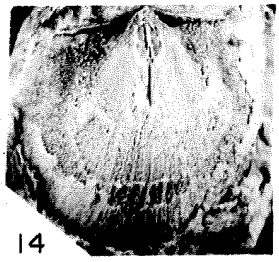

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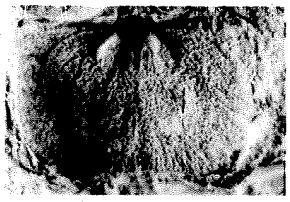

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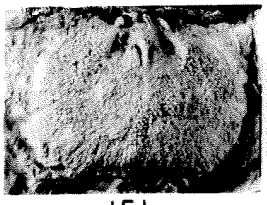

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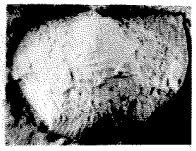

13b

Plate XIX

Figures 1 - 2 — Pholidostrophia (Mesopholidostrophia) cf. P. (M.) nitens Williams 1950

Middle member, Ross Brook Formation, Locality ME29, Pictou Co.

1 — Mold of exterior of brachial valve (X2). Specimen # 46442.

2 — Mold of exterior of brachial valve (X2). Specimen #46441.

Figures 3a - b — Lissostrophia sp.

Moydart Formation, Arisaig area, Locality D-2.

3a — Mold of interior of pedicle valve (X3). Specimen #46419.

3b — Mold of exterior of pedicle valve (X3). Counterpart of specimen in figure 3a. Specimen #46420.

Figures 4 - 5 — Pentlandina sp.

Lower member, Ross Brook Formation, Locality LRB1.

4a — Mold of exterior of pedicle valve (X1½). Specimen #464147.

4b — Mold of interior of pedicle valve (X1). Counterpart of specimen in Figure 4a. Specimen #464145.

5 — Mold of interior of brachial valve (X2). Specimen #464146.

Figure 6 — Leptaenid

Beechhill Cove Formation, Locality ZLBC.

Mold of interior of pedicle valve (X1). Specimen #464125.

Figures 7, 8 — Leptaena sp.

Beechhill Cove Formation, Locality A-4, Arisaig area.

7 Mold of interior of brachial valve (X1). Specimen #36446.

8 Mold of interior of pedicle valve (X1). Specimen #36441.

Figures 9 - 16 Leptaena cf L. depressa (Sowerby, 1825)

Figures 9, 10 upper member Ross Brook Formation, Locality B-5, Arisaig area; Figures 11, 13, 15 lower member McAdam Formation, Locality HAT, Pictou Co.; Figures 12, 14 lower member McAdam Formation, Locality DT12, Pictou Co.; Figure 16, lower member McAdam Formation, Locality C-1, Arisaig area.

9a Mold of exterior of pedicle valve (X1½). Specimen #464130.

9b Mold of interior of pedicle valve (X1½). Counterpart of specimen in figure 9a. Specimen #464130A.

10 Mold of interior of pedicle valve (X1). Specimen #4641302.

11a Mold of interior of pedicle valve (X1). Specimen #26446.

11b Rubber impression of specimen in figure 11a (X1).

12a Mold of interior of pedicle valve (X1). Specimen #26444.

12b Rubber impression of specimen in figure 12a (X1).

13a Mold of interior of brachial valve (X1). Specimen #26442.

13b Rubber impression of specimen in figure 13a (X1).

13c Rubber impression of specimen in figure 13a. Posterior view (X3).

14a Mold of interior of brachial valve (X1). Specimen #26441.

14b Rubber impression of specimen in figure 14a (X1).

15a Mold of interior of brachial valve (X1). Specimen #26443.

15b Rubber impression of specimen in figure 15a (X1).

16 Mold of exterior of brachial valve (X1). Specimen #264462.

Figures 17, 18 Leptaena cf. L. rhomboidalis

Stonehouse Formation, Locality E-2, Arisaig area.

17 Mold of interior of pedicle valve (X2). Specimen #4641321.

18 Mold of interior of pedicle valve (X2). Specimen #4641322.

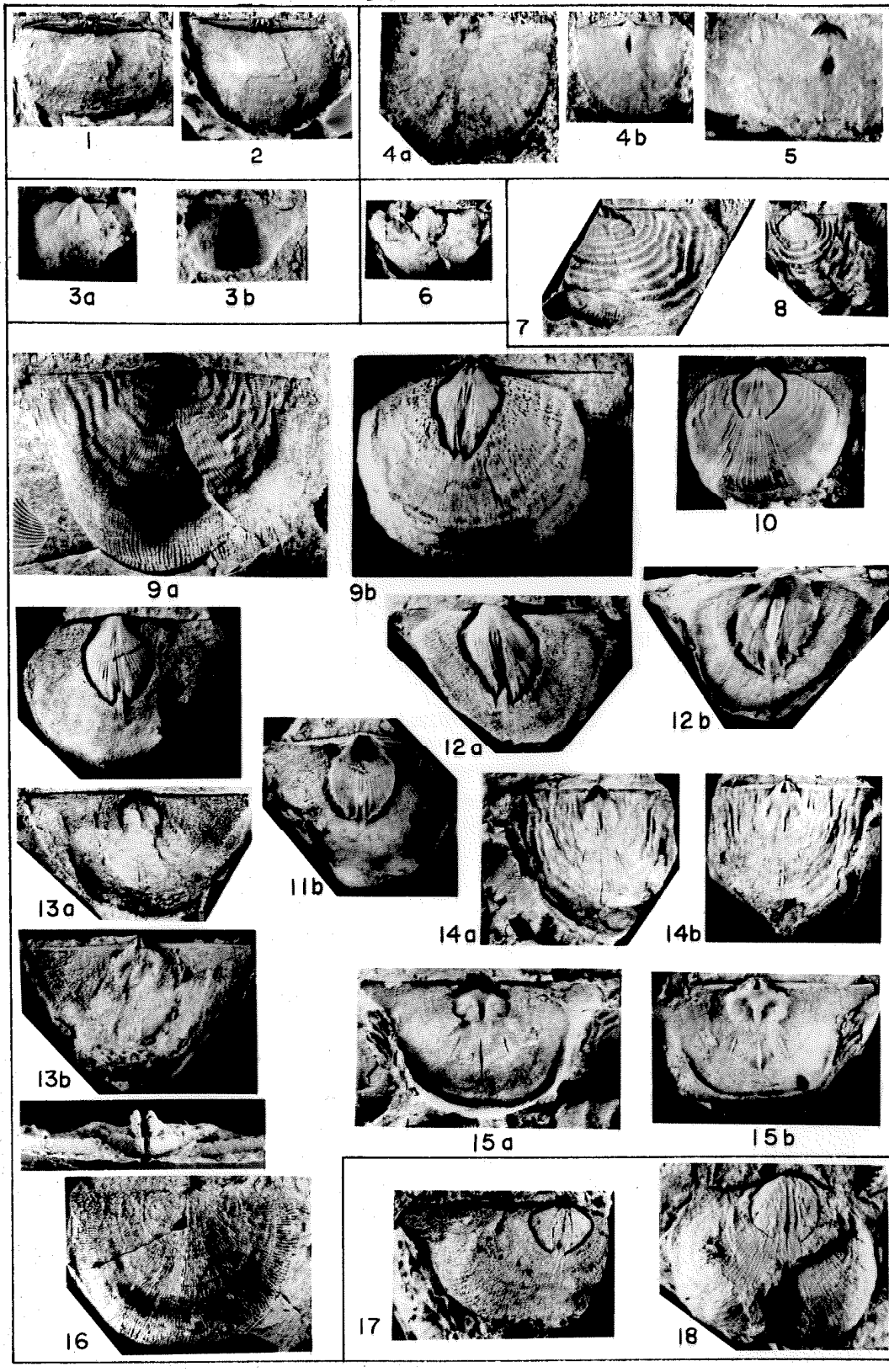
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Plate XX

Figure 1 — Leptaena cf. L. rhomboidalis

Stonehouse Formation, Locality E-2, Arisaig area

Mold of interior of brachial valve (X2). Specimen #4641323.

Figures 2 - 3, 5 — Fardenia ? sp.

Figures 2, 3 Beechhill Cove Formation, Locality A-3, Arisaig area; Figure 5 Glencoe Brook Formation, Locality FT5.

2a — Mold of interior of pedicle valve (X1½). Specimen #464143.

2b — Rubber impression of specimen in figure 2a (X1½).

3a — Mold of exterior of pedicle valve (X1½). Counterpart of specimen in figure 2a. Specimen #464143A.

3b — Rubber impression of specimen in figure 3a.

5 — Mold of interior of brachial valve (X1½) Specimen #464144.

Figures 4a-c, 6-12 — Fardenia sp.

Lower member, McAdam Formation, Figures 4, 6 Locality DT12, Pictou Co.; Figures 7, 8, 10, 11 Locality KA-62-400F, Cobequid Mountains; Figures 9, 12 Locality HAT, Pictou Co.

4a — Mold of interior of pedicle valve (X1). Specimen #46439A.

4b — Mold of exterior of brachial valve (X1). Counterpart of specimen in figure 4a. Specimen #46439.

4c — Rubber impression of specimen in figure 4b (X1).

6 — Mold of interior of pedicle valve (X1). Specimen #46440.

7 Mold of exterior of pedicle valve (X1). Specimen #46436.

8a Mold of interior of pedicle valve (X1). Specimen #46438.

8b Rubber impression of specimen in figure 8a (X1).

9a Mold of interior of brachial valve (X1). Specimen #46434.

9b Rubber impression of specimen in figure 9a. Top view (X1½).

9c Rubber impression of specimen in figure 9a. Posterior view (X1½).

10 Mold of interior of pedicle valve (X1). Specimen #46437.

11 Mold of interior of brachial valve (X1). Specimen #46435.

12a Mold of interior of brachial valve (X1). Specimen #46433.

12b Rubber impression of specimen in figure 12a. Top view (X1).

12c Rubber impression of specimen in figure 12a. Posterior view (X2).

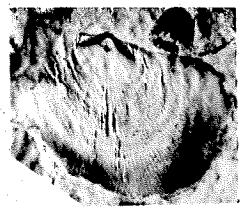
12d Rubber impression of specimen in figure 12a. Anterior view (X2).

Figures 13 - 15 Unidentified orthotetacid. Stonehouse Formation, Arisaig shore section, exact locality not known.

13 Interior of pedicle valve (X1½) GSC #5423.

14 Exterior of Brachial valve (X1½) GSC #5423 (on slab with specimen shown in figure 13).

15 Mold of exterior of pedicle valve (X1½). GSC #5423 (on slab with specimen shown in figure 13).



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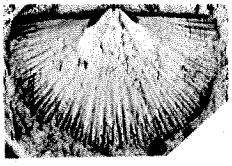

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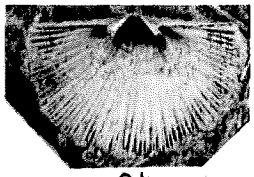

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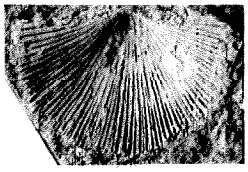

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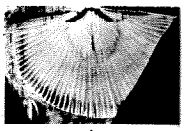

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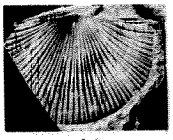

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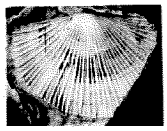

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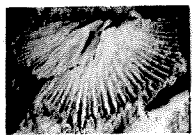

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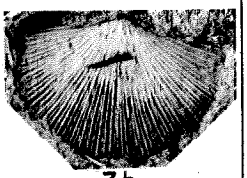

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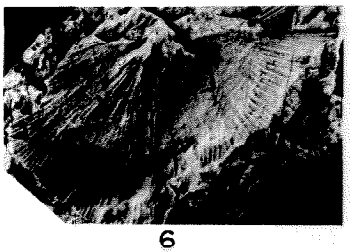

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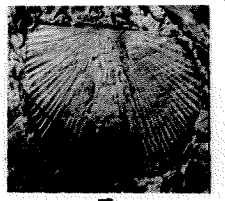

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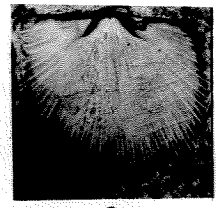

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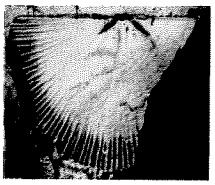

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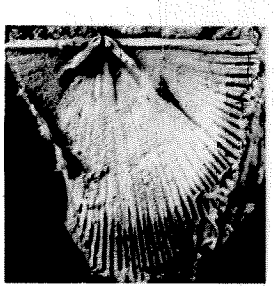

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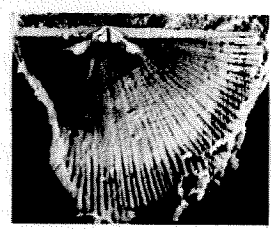

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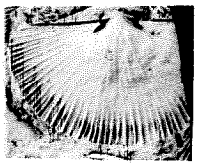

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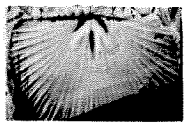

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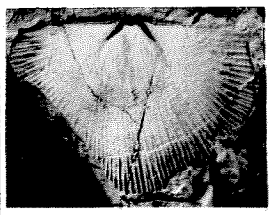

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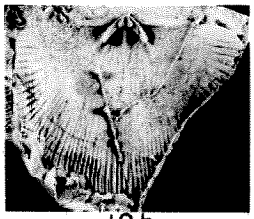

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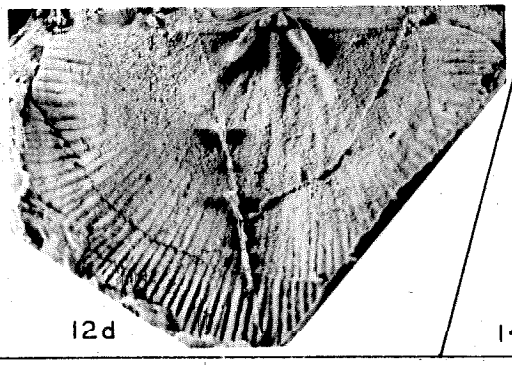

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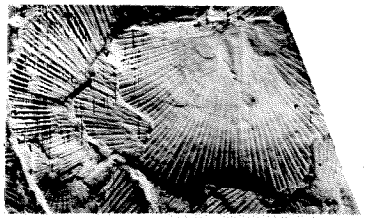

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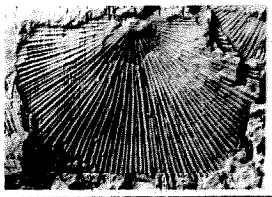

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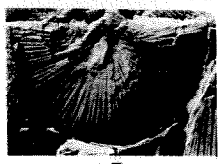

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Plate XXI

Figures 1 - 2 — Plectodonta sp.

Member 1, McAdam Formation, Locality KAR-63-123F, Cobequid Mountains.

1a — Mold of interior of pedicle valve Posterior view (X2). Specimen #36437.

1b — Mold of interior of pedicle valve Top view (X2). Specimen #36437.

