PROVINCE OF MANITOBA

DEPARTMENT OF MINES AND NATURAL RESOURCES

HON. C. H. WITNEY
Minister

J. G. COWAN, Q.C.
Deputy Minister

MINES BRANCH

J. S. RICHARDS
Director

PUBLICATION 59-6

FAUNA

of the

MANITOBA GROUP IN MANITOBA

by

HELEN McCAMMON

Winnipeg, 1960

Price $1.00

Printed by R. S. Evans, Queen's Printer for Province of Manitoba

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PREFACE

Apart from Whiteaves' studies of Tyrrell's fossil collection and the inclusion of faunal lists in stratigraphic reports little work has been done, or at least published, on the Devonian fauna in Manitoba.

In the present study of the Manitoba group, the author describes several new species and varieties. The investigation indicates that the Dawson Bay and Souris River formations both can be subdivided into 4 zones, each containing a particularly abundant and characteristic fossil form.

The Dawson Bay formation is correlated with the Cedar Valley formation of Iowa (late Middle Devonian), and the Souris River formation (early upper Devonian) with the Waterways formation of Alberta.

May, 1960

J. F. DAVIES,
Chief Geologist

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ABSTRACT

A faunal study of the Manitoba group in Manitoba indicates that the lower Dawson Bay formation is Middle Devonian and the upper Souris River formation is Upper Devonian. Faunal zonation of the two formations is proposed; the Dawson Bay and Souris River are each subdivided into four zones. Fauna from the Dawson Bay is shown to be unrelated to that in the underlying Winnipegosis and Elm Point formations. The Dawson Bay formation correlates closely with the Cedar Valley formation of Iowa, Illinois, and Minnesota and possibly with the Milwaukee dolomite of Wisconsin and the Williams Island formation of the James Bay lowland. The Souris River formation correlates closely with the Waterways formation of Alberta.

New species and varieties described from the Dawson Bay include: two stromatoporoids, *Anostylostroma bailliei* and *Ferestromatopora convergens;* six corals, *Amplexiphyllum salinensis, Buschoplhyllum minutum, Tabulophyllum gallina, Favosites pachymuralis, Thamnopora dumosa* var. *tabulata, Coenites hadrus;* one bryozoan *Cyphotrypa whiteavesi;* four brachiopods, *Atrypa manitobensis, Atrypa snakensis, Spinatrypa mascula* var. *manitobensis, Cyrtina paucicostata;* and one trilobite *Proetus manitobensis.*

CHAPTER I

INTRODUCTION

This report discusses in detail the invertebrate fauna of the Manitoba group (Middle and Upper Devonian) from Manitoba. The Manitoba group is compared faunally with the underlying Winnipegosis and Elm Point formations, and correlation with other areas in North America is suggested.

The study is based upon fossil collections made in 1956 and 1957. Collecting was done along the Red Deer River; the shores and islands of Dawson Bay, Lake Winnipegosis; and Lake Manitoba (Figure 1). A. D. Baillie's field notes (1949) and report (1950) were consulted for locations of particularly fossiliferous localities.

Careful collecting must be continued in Manitoba to determine completely the stratigraphic relations in the Manitoba group. The outcrops are isolated, and the beds have been deposited on an undulating biohermal Winnipegosis formation, so that elevations are of little use in determining the stratigraphic position of the outcrops.

PREVIOUS WORK

The first fossil collection from Manitoba was reported by Hinde from Snake Island, Lake Winnipegosis. Billings (1859, p. 187) studied these fossils and found the following: *Atrypa reticularis* (Linne) *s.l*, *Atrypa aspera* (Schlotheim) *s.l*, *Schizophoria* (*Orthis*) *iowensis* (Hall), two small species of *Productella*, and the pelecypods *Paracyclas* (*Lucina*) *elliptica* (Conrad), and *Lucina occidentalis* Billings, two species of *Euomphalus*, and a fragment of *Loxonema*, fragments of *Orthoceras*, *Gomphoceras*, and *Gyroceras*. Billings concluded from the fauna that the rocks on Snake Island were Devonian and probably Hamilton in age.

J. W. Spencer (1876) reported on the area between the Assiniboine River and Lake Winnipegosis. He gave a detailed description of Point Wilkins and the fossils occurring in that locality as well as several other localities in the area.

In 1888 and 1889, a detailed geologic investigation of northwestern Manitoba was undertaken by J. B. Tyrrell (1892). He divided the Devonian into three formations: the lower unfossiliferous sequence of red and other shales that he thought might be Early Devonian; the middle, Winnipegosan formation of Middle Devonian age containing numerous specimens of *Stringocephalus* and *Sphaerospongia tesselata* (Phillips); the upper, Manitoban formation which could possibly represent the Cuboides zone, although *Hypothyris cuboides* had not been found. Tyrrell listed 133 species obtained from the Manitoban and Winnipegosan formations.

J. F. Whiteaves identified the material collected by Tyrrell and reported much of his findings in two publications on the Manitoba Devonian (1891, 1892). His most important discovery was the occurrence of *Stringocephalus burtini* Defrance in the Winnipegosan formation, correlating the formation with the Middle Devonian of Germany.

E. M. Kindle (1914, pp. 251-257) subdivided the Devonian further and designated zones for each subdivision. Tyrrell's Winnipegosan formation was given definite limits, containing only the *Stringocephalus* zone. Below the Winnipegosan was the Elm Point formation consisting of the *Atrypa reticularis* var. A. zone. The Manitoba formation, considered to be either Middle or Upper Devonian, was subdivided into the lower *Cyrtina hamiltonensis* zone and the upper *Athyris fultonensis* zone.

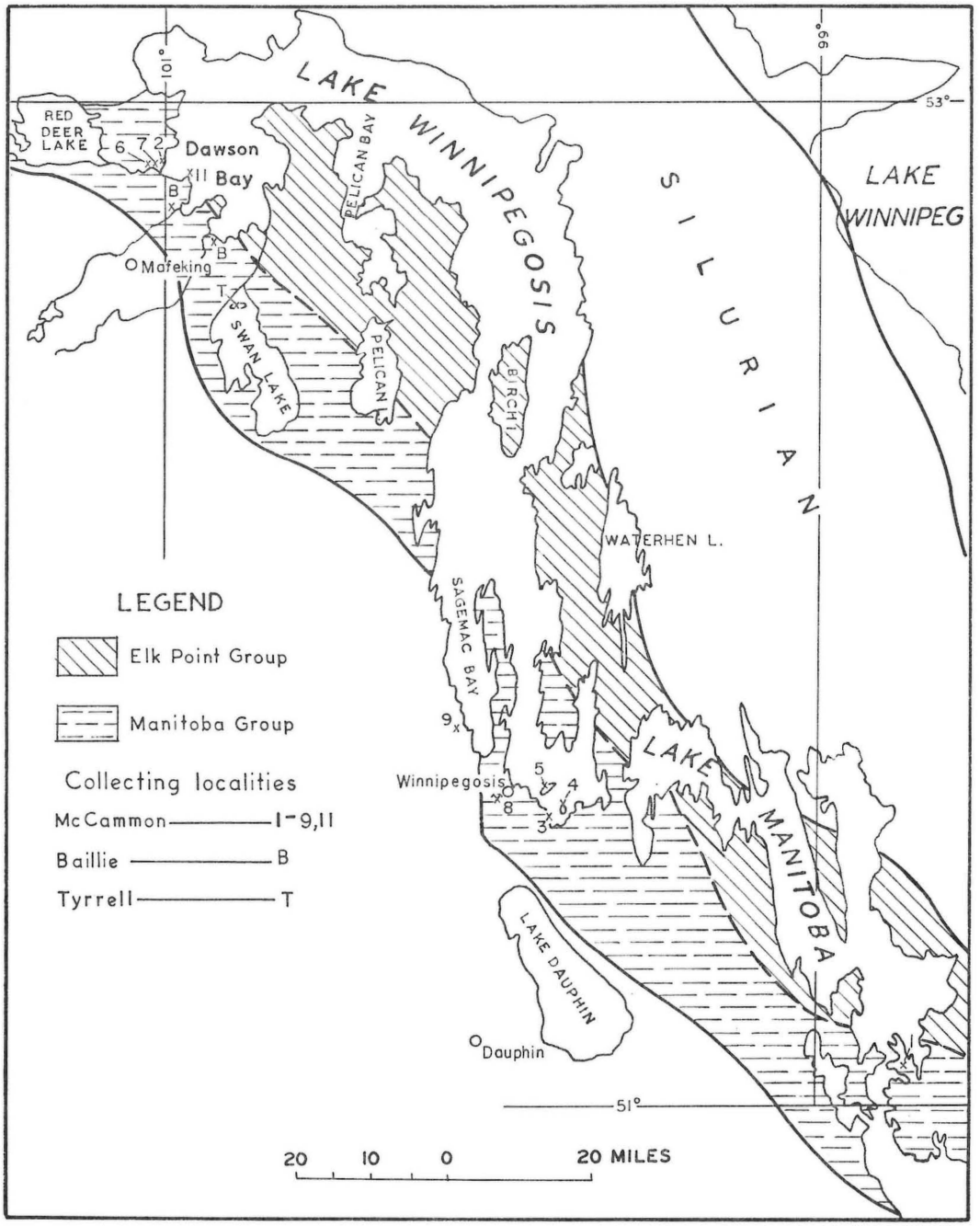
LAKE
WINNIPEGOSIS
SILURIAN
LAKE
WINNIPEG
RED
DEER
LAKE
6 7 2
Dawson
Bay
PELICAN BAY
Mafeking
SWAN LAKE
PELICAN
BIRCH
WATERHEN L.
SAGEMAC BAY
Winnipegosis
LAKE
MANITOBA
LAKE DAUPHIN
Dauphin
101°
99°
53°
51°
LEGEND
Elk Point Group
Manitoba Group
Collecting localities
McCammon — 1-9,11
Baillie — B
Tyrrell — T
20 10 0 20 MILES

Figure 1

Baillie (1950) discussed the Devonian stratigraphy of Manitoba and included faunal lists. He designated the Ashern formation for the red argillaceous beds which Tyrrell tentatively had considered lower Devonian, and the *Athyris fultonensis* zone of Kindle was given the name Point Wilkins member. Baillie considered the lower part of the Manitoban formation or the *Cyrtina hamiltonensis* zone to be Middle Devonian in age and the Point Wilkins member and overlying strata to be Middle or Upper Devonian. The fauna in the latter member was correlated with that of the Waterways formation of the Athabaska River area.

Later, Baillie (1953) proposed a revised classification of the Devonian in Western Canada. He included the Ashern, Elm Point, and Winnipegosis formations of the outcrop area in the Elk Point group. The Manitoba group contained the Dawson Bay formation and the Upper Manitoba strata, composed of the Point Wilkins and other unnamed members.

Hammond and Sandberg (1958) proposed the name Souris River formation for the subsurface strata overlying the Dawson Bay formation, called the upper Manitoba group by Baillie. Hammond and Sandberg considered the Souris River to be Upper Devonian in age.

MATERIAL

Most of the material used in this study was collected by the writer. The collection made by Baillie in 1949 and housed in the Manitoba Mines Branch has been studied to provide a more complete description of the species. Collections of Spencer, Tyrrell, Kirk, and others, at the Geological Survey of Canada in Ottawa, were studied after the writer's investigation of her own collection was almost completed.

Most of the types described and illustrated are preserved at the Geological Survey of Canada; a few hypotypes are stored at the Manitoba Mines Branch.

LIST OF COLLECTING LOCALITIES

1. Sec. 24, twp. 24, rge. 10 WPM; two miles west of Nina Lake along road to The Narrows, Lake Manitoba. Eight-tenths of a mile of continuous outcrop commencing from the cross roads. This outcrop, three miles east of Manitoba Island, is similar to the upper fossiliferous unit on Manitoba Island which was described in detail by Tyrrell (1892, p. 191E) and Baillie (1950, p. 49).

2. Lsd. 6, sec. 21, twp. 45, rge. 25 WPM. One and three-fifth miles up the Red Deer River from the mouth, on the north bank, with brine spring just behind and Highway 10 running behind the brine spring. Described briefly by Tyrrell (1892, p. 187E, first paragraph).

3. Sec. 21, twp. 30, rge. 17 WPM. South end of Lake Winnipegosis two miles south of Snake Island, and two miles west of Charlie Island. Outcrop located along beach of picnic area.

4. Charlie Island, Lake Winnipegosis, on the north side of island. Described by Tyrrell (1892, p. 162E) and Baillie (1950, p. 47).

5. Snake Island, Lake Winnipegosis along the western and northern shore. Described by Tyrrell (1892, p. 162E), Kindle (1914, p. 255) and Baillie (1950, p. 46).

6. Lsd. 7, sec. 17, twp. 45, rge. 25 WPM. North bank Red Deer River, 100 yards west of Highway 10 bridge between The Pas and Mafeking. Measured section in Tyrrell (1892, p. 187E) and Baillie (1951, p. 40, 1953, p. 74).

7. Lsd. 10, sec. 17, twp. 45, rge. 25 WPM. North shore Red Deer River, at bend in river, first outcrop below bridge of Highway 10.

8. NW¼ of lsd. 9, twp. 31, rge. 18 WPM. Abandoned quarry one and one-half miles west of the town of Winnipegosis, 50 feet south of Camperville road. Degenerating into garbage dump.

9. Along eastern boundary sec. 21, twp. 32, rge, 19 WPM. Outcrop along Camperville road and in dry creek bed, three miles south of turnoff to town of Pine River.

10. Point Wilkins on Dawson Bay, Lake Winnipegosis. Section measured by Baillie (1950, p. 41) and described by Tyrrell (1892, p. 183E).

LOCALITIES NOT VISITED BY THE WRITER

1. One mile east of Bell River outlet, at the eastern extremity of the main outcrop belt (Baillie collection).

2. Near Steeprock River, on dirt road from Wyatt's camp to Highway 10, lsd. 7, sec. 14, twp. 44, rge. 25 WPM. (Baillie collection).

3. Rose Island, Swan Lake, Manitoba (Tyrrell collection).

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Sincerest gratitude is accorded Dr. D. J. McLaren and Dr. A. W. Norris of the Geological Survey of Canada for their generous advice and stimulating discussion of the problem and also the many facilities made available by Dr. McLaren at the Geological Survey.

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CHAPTER II

DESCRIPTION OF MANITOBA GROUP

DEFINITION

The Manitoba group consists of a cyclical series of calcareous and argillaceous sedimentary rocks overlying the Winnipegosis formation (Table 1). The thickness of the group, determined from well sections in the Mafeking area, is estimated to be 190 feet (Baillie, 1950, p. 9). The regional dip of the beds is 12 feet per mile to the southwest but, locally, greater dips due to faulting and draping of beds over domed Winnipegosis reefs may be observed.

The Dawson Bay formation, 100 to 200 feet thick (Baillie, 1953, p. 26), is the lower part of the Manitoba group and represents a complete marine sedimentary cycle beginning with a shale and grading into a limestone which hosts the faunal climax of the formation; subsequently the sedimentary layers became more argillaceous and finally a reef sequence was developed (Table 2).

The upper portion of the Manitoba group has recently been named the Souris River formation by Sandberg and Hammond (1958, p. 2310). The Souris River formation is about 100 feet thick and has a sedimentary sequence similar to the underlying Dawson Bay. Neither the cyclical series nor the outcrop record, however, is as complete as in the Dawson Bay.

The stratigraphy of the Manitoba group has been discussed in detail by Baillie (1950, 1953) and Sandberg and Hammond (1950).

GEOGRAPHICAL DISTRIBUTION

The Manitoba group is one of a series of outcrop bands marking the northeastern rim of the Williston Basin (Figure 1). In Manitoba the group crops out from Red Deer Lake near the Saskatchewan boundary to the western and southern end of Dawson Bay, along the western edge of Lake Winnipegosis and Lake Manitoba to The Narrows of Lake Manitoba (Figure 1). The exposures are particularly good along the Red Deer River, on the shores of Dawson Bay, and on the islands in Lake Winnipegosis.

In subsurface, the Manitoba group is widespread, extending from the outcrop area to the western boundary of Saskatchewan and south into North Dakota and Montana. The strata become thicker and more completely developed toward the center of the Williston basin.

FAUNAL SUBDIVISION OF MANITOBA GROUP

A zone may be defined as a belt of strata each of which is characterized by an assemblage of organic remains of which one abundant and characteristic form is chosen as index. The proposed faunal zonation of the Manitoba group is given in Table 2; the lower four zones correspond to units of the Dawson Bay as subdivided by Baillie (1953, p. 74). A complete list of fauna occurring in the various zones is given in Table 3.