2a — Mold of interior of brachial valve (X2). Specimen #36436A.

2b — Rubber impression of specimen in figure 2a (X2).

2c — Mold of exterior of brachial valve (X2). Counterpart of specimen in figure 2a. Specimen #36436.

2d — Rubber impression of specimen in figure 2c (X2).

Figures 3 - 4 — Protochonetes stonehousensis new species

Stonehouse Formation Locality E-8, Arisaig area.

3 — Mold of interior of pedicle valve (X2). Specimen #464116.

4a — Mold of exterior of pedicle valve (X2). Specimen #4641162.

4b — Rubber impression of specimen in figure 4a (X2).

4c — Mold of interior of pedicle valve (X2). Specimen #4641162A.

Figures 5 - 9 — Protochonetes novascoticus (Hall, 1860)

Figures 5, 8, 9, upper member Ross Brook Formation, Locality DF38; Figure 6, upper member Ross Brook Formation, Locality DF9; Figure 7, upper member Ross Brook Formation.

5a Mold of interior of pedicle valve (X2). Specimen #464113.

5b Rubber impression of specimen in figure 5a (X2).

6 Mold of interior of pedicle valve (X2). Specimen #464115.

7 Mold of interior of pedicle valve (X2). Specimen #464112.

8a Mold of interior of brachial valve (X2). Specimen #464114.

8b Rubber impression of specimen in figure 8a (X3).

9 Mold of exterior of brachial valve (X2). Specimen #4641132.

Figures 10 - 16 Protochonetes novascoticus (Hall, 1860)

Stonehouse Formation, Arisaig area. Figures 10, 16 Locality GRED; Figures 11 - 15, Arisaig shore section, exact locality not known.

10a Mold of interior of pedicle valve (X1½). Specimen #464119.

10b Rubber impression of specimen in figure 10a (X1½).

10c Mold of exterior of pedicle valve (X1½). Counterpart of specimen in figure 10a. Specimen #464118.

10d Rubber impression of specimen in figure 10c

11a Mold of interior of pedicle valve (X1½) Specimen #464120.

11b Rubber impression of specimen in figure 11a (X1½).

12 Mold of interior of pedicle valve (X2). Hypotype Chonetes novascoticus crassistriatus GSC Specimen #5425.

13 Mold of interior of brachial valve (X1½). Specimen #464120.

14 Mold of interior of brachial valve (X1½). Specimen #464123.

15a Mold of interior of brachial valve (X1½). Specimen #464121.

15b Rubber impression of specimen in figure 15a (X2).

16a Mold of exterior of brachial valve (X1½). Specimen #464117.

16b Rubber impression of specimen in figure 16a (X1½).

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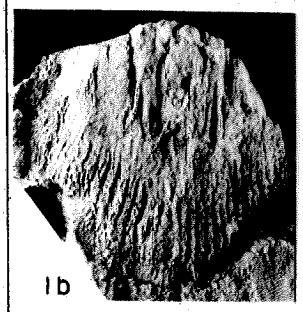

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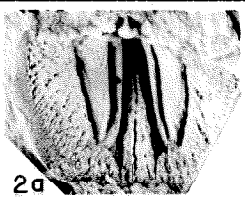

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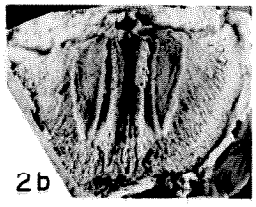

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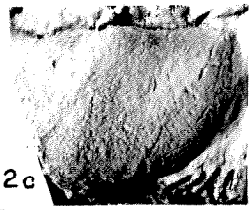

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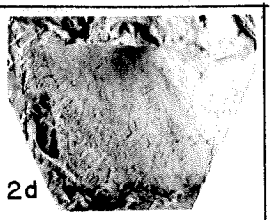

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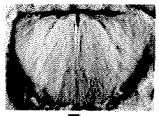

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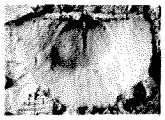

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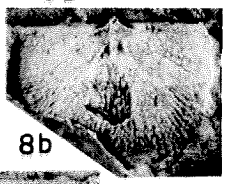

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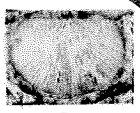

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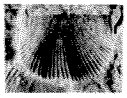

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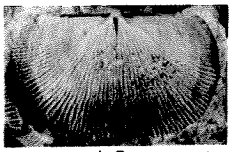

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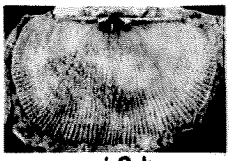

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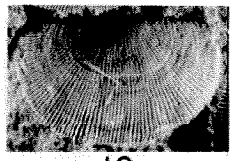

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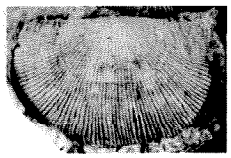

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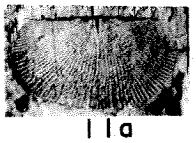

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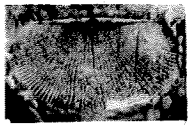

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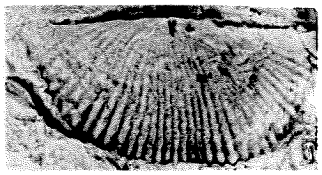

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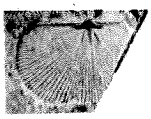

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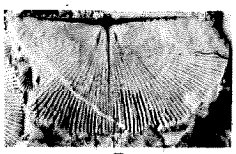

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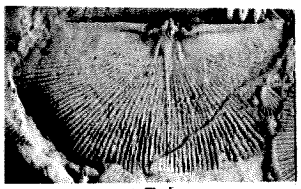

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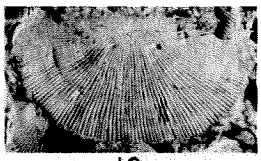

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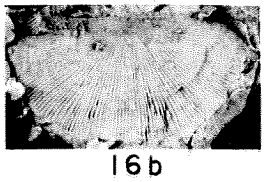


16b

Plate XXII

Figures 1 - 15 *Plagiorhyncha* aff *P. glassi*

Figures 1, 2, 5, middle member Ross Brook Formation, Locality B-2 Arisaig area; Figures 3, 4, 6-9, upper member, Ross Brook Formation, Locality DF49, Pictou Co.; Figure 10, middle member, Ross Brook Formation, Locality ME67, Pictou Co.; Figure 11, upper member, Ross Brook Formation, Locality B-5; Figures 12-15, Ross Brook Formation, Arisaig area, exact localities not known.

1 Mold of interior of pedicle valve (X2). Specimen #16428.

2a Mold of interior of pedicle valve (X1½). Specimen #16427.

2b Rubber impression of specimen in figure 2a (X1½).

3 Mold of interior of pedicle valve (X1½). Specimen #16422.

4 Mold of interior of pedicle valve (X1½). Specimen #16421.

5a Mold of interior of pedicle valve (X2). Specimen #16429A

5b Mold of exterior of pedicle valve (X2). Counterpart of specimen in figure 5a. Specimen #16429.

6a Mold of exterior of pedicle valve (X1½). Specimen #16424.

6b Rubber impression of specimen in figure 6a (X1½).

7a Mold of interior of brachial valve (X1½). Specimen 16419.

7b Rubber impression of specimen in figure 7a (X1½).

8a Mold of interior of brachial valve (X1½).

8b Rubber impression of specimen in figure 8a (X1½).

9a Mold of interior of brachial valve (X1½). Specimen #16420.

9b Rubber impression of specimen in figure 9a (X1½).

10 Mold of interior of brachial valve (X2). Specimen #16425.

11 Mold of interior of brachial valve (X1½). Specimen #16426.

12 Mold of interior of pedicle valve (X3). GSC Specimen #5440 (Plesiotype of P. decemplicata McLearn non Sowerby.)

13 Mold of interior of pedicle valve (X3). GSC Specimen #5438 (Plesiotype of P. decemplicata McLearn non Sowerby.)

14 Mold of interior of brachial valve (X3). GSC Specimen #5439 (Plesiotype of P. decemplicata McLearn non Sowerby.)

15 Mold of interior of brachial valve (X3). GSC Specimen #5437 (Plesiotype of P. decemplicata McLearn non Sowerby.)

Figures 16 - 20 Plagiorhyncha cf. P. plastica (McLearn, 1924).

French River Formation, Pictou Co. Figure 16, Locality FR22; Figures 17-20 Locality DF17.

16a Mold of exterior of pedicle valve (X1½). Specimen #16430.

16b Rubber impression of specimen in figure 16a (X1½).

17a Mold of interior of pedicle valve (X1½). Specimen #16431.

17b Rubber impression of specimen in figure 17a (X1½).

18 Mold of interior of pedicle valves (X1½). Specimen #16433.

19a Mold of exterior of brachial valves (X1½). Specimen #16434.

19b Rubber impression of specimen in figure 19a (X1½).

19c Mold of interior of brachial valves (X1½). Counterpart of specimen in figure 19a. Specimen #16434A.

19d Rubber impression of specimen on left in figure 19c. Top view (X1½).

19e Rubber impression of specimen on left in figure 19c, Posterior view (X1½).

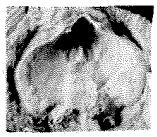
20a Mold of interior of articulated valves (X1½). Specimen #16436.

20b Rubber impression of specimen in figure 20a. Top view of pedicle valve (X1½).

20c Rubber impression of specimen in figure 20a. Top view of brachial valve (X1½).


1


2a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3


4

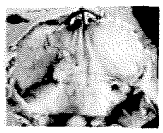

5a


5b


6a


6b


7a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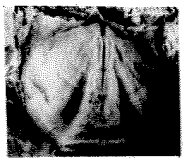
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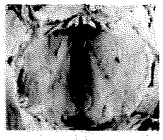
8b


9a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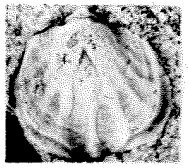
10


11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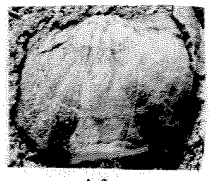
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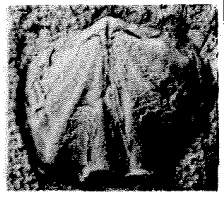
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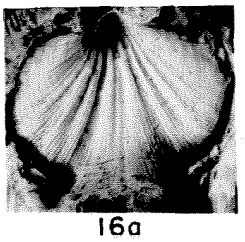
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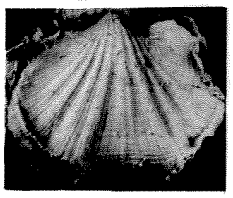
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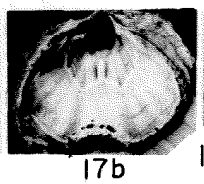
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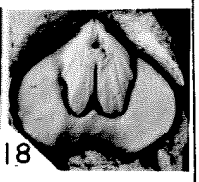
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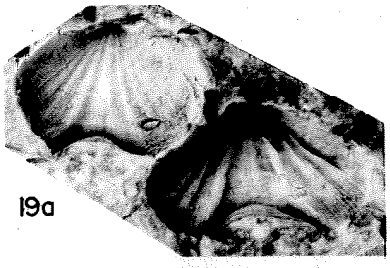
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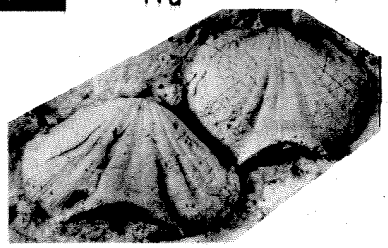
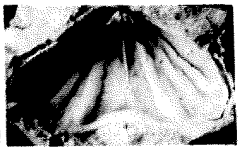

19b


20a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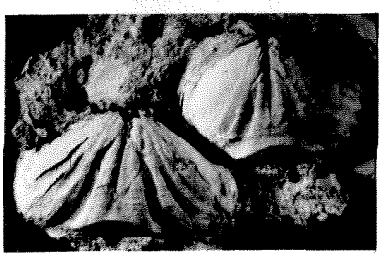
20b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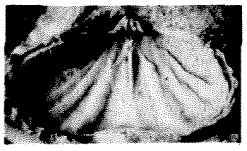
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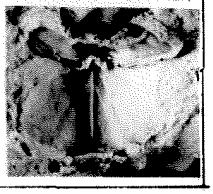
20c

Plate XXIII

Figures 1, 2 — Plagiorhyncha cf. P. plastica (McLearn, 1924)

French River Formation, Locality DF17, Pictou Co.

1a — Mold of interior of pedicle valve (X1½). Specimen #16432.

1b — Rubber impression of specimen in figure 1a (X1½).

2a — Mold of interior of pedicle valve (X1½). Specimen #16437.

2b — Mold of interior of pedicle valve (X1½). Specimen #16433.

Figures 3 - 10 — "Camarotoechia" bimesiornata (McLearn, 1924)

Figures 3-7, 9, 10, Beechhill Cove Formation, Locality A-2, Arisaig area; Figures 8a-c, Beechhill Cove Formation, MacGillivray Brook, exact location not known.

3a — Mold of interior of pedicle valve (X4). Specimen #307.

3b — Mold of exterior of pedicle valve (X4). Counterpart of Specimen in figure 3a. Specimen #311A.

4 — Mold of interior of pedicle valve (X4). Specimen #310.

5 — Mold of interior of pedicle valve (X3). Paratype G.S.C. #5427.

6a — Mold of interior of brachial valve (X3). Specimen #307.

6b — Rubber impression of specimen in figure 6a (X3).

6c — Mold of exterior of brachial valve (X3). Counterpart of specimen in figure 6a. Specimen #307A.

7 Mold of interior of pedicle valve (X3). Specimen #312.

8a Steinkern. Ventral view (X3). Holotype G.S.C. #5426.

8b Same as specimen in figure 8a. Dorsal view (X3).

8c Same as specimen in figure 8a. Posterior view (X3).

9 Mold of interior of pedicle valve (X4). Specimen #308.

10 Mold of interior of pedicle valve (X4). Specimen #309.

Figures 11 - 15 "Camarotoechia" rossonia (McLearn, 1924)

Figure 11, Ross Brook Formation, exact locality not known; Figures 12-15, middle member, Ross Brook Formation, Locality B-2.

11 Dorsal view (X2). Holotype G.S.C. #5430.

12 Mold of interior of brachial valve (X3). Specimen #16450.

13 Mold of interior of brachial valve (X3). Specimen #16451.

14a Mold of exterior of pedicle valve (X3). Specimen #16448.

14b Rubber impression of specimen in figure 14a (X3).

14c Mold of interior of brachial valve (X3). Counterpart of specimen shown in figure 14a. Specimen #16447.