TABLE 1

DEVONIAN FORMATIONS IN MANITOBA

Series	Group	Formation	Diagnostic Fossils
Upper Devonian	Manitoba	Souris River formation — Point Wilkins member	*Allanaria allani* (Warren) *Athyris vittata* Hall
Middle Devonian	Manitoba	Dawson Bay formation	*Atrypa bremerensis* Stainbrook *Spinatrypa mascula* (Stainbrook) *Proetus manitobensis* n. sp.
Middle Devonian	Elk Point	Prairie evaporite	
Middle Devonian	Elk Point	Winnipegosis formation	*Stringocephalus* sp.
Middle Devonian	Elk Point	Elm Point formation	*Atrypa arctica* Warren
Middle Devonian	Elk Point	Ashern formation	*unfossiliferous*

TABLE 2

ZONES AND UNITS IN MANITOBA GROUP

Baillie's Units of Dawson Bay (1953, p. 74)		LITHOLOGY	ZONES	
	Unit			
Souris River Formation		Dolostone and limestone saccharoidal to finely crystalline.	8	Stromatoporoid zone
		Point Wilkins member; Limestone, light grey, dense, highly fossiliferous.	7	*Athyris vittata* zone
		Limestone, argillaceous, light grey to yellow and red.	6	Lucinid zone
		Limestone, argillaceous, Yellowish brown.	5	*Stropheodonta* zone
Dawson Bay Formation	7	Limestone, finely crystalline, fragmental.		
	6	Limestone, slightly argillaceous, yellowish grey.		
	5	Argillaceous Limestone, calcereous shale, yellowish to bluish grey.		*Atrypa snakensis* zone
	4	Limestone, microgranular, yellowish grey, thick bedded.	3	*Atrypa bremerensis* zone
	3	Limestone, argillaceous, dense, yellowish-grey, thin bedded.	2	*Schizophoria iowensis* zone
	2	Shale, red to medium grey.	1	*Spinatrypa* zone
	1	Winnipegosis formation.		

Spinatrypa Zone

The lowest zone of the Manitoba group is based on the fossil collection at Locality 1. The exposure consists of thin-bedded, yellowish to pinkish grey argillaceous limestone with reddish and purplish mottles and layers. The thin red and purple layers are about ¼ inch thick and are composed of abundant fossiliferous fragments. The collector is impressed by the excellent preservation of spines on specimens of *Spinatyrpa* Stainbrook embedded in the limestone; such preservation indicates that the shells were not transported a great distance.

All faunal groups in the zone appear dwarfed except for *Atrypa independensis* Stainbrook, species of *Spinatrypa* Stainbrook and *Productella concentrica* (Hall). In the red-coloured layers, the fossils are almost all of small size, rarely with a normal adult size of *Spinatrypa*.

Numerous pelecypods occur in the grey limestone but none have been noticed in the reddish fragmental bands. All the pelecypod species are small, none reaching the size of the same species from localities higher in the stratigraphic section. Several fragments of *Phthonia* and related forms have been found in this locality, but only in two specimens is preservation sufficiently complete to permit positive generic identification. A few small trilobites and abundant fish fragments also occur in Zone 1.

The dwarfed aspect of much of the fauna indicates that environmental conditions were not favourable to most of the inhabitants of this area. The normal size of *Atrypa*, *Spinatrypa*, and *Productella* suggests that the frills and spines kept these animals out of the mud and thereby enabled them to obtain the oxygen and food necessary for normal development. Well-preserved spines on *Spinatrypa* indicate that either the currents were not strong or animals were not transported far after death. The thin red layers containing abundant small fossiliferous fragments suggest that currents could have swept in these fragments.

Schizophoria iowensis Zone

Locality 2 yielding fauna of the *Schizophoria iowensis* zone is about 4 feet thick, consisting of dense, slightly argillaceous, yellowish grey limestone with bedding planes one to two inches apart. This zone is comparable to Unit 3 of Baillie's section on the Red Deer River about 2 miles up the river from Locality 2.

The abundance and variety of the corals in this zone may be due to the excellent weathering of the strata. In other localities, especially Zone 3, corals may be as abundant but not as easily noticed. Solitary forms in Zone 2 are diverse without any one form predominating. Dendritic forms are common, with *Coenites hadrus* n. sp. forming a significant part of the total faunal assemblage.

Atrypa bremerensis Stainbrook and *Schizophoria iowensis* (Hall) are particularly abundant in this horizon. Many of the other brachiopods are too badly weathered for identification.

Some pelecypods have been observed at this locality, but they are well worn and often are mistaken for pebbles. Tyrrell (1892, p. 187E) reports finding *Paracyclas elliptica* Hall at this locality although it was not found by the writer.

The matrix of the limestone is composed in part of crinoid stems and indistinguishable organic fragments. Locally, there are pockets of abundant flat-lying shell fragments with few complete specimens among them.

Locality 2 is correlated with a unit similar in lithology, thickness, and stratigraphic sequence found two miles further up the river, but not regarded as particularly fossiliferous. Such a correlation may be explained in three ways: (1) the fauna was originally distributed more or less equally throughout the area and the assemblage found at Locality 2 is thanatocoenitic; (2) because the weathering has

not been as favourable in other areas, the varied fauna has not as yet become apparent; (3) the animals lived in Locality 2 with part of the assemblage being biocoenitic.

Atrypa bremerensis Zone

Collections from Localities 3, 4, 5, part of 6 and 7 are equivalent to Unit 4 of Baillie's Dawson Bay section. These localities constitute the most extensive zone of the Dawson Bay outcrop and are composed of medium to dark yellowish grey to yellowish brown limestone. Although the zone can be broken down into several stratigraphic units (Baillie, 1950, pp. 46, 47), more detailed study is necessary to determine the faunal zonation in these units. The entire zone has similar lithology and differs only in colour and thickness of bedding. The middle thick-bedded portion of limestone on Snake Island (Locality 5) contains many pelecypods and gastropods along with species of *Atrypa*. This thick-bedded sequence is also exposed on Charlie Island where an almost identical fauna is found. An outcrop on the mainland west of Charlie Island (Locality 3) is similar lithologically and faunally to outcrops on the two islands, but the rock is darker and the fossils are not as abundant.

Collections from Snake Island are from the middle and upper parts of the exposure. The middle portion contains many well-preserved fossils; the upper thinner bedded zone contains more fragmentary material along with well-preserved fossils. Gastropods and brachiopods from Baillie's Unit 5 on the Red Deer River (Locality 6) are very similar to those found on Snake Island; the lithology and position in stratigraphic sequence are also similar. Although the distance between the outcrops is 100 miles, it is suggested that these localities belong to the same zone.

Atrypa bremerensis Stainbrook is the dominant form in this zone; other species of *Atrypa* and *Spinatrypa* are common but not as abundant. Corals are common but not found in great quantity. *Coenites hadrus* n. sp., present at all localities of Zone 3, is not as plentiful as in Zone 2. All species of gastropods and cephalopods found in the Dawson Bay are represented in this zone. Fish remains are common.

The variety of species in this zone suggests that food was plentiful and competition high. Abundance of *Atrypa bremerensis* suggests this species had found a successful ecologic niche for itself.

Atrypa snakensis Zone

Zone 4 is represented by the upper limestone beds at Locality 6, and corresponds to Unit 6 of Baillie's subdivision of the Dawson Bay. The light yellowish brown limestone has a powdery appearance when weathered.

The large alate *Atrypa independensis* Webster and *Atrypa snakensis* n. sp. dominate this zone. Pelecypods of the *Paracyclas* group make up a significant portion of the fauna, and except for the pelecypods, no other molluscan fauna is represented. Of the corals, only a few *Coenites* occur within this zone. The sea bottom probably was becoming muddy so that forms like the winged *Atrypa* could live above the muddy layer, and the burrowing pelecypods could live in the muddy substratum.

The reefoid and stromatoporoid zone that developed at the top of the Dawson Bay in the subsurface (Baillie, 1953, p. 26) was not definitely identified in outcrop. Locality 8, which was at first thought to belong to this outcrop, was later found to be part of the Souris River formation.

SOURIS RIVER FORMATION

Stropheodonta Zone

The yellowish brown argillaceous limestone of Locality 9 dips to the southwest exposing a 6-foot vertical section. The lower strata in the creek bed are highly

fossiliferous and contain specimens of gastropods, *Stropheodonta* species and *Allanaria allani* (Warren). Many of the specimens are worn indicating that they were transported some distance before deposition; some specimens such as species of *Atrypa* of the *A. independensis* type are too badly worn to permit identification. Among these abraded forms are specimens with excellently preserved ornamentation such as *Naticonema* sp. and *Allanaria allani*. These forms probably died at or close to this locality with only slight abrasion prior to internment.

The great abundance of *Spinatrypa mascula* (Stainbrook) in the Dawson Bay contrasts with the few specimens of this species found at Locality 9. Above this zone *S. mascula* is absent. Abundant specimens of *Allanaria allani* date this zone as lower Souris River, Locality 9 being a little lower than Locality 11, where *Spinatrypa* is absent.

Lucinid Zone

At Locality 11 there are about 25 feet of highly argillaceous limestone which is light grey to yellowish brown with some red streaks scattered through the rock. Some thin limestone lenses containing many crinoid stems and brachiopods are dispersed throughout the section. Thin bands of shale, 1 to 2 inches thick, contain many well-preserved specimens of *Atrypa independensis* Webster. The only other abundant faunal elements in this zone are species from the pelecypod family Lucinidae. The ubiquitous *Atrypa* and the mud-tolerating lucinids appear to have been the only forms able to exist in this environment.

POINT WILKINS MEMBER

Athyris vittata Zone

The upper unit of Locality 11 consists of 48 feet of light yellowish grey, highly fossiliferous limestone with interbands of massive, non-fossiliferous limestone. The limestone breaks with an irregular fracture and often splits across rather than around the fossil. In places, brown pellets of iron sulphide stain the rock a deep yellow brown, and many of the fossils have iron sulphide disseminated in the shell material.

Atrypa independendensis Webster is the dominant form in this zone, followed in abundance by *Athyris vittata* Hall. Gastropods, although present, cannot be extracted from the rock in satisfactory condition for identification. *Atrypa bremerensis* Stainbrook and *Spinatrypa* species are conspicuously absent.

Zone 7 is superficially similar to Zone 3 but the fauna is somewhat different. Both zones are abundantly fossiliferous with a species of *Atrypa* dominant. In Zone 3 *A. bremerensis* is dominant; in Zone 7 *A. independensis* is the dominant form. *Atrypa independensis* is one of the hardiest Atrypas in the Manitoba group, ranging from Zone 1 to Zone 7, with an explosion of population in Zone 7 when environmental conditions were optimum for its development.

Stromatoporoid Zone

A vertical section 7 feet, 2 inches thick, is exposed at Locality 8. The dense, dolomitic limestone is light grey with some yellowish brown mottles and small patches and veins of calcite. Lithologically, the lower 4 feet of the section are similar to the upper 3 feet, yet the lower unit has few fossils except for some large bun-shaped stromatoporoids about 1 foot in diameter. The upper unit contains many specimens of *Atrypa independensis* Webster and *Allanaria allani* (Warren) along with the stromatoporoid *Gerronostroma* cf. *gromotuchense* Yavorsky.

The abundant stromatoporoids suggest a reef environment in clear though not necessarily shallow water. Specimens of *A. independensis* do not have the wings preserved. Whether the animals did not develop the wings or whether the alations were broken off after the animal died is not known. It would seem that unless the

TABLE 3

FAUNA OF THE MANITOBA GROUP

SPECIES	Dawson Bay formation								Souris River formation			
Zone	1	2			3			4	5	6	7	8
Locality	1	2	3	4	5	6 (lower)	7	6	9	11 (lower)	11	8
Anostylostroma bailliei n. sp.	..	..	..	..	x	..	..	..	..	..	..	..
Stromatoporella sp.	..	..	..	..	x	..	..	..	..	..	..	..
Gerronostroma cf. *gromotuchense* Yavorsky	..	..	..	..	..	..	..	..	..	..	..	x
Ferestromatopora convergens n. sp.	..	..	..	..	x	..	..	..	..	..	..	..
Idiostroma sp.	..	x	..	..	..	..	..	..	..	..	..	..
Amplexiphyllum salinensis n. sp.	..	x	..	..	..	..	..	..	..	..	..	..
Buschophyllum minutum n. sp.	..	x	..	..	..	..	..	..	..	..	..	..
Bethanyphyllum praecursor (Frech)	..	x	..	..	x	..	..	..	..	..	..	..
Bethanyphyllum cf. *praecursor* (Frech)	..	x	..	..	..	..	..	..	..	..	..	..
Ceratophyllum ? sp.	..	x	..	..	..	..	..	..	..	..	..	..
Breviphyllum waskasense (Whiteaves)	..	x	..	..	x	..	..	..	..	..	..	..
Breviphyllum cf. *richardsoni* (Meek)	..	x	..	..	..	..	..	..	..	..	..	..
Kunthia ? *petraioides* (Whiteaves)	..	x	..	..	x	x	..	..	..	..	..	..
Tabulophyllum gallina n. sp.	..	..	..	..	x	..	..	..	..	..	..	..
Hexagonaria arctica (Meek)	..	..	..	..	x	..	..	..	..	..	..	..
Favosites cf. *hamiltoniae* (Hall)*	..	..	..	..	..	..	..	..	..	..	..	..
Favosites pachymuralis n. sp.	..	..	..	..	x	..	..	..	..	..	..	..
Thamnopora dumosa var. *tabulata* n. var.	..	x	..	..	..	..	..	..	..	..	..	..
Thamnopora cervicornis (De Blainville)	..	x	..	..	..	..	..	..	..	..	..	..
Thamnopora polyforata (Schlotheim)	..	x	..	..	x	..	..	..	..	..	..	..
Trachypora sp.	..	x	..	..	..	..	..	..	..	..	..	..
Alveolites multiperforatus Salée	..	x	..	..	..	x	..	..	..	..	..	..
Coenites hadrus n. sp.	..	x	x	x	x	x	x	x	..	..	..	..
Aulocystis flabellata (Greene)	..	x	..	..	..	..	..	..	..	..	..	..

* Bell River

TABLE 3 (Continued)

FAUNA OF THE MANITOBA GROUP

SPECIES	Dawson Bay formation								Souris River formation			
Zone	1	2			3			4	5	6	7	8
Locality	1	2	3	4	5	6 (lower)	7	6	9	11 (lower)	11	8
Aulopora conferta Goldfuss	..	x	..	..	..	..	..	..	..	..	..	..
Aulopora sp.	..	..	..	..	x	..	x	..	..	..	..	..
Plexituba contexta Stainbrook	..	x	..	..	..	..	..	..	..	..	..	..
Reptaria stolonifera Rolle	..	..	..	..	..	..	..	x	..	..	..	..
Cyphotrypa whiteavesi n. sp.	..	..	..	..	x	..	..	..	..	..	..	..
Stropheodonta cf. *littletonensis* Stainbrook	..	..	..	..	..	..	..	..	x	..	..	..
Stropheodonta sp.	..	..	..	..	..	..	..	..	x	..	..	..
Chonetes aurora Hall	..	..	..	x	x	..	..	..	..	..	..	..
Productella concentrica (Hall)	x	..	..	x	x	x	x	x	..	..	..	..
Schizophoria iowensis (Hall)	..	x	..	..	x	..	..	..	..	..	..	..
Atrypa bremerensis Stainbrook	..	x	x	x	x	x	..	x	..	..	..	..
Atrypa manitobensis n. sp.*	..	x	x	x	x	..	..	..	..	..	..	..
Atrypa independensis Webster	x	x	x	x	x	..	..	x	?	x	x	x
Atrypa snakensis n. sp.	..	..	..	x	x	..	..	x	..	..	..	..
Atrypa sp.	..	..	..	..	..	..	..	..	..	x	..	..
Spinatrypa mascula (Stainbrook)	x	x	x	x	x	x	..	x	x	..	..	..
Spinatrypa mascula var. *manitobensis* n. var.	x	x	x	x	x	x	..	x	..	..	..	..
Emanuella richardsoni (Meek)	x	x	x	x	x	x	x	x	x	x	?	..
Allanaria allani (Warren)	..	..	..	..	..	..	..	..	x	..	x	x
Cyrtina hamiltonensis Hall	..	x	..	..	x	..	..	..	..	..	..	..
Cyrtina paucicostata n. sp.	x	..	..	..	x	x	x	..	..	..	..	..
Nucleospira sp.	..	..	..	..	..	..	..	..	x	..	..	..
Athyris vittata Hall**	..	..	..	..	..	..	x	..	..	..	x	..
Cranaena cf. *iowensis* (Calvin)***	..	..	..	..	..	..	..	..	..	..	x	..

* Bell River ** Rose Bush Island *** Near Steep Rock River

TABLE 3 (Continued)

FAUNA OF THE MANITOBA GROUP

SPECIES	Dawson Bay formation								Souris River formation			
Zone	1	2			3			4	5	6	7	8
Locality	1	2	3	4	5	6 (lower)	7	6	9	11 (lower)	11	8
Phthonia sp.	x	..	..	..	..	..	..	..	..	..	..	..
Nuculana cf. *rostellata* (Conrad)	..	x	..	..	..	..	..	..	..	..	..	..
Cypricardinia sp.	x	..	..	..	x	..	..	..	..	..	..	..
Paracyclas elliptica Hall*	x	..	..	..	..	..	..	x	..	..	..	..
Paracyclas proavia (Goldfuss)												
Form A	..	..	..	..	x	..	..	x	..	x	..	..
Form B	..	..	..	..	..	..	..	x	..	x	..	..
Form C	..	..	..	..	..	..	..	x	..	..	..	..
Phenacocyclas antiqua (Goldfuss)	..	..	x	..	x	..	..	x	..	x	..	..
Aviculopecten cf. *tenuis* Hall	x	..	..	..	..	..	..	..	..	..	..	..
Ptychospirina sp.	..	..	..	..	..	..	..	x	..	..	..	..
Naticonema sp.	..	..	..	..	..	..	..	..	x	..	..	..
Straparolus (*Straparolus*) *subtrigonalis* (Whiteaves)	..	..	..	..	x	x	..	..	x	..	..	..
Omphalocirrus ? *manitobensis* (Whiteaves)	x	..	..	x	..	x	..	..	..	..	..	..
Mastigospira alata La Rocque	..	..	x	x	x	x	..	..	..	..	..	..
Bellerophon pelops var.	x	..	..	..	x	..	..	x	..	..	..	..
Bucanopsis sp.	..	..	..	..	x	..	..	..	..	..	..	..
Buchelia tyrrelli (Whiteaves)*	..	x	..	x	x	x	..	..	..	..	..	..
Loxonema altivolvis Whiteaves	..	x	..	x	x	x	..	..	x	..	..	..
Crytogomphus tyrrelli Flower	..	..	..	..	..	..	..	..	..	..	x	..
"*Gomphoceras*" *manitobensis* Whiteaves	..	..	..	..	x	..	..	..	..	..	..	..
Tentaculites parvulus Whiteaves	..	..	..	..	..	..	..	..	x	..	..	..
Proetus manitobensis n. sp.	x	x	x	x	x	x	x	x	..	..	..	..

* Bell River

water was very quiet, the alations would be damaged against the reef. The writer believes alation in *Atrypa* developed through the stress of the environment and although some species were capable of growing wings, they did so only when the environment demanded. Therefore it is surmized that, in this zone, the alations would have been more of a deterent than an asset.

FAUNAL RELATIONSHIP TO UNDERLYING FORMATIONS

It has long been held, for correlation purposes, that the Dawson Bay formation is a stratigraphic unit of the *Stringocephalus* zone along with the underlying Winnipegosis formation which contains *Stringocephalus* and the Elm Point which does not contain *Stringocephalus*. Several authors have felt that a similar fauna is found in the Elm Point and Dawson Bay formations and, since some of the species common to both formations are also found in the Winnipegosis, the three formations should be grouped together.

WINNIPEGOSIS FORMATION

Four species from the Dawson Bay, *Emanuella richardsoni* (Meek), *Paracyclas proavia* (Goldfuss), *Loxonema altivolvis* Whiteaves, and *Buchelia tyrrelli* (Whiteaves), occur in the Winnipegosis strata. All are long ranging forms and do not necessarily show temporal relationship. Five species in the Dawson Bay suggest ancestry in the Winnipegosis. These are *Atrypa* cf. *independensis* which is extremely rare in the Winnipegosis; *Spinatrypa* cf. *mascula* Stainbrook, although more common than preceding, is also considered rare; *Productella* cf. *spinulicosta* Hall, as uncommon as the former species; and *Bellerophon pelops* Hall. *Coenites limitaris* (Rominger) from the Winnipegosis needs more thorough study to ascertain any relationship with *Coenites* in the Dawson Bay.

ELM POINT FORMATION

The species common to both the Elm Point and the Dawson Bay have been listed in various publications as *Atrypa arctica* Warren, *Spinatrypa mascula* (Stainbrook), *Productella spinulicosta* Hall, *Schizophoria striatula* (Schlotheim), *Buchelia tyrrelli* (Whiteaves), *Euomphalus* cf. *subtrigonalis* Whiteaves, and *Proetus mundulus* Whiteaves.

Although the writer has looked carefully in her collections of the Manitoba fauna, she was unable to find a specimen resembling *Atrypa arctica*, originally described by Warren (1944, p. 121) as having "numerous fine sharply rounded or angular striae which . . . toward the rear of the shell are so fine that they cannot be seen near the umbo on slightly exfoliated specimens. At the front of the shell, three or four striae occupy the space of 2 mm. Lines of growth or imbricating lamellae not present." Baillie's collection, made in 1949, has two small specimens from Steeprock River labeled *Atrypa arctica*. Both are biconvex which is characteristic of young forms of *Atrypa* in the Manitoba group. Since no adults of *A. arctica* were found, the writer cannot justify identification of these specimens as young forms of *A. arctica*. Of the four localities listed by Baillie (1951, p. 57) as having *A. arctica*, two were visited by the writer without finding this species; the specimens from Steeprock River have already been considered. The species was not found among the several collections Whiteaves studied. In examination of collections made by the writer of the Elm Point limestone, *A. arctica* as described by Warren has been found in abundance.

Specimens of *Spinatrypa* in the Elm Point are much smaller than the average specimens of this genus in the Dawson Bay formation. Elm Point forms are biconvex thus resembling *S. mascula* var. *manitobensis* n. var. but the hinge line is as great as the width, there are an average of three costae in 5 mm. at the front margin, and growth lines are more pronounced, becoming almost lamellate toward the margins.

Productella "spinulicosta" from the Elm Point differs from *Productella concentrica* Hall of the Dawson Bay in *P. "spinulicosta's"* larger size, much greater width in relation to length, the umbonal region of the pedicle valve not as greatly swollen, and the development of a slight anterior sulcus on the pedicle valve of some specimens.

Schizophoria striatula is a long ranging species and the form can easily be represented in both formations. (See remarks under *Schizophoria iowensis* in Chapter III.)

Buchelia tyrrelli is reported in the Elm Point, Winnipegosis, and Dawson Bay. However, it is also found in the Point Wilkins limestone of the Souris River formation which is considered to be Upper Devonian. Specimens of *B. tyrrelli, Euomphalus* cf. *subtrigonalis* and *Proetus mundulus* from the Elm Point were not examined by the writer.

The writer acknowledges that the lithologies and the general faunal aspect of the Elm Point and the Dawson Bay are similar and because of these recognizes the justification of connecting the two formations. However, it is believed that any similarity of the faunas is due to similarity of environment rather than close temporal relationship.

CORRELATION OF THE MANITOBA GROUP

The Manitoba group is middle and late Devonian in age. The Dawson Bay formation is late middle Devonian and the Souris River is early late Devonian. Sandberg and Hammond prefer to separate the Dawson Bay from the Souris River in the United States portion of the Williston basin by abandoning the term Manitoba group because ". . . the Souris River has a greater lithogenetic affinity to the overlying Upper Devonian rocks." (Sandberg and Hammond, 1958, p. 2307.)

Table 4 illustrates the correlation of the Manitoba group with other formations in North America.

DAWSON BAY FORMATION

Much of the fauna in the Dawson Bay formation is comparable to the fauna in the Cedar Valley formation of Iowa. *Tabulophyllum gallina* n. sp. in the Dawson Bay is almost identical to an unnamed coral from the Cedar Valley beds. Other tetracorals from the Dawson Bay show a close affinity to those in the Cedar Valley (Stumm, 1958, oral communication). *Astraeospongia hamiltonensis* (Meek and Worthen) was found in abundance at Snake Island by Kindle (1914, p. 255) and is also common in the Cedar Valley. Unfortunately the stromatoporoids of the Cedar Valley have not been studied so correlation of this group is not possible.

Atrypid brachiopods show the closest affinity to the Cedar Valley. Forms common to the two formations are *Atrypa bremerensis* Stainbrook, *Atrypa independensis* Webster, *Spinatrypa mascula* (Stainbrook), *Stropheodonta littletonensis* Stainbrook, and the long ranging *Athyris vittata* Hall, *Schizophoria iowensis* (Hall) and *Cyrtina hamiltonensis* Hall. *Spinatrypa bellula* (Stainbrook) of the Cedar Valley is very similar to *Spinatrypa mascula* var. *manitobensis* n. var.

The Cedar Valley formation in Minnesota has forms common to both Iowa and Manitoba, but the long ranging gastropods *Buchelia tyrrelli* and *Mastigospira alata* (Whiteaves) are not found in Iowa (Stauffer, 1922, p. 398).

In Wisconsin some species from the Milwaukee dolomite appear similar to those in the Dawson Bay. These forms are *Aulocystis flabellata* (Greene), *Reptaria stolonifera* Rolle, *Athyris vittata* Hall, *Cyrtina hamiltonensis* Hall, *Paracyclas elliptica* (Hall), *Productella concentrica* (Hall) and probably *Mastigospira alata* (Whiteaves). However, almost all these forms are long ranging and cannot be used as guides for correlation.

TABLE 4

CORRELATION TABLE OF FORMATIONS EQUIVALENT TO THE MANITOBA GROUP

	Alberta	Manitoba		Iowa	Wisconsin	James Bay Lowland
Upper Devonian	Waterways Formation	Manitoba Group	Souris River Formation			? Williams Island Formation
Middle Devonian			Dawson Bay Formation	Cedar Valley Formation	? Milwaukee Dolomite	?
		Elk Point Group			?	

The pelecypods and gastropods of the Dawson Bay formation are common forms showing little variation throughout the Devonian section in Manitoba. When a more detailed study on cephalopods is completed, these forms may have a great value in correlation.

Savage and Van Tuyl (1919, p. 375) correlated the Williams Island formation of the James Bay lowland with the Cedar Valley formation of Iowa and the Manitoba group. The fossils present in both formations are common forms such as *Schizophoria iowensis* (Hall), *Cyrtina hamiltonensis* Hall, *Athyris vittata* Hall, and *Favosites hamiltoniae* Hall. Rhynconellids are found in the Williams Island but none are found in Manitoba. Savage and Van Tuyl postulated that "After the Winnipegosan dolomite which contains *Stringocephalus burtoni* fauna had been deposited . . . , there probably occurred a great expansion of the sea in the Interior Continental province. During Manitoban time the Arctic Sea advanced as far south as Iowa, northwest Illinois and northern Missouri and spread eastward as far as the James Bay and Abitibi River region". The writer has found no evidence to dispute this theory.

The fauna of the Dawson Bay, except for *Atrypa bremerensis* Stainbrook is not related closely to that of the Devonian outcrop of Alberta. This substantiates Baillie's hypothesis (1958, oral communication) that the Dawson Bay formation pinches out at the western margin of the Williston basin, and thus leaves no faunal record of its continguity with any of the Alberta formations.

SOURIS RIVER FORMATION

The Souris River formation has an early late Devonian age, if, as is commonly accepted, the genus *Allanaria* makes its first appearance at this time. Warren (1944, p. 125) notes that "this small species group is proving an excellent index for a zone in the lower beds of the Upper Devonian over a large area of Western North America." *Allanaria allani* (Warren) is the diagnostic species in the Waterways formation of Alberta and is common in the Souris River formation of Manitoba. Other species found in the Waterways and in the Souris River are *Atrypa independensis* Webster and *Athyris vittata* Hall.

Crickmay (1950, p. 221) believes that because forms like *Atrypa bremerensis* (Stainbrook), various species of *Stropheodonta*, *Athyris angelica* Hall, and *Cyrtina billingsi* Meek, found in the Waterways, have counterparts in the Cedar Valley formation, the Waterways should be correlated with the Cedar Valley. The Cedar Valley, as previously mentioned, is correlative with the Dawson Bay formation. Therefore, both these latter formations would be equivalent to the Waterways. A correlation between the Dawson Bay and Waterways is strengthened by the occurrence of *Atrypa independensis* Webster, *Atrypa bremerensis*, and *Schizophoria* sp. in both formations. Crickmay further proposed that the Waterways is not upper but middle Devonian. The Souris River should then be considered middle Devonian from faunal similarity to the Waterways. This middle Devonian age determination of the Souris River disagrees with Sandberg and Hammond (1958, p. 2307) who consider the Souris River to be lithogenetically related to the Upper Devonian.

The Souris River may be a formation transitional between Middle and Upper Devonian. Sandberg and Hammond suggest, however, that this transition is probably present in the deepest part of the Williston basin where the thickest sequence of sediments was deposited.

CHAPTER III

SYSTEMATIC PALEONTOLOGY

Phylum COELENTERATA

Class HYDROZOA Owen

Order STROMATOPOROIDEA Nicholson and Murie

Most specimens of stromatoporoids found in the Manitoba group need further study for specific identification. The surface features of some specimens could not be determined because of the intergrowing and encrusting mode of growth. With the generous help of Dr. J. J. Galloway, the writer has been able to identify some of the stromatoporoid specimens.

The structural terms and classification of stromatoporoids published by Galloway in 1957 (pp. 350, 413) have been adopted in this study.

Family *CLATHRODICTYIDAE* Kuhn

Genus *Anostylostroma* Parks

Anostylostroma Parks, 1936, Univ. Toronto Studies, Geol. Ser., no. 39, pt. 1, p. 44.

Type species, *Anostylostroma hamiltonense* Parks, 1936, p. 46, pl. 8, figs. 1-4; pl. 13, figs. 5-6.

Anostylostroma bailliei n. sp.

(Pl. 1, figs. 1a-b, 2, 3)

Coenosteum laminar. One specimen, 4 mm thick, intergrowing with algae and other stromatoporoids; another specimen 10 mm thick with latilaminae 1 to 2 mm wide.

Vertical section: Laminae slightly undulating, thin, ranging from 0.03 to 0.08 mm in thickness, averaging 0.04 mm, 7 to 10, rarely 12 in 2 mm, light colored, transversely fibrous, in places with fine transverse pores. Pillars darker than laminae, of variable thickness, 0.07 to 0.13 mm broad, 5 to 8 in 2 mm, rod-shaped or enlarging upward, some becoming Y-shaped, rarely superposed, coarsely fibrous transversely. Mamelons small, low, 1 mm wide, 0.3 to 0.6 mm high. Dissepiments sporadic. Galleries rectangular to oval, generally wider than high.

Tangential section: Pillars round to vermicular; round pillars 0.10 to 0.17 mm in diameter. Laminae light coloured, indistinctly fibrous. Astrorhizal tubes 0.30 to 0.45 mm in diameter.

Remarks: Anostylostroma bailliei is characterized by thin, closely spaced laminae and round to vermicular pillars.

A. bailliei is similar to *Anostylostroma compactum* Galloway and St. Jean (1957, p. 108) but *A. compactum* has stronger, more distantly spaced laminae, pillars are more evenly spaced, and are round, never vermicular. *A. bailliei* resembles *Anostylostroma whiteavesii* (Nicholson, 1891, p. 320) in vertical section but *A. bailliei* lacks the characteristic rosette-like mamelons of *A. whiteavesii*. Also the tangential section of *A. bailliei* does not show a reticulate pattern of pillars.

Occurrence: Dawson Bay formation, Locality 5.

Types: Holotype G.S.C. 14767a. Paratypes 14768a; 14769a.

Genus *Stromatoporella* Nicholson

Stromatoporella Nicholson, 1886, Paleontolographical Soc. v. 39, p. 92, pl. 1, figs. 4, 5, 15; pl. 4, fig. 6; pl. 7, figs. 5, 6.

Type species, *Stromatopora granulata* Nicholson 1873, p. 94, pl. 4, fig. 3.

Stromatoporella sp.

(Pl. 1, fig. 4)

Coenosteum encrusting around *Coenites hadrus* n. sp.; both forms incorporated larger encrusting mass composed of tabulates and tetracorals, algae, and other stromatoporoids.

Vertical section: Laminae slightly curved, 0.03 to 0.07 mm thick, 8 to 10 in 2 mm. Pillars of one interlaminar length, not superposed, 0.04 to 0.13 mm in diameter, 7 to 8 in 2 mm, transversely fibrous. Galleries oval to rectangular, higher vertically. In places long galleries without pillars.

Remarks: Because of the intergrown nature of the specimen, surface features could not be seen, and a tangential section could not be cut successfully. In vertical section, the Manitoba species is similar to *Stromatoporella huronensis* (Parks, 1936, p. 83), both species having laminae of similar thickness and abundance, and a similar distribution of pillars. However, *S. huronensis* has diagnostically large mamelons. Mamelons are not found in the Manitoba specimen.

Occurrence: Dawson Bay formation, Locality 5.

Type: Hypotype, G.S.C. 14867a.

Family *ACTINOSTROMATIDAE* Nicholson 1886

Genus *Gerronostroma* Yavorsky

Gerronostroma Yavorsky, 1931 Bull. United Geol. Prosp. Service, U.S.S.R., v. 50, fasc. 94, p. 1406.

Type species, *Gerronostroma elegans* Yavorsky, 1931, p. 1406, pl. 1, fig. 12; pl. 2, figs. 3-6.