15 Mold of interior of brachial valve (X3). Specimen #16449.

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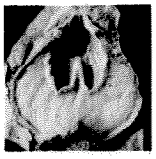

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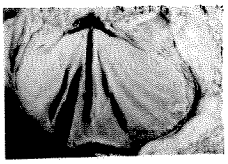
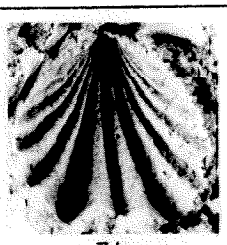


2a

2b

3a



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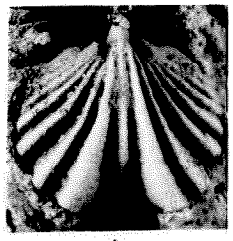

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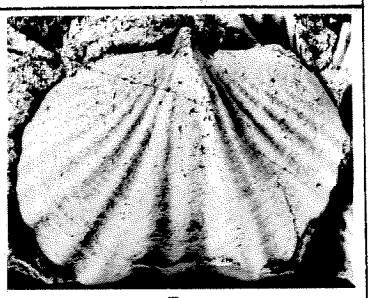

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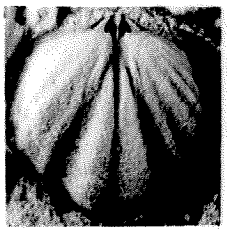
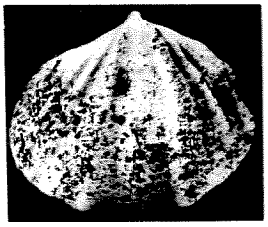


6a

6b

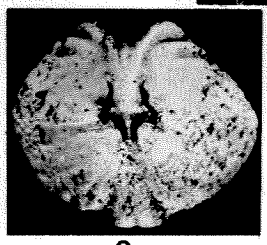
6c

7



8a

8b



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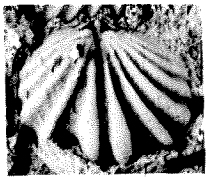

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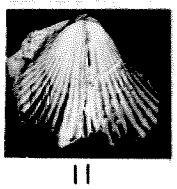

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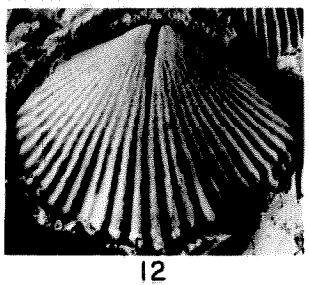

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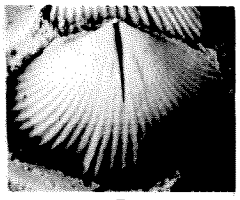

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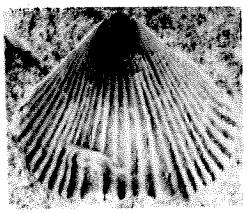
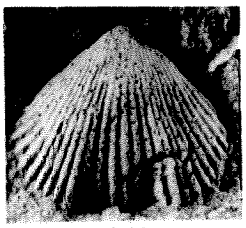
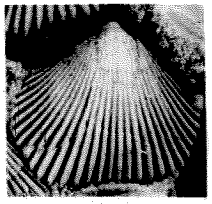


14a



14b

14c



15

Plate XXIV

Figure 1 — "Camarotoechia" rossonia (McLearn, 1924)

Middle member, Ross Brook Formation Locality B-2.

1 — Mold of interior of pedicle valve (X3). Specimen #16446.

Figures 2 - 3 — Sphaerirhynchia antigua (McLearn, 1924)

Ross Brook Formation, Arisaig shore section, exact locality not known.

2a — Ventral view (X3). Holotype. Peabody Museum Specimen #437.

2b — Dorsal view (X3) of same specimen as that in figure 2a.

2c — Anterior view (X3) of same specimen as that in figure 2a.

3 — Mold of interior of pedicle valve (X3). Paratype. Peabody Museum specimen #443.

Figures 4 - 10 — "Camarotoechia" westoni (McLearn, 1924)

Figures 4-7, 9, 10, member 2, McAdam Formation, Locality DT23, Pictou Co. Figure 8, member 1, McAdam Formation, Locality HA5A, Pictou Co.

4a — Mold of interior of pedicle valve (X2). Specimen #46413.

4b — Rubber impression of specimen in figure 4a (X2).

5 — Mold of interior of pedicle valve (X2). Specimen #46417.

6a — Mold of interior of brachial valve (X2). Specimen #46416.

6b — Rubber impression of specimen in figure 6a (X2).

7a — Mold of interior of brachial valve (X2). Specimen #46418.

7b Rubber impression of specimen in figure 7a (X2).

8a Mold of exterior of pedicle valve (X2). Specimen #46414.

8b Rubber impression of specimen in figure 8a (X2).

9a Mold of exterior of pedicle valve (X2). Specimen #46415.

9b Rubber impression of specimen in figure 9a (X2).

10a Mold of exterior of brachial valve (X2). Specimen #46430.

10b Mold of interior of brachial valve (X2). Counterpart of specimen in figure 10a. Specimen #464302.

Figures 11 - 12 "Camarotoechia" sp. aff. "C." planorugosa (McLearn, 1924)

Lower member, McAdam Formation, Arisaig Area. Figure 11, Locality C-1; Figure 12, Locality MCK49.

11a Mold of exterior of pedicle valve (X2). Specimen #46432.

11b Mold of interior of pedicle valve (X2). Specimen #46432a

12 Mold of interior of brachial valve (X2). Specimen #46431.

Figures 13 - 17 Sphaerirhynchia sp.

Figures 13, 14, 16, 17, Member 2, McAdam Formation, Locality HAF; Figure 15, member 1, McAdam Formation, Locality DM8.

13 Mold of interior of pedicle valve (X2). Specimen #46412.

14a Mold of interior of pedicle valve (X2). Specimen #46411.

14b Rubber impression of specimen in figure 14a (X2).

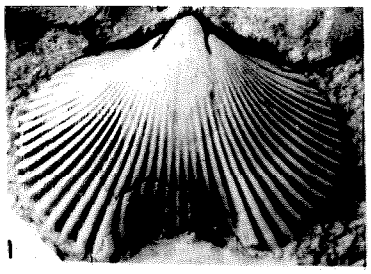
15 Mold of interior of pedicle valve (X2). Specimen #4648.

16a Mold of interior of brachial valve (X2). Specimen #46410.

16b Rubber impression of specimen in figure 16a (X2).

16c Rubber impression of specimen in figure 16a (X2).

17 Steinkern (small specimen). Posterior view (X3). Specimen #464122.



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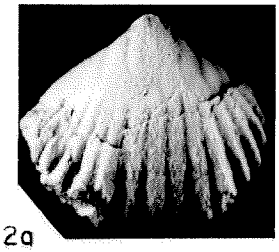

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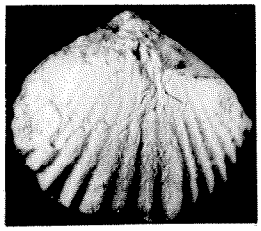

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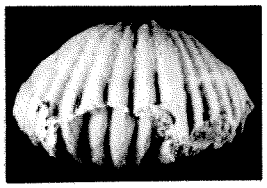

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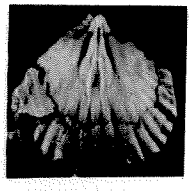

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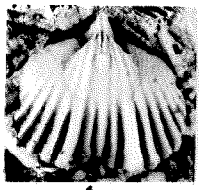

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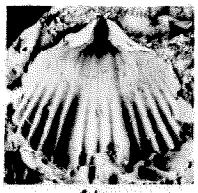

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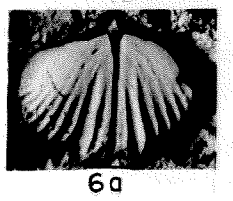

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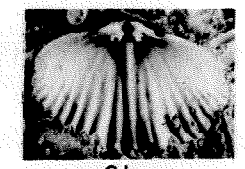

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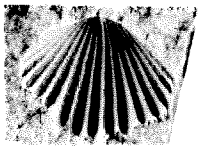

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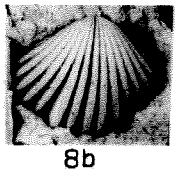

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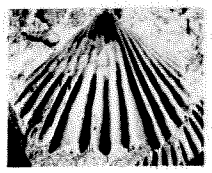

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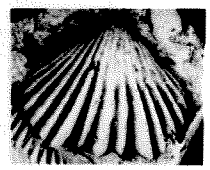

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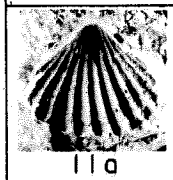

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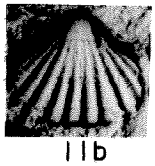

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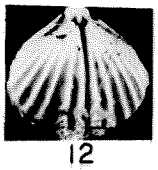

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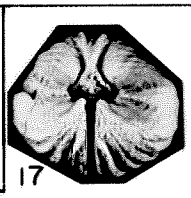

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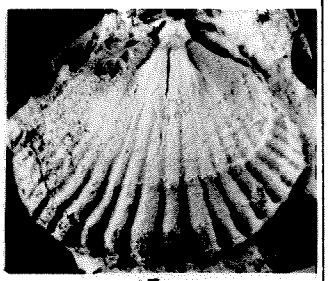

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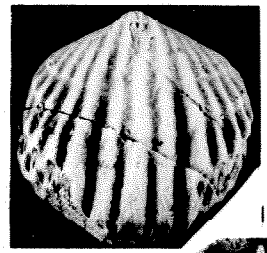

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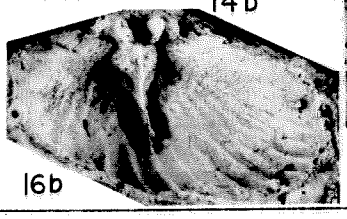

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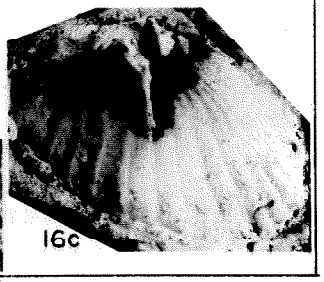


16c

Plate XXV

Figures 1 - 8 — *Sphaerirhynchia saffordi* (Hall, 1860)

Moydart Formation, Arisaig area. Figures 1-3, 5, 6, Locality D-2; Figure 4, Locality MCK33; Figures 7a-e, Arisaig shore section, exact locality not known.

1a — Mold of interior of pedicle valve (X2). Specimen #4643.

1b — Rubber impression of specimen in figure 1a (X2).

2 — Mold of interior of pedicle valve (X2). Specimen #4644.

3 — Mold of interior of pedicle valve (X2). Specimen #4645.

4 — Mold of interior of pedicle valve (X2). Specimen #4646.

5a — Mold of interior of brachial valve (X2). Specimen #4642.

5b — Rubber impression of specimen in figure 5a (X2).

6a — Mold of interior of brachial valve (X2). Specimen #4641.

6b — Rubber impression of specimen in figure 6a (X2).

7a — Ventral view (X2). Plesiotype. Peabody Museum Specimen #464.

7b — Side view (X2). Plesiotype. Peabody Museum Specimen #464.

7c — Dorsal view (X2). Plesiotype. Peabody Museum Specimen #464.

7d — Posterior view (X2). Plesiotype. Peabody Museum Specimen #464.

7e — Anterior view (X2). Plesiotype. Peabody Museum Specimen #464.

8 Pedicle valve. Holotype Wilsonia wilsoni stonehousensis G.S.C. Specimen #5436.

Figures 9 - 13 "Camarotoechia" squamifera (McLearn, 1924)

Moydart Formation, Arisaig area. Figures 9-12, Locality D-1, Figure 13, Arisaig shore section, exact locality not known.

9 Mold of interior of pedicle valve (X2). Specimen #46423.

10 Mold of interior of pedicle valve (X2). Specimen #46422.

11a Mold of interior of brachial valve (X2). Specimen #46421.

11b Rubber impression of specimen in figure 11a (X2).

12a Ventral view (X2). Specimen #46424.

12b Side view (X2). Specimen #46424.

12c Dorsal view (X2). Specimen #46424.

12d Anterior view (X2). Specimen #46424.

12e Posterior view (X2). Specimen #46424.

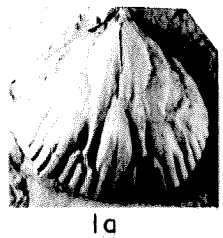
13a Ventral view (X2). Holotype. Peabody Museum Specimen #435.

13b Side view (X2). Holotype. Peabody Museum Specimen #435

13c Dorsal View (X2). Holotype. Peabody Museum Specimen #435.

13d Anterior view (X2). Holotype. Peabody Museum Specimen #435.

13e Posterior view (X2). Holotype. Peabody Museum Specimen #435.



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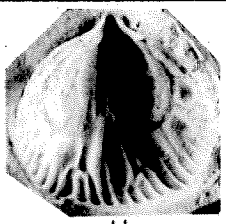

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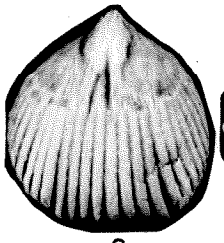

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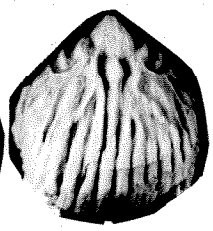

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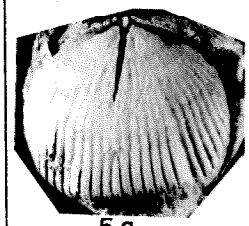

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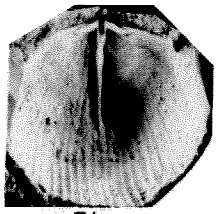

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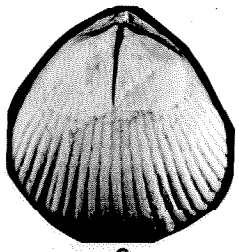

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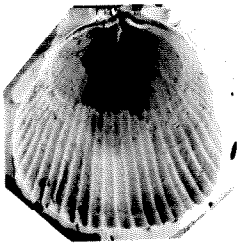

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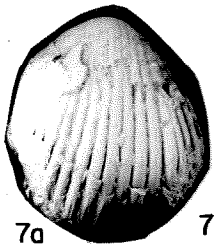

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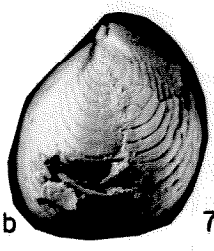

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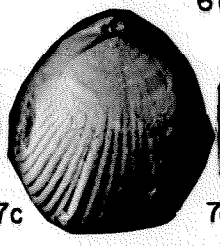

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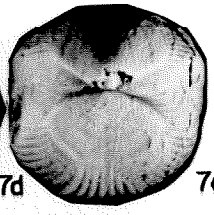

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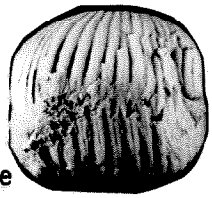

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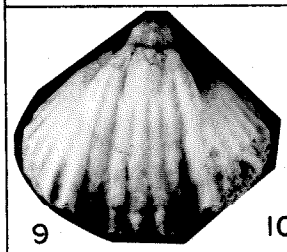

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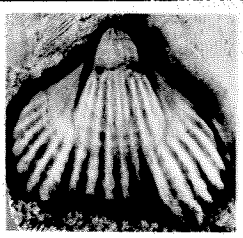