Gerronostroma cf. *gromotuchense* Yavorsky

(Pl. 2, figs. 1a-b)

Gerronostroma gromotuchense Yavorsky, 1957, Tr. Vsesoyuz. Nauchnoissledov. Geol. Inst. Minst. Geol. Okhr. Nedr. nov. ser., v. 18, p. 12, pl. 4, fig. 7; pl. 5, figs. 1, 2.

Coenosteum massive, hemispherical, about 6 inches in diameter. Latilaminae from 1 to 3 mm thick.

Vertical section: Laminae continuous through pillars, ranging from 0.03 to 0.06 mm in thickness, 10 to 16 in 2 mm, transversely fibrous and flocculent; thin secondary layers of material on both sides of a lamina. Pillars spool-shaped, thick, composed of lighter material than laminae, superposed, 0.07 to 0.16 mm thick, 5 to 7 in 2 mm. Galleries oval, elongate horizontally, from 1 to 5 times their height. Dissepiments scattered, rare to common, broadly curved.

Tangential section: Laminae thin to medium in thickness. Pillars round to elongate, 0.08 to 0.13 mm in diameter. Galleries thin, anastomosing. Astrorhizae irregularly distributed; astrorhizal tubes 0.28 to 0.31 mm wide.

Remarks: The Manitoba *Gerronostroma* is similar to the form Yavorsky describes from Upper Devonian of Western Ukraine (1957, p. 12). Laminae in the Russian form are 0.03 to 0.10 mm thick; 12 to 15 in 2 mm. In both forms the laminae are

darker than the pillars, although the pillars in the Manitoba specimens appear to be somewhat lighter than the pillars in the Russian specimens. The astrorhizal canals of Yavorsky's specimens are smaller than those in the Manitoba form. However, size of astrorhizal canals is not of great specific importance, because the dividing canals do not have a constant diameter.

Occurrence: Souris River formation, Locality 8.

Types: Hypotype, G.S.C. 14776a-c.

Family *STROMATOPORIDAE* Winchell 1867

Genus *Ferestromatopora* Yavorsky 1955

Ferestromatopora Yavorsky, 1955, Tr. Vsesoyuz. Nauchno-issledov. Geol. Inst., Minist. Geol. Okhr. Nedr., n. s., v. 8, p. 109.

Type species, *Ferestromatopora krupennikovi* Yavorsky, 1955, p. 109, pl. 58, figs. 1-5.

Ferestromatopora convergens n. sp.

(Pl. 2, figs. 2a-b, 3a-b)

Coenosteum laminar, one fragment 10 mm thick, intergrown with algae, corals, and other stromatoporoids. Latilaminae indistinct on some specimens, 1 to 3 mm thick on others.

Vertical section: Laminae 0.09 to 0.15 mm thick, 13 to 16 in 2 mm, separated by dark-coloured microlaminae, 0.01 to 0.16 mm thick, which in places consist of a line of maculae. Tissue of laminae light-coloured transverse cones of non-maculate converging fibers which are generally confined to one interlaminar space. Variable flocculent maculae 0.015 to 0.06 mm in diameter scattered through the tissue. Pseudozooidal tubes absent. Pillars indistinct, confined to one interlaminar space. Galleries round. Astrorhizal canals large, 0.2 to 0.5 mm in diameter in superposed clusters in mamelon columns, but without axial tube. One or two concave dissepiments in each canal. Mamelon columns represented by upturned laminae, approximately 3 mm in diameter, and 10 mm apart.

Tangential section: About 80 to 90 percent of the area consisting of finely maculate skeletal tissue; maculae with somewhat flocculent appearance. Converging fibres of feathery tissue especially evident around galleries. Astrorhizal canals large, 0.5 mm in diameter, radiating from centers, usually with curved dissepiments.

Remarks: The maculae in *Ferestromatopora convergens* are mostly flocculent spots, but some have open centers as in typical maculae. Presence of maculae along with the finely fibrous texture of the tissue is unusual, and has been found in an undescribed species of *Ferestromatopora* from the Shell Rock formation of Iowa. However, the fibrous texture may be caused by recrystallization of calcite.

Although the upper surface of the specimens is not seen, the mamelons are probably about 1 mm high.

The most distinctive characters of the species are the thin, closely spaced laminae, and the cones of light colored fibrous tissue.

F. convergens has the same number of thin laminae as *Stromatopora stricta* Lecompte (1952, p. 277). However, *F. convergens* does not have any pseudozooidal tubes, and the astrorhizal tubes are not scattered but occur in superposed clusters in mamelon columns.

Occurrence: Dawson Bay formation, Locality 5.

Types: Holotype G.S.C. 14868a. Paratype G.S.C. 14770a-c.

Family *IDIOSTROMATIDAE* Nicholson

Genus *Idiostroma* Winchell

Idiostroma Winchell, 1867, Proc. Amer. Assoc. Adv. Sci., v. 15, p. 99.
Type species, *Stromatopora caespitosa* Winchell, 1866, p. 91.

Idiostroma sp.

(Pl. 3, fig. 5a-b)

Coenosteum ramose, up to 8 mm in diameter, branching at acute angles. Surface weathered smooth, no visible structure.

Vertical section: Laminae arched, thick, in places obscure, averaging 0.2 to 0.3 mm, 5 to 6 in 2 mm. Pillars spool-shaped, thick, 1 to 3 mm in diameter. Galleries round to elongate, about 0.2 to 0.3 mm in diameter. Pseudozooidal tubes long, up to 0.3 mm in diameter. Axial tube not continuous.

Tangential section: Laminae concentric around axial area. Pillars extending from lamina to lamina. Galleries oval.

Remarks: Sections sufficiently thin to see the structure of the tissue could not be obtained before the specimen would fracture.

Other ramose stromatoporoids, 3 to 4 mm in diameter, found in the same locality could not be identified because of recrystallization of the interiors.

Occurrence: Dawson Bay formation, Locality 2.

Types: Hypotype G.S.C. 14869, 14869a.

Class *ANTHOZOA* Ehrenberg

Order TETRACORALLA Haeckel

In this study, the writer uses the classification of tetracorals set up by Stumm (1949) rather than that established by Hill (1956) because the corals from Manitoba have a more convenient grouping with Stumm's classification.

Structural terms used in the description of tetracorals are those used by Hill (1956) and Shrock and Twenhofel (1953).

Family *METRIOPHYLLIDAE* Hill

Genus *Amplexiphyllum* Stumm

Amplexiphyllum Stumm, 1949, Geol. Soc. Amer., Mem. 40, p. 9, pl. 3, figs. 32-36.
Type species, *Amplexus hamiltoniae* Hall, 1876, pl. 19, figs. 20-23.

Amplexiphyllum salinensis n. sp.

(Pl. 3, fig. 1a-e)

Corallum simple, small, turbinate, 10 mm wide, 15 to 20 mm long. Calyx completely filled with limestone. Epitheca thin, with numerous transverse striations; septal ridges visible through epitheca. Where epitheca removed, septal ridges moderately well defined; horizontal tabulae seen occasionally in interseptal spaces.

Transverse section: Septa thick, dilating at periphery to form stereozone 0.5 mm or slightly more in width. Major septa 22 in number, rhopaloid at axial ends, extending one-half to two-thirds distance to center, locally 2 or 3 septa joined axially by deposit of stereoplasm. Minor septa poorly developed.

In neanic stage (pl. 3, fig. 1a) counter and alar septa developed, alar septa extending below center to join counter septum. Cardinal septum not developed, producing large fossula occupying over half the area of the section.

In early ephebic stage (pl. 3, fig. 1b), septa becoming radially arranged, though cardinal septum still reduced and septa in the cardinal quadrants joined at axial ends. Fossula occupying half of corallum.

In middle and late ephebic stages (pl. 3, figs. 1c, 1d), continued radial arrangement of septa with reduced cardinal septum. Rhopaloid septa extend only half way to center.

Remarks: Diagnostic features of *Amplexiphyllum salinensis* are the short rather thick septa and thick stereozone. *A. salinensis* differs from *Amplexiphyllum tabulata* (Busch 1941, p. 401) in more amplexoid and fewer septa, and not as well developed minor septa.

Occurrence: Dawson Bay formation, Locality 2.

Types: Holotype G.S.C. 14771a, b.

Genus *Buschophyllum* Stumm

Buschophyllum Stumm, 1949, Geol. Soc. Amer., Mem. 40, p. 9, pl. 3, figs. 37-39.

Type species, *Caninia complexa* Busch, 1941, p. 399, text fig. 28-33 on p. 400.

Buschophyllum minutum n. sp.

(Pl. 3, figs. 2a-d, 3)

Small, simple, trochoid corals, 10 to 15 mm in diameter, 20 mm in length. Calyx shallow, oval axial pit 3 mm in diameter. Coarse septa of two orders; major septa extending to axial pit; minor septa short or rudimentary, axial ends joined to major septa. Cardinal fossula formed by atrophy of cardinal septum on concave side of corallum. Epitheca thin, transversely and longitudinally striate; septal furrows seen through epitheca.

Transverse section: Septa 38 to 40 in number; major septa 0.2 to 1.0 mm thick in tabularium, thinning and breaking into 3 or more strands at periphery, extending ½ to ¾ distance into tabularium and commonly becoming rhopaloid at axial ends. Minor septa if developed, ending at margins of tabularium, rarely extending into tabularium where axial ends become joined to major septa. One or 2 tabulae intersecting interseptal areas in tabularium. Dissepiments thick, sparsely developed.

Longitudinal section: Tabularium composed of irregularly spaced, arched incomplete tabulae and dissepiments forming moderately deep concave floors. Dissepimentarium narrow, with 2 or more rows of steeply inclined, globose dissepiments.

Remarks: Buschophyllum minutum differs from *Buschophyllum complexa* (Busch 1941, p. 400) in the shorter, more abundant tabulae, and in fewer septa which break up peripherally. Distinguishing features of *B. minutum* are its small size, few thick septa, and arched tabellae which are almost indistinguishable from the dissepiments.

Occurrence: Dawson Bay formation, Locality 2.

Types: Holotype G.S.C. 14772, 14772a-c. Paratype G.S.C. 14773.

Family *BETHANYPHYLLIDAE* Stumm

Genus *Bethanyphyllum* Stumm

Bethanyphyllum Stumm, 1949. Geol. Soc. Amer., Mem 40, p. 18.

Type species, *Cyathophyllum robustum* Hall, 1876, pl. 22, figs. 1-14.

Bethanyphyllum praecursor (Frech)

(Pl. 3, figs. 4a-b)

Cyathophyllum vermiculare Goldfuss mut. n. *praecursor* Frech, 1886, Paleont. Abhandl., band 3, heft 3, p. 63, pl. 2(14), figs. 4, 6-10; Whiteaves, 1892, Canada Geol. Surv. Contrib. Canadian Paleont., v. 1, no. 4, p. 263, pl. 35, figs. 1, 1a and 1b; Lambe, 1901, *ibid.*, v. 4, pt. 2, p. 140.

Astrocyathus vermicularis Ludwig, 1866, Paleontolographica, band 14, tome 58, f. 4 (in fide Frech, 1886).

Corallum ceratoid, 45 mm in length, laterally compressed, 28 to 33 mm in maximum diameter. Calyx oval, funnel-shaped, moderately deep, extending through ⅓ of corallum. Epitheca thick, longitudinal and faint transverse striation, few strong transverse annulations.

Transverse section: Septa thin, 60 to 75 in number, radially arranged, dilating at periphery to form narrow stereozone of two orders. Major septa attenuate to within 5 mm of axis, then thickening slightly to 0.09 mm and extending into axis. Minor septa ½ to ¾ as long as major septa. Dissepiments concentric.

Section through earlier part of corallum shows septa thickening to 0.16 mm in tabularium. Minor septa ⅓ as long as major septa. Dissepiments thick, 0.1 to 0.3 mm wide.

Longitudinal section: Tabularium composed of short, arched tabellae, and few complete horizontal or distally convex tabulae. Dissepimentarium grading into tabularium, composed of globose dissepiments, becoming inclined toward tabularium and merging with tabellae.

Remarks: The writer elevates *Bethanyphyllum praecursor* from variety to species rank for the following reason. Frech illustrates species of *Cyathophyllum vermiculare* Goldfuss, showing interior of calyx with carinate septa, thick peripheral stereozone and short secondary septa. *C. vermiculare* mut. *praecursor* does not have carinae, has a narrow to non-existent stereozone, and secondary septa which are ½ as long as the primaries.

Occurrence: Dawson Bay formation, Localities 2 and 5.

Types: Hypotypes G.S.C. 14774a, b; 14775a-e; M.M.B. 5814.

Bethanyphyllum cf. *praecursor* (Frech)

(Pl. 4, figs. 1, 2a-b)

Corallum trochoid to ceratoid, 25 mm long, 22 mm wide. Epitheca with transverse striations and annulations and with longitudinal furrows. Calyx bell-shaped, deep, slightly less than ½ the length of corallum.

Transverse section: Septa 65 to 70 in number, appearing weakly carinate locally, attenuate, dilating at periphery to form narrow stereozone, thinning axially. Major septa extending to or almost to axis. Minor septa ½ to ¾ the length of majors. Dissepiments numbering 10 to 12 in interseptal spaces. Circle of dissepiments near inner margin of dissepimentarium thicker than other dissepiments.

Longitudinal section: Tabularium composed of few complete mostly incomplete tabulae. Incomplete tabulae concave distally, rarely horizontal. Dissepimentarium distinct, composed of vertical or inclined, globose dissepiments.

Remarks: Bethanyphyllum cf. *praecursor* differs from the previously described species in its distinct tabularium, and the thick ring of dissepiments at the inner margin of dissepimentarium seen in transverse section.

Occurrence: Dawson Bay formation, Locality 2.

Types: Hypotype G.S.C. 14870a, b; 14871a, b; M.M.B. 5810/61; 5810/63.

Genus *Ceratophyllum* Gürich

Ceratophyllum Gürich, 1896, Verh. Russ. Kais. Min. Gesell. St. Petersburg, v. 32, p. 163.

Types species, *Ceratophyllum typus* Gürich, 1896, p. 163.

Ceratophyllum ? sp.

(Pl. 4, figs. 3a-e)

Corallum trochoid, 15 to 22 mm in length, diameter 15 to 20 mm. Calyx bell-shaped, about 8 mm in depth, with steep walls and moderately reflexed margin. Epitheca thin, usually removed, where present having faint transverse striations and on some specimens strong annulations indicating intermittent growth. Septal grooves and interseptal ridges visible through epitheca.

Transverse sections: 1 mm above apical end, peripheral stereozone 0.3 mm thick. Septa thick, dilating; cardinal septum extending into center of corallum and partially fused with distal extremities of alar septa. Two major septa developed in each cardinal quadrant. Septa in counter quadrants extending almost to center and fused axially.

In section 4 mm above apical end, 34 major and minor septa developed; minor septa 1 mm long, extending only to margin of tabularium. Major septa in indistinct tetrameral symmetry, thick, dilating at margin of tabularium to form stereozone, forming a pseudocolumella in central area.

In section 5 mm from apical end, septa 42 in number, minor septa up to 2 mm in length, confined to dissepimentarium. One, rarely 2 dissepiments in interseptal spaces. Primary septa of similar arrangement as in previous section.

In section 7 mm above apical end, septa 47 in number, dilating at periphery to form narrow stereozone, minor septa ½ as long as major septa, extending only a short distance into tabularium. Major septa thick in tabularium, dilating at margin of tabularium to form stereozone 0.8 mm thick, twisting in axial area and forming pseudocolumella. Septa in cardinal quadrants thinner than in the other quadrants. Two to three dissepiments between septa.

Succeeding section showing (1) increase of septa from 50 to 60 in number, (2) more rapid attenuation of septa in cardinal quadrants, (3) septa gradually retreating from axis, (4) deposits of stereoplasm uniting axial ends of septa gradually diminishing first in cardinal quadrants and later in counter quadrants, and (5) septa weakly carinate in ephebic stage.

Remarks: The species cannot be assigned definitely to genus *Ceratophyllum* because the longtitudinal section is unknown. However, the thickened septa in the tabularium are very similar to those of the genotype *Ceratophyllum dohmi* (Wedekind in Stumm 1949, pl. 8, fig. 15).

Occurrence: Dawson Bay formation, Locality 2.

Types: Hypotype G.S.C. 14872a-g.

Family *LEPTOINOPHYLLIDAE* Stumm

Genus *Breviphyllum* Stumm

Breviphyllum Stumm, 1949, Geol. Soc. Amer., Mem. 40, p. 25, pl. 12, figs. 1-7.

Types species, *Amplexus lonensis* Stumm, 1937, p. 428, pl. 53, fig. 4; pl. 54, figs. 4a-b.

Breviphyllum waskasense (Whiteaves)

(Pl. 4, figs. 4a-c, 5)

Cyathophyllum waskasense Whiteaves, 1892, Canada Geol. Surv. Contrib. Canadian Paleont., v. 1, pt. 4, p. 264, pl. 34, figs. 5, 5a, 6, 7; Lambe, 1901, *ibid.*, v. 4, pt. 2 p. 144.

Cyathophyllum dianthus Whiteaves, 1892, *ibid.*, v. 1, pt. 4, p. 264 (partim, only those specimens from Red Deer River).

Corallum subcylindrical to trochoid. Many of the subcylindrical specimens with lateral budding of 3 or more corallites. Type specimens ranging in length from 20 to 46 mm, width from 15 to 20 mm. Budded forms 10 to 13 mm in length, width equal to, slightly more or less than the length. Epitheca irregularly wrinkled transversely, longitudinally striate. Where epitheca removed, septa and dissepiments with reticulate appearance. In mature specimens calyx relatively shallow with steeply sloping walls and flat floor, in young specimens calyx deep.

Transverse section: Septa thin, attenuate, dilated slightly at periphery, about 60 in number. Minor septa ½ to ⅓ as long as major septa. Interseptal space with 5 to 6 rows of dissepiments. In transverse section of immature forms, major septa 20 to 25 in number, attenuate, 0.3 mm at periphery, thinning rapidly to 0.07 mm and reaching axial area with 0.03 to 0.05 mm thickness, but leaving axis free. Minor septa of same thickness as major but extending only ¼ distance to axis or 1 mm from periphery.

Longitudinal section: Tabularium wide, up to 12 mm in diameter in lectotype, distinct from dissepimentarium. Tabulae thin, somewhat regularly spaced, generally complete, horizontal or slightly concave upward. Dissepimentarium narrow, composed of several rows of steeply inclined or vertical, globose dissepiments.

Remarks: The distinct tabularium with flat tabulae and narrow dissepimentarium distinguish this species from most others in the genus. Budding in *Breviphyllum waskasense* is common and often only the daughter buds are found.

Occurrence: Dawson Bay formation, Localities 2 and 5.

Types: Lectotype here designated G.S.C. 3868d, 3868d′; pl. 34, fig. 5, 5a in Whiteaves (1892). Paratypes G.S.C. 3868c, e, f, g; Hypotypes G.S.C. 14777a, 14778a, b; M.M.B. 58F/12.

Breviphyllum cf. *richardsoni* (Meek)

(Pl. 4, 6a-c)

Aulophyllum ? *richardsoni* Meek, 1867, Trans. Chicago Acad. Sci., v. 1, art. 3, pl. 81, p. 9, figs. 3, 3a.

Corallum subcylindrical, 13 to 15 mm in diameter. Calyx moderately deep, about 10 mm in depth, with steep walls and flat floor. Epitheca thin, strongly wrinkled transversely, longitudinally striate. Where epitheca removed, septa and dissepiments having reticulate appearance.

Transverse section: Septa thin, 0.01 mm in thickness, 60 to 70 in number, alternating minor septa extending from periphery to tabularium; major septa weak, some broadly denticulate in tabularium, becoming twisted in central area, few extending into axis. Dissepiments 0.03 to 0.06 mm wide; 4 to 6 dissepiments between 2 septa.

Longitudinal section: Tabularium averaging 8 to 10 mm in diameter, composed of thin, mostly incomplete tabulae bending down from periphery and arching up into flat dome in central area. Five to 8 tabulae in 2 mm. Dissepimentarium 3 mm wide, in places grading into tabularium. Dissepiments large, 0.06 mm in width, globose to vertically elongate, extending into tabularium.

Remarks: Specimens from Manitoba closely resemble specimens from the Mackenzie River area identified by Smith as *Mictophyllum richardsoni* (1945, p. 34). Smith examined Whiteaves' homeotypes; Meek's original specimens cannot be found.

Occurrence: Dawson Bay formation, Locality 2.

Types: Hypotypes G.S.C. 3868a. b; 14779a-d.

Genus *Kunthia* Schlüter

Kunthia Schlüter, 1885, Verhandl. Naturhist. Vereines preuss. Rheinlande und Westfalens, Jahrg. 42, sitz. -ber. p. 7.

Type species, *Kunthia crateriformis* Schlüter, 1885, p. 7 and 1889, p. 4, pl. 1, figs. 10-11.

Kunthia ? petraioides (Whiteaves)

(Pl. 4, figs. 7a-b, 8)

Cyathophyllum petraioides Whiteaves, 1892, Canada Geol. Surv., Contrib. Canadian Paleont., v. 1, pt. 4, p. 265, pl. 34, figs. 1, 1a, and 2; Lambe, 1901, *ibid.*, v. 4, pt. 2, p. 144.

"Cyathophyllum" petraioides Stumm, 1938, Jour. Paleont., v. 12, no. 5, p. 479, pl. 58, figs. 2a-c.

Cyathophyllum n. sp. Walcott, 1884, U.S. Geol. Survey, Mono. 8, p. 105.

Corallum trochoid, maximum length 28 mm, maximum width 23 mm; measurements of immature specimens 12 mm long, 10 mm wide. Base of corallum expanded for attachment. Calyx filled subsequently with calcite except in one specimen where distal area has exposed 45 to 50 short ridge-like septa, dilating at periphery to form stereozone about 0.5 mm thick. Epitheca thin, with strong longitudinal striations and faint transverse striations.

Longitudinal section of adult: Calyx deep, at least ¾ of total length. Tabulae complete, distally concave in axial area, horizontal toward margin, regularly spaced, few incomplete tabulae. Dissepimentarium composed of two rows, rarely a third incomplete row of small, slightly inclined, globose dissepiments.

Longitudinal section of immature form (pl. 4, fig. 7a): Calyx extremely deep, reaching to within 1 to 4 mm of apical end. Shallow depression developed on concave side of calyx floor. Walls of corallum consisting of two rows of horizontal or slightly inclined dissepiments. Base of corallum with septal ridges and indistinct dissepiments in interseptal area. One tabula covering basal area. In smallest specimen, tabulae not developed.

Remarks: The extremely deep calyx and narrow dissepimentarium are the major reasons for placing *K. petraioides* in genus *Kunthia.*

Occurrence: Dawson Bay formation, Localities 2, 5, and lower unit of Locality 6.

Types: Holotype G.S.C. 3867a; Hypotypes G.S.C. 14780, 14781, 14781a; M.M.B. 5813, 5818, 5819.

Genus *Tabulophyllum* Fenton and Fenton

Tabulophyllum Fenton and Fenton, 1924, Michigan Univ., Contrib. Mus. Paleont., v. 1, p. 30.

Type species, *Tabulophyllum rectum* Fenton and Fenton, 1924, p. 31, pl. 6, figs. 8-12.

Tabulophyllum gallina n. sp.

(Pl. 5, fig. 1a-c)

Corallum ceratoid, incomplete length 50 mm, apical end broken, laterally compressed, maximum width 25 mm. Epitheca transversely striate. Calyx interred in limestone matrix.

Transverse section: Septa 54 in number, thin, attenuate, dilating at periphery to form thin to moderately thick stereozone, averaging 0.5 mm in thickness, of two orders, major and minor. Major septa extending within 1 mm of center; minor

septa short, averaging 1 mm in length, commonly joining major septa axially. Plate 5, figure 1b showing retreat of septa from periphery to form partial lonsdaleioid dissepimentarium.

Longitudinal section: Tabularium wide; tabulae complete, horizontal. Septa rarely resting on tabulae. Dissepimentarium narrow, composed of few, steeply sloping, long dissepiments.

Remarks: Tabulophyllum gallina resembles, in general structure, *Tabulophyllum normale* (Walther, 1928, *in* Stumm, 1949, pl. 12, figs. 15 and 16). Both species have the same number of septa except that *T. gallina* has septa extending further into axis. An undescribed species from the Cedar Valley formation of Iowa is similar to *T. gallina* in longitudinal section, with long steeply inclined dissepiments and widely spaced tabulae. Distinguishing features of *T. gallina* are the long, widely spaced dissepiments and the distinct horizontal tabulae.

Occurrence: Dawson Bay formation, Locality 5.

Types: Holotype G.S.C. 14782, 14782a-d.

Family *DISPHYLLIDAE* Hill 1939

Genus *Hexagonaria* Gürich

Hexagonaria Gürich, 1896, Verhandl. Russ. Kais. Min. Gessell. St. Petersburg, v. 32, p. 171.

Type species, *Cyathophyllum hexagonum* Goldfuss, 1826, p. 61, pl. 19, figs. 5e-f, pl. 20, figs. 1a-b.

Hexagonaria cf. *arctica* (Meek)

(Pl. 5, fig. 2)

Cyathophyllum articum Meek, 1867, Trans. Chicago Acad. Sci., v. 1, art. 3, p. 79, pl. 11, figs. 8, 8a-b.

Species identified from a group of coralla enclosed in an intergrowth of bryozoans, algae, and stromatoporoids. No external structure seen.

Transverse section: Polygonal walls straight or slightly curved, thin except where in contact with other corallites. Major septa about 20 in number, thin 0.03 mm wide, thickening to 0.10 mm peripherally, ending about 0.15 to 0.2 mm from axis, few extending into axis. Minor septa very short, 0.2 to 0.5 mm in length, same thickness as majors at periphery, thinning abruptly toward interior.

Olique section: Dissepimentarium about 2 mm wide consisting of three to four rows of globose dissepiments. Septa in dissepimentarium weakly carinate; carinae offset. Tabularium indistinct; tabulae thin.

Remarks: The Manitoba form differs from *Hexagonaria* described by Smith (1945, p. 47) from the Mackenzie River area and Alaska in not having septa as strongly dilated at the periphery.

H. arctica differs from *Hexagonaria quadrigemina* (Goldfuss) only in the secondary septa which are short in the former and long in the latter. *Hexagonaria bompasi* (Smith, 1945, p. 49) is similar in form to *H. arctica* but is a much smaller species.

Occurrence: Dawson Bay formation, Locality 5.

Types: Hypotype G.S.C. 14873.

Order TABULATA Edwards & Haime

Family *FAVOSITIDAE* Dana

The terminology for the favositids follows that discussed by Swann (1947, p. 246) and Hill and Stumm (1956, p. F445). Swann has adapted to the Favositidae,

wall structure terms that Hill (1935, p. 482) used for wall structure of tetracorals. Below are less common terms used in the description of favositid species.

Glossary of Terms (after Swann, 1947, p. 255)

Diameter of corallite—The diameter measured from the center of one intercorallite wall to the center of the opposite wall.

Growth lamellae—Parallel bands of clear limpid buff-coloured calcite alternating with cloudy grey bands and marking the position of the margins of the peripheral stereozone at successive stages in its deposition. The lamellae are distinguished as low-angled (less than 3 to 5 degrees), medium-angled, or high-angled (more than 15 degrees), according to the angle they make with the primary wall.

Incomplete tabulae—Tabulae abutting against the next lower and previously formed tabula.

Intramural coenozone—The centrally located portion of the wall of favositids, situated between the primary walls of neighboring corallites and presumably deposited by the coenosarc. Possibly homologous with the coenenchyma of Hexacoralla, but taking no part in the increase of the corallum.

Lumen—The space between the walls of a corallite, partially divided by squamulae and crossed by tabulae.

Peripheral stereozone—A marginal zone of dilation produced by deposition of sclerenchyma and lining the epitheca of tetracorals or the primary wall of tabulates.

Pore plate—A thin vertical element homologous in structure to a tabula, but extending across and blocking a mural pore.

Primary wall—The thin lateral opaque portion of the wall of a single corallite, deposited before the formation of the adjacent peripheral stereozone, covering the rest of the corallite, and delimiting the intramural coenozone. It is homologous with the pitheca of tetracorals.

Pseudoperculum—An operculiform specialization of the holotheca permanently closing the apertures of abandoned corallites of Favositidae.

Sclerenchyma—The tissue dilating many primary structures of the corallite.

Squamulae—Linguiform or petal-shaped plates of septal origin projecting like shelves from the corallite wall into the lumen and ending in a free edge.

Suspended tabulae—Tabulae attached to the lower surface of squamulae instead of extending entirely across the lumen.

Wall (intercorallite wall)—The entire series of skeletal deposits between the lumina of adjacent corallites. It is divided into an intramural coenozone common to the two corallites and centrally located in the wall, two primary walls, and two peripheral stereozones situated next to the lumina of the two corallites.

Unlike Swann, the writer does not measure thickness of the primary wall separately from the intramural coenozone. In specimens examined, the primary wall is extremely thin so that its thickness is included in the measurements of the coenozone.

Genus *Favosites* Lamarck

Favosites Lamarck, 1816, Hist. Nat. Animal Sans Vert., v. 2, p. 204.

Type species, *Favosites gothlandicus* Lamarck, 1816, p. 205.

Favosites cf. *hamiltoniae* Hall

(Pl. 5, fig. 3)

Favosites hamiltoniae Hall, 1877, New York Geol. Surv., Paleontology, pl. 34, figs. 1-9.

Corallum massive, corallites polygonal.

Longitudinal section: Corallites 0.9 to 1.3 mm in diameter. Intercorallite walls 0.10 to 0.14 mm, thickest toward growing end. Tabulae 95 per cent complete, horizontal or slightly convex upward, 0.05 to 0.07 mm thick; 0.2 to 1.0 mm apart. Mural pores uniserial, round or oval, average diameter 0.2 mm; average spacing 0.5 mm, uniform where observed.

Remarks: A persistent single horizon of tabulae, 0.1 mm thick, is formed a few millimeters below the growing surface of corallum.

This specimen of *Favosites* agrees with Hall's original description except for the size and mural pores which Hall described as "irregularly and widely spaced, in two indefinite rows." Ross (1953, p. 63) has redescribed the species and finds the mural pores closely spaced, 0.5 to 0.6 mm apart. Uniserial and closely spaced mural pores in the Manitoba specimen are seen only in one area. The size of corallites on the Manitoba specimen is smaller than described by both Ross and Hall. Because *F. hamiltoniae* has a wide range in size of corallites, the Manitoba form is probably an extreme variant of this species.

Occurrence: Dawson Bay formation, Bell River outlet, Dawson Bay, Lake Winnipegosis, Manitoba.

Type: Hypotype G.S.C. 14874a.

Favosites pachymuralis n. sp.

(Pl. 5, figs. 5a-c)

Corallum massive, encrusting on stromotoporoid, surface irregular; thickness ranging from 10 to 22 mm, averaging 12 mm. Corallites polygonal or rounded, up to 1 mm in diameter.

Tangential section: Corallites 0.55 to 1.1 mm in diameter, averaging 0.85 mm measuring from center of one wall to center of opposite wall. Intramural coenozone, clear with dark granules, thickness 0.025 to 0.12 mm. Primary wall or epitheca, a thin dark line, commonly destroyed. Peripheral stereozone with concentric banding representing the growth lamellae; translucent fibrous structure radiating around lumen; thickness variable from 0.12 to 0.2 mm.

Longitudinal section: Corallites vertical or radiating. Wall thickness variable from 0.08 to 0.4 mm, averaging 0.3 mm. Intramural coenozone clear with dark granules; in a few places exhibiting elongate beaded structure similar to that found in bryozoans; thickness variable from 0.17 mm up to 0.10 mm in rare instances. Peripheral stereozone 0.025 to 0.13 mm thick. Growth lamellae low-angled in early developmental stages, medium-angled in later stages of growth.

Tabulae horizontal or slanting, sometimes suspended from squamulae, 0.008 to 0.017 mm thick, abundant in first formed portion of corallite, sparse and incomplete in remainder of corallite. Distance between tabulae about 1.0 mm in early part of corallite, irregular in older portions of corallite. Squamulae abundant in adult portions of corallite, horizontal or inclined, averaging 0.33 mm in thickness; horizontal squamulae commonly overlapping in center. Mural pores uniserial or alternately biserial, rarely two pores side by side; round, average diameter 0.2 mm; pores in pits; distance between pores 0.35 mm to 0.65 mm averaging 0.5 mm apart.

Remarks: The large uniserial mural pores in *Favosites pachymuralis* place it in the *Favosites turbinatus* group. The small corallites, very thick walls, and type of squamulae distinguish *F. pachymuralis* from other forms in the group. *Favosites*

gibsoni Parks (pl. 5, fig. 4) has the same size corallites and similar size and arrangement of mural pores as *F. pachymuralis*. However, the squamulae and tabulae of *F. gibsoni* are completely different from those in *F. pachymuralis*.

Excessive thickening in walls of tabulate corals may be caused by strong currents in the marine environment (Lecompte, 1939, pp. 19, 187). Nonetheless, ignoring wall thickening, the nature and distribution of the tabulae and squamulae along with the small size of corallites are enough to distinguish the Manitoba species from others.

Occurrence: Dawson Bay formation, Locality 5.

Types: Holotype G.S.C. 14875a-c.

Genus *Thamnopora* Steininger

Thamnopora Steininger, 1831 Bemerkungen über die Versteinerungen welch in dem Ubergangs-Kalkebirge der Eifel gefunden werderz; p. 10.

Type species, *Thamnopora madreporacea* Steininger 1831, p. 11.

Thamnopora dumosa var. *tabulata* n. var.