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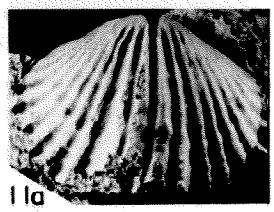

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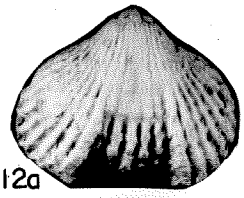

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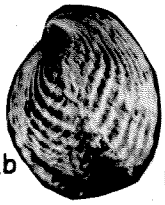

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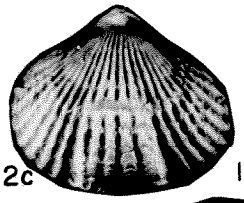

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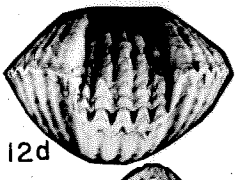

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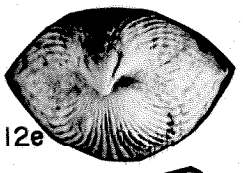

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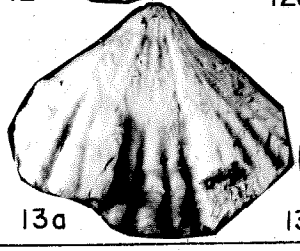

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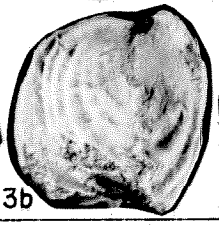

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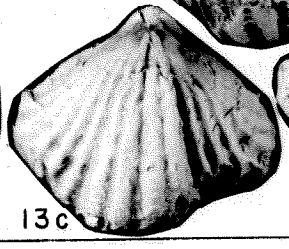

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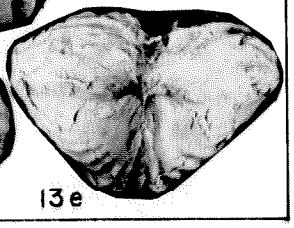


13e

Plate XXVI

Figures 1 - 7 — Eatonioides lamellornatus McLearn, 1918

Moydart Formation, Arisaig area, Figures 1-5, Locality D-3; Figures 6, 7 Arisaig shore section, exact locality not known.

1a — Mold of interior of pedicle valve (X1½). Specimen #46425.

1b — Rubber impression of specimen in figure 1a (X1½).

1c — Mold of exterior of pedicle valve (X1½). Counterpart of specimen in figure 1a. Specimen #46425A.

2 — Mold of interior of pedicle valve (X1½). Specimen #46426.

3a — Mold of interior of brachial valve (X1½). Specimen #46427.

3b — Rubber impression of specimen in figure 3a (X1½).

4 — Mold of interior of brachial valve (X1½). Specimen #46428.

5 — Mold of interior of brachial valve (X1½). Specimen #46429.

6a — Steinkern. Ventral view (X1½). Paratype GSC #5434.

6b — Steinkern. Dorsal view (X1½). Paratype GSC #5434.

6c — Steinkern. Anterior view (X1½). Paratype GSC #5434.

6d — Steinkern. Posterior view (X1½). Paratype GSC #5434.

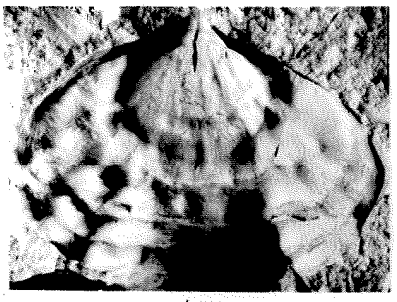
7a — Dorsal view (X1½). Holotype GSC #5435.

7b — Ventral view (X1½). Holotype GSC #5435.

7c — Posterior view (X1½). Holotype GSC #5435.

7d Anterior view (X1½). Holotype GSC #5435.

7e Side view (X1½). Holotype GSC #5435.



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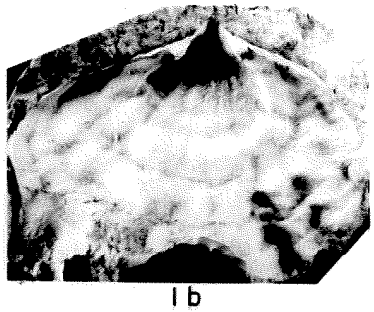

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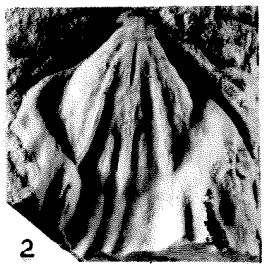

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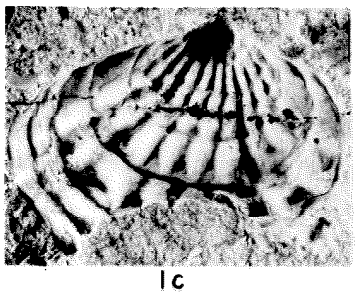

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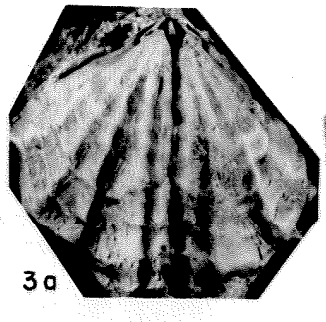

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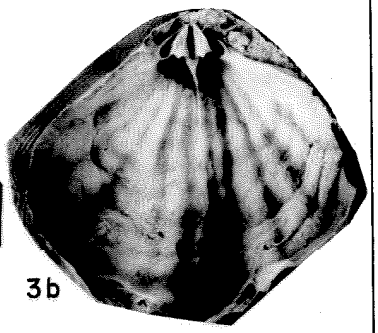

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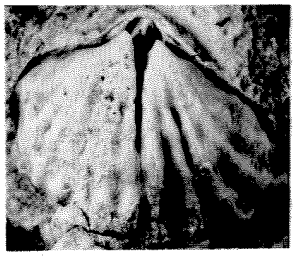

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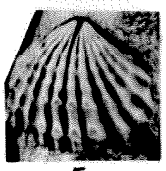

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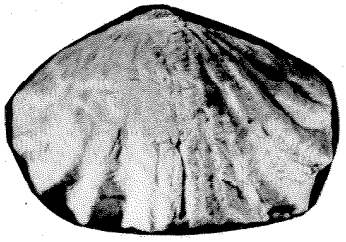

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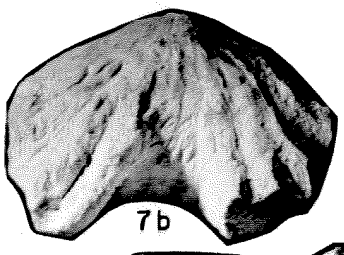

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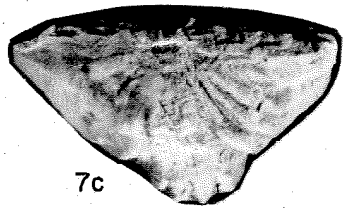

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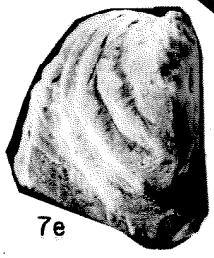

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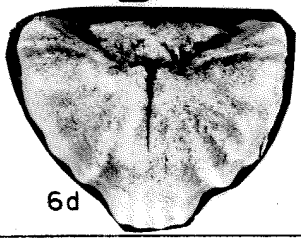

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Plate XXVII

Figures 1a - e — "Camarotoechia" moydartensis (McLearn, 1924)

Moydart Formation, Arisaig shore section, exact locality not known.

1a — Ventral view (X3). Holotype. G.S.C. Specimen #5429

1b — Dorsal view (X3). Holotype. G.S.C. Specimen #5429.

1c — Posterior view (X3). Holotype. G.S.C. Specimen #5429.

1d — Side view (X3). Holotype. G.S.C. Specimen #5429.

1e — Anterior view (X3). Holotype. G.S.C. Specimen #5429.

Figures 2a - d — "Camarotoechia" glomerosa (McLearn, 1924)

Stonehouse Formation, Arisaig shore section, exact locality not known.

2a — Ventral view (X2). Holotype. G.S.C. Specimen #5433.

2b — Side view (X2). Holotype. G.S.C. Specimen #5433.

2c — Dorsal view (X2). Holotype. G.S.C. Specimen #5433.

2d — Posterior view (X2). Holotype. G.S.C. Specimen #5433.

Figures 3a - c — "Camarotoechia" sp. aff. "C." planorugosa McLearn, 1924)

Moydart Formation, Locality D-2, Arisaig area.

3a — Pedicle valve (X2). Specimen #46440.

3b — Mold of interior of brachial valve (X2). Specimen #464402.

3c — Mold of interior of pedicle valve (X2). Specimen #46441.

Figures 4a, b — "Camarotoechia" planorugosa (McLearn, 1924)

Stonehouse Formation, Arisaig shore section, exact locality not known.

4a — Ventral view (X3). Holotype. Peabody Museum Specimen #432.

4b — Dorsal view (X3) of specimen in figure 4a.

Figure 5 — "Camarotoechia" marklandensis (McLearn, 1924)

Stonehouse Formation, Arisaig shore section, exact locality not known.

5 — Mold of exterior of brachial valve (X2). Peabody Museum Specimen #434.

Figures 6 - 9, 18 — Rhynchospirina sp. A

Figures 6 - 9, Member 1, McAdam Formation, Figures 6, 8, Locality C-1, Arisaig area, Figures 7, 9, Locality HAT, Pictou Co; Figure 18, Stonehouse Formation Locality E-2.

6a — Mold of exterior of brachial valve (X2). Specimen #46433.

6b — Rubber impression of specimen in figure 6a (X2).

7a — Mold of interior of brachial valve (X2). Specimen #46434.

7b — Rubber impression of specimen in figure 7a (X2).

8 — Mold of interior of pedicle valve Specimen #46435.

9 — Mold of exterior of pedicle valve Specimen #46436.

18 — Rubber impression of specimen #464992 (Mold of interior of brachial valve). (X2)

Figures 10 - 12 Rhynchospirina ? sp. B

Member 1, McAdam Formation, Locality KAR-63-115F, Cobequid Mountains.

10 Mold of interior of pedicle valve (X2). Specimen #46437.

11 Mold of interior of pedicle valve (X2). Specimen #46438.

12 Mold of interior of brachial valve (X2). Specimen #46439.

Figures 13a, b Rhynchospirina acadiae (Hall, 1860)

Moydart Formation, Arisaig shore section.

13a Ventral view (X2). Plesiotype. Peabody Museum Specimen #467.

13b Dorsal view (X2). Plesiotype. Peabody Museum Specimen #467.

Figures 14 - 17 Rhynchospirina sinuata (Hall, 1860)

Stonehouse Formation, Arisaig area, Figures 14, 16, Locality E-8; Figures 15, 17, Locality E-2.

14 Mold of interior of pedicle valve (X2). Specimen #46498.

15a Mold of interior of brachial valve (X2). Specimen #46497.

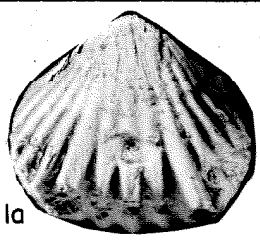
15b Rubber impression of specimen in figure 15a. Top view (X2).

15c Rubber impression of specimen in figure 15a. Anterior view (X2).

16 Mold of interior of pedicle valve (X2). Specimen #46499.

17a Mold of interior of brachial valve (X1½). Specimen #46495.

17b Rubber impression of specimen in figure 17a. (X1½).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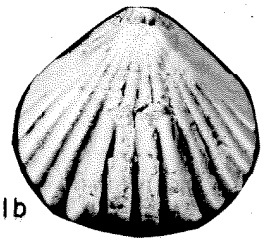
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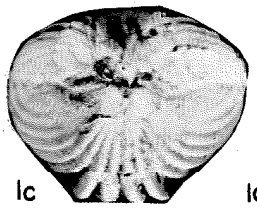
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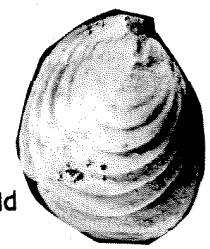
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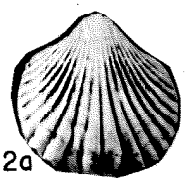
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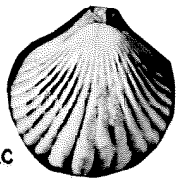
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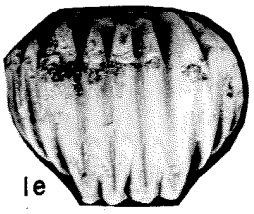
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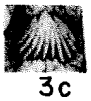
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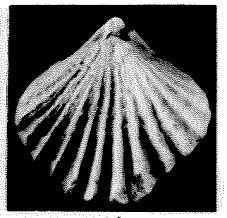
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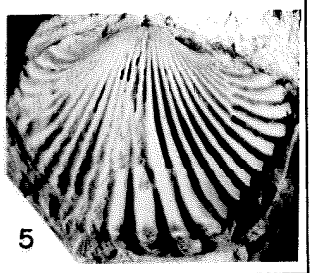
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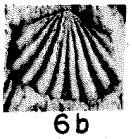
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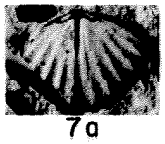
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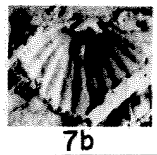
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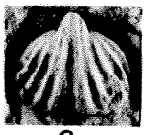
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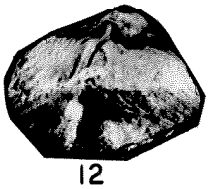
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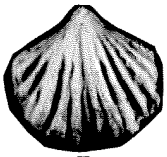
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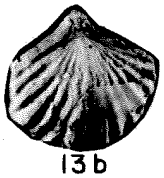
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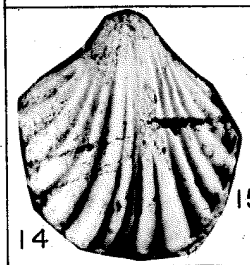
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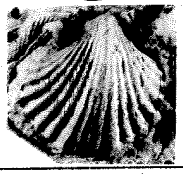
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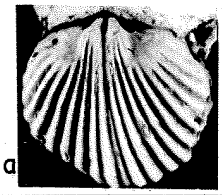
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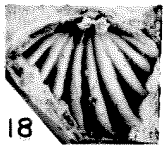
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Plate XXVIII

Figures 1 - 5 — Eocoelia aff. hemisphaerica

Middle member, Ross Brook Formation
Figure 1, Locality ME64; Figures 2, 3 Locality ME28; Figure 4, Locality UE5; Figure 5, Locality UEA.

1a — Mold of exterior of brachial valve (X3). Specimen #16412.

1b — Rubber impression of specimen in figure 1a (X3).

1c — Mold of interior of brachial valve (X3). Counterpart of specimen in figure 1a. Specimen #16411.