(Pl. 5, fig. 6a-b)

Corallum cylindrical, stems 15 mm wide, ending bluntly, surface even and regular. Corallites 1.0 to 1.4 mm in diameter, elongate transversely.

In section, corallites round or subpolygonal, radiating from central region, opening at right angles to surface, 0.6 mm in diameter in axial region, expanding to 1.5 mm average at periphery, variation in size of corallites on surface 1.0 to 1.7 mm. Walls straight, rarely undulating, undulations best seen in coenozone, thicken distally, total wall thickness 0.13 mm at axis to 0.5 mm at periphery; intramural coenozone 0.017 mm in center to 0.033 mm at edge; peripheral stereozone 0.03 mm in axis expanding to 0.2 mm at surface; low-angled growth lamellae at inner peripheral region, medium-angled at outer peripheral region. Tabulae straight or slightly curved, 99 per cent complete, irregular variation in thickness, 0.03 to 0.05 mm., average spacing 0.6 mm, range in spacing 0.4 mm to 2.1 mm. Mural pores uniserial or biserial, round to oval, average diameter 0.2 mm, spacing 0.9 mm; rims occasionally present.

Remarks: The specimen of *T. dumosa* var. *tabulata* is a broken off tip of a corallum measuring 20 mm in length and 15 mm in diameter. The lower section of the corallum is not known. As the peripheral characters of the Manitoba specimen compare so closely with *T. dumosa* Winchell, the writer assigns it to this species. Dissimilarity between these forms is in the nature of tabulae which are thicker and more closely spaced in the Manitoba form. These characters may be due to adverse conditions in the environment.

Occurrence: Dawson Bay formation, Locality 2.

Type: Holotype G.S.C. 14783a.

Thamnopora cervicornis (DeBlainville)

(Pl. 6, figs. 1a-b)

Alveolites cervicornis DeBlainville, 1830, Dict. Sci. Nat., t. 60, p. 369.

Favosites cervicornis Lecompte, 1936, Mus. Royal Hist. Nat. Belgique, mem. 75, p. 9, pl. 2, figs. 3, 3a-e; pl. 3, fig. 1 (see Lecompte for complete synonymy).

Thamnopora cervicornis Smith, 1945, Geol. Soc. Amer., Spec. Paper no. 59, p. 62.

Corallum with cylindrical stems about 2 cm in diameter, specimen imbedded in limestone, complete corallum not seen. Corallites of two distinct sizes, large, rounded openings, 1.5 to 2.2 mm in diameter, averaging 1.6 mm; small subangular openings 0.5 to 0.8 mm, averaging 0.65 mm in diameter.

Internally, corallites parallel to branching in axial region, bending gradually toward periphery until 3 to 4 mm of corallite perpendicular to surface. Walls of corallite straight, rarely undulating, thickening distally, total wall diameter 0.20 to 0.24 mm in axial region, 0.37 to 0.50 mm at periphery. Intramural coenozone thickest around center corallite, 0.1 mm wide, 0.033 mm in remaining wall. Peripheral stereozone thickest in distal region, 0.066 to 0.1 mm thick in axial region, 0.1 to 0.23 mm in peripheral region. Growth lamellae in transverse section appear concentric around corallite, in longitudinal section low-angled in axial region, medium-angled in thickened stereozone.

Tabulae 70 per cent horizontal, 30 per cent curved; 99 per cent complete and ranging in thickness from 0.17 to 0.033 mm; greatly thickened by subsequent calcite deposition; spacing 0.7 to 1.7 mm, averaging 1.5 mm. Mural pores uniserial or biserial, rarely alternately biserial; biserial pores at angles of corallites; round, 0.13 to 0.23 mm in diameter, spacing 0.9 mm; pores in deep to moderately deep pits.

Remarks: The measurements for the Manitoban *T. cervicornis* fall well within the limits of the measurements given by Lecompte (1936, p. 14) for types of *T. cervicornis*. The structure of the walls which Lecompte described is seen clearly in the Manitoban form.

Occurrence: Dawson Bay formation, Locality 2.

Type: Hypotype G.S.C. 14784, 14784a.

Thamnopora polyforata (Schlotheim)

(Pl. 6, fig. 2a-b)

Milleporites polyforatus Schlotheim, 1820, Die Petrefact., Gotha, p. 365 (partim).

Favosites dubius (De Blainville) Lecompte, 1936, Mus. Royal Hist. Nat. Belgique, mem. 75, p. 54, pl. 10, figs. 1, 1a-b.

Thamnopora polyforata Smith, 1945, Geol. Soc. America, Spec. Paper no. 59, p. 63, pl. 28, figs. 1 and 2. (See Smith for complete synonymy).

Corallum ramose, branches oval, from 0.5 to 0.7 mm in diameter. Corallites 1 to 2 mm in diameter, averaging 1.5 mm; corallite openings extremely oblique in some areas but almost normal to surface locally.

In section, corallites expand from 0.5 mm in axial region up to 1.5 mm at distal end. Walls thicken distally from 0.1 to 0.3 mm. Tabulae thin, complete, horizontal or slightly curved; irregularly spaced, 0.5 to 1.2 mm apart, average spacing 1.0 mm.

Remarks: Lecompte (1936, p. 57) describes fully the specimens of Goldfuss which Lecompte calls *Favosites dubius* and which Goldfuss originally named *Calamopora polymorpha* var. *gracilis* (1826, p. 75). Smith examined both Goldfuss' specimens and Schlotheim's syntypes and felt that both forms were conspecific. Smith's and Lecompte's descriptions are similar except for nature of the tabulae. Lecompte finds few tabulae in longitudinal section. Smith's illustrations of longitudinal sections of *T. polyforata* (1945, p. 113, pl. 28, figs. 1c and 1d) show tabulae as common; fig. 1e shows the lectotype having abundant tabulae.

T. polyforata resembles both *Coenites* and *Thamnopora* but is placed in genus *Thamnopora* because of the abundant thin tabulae. The branches with the inclined corallites are distinguished externally from other ramose forms in the Manitoba group by their larger corallites, and internally by their abundant tabulae.

Occurrence: Dawson Bay formation, Localities 2 and 5.

Types: Hypotypes G.S.C. 14785, 14785a, 14786.

Genus *Trachypora* Edwards & Haime

Trachypora Edwards and Haime, 1851, Arch. Mus. Hist. Nat., Paris tome 5, p.305.

Type species, *Trachypora davidsoni*, Edwards and Haime, 1851, p. 305, pl. 17, figs. 7, 7a.

Trachypora cf. *neglecta* (Rominger)

(Pl. 6, figs. 3a-b)

Dendropora neglecta Rominger, 1876, Michigan Geol. Surv., v. 3, pt. 2, p. 63, pl. 23, fig. 4.

Corallum palmate or irregularly branching, branches 6 to 7 mm in diameter, palmate coralla about 12 mm in transverse diameter. Corallites irregularly distributed, opening obliquely to surface, commonly round, less commonly elliptical with projecting rim elevating them above general surface of corallum. Rims may be worn off level with surface, leaving concentric markings around corallite openings. Diameter of openings 0.7 to 1.0 mm. No superficial markings on interstitial material. Distance between corallites greater than corallite diameter.

Internally, corallites expanding from central region to surface, 0.5 mm in diameter near axis. Walls thickening distally from 0.3 mm in axial region to 0.5 mm at periphery. Tabulae rare. Mural pores large and distant, 0.2 to 0.3 mm in diameter.

Remarks: Trachypora cf. *neglecta* resembles Rominger's original illustrations of *Trachypora neglecta* in size of corallites, but differs in having only a few septal spines; in the original, septal spines are arranged in longitudinal rows. The Manitoba forms of *Trachypora* have small closely spaced openings, without any superficial margins on interstitial material.

Occurrence: Dawson Bay formation, Locality 2.

Types: G.S.C. 14788, 14788a.

Genus *Alveolites* Lamarck

Alveolites Lamarck, 1801, Syst. des Animaux sans Vert., p. 375.

Type species, *Alveolites suborbicularis* Lamarck, 1801, p. 376.

Alveolites multiperforatus Salée

(Pl. 6, figs. 4a-b)

Alveolites multiperforatus Salée in Lecompte, 1933, Mem. Mus. Roy. Hist. Nat. Belgique, Mem. 55, p. 39, pl. 3, figs. 1, 1a-b; Smith, 1945, Geol. Soc. America, Spec. Paper no. 59, p. 13, pl. 26, figs. 3-5.

Alveolites vallorum Meek, Whiteaves, 1891, Canada Geol. Surv., Contrib. Canadian Paleont., v. 1, pt. 3, p. 207; Lambe, 1899, *ibid.*, v. 4, pt. 1, p. 25 (partim).

Corallum massive, probably sheet-like growth, 2.5 cm thick, banded, in a few cases with very thin layers of sediment between the bands. Complete size of corallum not known.

Tangential section: Corallites roughly diamond-shaped or semilunar, usually 0.7 mm in long diameter, but may reach from 0.5 to 1.0 mm in short diameter.

Vertical section: Corallites inclined, opening obliquely to surface; diameter of corallites measuring from interior of walls, typically 0.4 mm; thickness of corallite wall ranging from 0.1 to 0.4 mm. Tabulae complete, irregularly spaced, at right angles to corallite walls; minimum observed spacing 0.2 mm. Mural pores 0.2 mm in diameter, ranging from 0.4 to 0.7 mm apart.

Remarks: Alveolites multiperforatus and *Alveolites suborbicularis* Lamarck are very similar and, according to Smith (1945, p. 13), seem to grade into one another. The size of corallites of the Manitoba specimens corresponds more closely to *A. suborbicularis* and the corallites are not as round as those in *A. multiperforatus*. Septal spines are not observed in the Manitoba form although *A. suborbicularis* and *A. multiperforatus* may possess these structures. The greatest similarity of the Manitoba specimen with *A. multiperforatus* is in the character of mural pores. When found, the mural pores in the Manitoba form are large and close spaced, as is characteristic of *A. multiperforatus*.

Smith has re-examined many of the specimens identified by Whiteaves (1891, p. 207) and Lambe (1899, p. 25) as *A. vallorum* Meek 1867 from the Mackenzie River basin. He finds that those from the Upper Devonian beds belong to species *A. multiperforatus*. The corallites in these specimens are not as compressed as those originally described by Meek. Specimens from the Dawson Bay also do not have the highly compressed corallites of *A. vallorum*.

Occurrence: Dawson Bay formation, Localities 2 and 6 (lower).

Type: Hypotype G.S.C. 14787, 14787a; M.M.B. 58170.

Genus *Coenites* Eichwald

Coenites Eichwald, 1829, Zoologia Specialis, v. 1, p. 179, Vilna.

Type species, *Coenites juniperinus* Eichwald, 1829, p. 179, pl. 2, fig. 16.

Coenites hadrus n. sp.

(Pl. 6, figs. 5-9)

Corallum ramose, with roundly tapered extremities, bifurcating 70 to 100 degrees, 5 to 12 mm in diameter, averaging 7 mm. Corallites longitudinally or transversely elongate, opening obliquely to surface, 7 in 10 mm longitudinally, 3 in 5 mm transversely.

Tangential section: Walls with dark and light concentric banding; wall structure transversely fibrous.

Transverse section: Corallites subcircular in axial region, becoming elliptical distally. Walls 0.1 mm in center, thickening outward. Stereozone fibrous, lighter banding around corallite, darker toward intramural coenozone. Intramural coenozone 0.015 mm in axial region.

Longitudinal section: Corallite length about 25 mm, bending gradually from axis, reaching surface at 45 to 55 degrees; corallites 0.5 mm wide in axial region, expanding to 1.0 mm, rarely to 1.3 mm at surface. Walls thickening distally from 0.13 to 0.45 mm. Peripheral stereozone fibrous, fibers perpendicular to intramural coenozone. Coenozone 0.017 mm in axial area, 0.025 mm at surface. Mural pores oval to round, up to 0.25 mm in long diameter, 0.15 mm in short diameter. Tabulae rare, thin, less than 0.15 mm thick. Septal spines absent.

Remarks: A longitudinal section reveals a partially destroyed tabula. This may indicate that the tabulae were more abundant during growth but have been subsequently destroyed.

With two exceptions, *C. hadrus* is distinguished from other *Coenites* by its thick walls. In the first exception, *Coenites dichotoma* (Hall), the intercorallite distance exceeds the diameter of the corallite. The second exception, *Coenites bifurcata* (Grabau), is surficially similar to *C. hadrus* but the abundance and small size of mural pores, which are distributed throughout the corallum, distinguish *C. bifurcata* from *C. hadrus*. *Thamnopora polyforata* (Schlotheim) and *Thamnopora* near *T. polyforata* (Smith, 1945, p. 64) are distinguished from *C. hadrus* by the abundance of tabulae and size of corallites.

Occurrence: Common throughout the Dawson Bay formation.

Types: Holotype G.S.C. 14789, 14789a. Paratypes G.S.C. 14790, 14791, 14792, 14793a.

Family *AULOPORIDAE* Edwards and Haime

Genus *Aulocystis* Schlüter

Aulocystis Schlüter, 1885, Verhandl. Nat. Vereines preuss, Rheinlande, Westfalens, Jahrd., v. 42, p. 148.

Type species, *Aulocystis cornigera* Schlüter, 1885, p. 148.

Aulocystis flabellata (Greene)

(Pl. 7, figs. 1a-b)

Ceratopora flabellata Greene, 1902, Contrib. Indiana Paleont., pt. 9, p. 75, pl. 25, figs. 2-4; Cleland, 1911, Wisconsin Geol. Survey Bull. 21, p. 34, pl. 2, fig. 7; Stewart, 1927, Ohio Geol. Surv., 4th ser., Bull. 32, p. 20, pl. 1, fig. 5; , 1938, Geol. Soc. America, Spec. Paper no. 8, p. 81, pl. 20, figs. 1-3.

Colonies erect, branching at oblique angles; buds not remaining in contact with parent corallite. Corallites cylindrical, transversely wrinkled due to irregularities of growth, 20 mm long, 4 to 5 mm wide.

Transverse section: Calices round, proximally becoming funnel-shaped due to horseshoe form of cyst growth. Wall thickness 0.65 to 1.0 mm. Cysts of irregular thickness and spacing.

Longitudinal section: Cysts usually convex upward. Spacing of cysts irregular, minimum 0.1 mm apart. Small spines or ridges irregularly dispersed along interior of corallite wall.

In both tangential and longitudinal section, the main walls of medium grey colour are much denser than material filling the tubes. Material between corallite walls clear except for the darkened outlines of the cysts.

Remarks: Corallites in the Manitoba specimens are somewhat larger than those in the type specimens. Greene describes the corallites as closely connected throughout their length. This is not always true either in the Manitoba form or in Greene's forms as evidenced by his illustration on pl. 25, fig. 2 (1902).

Occurrence: Dawson Bay formation, Locality 2.

Types: Hypotype G.S.C. 14794, 14794a.

Genus *Aulopora* Goldfuss

Aulopora Goldfuss, 1829, Petrefacta Germaniae, Thl. 1, p. 82.

Type species, *Aulopora serpens* Goldfuss, 1829, p. 82, pl. 29, figs. 1a-d.

Aulopora conferta Winchell

(Pl. 4, fig. 6a)

Aulopora conferta Winchell, 1866, The Grand Traverse region, p. 91; Rominger, 1876, Michigan Geol. Survey, v. 3, pt. 2, p. 88, pl. 33, fig. 1; Fenton, 1937, American Midland Nat., v. 18, no. 1, p. 117, pl. 1, figs. 2-5, pl. 3, fig. 6; Fenton & Fenton, 1947 in Stumm, Wagner Free Instit. Sci., Unit 1E, pt. A, card 14; Fritz, Lemon and Norris, 1957, Geol. Assoc. Canada, v. 9, p. 31, pl. 3, fig. 7.

Colonies attached to corals in crowded fan-like emanations. Corallites 2 to 3 mm in length, 0.9 to 1.1 mm in diameter at the widest point, faintly wrinkled transversely. Apertures round to oval, 0.5 to 0.6 mm wide, some raised slightly above general surface, few apertures oblique and not raised above the surface. Corallum increasing by basal gemnation, corallites emanating outward in a fan-like growth from parent. Tabulae not present.

Remarks: Illustrations of Hackberry specimens (Fenton, 1937, pl. 1, fig. 3), closely resemble the Manitoba specimen. *Aulopora jugalis* Fenton is similar to *A. conferta* but tubes are not as distinct. *Aulopora munda* Fenton has the same size of corallites as *A. conferta* but budding is never at midlength of parent cells. Corallites in *A. munda* are directed upward but do not have the pronounced upward growth of *A. conferta*.

Occurrence: Dawson Bay formation, Locality 2.

Types: Hypotype G.S.C. 14795.

Aulopora sp.

(Pl. 7, fig. 3)

? *Aulopora* sp. *A* Smith, 1945, Geol. Soc. America, Spec. Paper no. 59, p. 17, pl. 28, fig. 11.

Colonies repent at base but becoming erect with growth; basal portion with corallites that are closely spaced and dividing laterally. Corallites 0.8 to 0.9 mm wide; walls thin; maximum thickness 0.07 mm. Openings of corallites buried in limestone matrix.

Remarks: The description is based on a specimen showing the underside of the colony and a small area of erect corallites.

The specimen has been placed in genus *Aulopora* because of the thin walled corallites. In manner of growth, the species described above approaches more closely genus *Aulocystis*. However, in *Aulocystis*, the calices narrow downward by thickening of walls with cysts.

From Smith's brief but concise description of *Aulopora* sp. *A* it appears that the Hay River form and the Manitoba form are very similar if not identical.

Occurrence: Dawson Bay formation, Localities 5 and 7.

Types: G.S.C. 14876, 14877.

Genus *Plexituba* Stainbrook

Plexituba Stainbrook, 1946, Jour. Paleont., v. 20, no. 5, p. 424.

Type species, *Plexituba contexta* Stainbrook, 1945, p. 426, pl. 58, figs. 44, 45, pl. 59, figs. 4, 9.

Plexituba contexta Stainbrook

(Pl. 4, fig. 8; Pl. 7, fig. 2)

Plexituba contexta Stainbrook, 1946, Jour. Paleont., v. 20, no. 5, p. 426, pl. 58, figs. 44-45; pl. 59, figs. 4-9; Stumm, 1949, Wagner Free Instit, Sci., Philadelphia, Pa., Unit 1E, Part A, card 88.

Corallum prostrate, attached to surface of horn corals. Corallites 4 to 5 mm in length, 2 mm in diameter at point of origin, increasing to 3.5 mm at calyx. Calices oval to round, 1.5 mm in diameter, deep, erect; calicinal rim 2 mm high; walls thick.

Remarks: The Manitoba specimens of *P. contexta* have wider corallites than the type specimens from Iowa which have an average diameter of 2.2 mm. In diameter, the Manitoba form resembles *Plexituba maxima* (Fenton and Fenton), but differs in corallite length, height of calicinal rim above surface, and in apertural characters.

Occurrence: Dawson Bay formation, Locality 2.

Types: Hypotype G.S.C. 14878, 14879.

Phylum BRYOZOA

Order CYCLOSTOMATA Busk

Family *REPTARIIDAE* Simpson

Genus *Reptaria* Rolle

Reptaria Rolle, 1851, Leonhard and Bronn. Neues Jahrb., Min., p. 810.

Type species, *Reptaria stolonifera* Rolle, 1851, p. 810.

Reptaria stolonifera Rolle

(Pl. 7, fig. 7)

Reptaria stolonifera Rolle, 1851, Leonhard and Bronn, Neues Jahrb., p. 810, pl. 9, figs. 5, 6; Hall and Simpson, 1887, New York Geol. Surv., Paleontology, v. 6, p. 274, pl. 65, figs. 17-19; Simpson, 1897, Fourteenth Ann. Rept. State Geol. New York for 1894, pl. 25, figs. 8, 9; Grabau, 1899, Bull. Buffalo Soc. Nat. Sci., v. 6, p. 178, fig. 76; Cleland, 1911, Wisconsin Geol. Surv., Bull. 21, p. 57, pl. 6, figs. 7, 8.

Ptilionella penniformis Hall, 1881, Trans. Albany Instit., v. 10, p. 195; , 1884, Rept. of State Geol. for 1883, p. 56.

Zoarium parasitic, branching, attached throughout length. Zooecia 0.5 mm wide approximately 2 mm in length, alternating, arising regularly from basal portions of preceding alternate one. Openings of zooecia parallel to central axis. Only one example of this species was found; it was encrusted on a cephalopod.

Occurrence: Dawson Bay formation, Locality 6 (upper).

Types: Hypotype G.S.C. 14796.

Order *TREPOSTOMATA* Ulrich

Genus *Cyphotrypa* Ulrich & Bassler

Cyphotyrpa Ulrich and Bassler, 1904, Smithsonian Misc. Coll., v. 47, p. 29.
Type species, *Leptotrypa acervulosa* Ulrich, 1895, p. 318, pl. 27, figs. 24-25.

Cyphotrypa whiteavesi n. sp.

(Pl. 7, figs. 9a-b)

Zoarium encrusting in one or two layers; each layer about 0.5 to 0.8 mm thick. No monticules or maculae observed, because specimens encrusted by other organisms.

Tangential section: Zooecia polygonal to subpolygonal, about 0.2 mm in diameter, averaging 8 to 8½ in 2 mm; walls thick, amalgamate. Mesopores absent. Acanthopores large, approximately 0.05 mm in diameter, scattered unevenly, not always located at angles of zooecia. Monticules and maculae not observed.

Longitudinal section: Zooecia more or less straight, walls rather thick. Diaphragms well defined, thin, 0 to 3, rarely 4 in a zooecium, variably spaced, horizontal to moderately inclined.

Remarks: The writer places this species in the genus *Cyphotrypa* because of the relatively abundant diaphragms, although it could be placed in the genus *Leptotrypa* on the basis of the few acanthopores. The species differs from the definition of both genera in having rather thick zooecial walls.

Cyphotrypa whiteavesi resembles *Cyphotrypa* ? *unica* Duncan (1939, p. 201) in its short zooecia with thin distant diaphragms; but differs from the latter species in smaller zooecia and smaller acanthopores that are not always developed at the junction of zooecial walls.

Occurrence: Dawson Bay formation, Locality 5.

Types: Holotype G.S.C. 14880a.

Phylum BRACHIOPODA

Class ARTICULATA Huxley

Classification of brachiopods corresponds to that adopted by Roger (1952). Terminology is the same as used by Shrock and Twenhofel (1953) and Moore, Lalicker and Fisher (1953).

Order PSEUDOPUNCTATA PROTREMATA Roger

Family *STROPHOMENIDAE* King

Genus *Stropheodonta* Hall

Stropheodonta Hall, 1852, Nat. Hist. New York, Paleontology, v. 2, p. 63.

Type species, *Strophomena demissa* Conrad, 1842, p. 258.

Stropheodonta cf. *littletonensis* Stainbrook

(Pl. 7, figs. 4-6)

Stropheodonta littletonensis Stainbrook, 1938, Jour, Paleontology, v. 12, no. 3, p. 253, pl. 34, figs. 10, 11, 14; pl. 35, fig. 7.

Shell large, subquadrate, concavo-convex, length 3/5 of width, hinge line as long as or slightly shorter than greatest width; cardinal angles rounded, obtuse or right angled; lateral and anterior margins broadly convex. Dimensions of two specimens: length 23.5 mm, 27 mm; width 40 mm, 45 mm; thickness 8.5 mm, 9.5 mm (shell material removed).

Pedicle valve moderately convex along midline, maximum convexity at midlength, median portion swollen, steeply sloping toward posterior margin, flattening out postero-laterally, abruptly sloping toward the lateral and anterior margins.

Brachial valve concave with greatest concavity at midlength reflecting greatest convexity of pedicle valve. Areas not preserved.

Shell costellate; costellae narrow, subangular, 10 in 5 mm at front margin, varying slightly in strength, some slightly less elevated. Furrows wider than costellae, with very fine concentrically arranged threads in well preserved specimens. Shell material fibrous and pseudopunctate.

Internal structure: Diductor muscle areas in pedicle valve large, flabellate, scored by numerous longitudinal somewhat radial high narrow ridges. Each muscle impression 8 mm long, 13 mm wide on large specimen measured. Remaining surface pustulose.

Remarks: True convexity of the pedicle valve is not obtainable because all specimens have the central area worn away revealing interior of the valve. One specimen is worn to such an extent that a small portion of the brachial valve is visible.

Because all the specimens are weathered, the complete hinge line has not been preserved. Excluding this deficiency, the form resembles *S. littletonensis* more closely than any other species with which the writer has compared it. The length: width ratio, the general description of the pedicle valve, and the wide intercostal spaces with the concentric striae are the same in both species.

Occurrence: Souris River formation, Locality 9.

Types: Hypotype G.S.C. 14881, 14882, 14883; M.M.B. 5855; 5858.

Stropheodonta sp.

(Pl. 7, figs. 8a-b)

Shell large, subquadrate, concavo-convex, width 1.2 to 1.3 times the length; hinge line slightly shorter than greatest width; angles broadly rounded; lateral margins almost straight, curving broadly antero-laterally; anterior margin slightly curved. Shell material fibrous, pseudopunctate. Dimensions of 2 specimens: length 26 mm, 24 mm; width 33 mm, 29 mm; thickness 9 mm, 8 mm.

Pedicle valve regularly convex, most curvature at midlength, from there sloping gradually anteriorly and laterally, more rapidly toward posterior. Umbo small, prominent, beak extending beyond hinge line. Brachial valve concave, most of it not exposed.

Interior structure unknown.

Valves costellate, costellae unequal in size especially near median line, narrow, highly arched, 9 to 10 in 5 mm, measured 15 mm from hinge line, increasing by implantation and division. Furrows broad, shallow, same width or wider than costae and with coarse concentric striae on well preserved specimens.

Remarks: *Stropheodonta* sp. differs from *Stropheodonta cedarensis* Stainbrook (1938, p. 247) in the former species' larger size and coarser costae. The thin body cavity, greater convexity of pedicle valve, finer, more angular and more regular costae of *Stropheodonta* sp. distinguish this species from *Stropheodonta randalia* Stainbrook.

Occurrence: Souris River formation, Locality 9.

Type: Hypotype G.S.C. 14884.

Family *CHONETIDAE* Hall & Clarke

Genus *Chonetes* Fischer de Waldheim

Chonetes, Fischer de Waldheim, 1830, Oryctographie du Gouv. de Moscou, pt. 2, p. 134, pl. 26, figs. 8, 9.

Type species, *Leptaena variolata* d'Orbigny 1842, p. 49, pl. 4, figs. 10-11.

Chonetes aurora Hall

(Pl. 8, figs. 1, 2)

Chonetes logani var. *aurora* Hall, 1867, Nat. Hist. New York, Paleontology v. 4, pt. 1, p. 137, pl. 22, figs. 16-28; Whiteaves, 1891, Canada Geol. Surv., Contrib. Canadian Paleont., v. 1, pt. 3, p. 215, pl. 29, figs. 2, 2a; 1892, *ibid.*, v. 1, pt. 4, p. 281.

Chonetes pusilla Hall ? Meek, 1867, Trans. Chicago Acad. Sci., v. 1, art. 3, p. 93, pl. 13, fig. 2a-d.

Chonetes aurora Cooper and Williams, 1935, Geol. Soc. America, v. 46, p. 838, pl. 57, figs. 2, 5, 6, 7, and 9.

Shell very small, transversely subquadrate, extremities angular. Lateral margins straight posteriorly, becoming rounded anteriorly; anterior margin broadly rounded. Dimensions of hypotype: length 5.2 mm; width 6.6 mm, thickness of pedicle valve 1.7 mm.

Ventral valve gently regularly convex along midline. Postero-lateral surface sloping gently, becoming flat toward cardinal angles, antero-lateral and anterior surface sloping rapidly to margins. Surface of ventral valve with abundant distinct rounded costellae, indistinct at postero-lateral angles, increasing by division; 3 in 1 mm at front margin. Furrows broadly concave, wider than costellae. Concentric wrinkles regularly arranged, covering costellae and furrows, predominating over the radial structures near postero-lateral margins, 11 to 12 in 1 mm anterior to mid-length.

Brachial valve unknown.

Remarks: According to Hall (1867, p. 137), this long ranging form extends from upper Hamilton to the base of the Mississippian in eastern United States. Size and number of costae in the Canadian specimens are all within the range of this species, although the eastern form is slightly broader.

When Meek (1867, p. 93) identified *C. pusilla*, he had only a short description and no illustration of Hall's species. He commented:

> "It is with considerable doubt that this little shell is here referred to *C. pusilla*, not only in consequence of the fact that only very imperfect specimens were obtained, all imbedded in the matrix, but because it seems to

be rather more coarsely striated, while its striae bifurcate farther from the beak, and are apparently marked by stronger concentric striae. As I only have a description without figures of *C. pusilla* for comparison, I am not fully satisfied that our shell is distinct, though it probably is."

Hall gave a more detailed description with illustrations of *C. pusilla* in 1867 (p. 128, pl. 21, figs. 6a-c). On comparison with Hall's illustrations, Meek's forms from Great Slave Lake have coarser costae and are about half the size of Hall's specimens from Illinois.

Chonetes bellarugosus Stainbrook is similar to *C. aurora* but has a more prominent beak and slightly coarser costae which average 18 in number on the ventral valve.

Occurrence: Dawson Bay formation, Localities 4 and 5.

Types: Hypotypes G.S.C. 14797, 14798.

Family *PRODUCTIDAE* Gray

Genus *Productella* Hall

Productella Hall, 1868, New York State Cabinet, Nat. Hist. Ann. Rept. 20, p. 250. Type species, *Productus subaculeatus* Murchison, 1840, p. 255, pl. 2, figs. 9a-c.

Productella concentrica (Hall)

(Pl. 8, figs. 4, 6, 7)

Productus concentricus Hall, 1857, 10th Rept. New York State Cabinet, Nat. Hist., p. 180; 1858, Iowa Geol. Surv., v. 1, pt. 2, p. 517, pl. 7, fig. 3.

Productella concentrica Weller, 1914, Illinois State Geol. Surv., Monog. 1, p. 98, pl. 19, figs. 22-34 (complete synonymy of *P. concentrica*).

Productus spinulicosta Hall, 1857, Tenth Rept. State Cabinet, Nat. Hist., p. 173 (partim, in fide Hall); Cleland, 1911, Wisconsin Geol. Surv., Bull. 21, Sci. Ser. no. 6, p. 93, pl. 18, figs. 14-16.

Productus shumardianus Hall, 1858, Iowa Geol. Surv., v. 1, pt. 2, p. 499 pl. 3, fig. 9, pl. 7, fig. 2.

Productella shumardiana Hall, 1867, Geol. Surv. New York, Paleontology, v. 4, pt. 1, p. 157, pl. 23, figs. 36, 37.

Productella subaculeata (Murchison) Whiteaves, 1892, Canada Geol. Surv., Contrib. Canadian Paleont., v. 1, pt. 4, p. 283 (partim).

Shell small, productiform in shape, suboval in outline; concavo-convex; width slightly greater than length; greatest width near midlength; anterolateral margins angular or subrounded. Dimensions of 2 hypotypes: length 16 mm, 12 mm; width 17 mm, 13 mm; convexity of pedicle valve 7 mm and 5 mm.

Pedicle valve highly convex, highest in umbonal region, from there steeply sloping anteriorly and laterally, flat at postero-lateral angles. Umbo strongly convex, projecting 2 mm beyond hinge line. Surface marked by numerous stout spine bases about 0.5 mm in diameter toward the anterior portion of valve. Concentric rugae covering valve, about 3 in 5 mm measured from anterior margin. Fine growth lines seen on well preserved specimens.

Brachial valve moderately concave, greatest curvature in middle, regularly arched to anterior margin, curvature decreasing gradually posteriorly until postero-lateral and posterior margins flat. Umbo small, depressed below surrounding flat area. Surface wrinkled with strong concentric rugae especially prominent toward hinge, closely spaced posteriorly, wider apart anteriorly. Rugae covered with small pits which become larger anteriorly and reaching a diameter of 1 mm near the margin. Pits arranged in irregular longitudinal rows.

Remarks: Similarity of species to *Productella spinulicosta* Hall has caused much confusion in genus *Productella*. Schuchert (1897, p. 318) regarded all American forms of *P. subaculeata* Murchison synonymous with *P. spinulicosta*. He also felt that subsequently *P. shumardiana* (Hall) would prove to be synonymous with *P. spinulicosta*. Hall himself was not entirely satisfied with the difference between *P. spinulicosta* and *P. shumardiana*. He wrote (1867, p. 160):

> "The distinction between the species (*P. spinulicosta*) and the authentic specimens of *P. shumardiana* is not such as to entirely satisfy me of their specific difference."

Weller (1914, p. 99) found that:

> "*Productella shumardiana* was described from two specimens, a pedicle valve from the same horizon and locality from which the type of *P. concentrica* was obtained, and a brachial valve from the Louisiana limestone of Clarksville, Missouri; the first of these specimens is undoubtedly a member of the same species as the type of *P. concentrica*, while the second specimen is an example of *P. pyxidata*."

After examining the type specimens of *P. shumardiana* (Pl. 8, figs. 4 and 5), the writer agrees with Weller that the two type specimens of *P. shumardiana* comprise two different species.

Weller further states that *P. concentrica* is similar to:

> "The middle Devonian *P. spinulicosta*, and it has sometimes been suggested that these two forms are identical, both having the same general form, size, and surface markings. It is possible that this interpretation should be held, but for the present these Mississippian shells will be considered as distinct from the middle Devonian form, although an entirely satisfactory method of distinguishing them cannot be pointed out."