1d — Rubber impression of specimen in figure 1c (X3).

2 — Mold of interior of pedicle valve (X3). Specimen #16417.

3a — Mold of exterior of pedicle valve (X3).

3b — Rubber impression of specimen in figure 3a (X3).

3c — Mold of interior of pedicle valve (X3). Counterpart of specimen in figure 3a. Specimen #16413.

4a — Mold of interior of brachial valve (X3). Specimen #16415.

4b — Rubber impression of specimen in figure 4a (X3).

5a — Mold of exterior of brachial valve (X3). Specimen #16416.

5b — Rubber impression of specimen in figure 5a (X3).

Figures 6 - 14 — Eocoelia cf. sulcata.

Upper member, Ross Brook Formation
Figures 6 - 8, 10, 12, 13, Locality B-5; Figure 9, Locality B-6; Figures 11, 14, Locality DF9.

6a Mold of exterior of brachial valve (X3). Specimen #1647.

6b Rubber impression of specimen in figure 6a (X3).

7a Mold of interior of brachial valve (X3). Specimen #1646.

7b Mold of exterior of brachial valve (X3). Counterpart of specimen in figure 7a. Specimen #1646A.

8a Mold of exterior of pedicle valve (X3). Specimen #1643.

8b Rubber impression of specimen in figure 8a (X3).

9a Mold of interior of brachial valve (X3). Specimen #1645.

9b Rubber impression of specimen in figure 9a (X3).

10a Mold of interior of pedicle valve (X3). Specimen #1642.

10b Rubber impression of specimen in figure 10a (X3).

11a Mold of interior of brachial valve (X3). Specimen #16410.

11b Rubber impression of specimen in figure 11a (X3).

12 Mold of interior of brachial valve (X3). Specimen #1648.

13 Mold of interior of pedicle valve (X3). Specimen #1641.

14 Mold of interior of pedicle valve (X3). Specimen #1641.

Figures 15a - d <u>Megumatrypa glencoensis</u> new species.

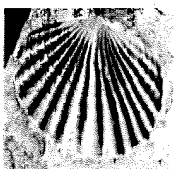
Glencoe Brook Formation, Locality TT1, Pictou Co.

15a Mold of exterior of brachial valve (X2). Specimen #26420.

15b Rubber impression of specimen in figure 15a (X2).

15c Mold of interior of brachial valve (X2). Specimen #26421.

15d Rubber impression of specimen in figure 15c (X2).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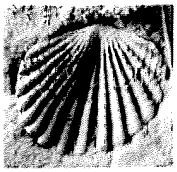
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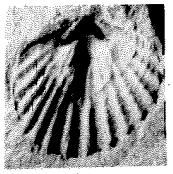
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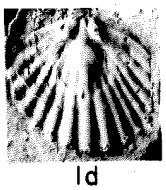
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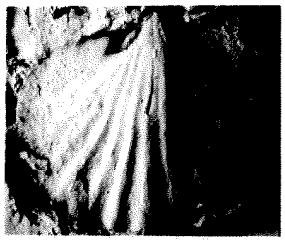
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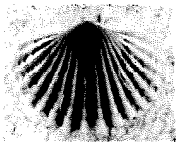
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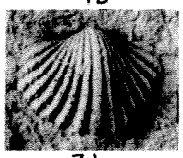
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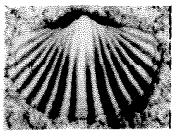
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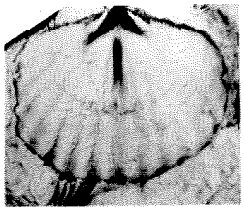
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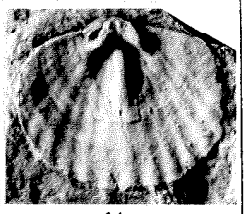
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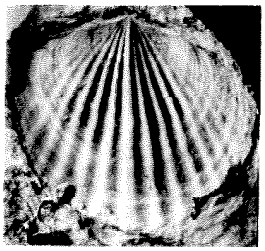
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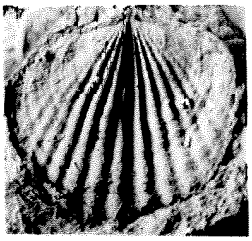
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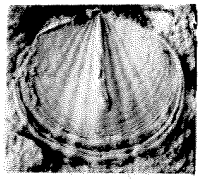
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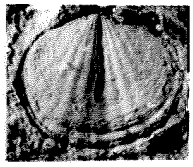
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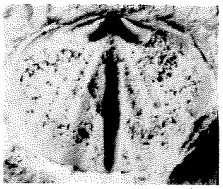
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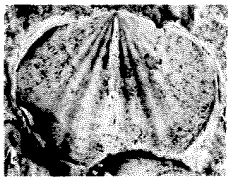
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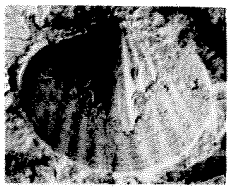
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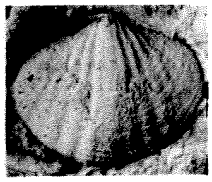
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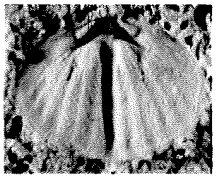
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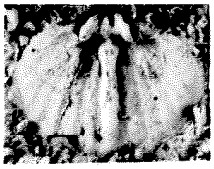
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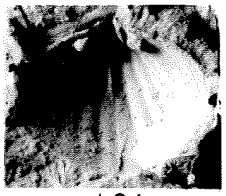
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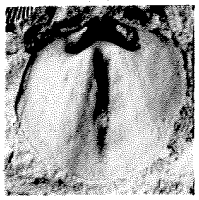
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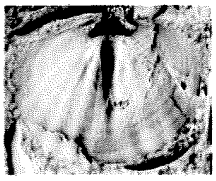
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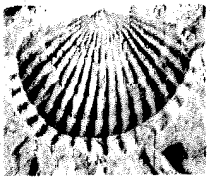
13


14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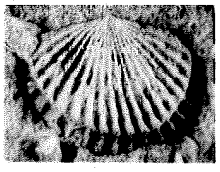
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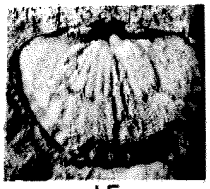
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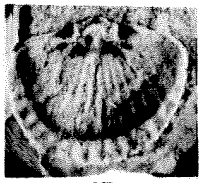
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Plate XXIX

Figures 1 - 10 *Megumatrypa glencoensis* new species

Glencoe Brook Formation, Pictou Co. Figures 1, 7, Locality TT11; Figures 2, 6, Locality MT2B; Figure 5, Locality I1; Figures 3, 4, 8-10, Locality MT2A.

1a Mold of interior of brachial valve (X2). Specimen #26422.

1b Rubber impression of specimen in figure 1a (X2).

2a Mold of interior of brachial valve (X2). Specimen #26423.

2b Rubber impression of specimen in figure 2a (X2).

3a Mold of interior of brachial valve (X2). Specimen #26425.

3b Rubber impression of specimen in figure 3a (X2).

4a Mold of interior of pedicle valve (X2). Specimen #26432.

4b Rubber impression of specimen in figure 4a (X2).

5a Mold of interior of pedicle valve (X2). Specimen #26439.

5b Rubber impression of specimen in figure 5a (X2).

6a Mold of interior of pedicle valve (X2). Specimen #26429.

6b Rubber impression of specimen in figure 6a (X2).

7a Mold of interior of pedicle valve (X2). Specimen #26427.

7b Mold of exterior of pedicle valve (X2). Counterpart of specimen in figure 7a. Specimen #26428.

8 Mold of interior of pedicle valve (X2). Specimen #26430.

9a Mold of exterior of brachial valve (X2). Specimen #264292.

9b Rubber impression of specimen in figure 9a (X2).

10 Anterior view of internal mold of articulated specimen with spire exposed (X4).

Figures 11 - 14 Atrypa cf A. reticularis (Linnaeus, 1750)

Middle member, Ross Brook Formation, Locality ME29, Pictou Co.

11a Mold of interior of brachial valve (X2). Specimen #364134.

11b Rubber impression of specimen in figure 11a (X2).

11c Mold of exterior of brachial valve (X2). Counterpart of specimen shown in figure 11a. Specimen #364135.

11d Rubber impression of specimen in figure 11c.

12 Mold of interior of pedicle valve (X2). Specimen #364136.

13 Mold of interior of pedicle valve (X1). Specimen #364137.

14a Mold of exterior of pedicle valve (X2). Specimen #364138

14b Rubber impression of specimen in figure 14a (X2).

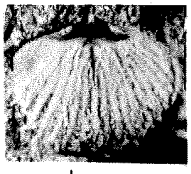
Figures 15 - 16 Atrypa cf. A. gedinnianna (Fuchs, 1934)

Stonehouse Formation, Locality E-4, Arisaig area.

15a Mold of interior of brachial valve Posterior view. (X1½). Specimen #4E-1.

15b Mold of interior of brachial valve
Top view of specimen shown in figure 15a
(X1½).

16 Mold of interior of pedicle valve (X1½).
Specimen #4E-2.



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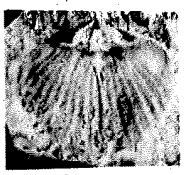
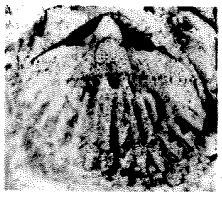


1b

2a

2b

3a

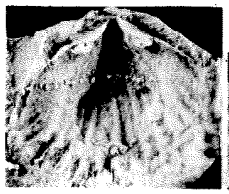


4a

5a

5b

3b



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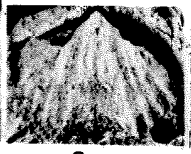

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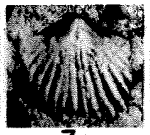

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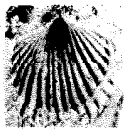

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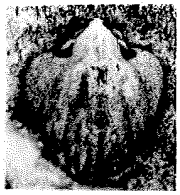

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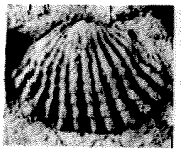

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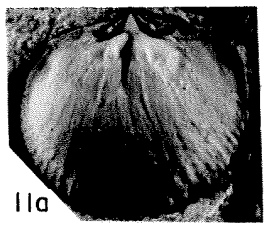

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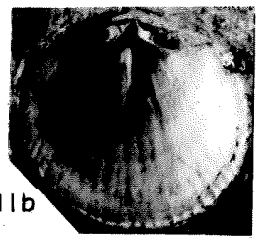

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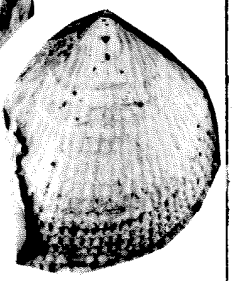
14a



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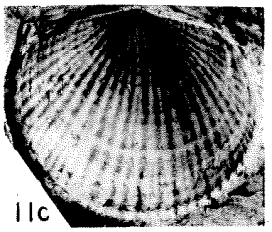

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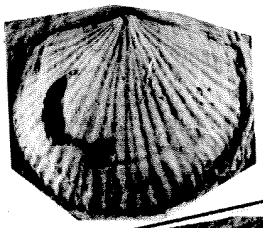

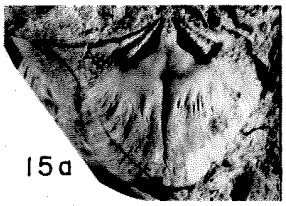

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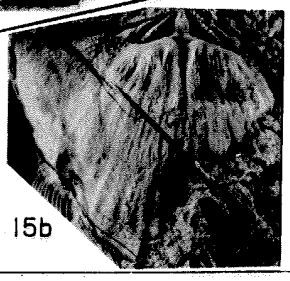

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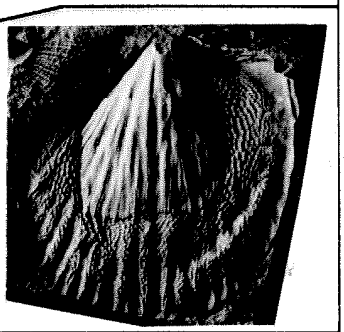

16

Plate XXX

Figures 1a, b — *Atrypa* cf. *A. gedinniana* (Fuchs, 1934)

Stonehouse Formation, Locality E-4, Arisaig area.

1a — Mold of exterior of pedicle valve (X1). Specimen #464133.

1b — Rubber impression of specimen in figure 1a (X1).

Figures 2 - 7 — *Cryptothyrella beechhillinsis* (McLearn, 1924)

Figures 2 - 6, Glencoe Brook Formation, Locality FT5, Pictou Co.; Figure 7, Cameron Brook, Pictou Co., exact locality not known.

2a — Mold of interior of pedicle valve Posterior view (X2). Specimen #353.

2b — Mold of interior of pedicle valve Top view (X2). Same specimen as that shown in figure 2a.

2c — Rubber impressions of specimen in figures 2a, 2b. Anterior view (X2).

2d — Rubber impressions of specimen in figures 2a, 2b. Top view (X2).

3a — Mold of interior of pedicle valve Top view (X1½). Specimen #351.

3b — Mold of interior of pedicle valve Side view (X1½). Same specimen as that shown in figure 3a.

3c — Mold of interior of pedicle valve Posterior view (X1½). Same specimen as that shown in figure 3a.

3d — Rubber impression of specimen in figure ea (X2).

4 — Mold of interior of pedicle valve (X2). Specimen #352

5a Mold of interior of brachial valve (X2). Specimen #3502.

5b Rubber impression of specimen in figure 5a (X2).

6a Mold of interior of brachial valve (X2). Specimen #350.

6b Rubber impression of specimen in figure 6a (X2).

7a Steinkern Ventral view (X2). Hypotype - Whitfieldella cf. angustifrons McLearn non M'Coy. GSC #5447

7b Posterior view (X2) of specimen shown in figure 7a.

7c Side view (X2) of specimen shown in figure 7a.

Figures 8 - 15 Meristina billingsi (Dawson, 1880)

Lower member, McAdam Formation. Figure 8 Locality KAR-63-115F, Cobequid Mountains Figure 9, 10, 14, Locality 106, Pictou Co.; Figures 11, 12, Locality HAT, Pictou Co.; Figure 15, Arisaig shore section, exact locality not known.

8 Mold of interior of pedicle valve (X1). Specimen #26451.

9 Mold of interior of pedicle valve (X1). Specimen #26449.

10 Mold of interior of pedicle valve (X1). Specimen #26450.

11 Mold of interior of pedicle valve (X1). Specimen #26453

12 Mold of interior of pedicle valve (X1). Specimen #26452.

13 Mold of interior of pedicle valve (X1). Hypotype GSC #5451.

14 Mold of interior of pedicle valve (X1). Specimen #264492.

15 Mold of interior of pedicle valve (X1). Hypotype GSC #5450.

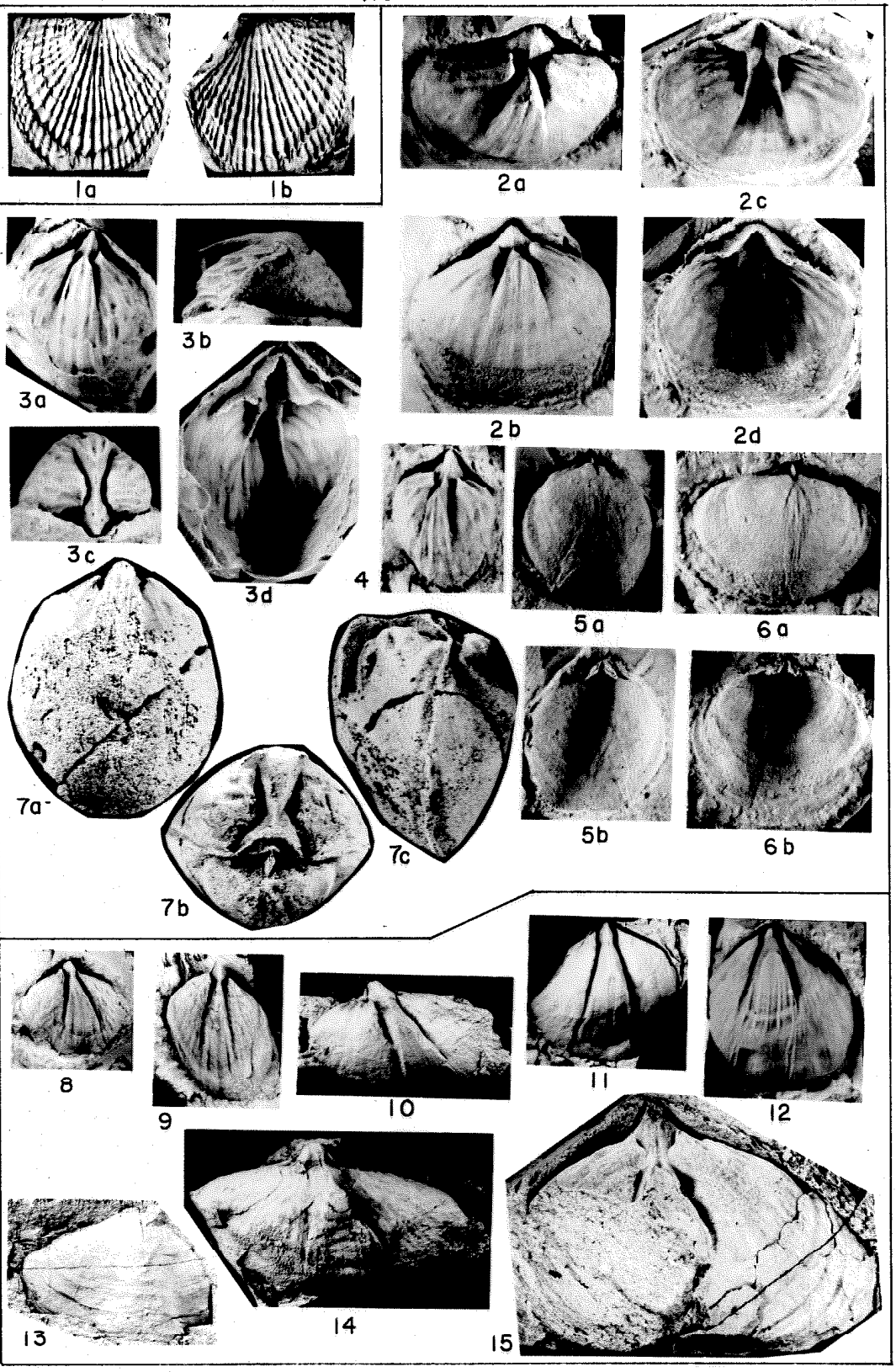
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Plate XXXI

Figures 1a - c — Meristina billingsi (Dawson, 1880)

French River Formation, Locality DF17, Pictou Co.

1a — Mold of interior of brachial valve (X1). Specimen #26447.

1b — Rubber impression of specimen in figure 1a Top view (X1)

1c — Rubber impression of specimen in figure 1a Oblique anterior view (X2).

Figures 2 - 11 — Hyattidina sp.

Upper member, Ross Brook Formation Figure 3, 4, 6, 9, 11, Locality DF9, Pictou Co.; Figures 2, 5, 7, 8, 10, Locality B-5, Arisaig area.

2 — Mold of interior of brachial valve (X5). Specimen #16452.

3 — Mold of interior of brachial valve (X5). Specimen #16456.

4 — Mold of interior of pedicle valve (X4). Specimen #16454.

5 — Mold of interior of pedicle valve (X5). Specimen #16451.

6 — Mold of interior of pedicle valve (X5). Specimen #16458.

7 — Mold of interior of pedicle valve (X5). Specimen #16460.

8 — Mold of interior of pedicle valve (X5). Specimen #16450.

9 — Mold of interior of pedicle valve (X5). Specimen #16459.

10 — Mold of interior of pedicle valve (X5). Specimen #16454.

11 — Mold of exterior of pedicle valve (X4). Specimen #16457.

Figures 12 - 21 Hyattidina northumberlandensis (McLearn, 1924)

Figure 12, Lower member, McAdam Formation Locality HAT, Pictou Co., Figures 13, 14, 16-21, Moydart Formation, Arisaig area. Figure 13, 19, 20, exact locality not known; Figures 14, 16, 17, 21, Locality D-2; Figure 18, Locality SB4; Figure 15, unnamed quartzite bed correlative with Moydart Formation, Cape George area.

12 Mold of interior of pedicle valve (X3). Specimen #36439.

13 Exterior pedicle valve (X3). Holotype - Peabody Museum #469.

14 Mold of interior of pedicle valve (X2). Specimen #46482.

15 Mold of interior of pedicle valve (X2). Specimen #46491.

16 Mold of interior of pedicle valve (X2). Specimen #46492.

17 Mold of interior of pedicle valve (X2). Specimen #46495

18a Mold of interior of pedicle valve (X2). Specimen #46490.

18b Rubber impression of specimen in figure 18a Top view (X2).

18c Rubber impression of specimen in figure 18a Anterior view (X2).

19 Exterior pedicle valve (X1). Hypotype - Meristina tumida ? McLearn non Dalman GSC #5449.

20 Exterior pedicle valve (X1). Hypotype - Meristina tumida ? McLearn non Dalman GSC #5448.

21a Mold of interior of brachial valve (X2). Specimen #46494.

21b Rubber impression of specimen in figure 21a (X2).

Figures 22 - 24 Protathyris ? sp.

Stonehouse Formation, Locality 4E, Arisaig area.

22 Mold of interior of pedicle valve (X4). Specimen #415646.

23 Mold of interior of pedicle valve (X4). Specimen #415644.

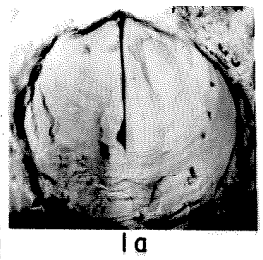
24 Mold of interior of pedicle valve (X4). Specimen #415645.

Figures 25a - b Podollella ? sp.

Stonehouse Formation, Locality LR4A, Pictou Co.

25a Steinkern Dorsal view (X3). Specimen #36444.

25b Ventral view (X3). of specimen shown in figure 25a.



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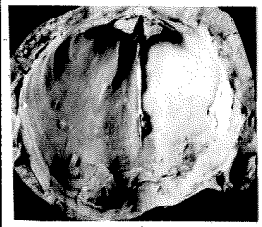

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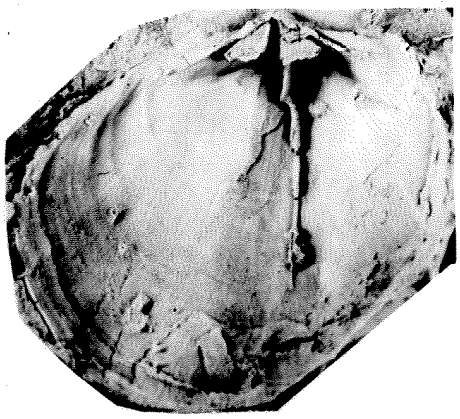
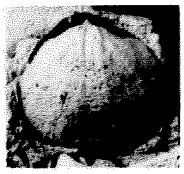


1c

2



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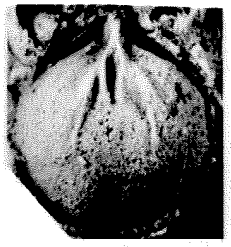

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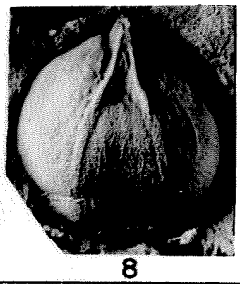

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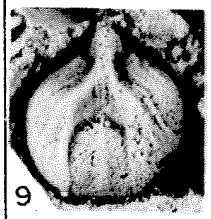

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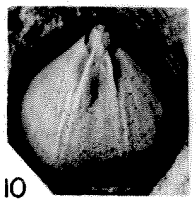

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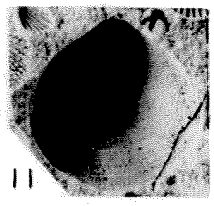

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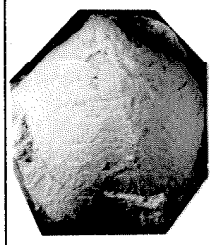
18a

12



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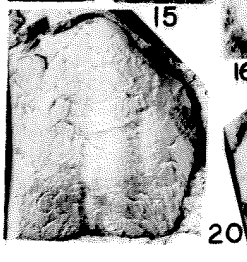
15

16

17

18b

18c



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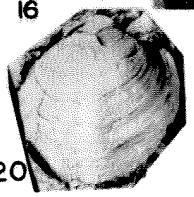

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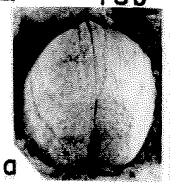
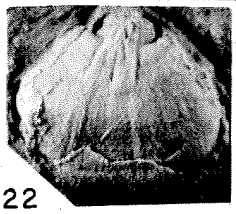


21a

21b



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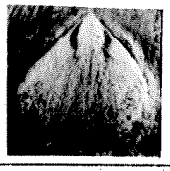

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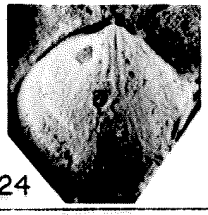


24

25a

25b

Plate XXXII

Figures 1a - e — Nucleospira sp.

Lower member McAdam Formation, Locality KAR-63-123F, Cobequid Mountains.

1a — Mold of exterior of brachial valve (X1½). Specimen #36435.

1b — Rubber impression of specimen in figure 1a (X2½).

1c — Mold of interior of brachial valve (X2½). Counterpart of specimen in figure 1a. Specimen #36434.

1d — Rubber impression of specimen in figure 1c Top view (X2½).

1e — Rubber impression of specimen in figure 1c Anterior view (X2½).

Figures 2 - 5 — Striispirifer stonehousensis (McLearn, 1924)

French River Formation. Figure 2, Locality MCK6, Arisaig area; Figure 3, Locality DF15, Pictou Co.; Figure 4, Locality DF17, Pictou Co.; Figure 5, Locality DF13, Pictou Co.

2a — Mold of interior of pedicle valve Posterior view (X1). Specimen #354.

2b — Mold of interior of pedicle valve Same specimen as in figure 2a. Top view (X1).

3a — Posterior view (X1) of mold of the interior of articulated valves. Specimen #356.

3b — Rubber impression of specimen in figure 3a. Anterior view (X1½).

4a — Mold of interior of pedicle valve (X1). Specimen #355.

4b — Rubber impression of specimen in figure 4a Top view (X1).

4c — Rubber impression of specimen in figure 4a Anterior view (X1).

5 Mold of exterior of pedicle valve (X2). Specimen #36438.

Figures 6 - 9 Howellella moydartensis

Moydart Formation. Figure 8, Locality KA-62-4F, Cobequid Mountains; Figure 6, 7, Locality MCK33, Arisaig area; Figure 9, Arisaig shore section, exact locality not known.

6 Mold of interior of pedicle valve (X2). Specimen #464142.

7 Mold of interior of pedicle valve (X2). Specimen #464141.

8 Mold of interior of brachial valve (X2). Specimen #464139.

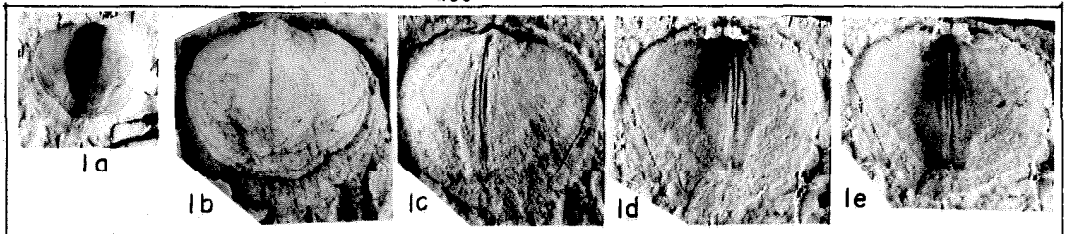
9a Articulated specimen #464140. Side view (X2).

9b Articulated specimen #464140. Ventral view (X2).

9c Articulated specimen #464140. Anterior view (X2).

9d Articulated specimen #464140. Dorsal view (X2).

9e Articulated specimen #464140. Posterior view (X2).

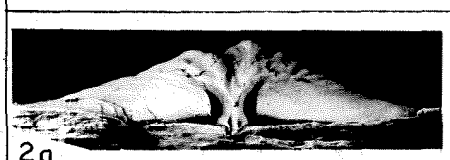

1a

1b

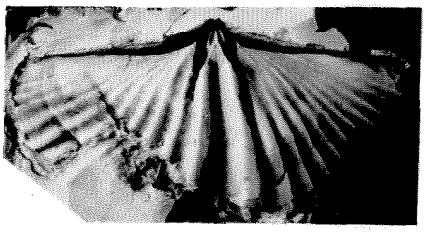
1c

1d

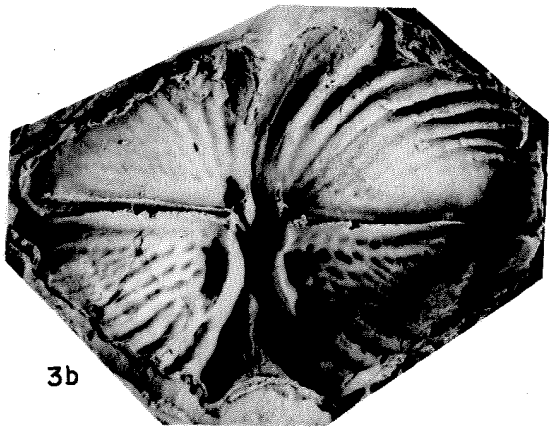
1e


2a


2b




3a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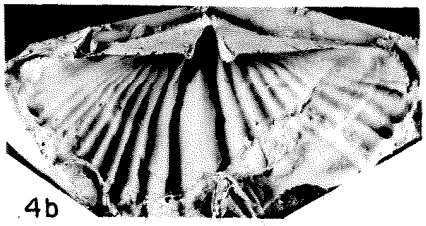
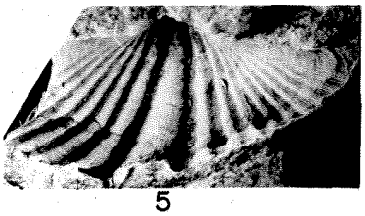

4b


4c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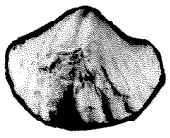
9a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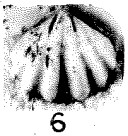
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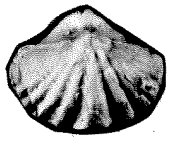
7


8


9d


9e

Plate XXXIII

Figures 1 - 10 — Delthyris (Quadrifarius) rugaecosta (Hall, 1860)

Stonehouse Formation, Arisaig area. Figures 1, 2, 5, 10, Locality MCK27; Figure 3, Locality E-3; Figures 4, 6, Locality E-4; Figure 7, Locality E-8; Figures 8, 9, Arisaig shore section, exact locality not known.

1 — Mold of interior of pedicle valve (X1½). Specimen #46472.

2 — Mold of interior of pedicle valve (X1½). Specimen #46471.

3a — Mold of interior of pedicle valve (X2). Specimen #46473.

3b — Rubber impression of specimen in figure 3a (X1½).

4a — Mold of interior of pedicle valve (X1½). Specimen #46470.

4b — Rubber impression of specimen in figure 4a (X1½).

5a — Mold of interior of brachial valve (X2). Specimen #46476.

5b — Rubber impression of specimen in figure 5a (X2).

6 — Mold of interior of pedicle valve (X1½). Specimen #46469.

7a — Mold of interior of brachial valve (X1½). Specimen #46477.

7b — Rubber impression of specimen in figure 7a Top view (X2).

7c — Rubber impression of specimen in figure 7a Anterior view (X2).

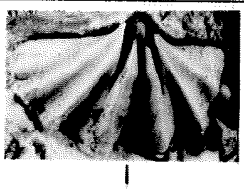
8a — Steinkern Ventral view (X2). Hypotype GSC #3-95.

8b Same specimen as in 8a Dorsal view (X2).

9 Brachial valve (X1). Holotype Delthyris rugaecosta mut. prima McLearn. Peabody Museum specimen #462.

10a Mold of exterior of pedicle valve (X2). Specimen #46474.

10b Rubber impression of specimen in figure 10a (X2).



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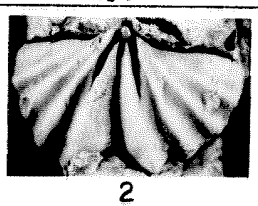

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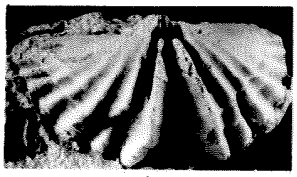
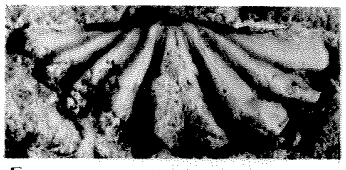
3a



4a

4b

3b

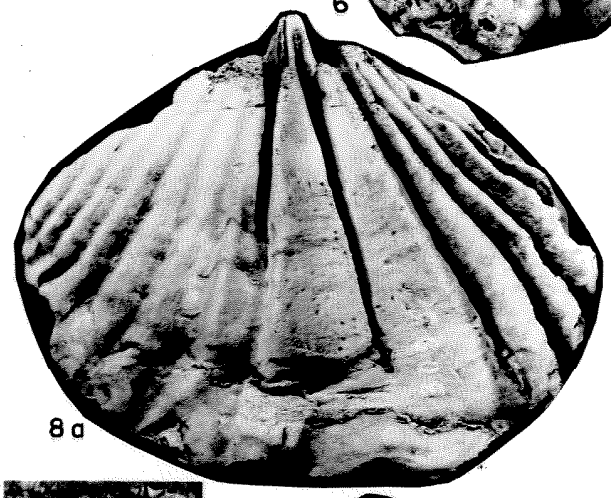


5a

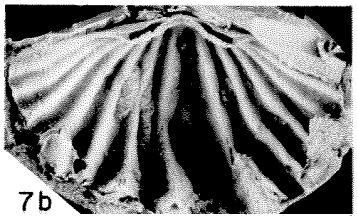
5b

6

7a



8a



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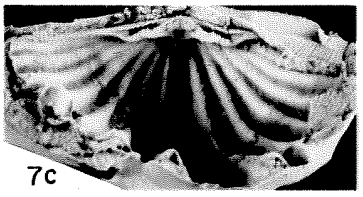
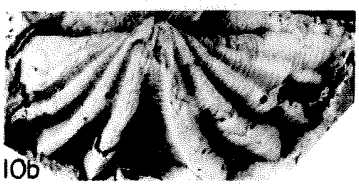


7c

9

10a



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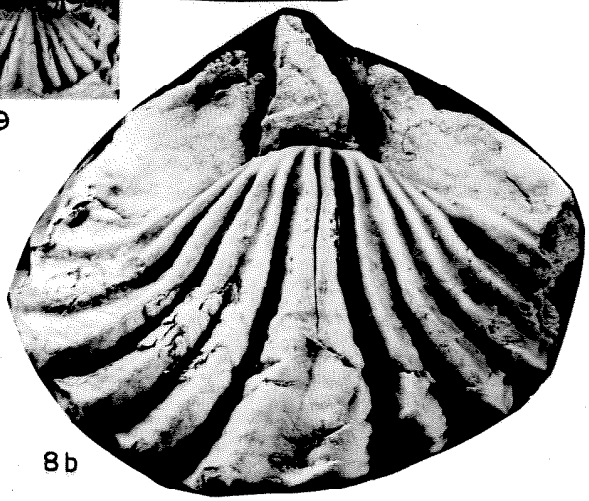


8b

Appendix I. Fossil Localities

The fossil localities in the Arisaig area are shown on Map 2. The localities in Pictou Co. are given in Dr. R. H. Maehl's Ph.D. Thesis (Maehl, 1960, figs. 4-14). The localities in the Cape George area are shown on an unpublished geologic map of the Cape George area compiled by Mr. John Griffin of the U.S.G.S. Fossil localities in the Lochaber area are shown on geologic maps compiled by Sakrison, Saunders, Howard, Erlanger, Kenyon and Cohen during the summer of 1959, while students at the M.I.T. Geology Summer Camp. Copies of the Cape George and Lochaber maps referred to are in the files of Dr. A. J. Boucot.

The localities in the Cobequid Mountains in the area marked 1 on map 1 are as follows: KAR-63-135F 1.35 miles southwest of The Falls: KAR-63-392 2.4 miles south of The Falls on highway 11; KA-63-115F Waugh River, 1.2 miles northwest of junction with Ferguson Brook; KAR-63-141F 1.7 miles due east of locality KA-63-115F; KAR-63-126F 1.1 mile northwest of Earltown; KAR-63-377 .9 mile east of Earltown; KAR-63-127F 1 mile southwest of North Earltown; KA-63-135F 1.1 mile south of Balmoral Mills. The localities in the Cobequid Mountains in the area marked 2 on map 1 are as follows: 17057 Wentworth Station; 44968 Shales 300 feet west of Wentworth Station. The locality in the area marked 3 on map 1 is locality KA-62-11F Portapique River, 200 feet downstream from junction of Wilson Brook and Portapique

River. The localities in the Cobequid Mountains in the area marked 4 on map 1 are as follows: KA-62-383F West Brook, N.S. southeast of New Canaan, 60 feet south of volcanic and sedimentary fault contact; KA-62-4F about 500 feet upstream from locality KA-62-383F; KA-62-394F Branch of West Brook from southwest junction of brooks 1 mile north of 45° 30' latitude near 64° 15' longitude; KA-62-400F Brown's Brook, 1 mile southwest of New Canaan.

The distribution of species in the units of the Arisaig series and in the Glencoe Brook and Kerrowgare Formations is given in tables XI-XIX.

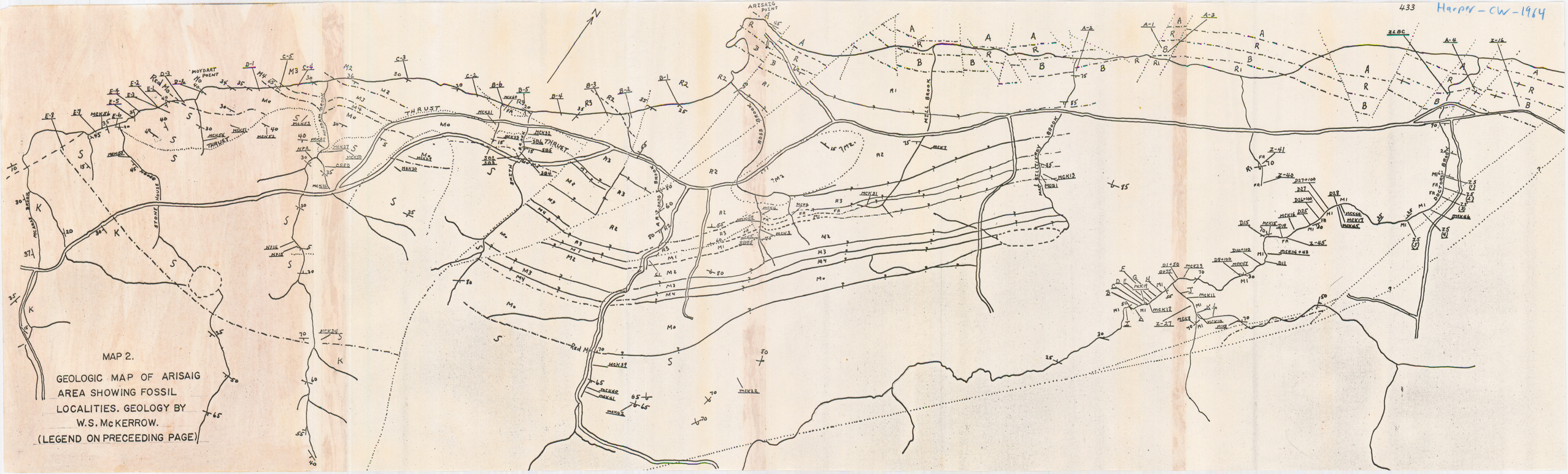
Scale and Legend to accompany Map # 2 on following page:

SCALE: 1" = 1000'

LEGEND

- [K] KNOYDART FORMATION
- [S] STONEHOUSE FORMATION
- [RED MO] RED BAND, MOYDART FORMATION
- [MO] MOYDART FORMATION
- [M4] MEMBER 4 McADAM FORMATION
- [M3] MEMBER 3 McADAM FORMATION
- [M2] MEMBER 2 McADAM FORMATION
- [M1] MEMBER 1 McADAM FORMATION
- [FR] FRENCH RIVER FORMATION
- [R3] UPPER MEMBER ROSS BROOK FORMATION
- [R2] MIDDLE MEMBER ROSS BROOK FORMATION
- [R1] LOWER MEMBER ROSS BROOK FORMATION
- [B] BEECHHILL COVE FORMATION
- [R] RYOLITE BEDS
- [A] ANDRESITE BEDS

- ——— FORMATION BOUNDARY
- —·—·— FORMATION BOUNDARY (UNCERTAIN)
- ? ——— ? FORMATION BOUNDARY (VERY UNCERTAIN)
- ····· FAULT
- MCK33 FOSSIL LOCALITY
- 30 STRIKE AND DIP OF BED
- 30 STRIKE AND DIP OF OVERTURNED BED
- ═══ ROAD



MAP 2.

GEOLOGIC MAP OF ARISAIG AREA SHOWING FOSSIL LOCALITIES. GEOLOGY BY W.S. McKERROW.

(LEGEND ON PRECEEDING PAGE)

	Dolerorthis sp.	*Ptychopleurella* ? sp.	*Dalmanella* sp. A.	*Dalmanella* ? sp.	*Dalmanella* ? *primitiva*	*Mendacella arisaigensis*	*Isorthis prima*	*Linoporella* sp.	*Foleptostrophia beechhillensis*	*Leptaena* sp.	Indet. leptaenid	*Fardenia* ? sp.	"*Camarotoechia*" *bimesiornata*	*Cryptothyrella beechhillensis*
Arisaig area:														
A-1						X			X					
A-2			X	X		X	X	X	X			X	X	X
A-3					X				X	X		X	X	
A-4 X	X									X			X	
ZLBCX								X			X			
Pictou Co:														
DW1								X	X	X			X	
FP16						X							X	
FP17													X	X
FP21														X
UE22						X			X					
A-11									X				X	X
AV1													X	
MH2									X					
WB137						X								
DW4						X								

Table XI
Distribution of Species in the Beechhill Cove Formation by locality.

Table XII

Distribution of Species in the Glencoe Brook Formation.

	Dolerorthis sp.	*Dalmanella* sp. B	*Fascifera* ? sp.	*Mendacella arisaigensis*	*Koleptostrophia beechhillensis*	*Fardenia* ? sp.	*Megumatrypa glencoensis*	*Cryptothyrella beechhillensis*
TT1				X				
GB5							X	
NR6							X	
NR6A							X	
NR9			X					
GB2		X					X	
I-1		X					X	
TT11		X					X	
MT2A		X					X	
MT2B		X					X	
FT5	X		X		X	X	X	X

Table XIII

Distribution of Species in the Ross Brook Formation by locality.

Localities	*Visbyella nana*	*Salopina conservatrix*	*Eoleptostrophia beechhillensis*	*P.* (*Mesopholidostrophia*) cf. *P.* (*M.*) *nitens*	*Pentlandina* ? sp.	*Leptaena* cf. *L. depressa*	*Protochonetes tenuistriatus*	*Plagiorhyncha plastica*	*Plagiorhyncha* aff. *P. glassi*	"*Camarotoechia*" *rossonia*	*Sphaerirhynchia antigua*	*Hyattidina* sp.	*Eocoelia* aff. *E. hemisphaerica*	*Eocoelia* cf. *E. sulcata*
Arisaig area:														
Lower member														
LRB1					X									
Middle member														
MCK7										X				
B-1	X								X				X	
B-2	X								X	X				
Upper member														
B-3									X	X				
B-4	X	X		X			X		X	X		X		X
B-5		X				X	X			X		X		X
B-6		X					X		X					X
Shore section (locality not known)								X			X			
Pictou Co:														
Middle member														
ME7													X	
ME14	X												X	
ME21														
ME50	X												X	
ME57										X				
ME60							X						X	
ME62														
ME63														
ME64													X	
ME65													X	
ME66														
ME67	X												X	
ME68													X	
ME69													X	
ME28													X	
ME29	X		X	X									X	
ME38														

Table XIII
(cond.)

Pictou Co. Middle member (cont.)	*Visbyella nana*	*Saliopina conservatrix*	*Coleptostropnia beechhillensis*	*P.* (*Mesopholidostrophia*) cf. *P.* (*M.*) *nitens*	*Pentlandina* ? sp.	*Leptaena* cf. *L.* *depressa*	*Protochonetes tenuistriatus*	*Plagiorhyncha plastica*	*Plagiorhyncha* aff. *P.* *glassi*	"*Camarotoechia*" *rossonia*	*Sphaerirhynchia antigua*	*Hyattidina* sp.	*Eocoelia* aff. *E.* *hemisphaerica*	*Eocoelia* cf. *E.* *sulcata*
LE33													X	
LE70													X	
LE78													X	
A20									X				X	
FR80													X	
DF60													X	
ES5									X				X	
FP18													X	
FP19													X	
FR114													X	
FR130													X	
MH1									X				X	
040													X	
Upper member														
DF6														X
DF8		X												X
DF9		X					X					X		X
DF18														X
DF30														X
DF36						X			X	X				
DF38	X						X		X	X				X
DF43	X	X												X
DF45	X								X					
DF48	X								X					
DF49	X								X					
DF50														X
ES1A	X								X					X
ES2	X													X
F-16									X					X
F-24														X
UEA														X
UEA4									X					X
UEA12														X
FR45			X											X
FR18												X		

Table XIII
(cond.)

Cobequid Mountains Middle member	*Visbyella nana*	*Salopina conservatrix*	*Eoleptostrophia beechhillensis*	*P.* (*Mesopholidostrophia* cf. *P.* (*M.*) *nitens*	*Pentlandina* ? sp.	*Leptaena* cf. *L. depressa*	*Protochonetes tenuistriatus*	*Plagiorhyncha plastica*	*Plagiorhyncha* aff. *P. glassi*	"*Camarotoechia*" *rossonia*	*Sphaerirhynchia antigua*	*Hyattidina* sp.	*Eocoelia* aff. *E. hemisphaerica*	*Eocoelia* cf. *E. sulcata*
17057	X								X				X	
44968									X				X	

Table XIV

Distribution of Species in the French River Formation by locality.

	Marklandella maehli	Salopina submedia	Leptostrophia sp.	Fardenia sp.	Leptaena sp. cf. L. depressa	P. cf. P. plastica	Strisispirifer stonehousensis	Meristina billingsi
Arisaig area:								
MCK4		X				X		
MCK6		X				X	X	
MCK60						X		
D26-100							X	
ZS-3						X		
Z-40						X	X	
Z-41								
Z-45								
Z-50								
Z-52						X		
Pictou Co.								
DF13	X	X	X	X	X	X	X	
DF15	X	X	X			X	X	
DF16	X	X		X	X	X	X	X
DF17	X	X				X	X	X
FR22		X				X		

Table XV.

Distribution of Species in the McAdam Formation by locality.

Arisaig area: Member 1	*Resserella* cf. *R.* concavoconvexa	*Dalejina* sp.	*Marklandella mcadamica*	*Idiorthis matura*	*Isorthis mcadamensis*	*Salopina submedia*	*Leptostrophia* sp.	*Amphistrophia funiculata*	*Amphistrophia striata*	*Mclearnites* sp.	*Leptaena* sp. cf. *L.* depressa	*Fardenia* sp.	*Plectodonta* sp.	*Protochonetes novascoticus*	*Plagiorhyncha* sp. *A.*	"*C.*" *westoni*	"*C.*" sp. aff. "*C.*" planorugosa	*Sphaerirhynchia* sp. *A.*	*Rhynchospirina* sp. *A.*	*Rhynchospirina* ? sp. *B*	*Atrypa* sp. cf. *A. reticularis*	*Howellella moydartensis*	*Strispirifer stonehousensis*	*Meristina billingsi*	*Hyattidina northumberlandensis*	*Nucleospira* sp.
C-1		X				X	X			X	X			X			X	X	X		X			X		
MCK3																								X		
MCK5					X																					
MCK13						X					X			X										X		
MCK31																								X		
MCK49																	X							X		
RB70	X											X										X		X		
MGB1								X				X												X		
ZS1					X																					
ZS4																										
ZS5					X						X													X		
MCK8																										
MCK9																										
MCK10																										
MCK11																										
MCK14																								X		
MCK16																										
MCK17					X																					
MCK18																								X		
MCK19								X																X		
MCK43																										
MCK44																		X								
MCK45																								X		
MCK46																										
MCK47																		X								
MCK48				X														X								
D-11																								X		
D-15?																		X								
D-27																		X				X		X		

Table XV
(cond.)

	Resserella cf. *R. concavoconvexa*	*Dalejina* sp.	*Marklandella mcadamica*	*Idiorthis matura*	*Isorthis mcadamensis*	*Salopina submedia*	*Leptostrophia* sp.	*Amphistrophia funiculata*	*Amphistrophia striata*	*Mclearnites* sp.	*Leptaena* sp. cf. *L. depressa*	*Fardenia* sp.	*Plectodonta* sp.	*Protochonetes novascoticus*	*Plagiorhyncha* sp. *A.*	"*C.*" *westoni*	"*C.*" sp. aff. "*C.*" *planorugosa*	*Sphaerirhynchia* sp.	*Rhynchospirina* sp. *A.*	*Rhynchospirina* ? sp. *B.*	*Atrypa* sp. cf. *A. reticularis*	*Howella moydartensis*	*Strispirifer stonehousensis*	*Meristina billingsi*	*Hyattidina northumberlandensis*	*Nucleospira* sp.
Arisaig area:																										
Member 1 (cont.)																										
D-28																					X			X		
B																										
C																		X								
D																		X								
E																										
F						X																				
G																										
H																		X								
I						X																		X		
J																										
K																										
Member 2																										
C-2			X	X		X	X	X			X			X		X	X				X					
C-3						X										X										
MCK21																										
MCK32						X									X							X				
Member 3																										
C-4						X								X	X	X	X									
Member 4																										
C-5						X								X			X					X				

Table XV
(cond.)

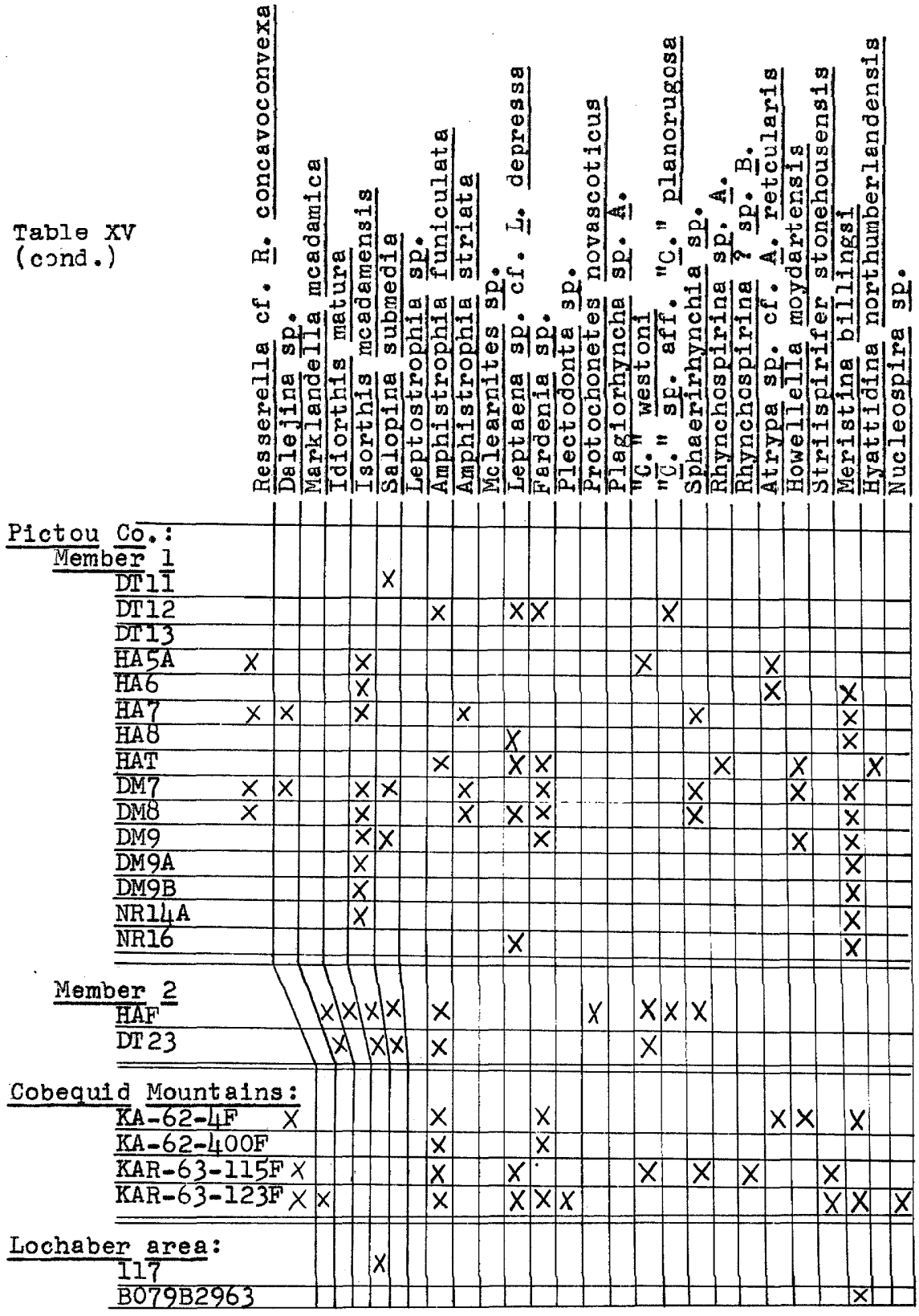


Table XVI

Distribution of Species in the Moydart Formation by Locality.

	Salopina submedia	Shaleria gilpeni	Lissostrophia sp.	Protochonetes novascoticus	Eatonioides lamellornatus	"Camarotoechia" aff. "C." planorugosa	"Camarotoechia" squamifera	"Camarotoechia" moydartensis	Sphaerirhynchia saffordi	Rhynchospirina acadiae	Howellella moydartensis
Arisaig area:											
D-1	X			X			X				X
D-2	X		X	X		X	X		X		X
D-3	X	X		X	X					X	
MCK33				X					X		X
MCK59				X							
SB2	X			X						X	
SB3				X							
SB4	X					X					
SB5	X			X							
SB6	X			X		X				X	X
Shore section								X			
Pictou Co.											
DM13						X					
DS5						X					
SR101B						X			X		
DS43	X			X							
DS53	X			X							
DT20					X						
DS6									X		
Cape George area:											
F-3					X						
Lochaber area:											
74					X						
117				X							X

Table XVII.

Distribution of Species in the Stonehouse Formation by Locality.

Arisaig area:	Isorthis fornicatimcurvata	Schizophoria sp.	Proschizophoria sp.	Salopina submedia	Salopina stonehousensis	Shaleria gilpeni	Shaleria honeymani	Mclearnites mertoni	Leptaena sp. aff. L. rhomboidalis	indet. orthotetacid	Protochonetes novascoticus	Protochonetes stonehousensis	"Camarotoechia" planorugosa	"Camarotoechia" glomerosa	Rhynchospirina sinuata	Rhynchospirina sp. A.	Atrypa sp. cf. A. gedinniana	Protathyris ? sp.	Delthyris (Quadrifarius) rugaecosta	Podolella ? sp.
E-1	X							X	X		X	X	X		X				X	
E-2	X				X			X	X		X		X		X	X			X	
E-3	X										X		X		X				X	
E-4	X	X			X			X			X	X	X				X	X	X	
E-5	X	X			X	X					X		X						X	
E-6	X										X		X						X	
E-7					X	X					X				X				X	
E-8					X	X					X	X	X		X		X		X	
MCK26	X					X					X		X		X				X	
MCK27	X				X	X					X		X						X	
MCK29											X		X							
MCK30	X										X								X	
MCK39	X			X		X							X						X	
MCK40	X				X	X							X		X		X			
MCK41					X	X														
MCK42											X									
MCK50						X					X		X						X	
MCK51	X												X						X	
MCK52	X																		X	
MCK53	X										X		X		X				X	
MCK54	X					X					X								X	
MCK55	X					X					X				X				X	
MCK56	X					X					X		X		X				X	
MCK57	X					X													X	
NF14	X			X																
NF15	X			X											X					
CRED	X			X															X	
NFA	X			X									X					X		
Shore section							X			X				X						

Table XVII. (cond.)

	Isorthis fornicatimcurvata	*Schizophoria* sp.	*Proschizophoria* sp.	*Salopina submedia*	*Salopina stonehousensis*	*Shaleria gilpeni*	*Shaleria honeymani*	*Mclearnites mertoni*	*Leptaena* sp. aff. *L. rhomboidalis*	indet. orthotetacid	*Protochonetes novascoticus*	*Protochonetes stonehousensis*	"*Camarotoechia*" *planorugosa*	"*Camarotoechia*" *glomerosa*	*Rhynchospirina sinuata*	*Rhynchospirina* sp. *A*	*Atrypa* sp. cf. *A. gedinniana*	*Protathyris* ? sp.	*Delthyris* (*Quadrifarius*) *rugaecosta*	*Podolella* ? sp.
Pictou Co:																				
LR1					X						X		X						X	
LR2											X		X						X	
LR3											X								X	
LR4A			X								X									X
LR8	X					X							X				X			
LR9	X										X		X						X	
NR3					X															
DT1					X						X									
45432				X																
Cape George area																				
F-1											X									
F-2						X														
F-8											X									
F-9						X					X								X	
F-14													X							
F-15													X							
F-18	X					X					X		X							
F-19													X							
Lochaber area:																				
81	X																			
SS-B								X			X								X	
3.58											X									
3.61													X						X	
3A																			X	
Cobequid Mountains:																				
11F	X					X							X						X	
KA-62-394F	X				X	X													X	
KAR-63-377F						X							X		X				X	
KAR-63-128F	X							X					X						X	
G.S.C.#44971	X					X													X	

Table 18.

List of species in the Kerrowgare Formation by locality.

Locality	Species
SP1	Visbyella nana, Plagiorhyncha sp. aff. P. glassi.
I3	Eocoelia aff.E. hemisphaerica.
HB83	Salopina submedia, Protochonetes novascoticus, unidentified rhynchonellid.
HB83A,B	unidentified rhynchonellid
HB85	Salopina submedia, unidentified rhynchonellid
HB91	Salopina submedia, unidentified rhynchonellid, Howellella sp.
ML109	unidentified plant fragments
I06	Salopina submedia, Atrypa cf. A. reticularis, Leptaena sp. cf. L. depressa, Mclearnites sp., "Camarotoechia" sp. aff. C. planorugosa, Meristina billingsi.

Table 19.

List of species in the unnamed quartzite in the Cape George area.

Locality	Species
F-12	Hyattidina northumberlandensis Sphaerirhynchia saffordi "Camarotoechia" squamifera "Camarotoechia" sp. aff. C. planorugosa? Protochonetes novascoticus
F-17	Hyattidina northumberlandensis Salopina submedia "Camarotoechia" squamifera Protochonetes novascoticus

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