The writer has examined the types of *P. spinulicosta* and *P. shumardiana* and has concluded that they are two distinct species. The major difference in the two forms is in the convexity of the umbonal region. In *P. spinulicosta* the umbo is extremely swollen, broad, projecting well beyond the hinge line; whereas in *P. shumardiana* the umbonal region is narrow, projecting only moderately beyond the hinge line. Also the auriculations are much more compressed in *P. shumardiana*. Unfortunately, the writer did not examine the type of *P. concentrica* Hall, but from the original illustration it very closely resembles *P. shumardiana*.

The Manitoba specimens differ from *P. concentrica* in their coarser, more conspicuous rugosities. The specimens previously identified from the Dawson Bay formation as *P. spinulicosta* (Baillie, 1950, p. 57) are examples of *P. concentrica*.

Occurrence: Dawson Bay formation, Localities 1, 4, 5, 6, 7.

Types: Hypotypes G.S.C. 14799-14802; M.M.B. 5882.

Order PUNCTATA PROTREMATA Roger

Family *SCHIZOPHORIDAE* Schuchert

Genus *Schizophoria* King

Schizophoria King, 1850, Monog. Permian Fossils, Paleontolographical Soc., v. 3, p. 106.

Type species, *Anomites resupinatus* Martin, 1809, pl. 49, figs. 13, 14.

Schizophoria iowensis (Hall)

(Pl. 8, figs. 8, 9)

Orthis iowensis Hall, 1858, Iowa Geol. Surv., v. 1, pt. 2, p. 488, pl. 2, figs 4a-i; Meek, 1867, Trans. Chicago Acad. Sci., v. 1, p. 90, pl. 12, figs. 2a-h; White,

1880, 2nd Annual Rept. Indiana Bureau of Statistics and Geol., p. 501, pl. 5, figs. 10-12; Keys, 1895, Missouri Geol. Surv., v. 5, p. 62, pl. 38, fig. 6.

Schizophoria iowensis Warren, 1944, Trans. Roy. Soc. Canada, sec. 4, v. 38, p. 109.

Schizophoria iowaensis Fenton and Fenton, 1924, Michigan Univ., Contrib. Mus. Paleont., v. 1, p. 83, pl. 19, figs. 5-11; Laird, 1947, Jour. Paleont., v. 21, p. 455, pl. 64, figs. 25, 26.

Orthis (*Schizophoria*) *striatula* Schlotheim, Whiteaves, 1892, Canada Geol. Surv., Contrib. Canadian Paleont., v. 1, pt. 4, p. 283.

Shell medium in size, biconvex, subquadrate, broadest slightly anterior to or at midlength; hinge line short, ⅔ of greatest width, posterior angles well rounded, front margin uniplicate. Dimensions of three hypotypes: length 20 mm, 23 mm, ——; width 25 mm, 28 mm, 30 mm; thickness 15 mm, 15 mm, 22 mm.

Pedicle valve strongly convex, with greatest curvature in umbonal region, sloping steeply toward posterior margin, gradually toward lateral margins, and more abruptly toward front margin resulting in a broad indistinct sulcus. Beak prominent, erect; foramen submesothyrid; beak ridges moderately distinct; cardinal area curving near beak, transversely striate; striations most obvious near hinge line. Delthyrium longer than wide, with an angle of about 50 degrees.

Brachial valve slightly more convex than pedicle valve; umbonal region greatly enlarged, projecting well beyond hinge line as the highest point of both valves. Beak closely incurved over cardinal area; area half as long as wide, indistinctly transversely striate.

Costellae fine, 14 to 15 in 5 mm at front margin, rounded, increasing by implantation and division on pedicle valve, by implantation on brachial valve. Furrows generally narrower posteriorly, wider anteriorly although never as wide as costellae. Where shell material partially exfoliated, extremely minute punctae cover the surface.

Internal structure: In brachial valve dental sockets deep, bounded posteriorly by the hinge line, laterally and anteriorly by the brachiophore. Cardinal process oval, about 1 mm in diameter. Adductor muscle impressions deep, divided longitudinally by a strong median septum and transversely by a broad rounded elevation. Anterior impressions larger than posterior impressions. A low well-marked ridge encircling muscle impressions. Each anterior muscle impression 4.5 mm wide, about 4.5 mm long; posterior muscle impressions 3 mm wide, 4 mm long.

Remarks: The Manitoba specimens of *Schizophoria* vary in thickness but the length-width ratio remains constant. Whiteaves identified this species as *Schizophoria striatula* Schlotheim. Schuchert (1897, p. 375) placed *S. iowensis* in synonymy with *S. striatula* after comparing specimens of *S. striatula* from Germany with *S. iowensis* in America. However, on close comparison of the two species, the writer believes that *S. striatula* is larger, rounder, not as elongate transversely, and the cardinal area on the pedicle valve is smaller and more abruptly curved. The Manitoba form resembles *S. striatula* more than *S. iowensis* only in the broader shallower sulcus on the pedicle valve.

Occurrence: Dawson Bay formation, Localities 2 and 5.

Types: Hypotypes G.S.C. 14804, 14805; M.M.B. 5851, 5853, 5854.

Order IMPUNCTATA TELOTREMATA Roger

Family *ATRYPIDAE* Gill

The family Atrypidae Gill is classified mainly on internal structures. Atrypids, according to Roger (1952, p. 96), have short crura connected to primary lamellae which diverge to the antero-lateral margins of the test; the spiralia are located between the lamellae.

Subfamily *ATRYPINAE* Waggen

In the subfamily Atrypinae (Roger, 1952, p. 98), the posteriorly situated jugum is discontinuous in adult forms; the spiralia diverge toward the middle of the dorsal valve, and a median septum is present and dental lamellae are absent. Members of this subfamily dominate the fauna of the Manitoba group.

Genus *Atrypa* Dalman

Atrypa Dalman, 1828, Kongl. Vet. Acad. Handl. Stokholm 1827, p. 93, pl. 4, figs. 2, 3, 4, pl. 5.

Type species, *Anomia reticularis* Linnaeus, 1758, p. 702, pl. 5, fig. 5.

Atrypa bremerensis Stainbrook

(Pl. 8, figs. 10-12)

Atrypa bremerensis Stainbrook, 1938, Jour. Paleont., v. 12, no. 3, p. 231, pl. 31, figs. 11-14.

Shell medium, dorsi-biconvex, suboval, broadest across midlength, broadly sulcate along front margin; hinge line straight, postero-lateral angles broadly rounded. Measurements of four hypotypes: length 19.5 mm, 18 mm, 16 mm, 15 mm; width 20 mm, 20 mm, 18mm, 14.5 mm; thickness 15.5 mm, 15 mm, 14 mm, 7.5 mm of which 14 mm, 12.5 mm, 11 mm and 7.5 mm respectively is thickness of brachial valve.

Pedicle valve slightly arched from beak to front along midline, moderately convex in umbonal region, flattening and becoming concave toward antero-lateral margins. Anterior margin having a broad shallow sulcus with a short lingual extension. Beak broad, pointed, becoming increasingly incurved with age.

Brachial valve strongly arched especially from midlength to umbonal region, transversely highly convex, flattening at lateral margins in older individuals. Gibbosity of valve increasing with age, often extending the umbonal region well beyond the hinge line. Fold indistinct.

Costae of both valves coarse, broadly rounded, diverging and becoming broader antero-laterally, increasing by implantation, 4 to 5 in 5 mm at front margin. Furrows narrow, moderately shallow in umbonal region, becoming almost as wide as costae toward anterior margin. Growth lines not prominent, more pronounced on brachial than on pedicle valve, absent in some specimens.

Internal structure: In the pedicle valve, adductor impressions small, forming small triangular depression 1.8 mm wide at base and 2 mm high; apex of this triangle located 3 mm from hinge line, 1.2 mm distant from bases of teeth. Diductor impression large, deep, causing the umbonal convexity on valve, pyriform in shape, base of narrow portion being base of adductor scars. Greatest width of both diductor impressions 9 mm, total length 9 mm, length of bulbous portion of muscles 7.5 mm. Grooves somewhat radiating, extending from base of adductor scars to base of diductor scars. Some specimens with a distinct ridge surrounding the muscle impression. Vascular impressions not clearly marked. Coarse genital markings surrounding muscle area in a wide zone. Two distinct grooves representing depression of first ascending lamellae running from muscle area to front margin, increasing in width to 2 mm toward margin. Measurements of interior of pedicle valve made on hypotype 17.3 mm long, 18 mm wide, 12 mm thick.

In brachial valve, dention and spiralia not exposed. Adductor muscle impressions distinct, oval, very deep in gerontic specimens resulting in extreme gibbosity of umbonal region. At this growth stage, 3 or 4 deep lengthwise grooves located in posterior area of adductor impression, the third groove from the margin being broadest, 0.7 mm wide, other grooves approximately 0.4 to 0.5 mm wide. Median

septum seen as a ridge with a slight depression running through the middle. Measuring two hypotypes, width of each muscle scar, 5.2 mm, 4 mm; length 7.4 mm, 4.8 mm. Size of specimens on which measurements of brachial valve made: length 19 mm, 17 mm; width 17 mm, 18.5 mm; thickness 16 mm, 12 mm, respectively. No genital impressions within 5 mm radius of muscle area; beyond this radius, genital impressions large, oval, elongate transversely, averaging 0.8 to 0.9 mm in greatest diameter; toward margins, impressions smaller, rounder, 0.4 to 0.5 mm in diameter, more obviously arranged in rows. Vascular impressions composed of two main trunks originating from anterior margin of adductor impression, paralleling the septum and 1 to 3 mm from it. Secondary trunk branching from main trunk ¼ distance from muscle scars to anterior margin. Main trunk dividing again into 4 minor branches, which in turn divide twice more. Major trunk continuing from secondary branch to ½ distance between muscle scars and anterior margins when it divides again and a few millimeters above anterior margin divides for the last time.

Remarks: The Manitoba specimens have a less pronounced sinute margin than the specimens from the type locality at Iowa. Also in mature specimens from Manitoba, the width commonly exceeds the length; the Iowa forms are usually longer than wide. Both forms have a highly arched brachial valve, similar size of shell and similar number of costae.

Specimens identified from Charlie Island as *Atrypa* n. sp. by Baillie (1950, p. 57) are *A. bremerensis.*

Occurrence: Dawson Bay formation, Localities 2, 4, 5, 6.

Types: Hypotypes G.S.C. 14810-14812.

Atrypa manitobensis n. sp.

(Pl. 8, figs. 13, 14)

Shell medium in size, unequally biconvex, greatest width posterior to midlength; hinge line slightly curved, long but angles usually broken off; front margin with a slight plication. Dimensions of holotype and three paratypes: length *32 mm,* 23.5 mm, 24.5 mm, 21 mm (incomplete); width *30 mm,* 21.5 mm (incomplete), 23.5 mm, 20.5 mm; thickness *16.5 mm,* 12.5 mm, 12 mm, 10 mm.

Pedicle valve slightly convex along mid-line; convexity greatest in umbonal region, not as pronounced anterior to midlength, flattening along lateral margins, concave toward postero-lateral margin, becoming flat at extremities. Sulcus not developed. Beak pointed, suberect, extending 2.5 mm beyond hinge line in holotype, 2 mm in a paratype; foramen large, oval, submesothyrid.

Brachial valve moderately convex; greatest curvature posterior to midlength, gradually sloping anteriorly, more steeply sloping anterolaterally and again more gradually postero-laterally. Fold not developed.

Surface with coarse angular radiating costae, 4 to 5 in 5 mm, increasing by division in marginal area on pedicle valve, increasing by implantation on brachial valve. Furrows equal to or wider than costae. Growth lines not well developed.

Internal structure: On pedicle valve teeth 1.5 mm in greatest width, 3 mm in length, forming large deep elongate depressions 3 mm from hinge line and 2 mm from median septum. Muscle scars less prominent than tooth depressions. Adductor muscle scar 3 mm from hinge line, elongate, 4 mm in length. Diductor impression 10 mm wide, 9 mm long, shallow, subtriangular to subquadrate; outlined by a faint ridge, bounded posterolaterally by tooth impressions. Other internal structures masked by costae.

In brachial valve adductor impressions triangular, angles rounded, not well defined, 11 mm in greatest width, 10 mm in length. Three weakly developed grooves in upper narrowing portion of muscle impression. All other structures masked by impressions of costae.

Remarks: Valves are biconvex in early growth stages. With age, the brachial valve increases in convexity and the umbo pedicle valve becomes more pronounced especially in gerontic specimens. All internal structure of young forms is masked by impressions of costae extending from beak to margin.

A. manitobensis differs from *A. independensis* in coarser costae, more prominent beak, width less than length, lack of growth lamellae and interiorly in muscle structure. Externally, *A. manitobensis* resembles *Atrypa snakensis* n. sp. but differs in its smaller size, more prominent beak, and no fold or sulcus. Internally the two species are completely different.

Occurrence: Dawson Bay formation, Localities 2, 4, 5, 6, Bell River outlet, Dawson Bay, Lake Winnipegosis.

Types: Holotype G.S.C. 14813, Paratypes G.S.C. 14814-14816, Hypotypes LM17, LM10 (Baillie collection).

Atrypa independensis Webster
(Pl. 9, figs. 1-4)

Atrypa reticularis (Linné) Hall and Whitney, 1858, Geol. Survey Iowa, v. 1, pt. 2, p. 515, pl. 6, figs. 4, 5; Hall, 1867, New York Geol. Surv., Paleontology, v. 4, pt. 1, p. 316, pl. 53, figs. 14, 15, 16? (partim); Whiteaves, 1892, Canada Geol. Surv. Contrib. Canadian Paleont., v. 1, pt. 4, p. 289, pl. 37, fig. 8 (partim); Thomas, 1916, Iowa Acad. Sci. Proc., v. 23, p. 173, pl. 5C, figs. 1-8.

Atrypa independensis Webster, 1921, American Midland Nat., v. 7, p. 15; Stainbrook, 1938, Jour. Paleont., v. 12, p. 229, pl. 30, figs. 10, 15, 16.

Atrypa independensis Fenton and Fenton, 1932, American Midland Nat., v. 13, p. 206, figs. 1, pl. 21, figs. 1-4; Fenton and Fenton, 1935, Jour. Paleont., v. 9, no. 5, p. 377, pl. 41, figs. 9-12, pl. 42, figs. 14-16, pl. 43, fig. 12.

Atrypa expansa Webster, 1921, American Midland Nat., v. 7, p. 15.

Shell medium-sized or larger, unequally biconvex, suboval, broadest posterior to midlength; hinge line straight, slightly shorter than greatest width; frilled lateral and anterior margins; anterior margin uniplicate in adults, smooth in immature specimens. Dimensions of three hypotypes: length 40 mm, 26.5 mm (incomplete), 26 mm; width 50 mm, 30 mm, 25 mm; thickness ——, 13 mm, 15 mm.

Pedicle valve slightly convex from beak to front margin, greatest curvature in umbonal region, flattening laterally, sloping gradually to front margin forming shallow sulcus extending from midlength to front margin. Beak broad, low, incurved in adults, more pointed and less incurved in young forms.

Brachial valve moderately convex, greatest convexity at midlength, sloping steeply antero-laterally, flattening at cardinal angles. Fold indistinct, rarely with slight flexure to mark the limits of the fold. Beak hidden.

Costae fine, sharply rounded, 7 to 8 in 5 mm, increasing by division. Furrows deep, about half as wide as costae. Growth lamellae prominent, far apart on valve, more numerous on frills.

Internal structure: Brachial valve with adductor impressions distinct, large, round, located on each side of median septum which becomes prominent at anterior portion of scars; posterior edge of impression 4 mm above hinge line. Muscle impressions with 5 grooves about 3 mm wide. Grooves very deep at posterior portion, indistinguishable in anterior portion of muscle scar. Each muscle scar 5 mm in width, 6 mm in length. Area between muscle impression and main vascular trunk, 4.5 mm at hinge line increasing to 10 mm at anterior, punctuated by genital pores. Vascular trunk surrounding this area; beyond boundary of trunk main branches dichotomize several times.

Remarks: In immature forms, valves are biconvex. During growth the animal becomes less biconvex, the pedicle valve gradually flattens at the margins. Forms under 15 mm in length have internal structure obscured by impressions of costae.

In brachial valves, ridges bounding the median septum in the umbonal region are strongly developed.

Specimens of *A. independensis* from the Point Wilkins member do not attain the large size found in other units, also muscle development is stronger in the Point Wilkins forms, making umbonal region of brachial valve more swollen.

Occurrence: Dawson Bay formation, Localities 1, 2, 4, 5, 6, and 88 (Baillie), near Steeprock River. Souris River formation, Localities 8 and 11.

Types: Hypotypes G.S.C. 14817-14820; M.M.B. 5832, 58149-58151; UM3 (Baillie collection).

Atrypa snakensis n. sp.

(Pl. 9, figs. 5-9)

Shell large, unequally biconvex, subquadrate to shield-shaped, widest posterior to midlength, hinge line straight, slightly shorter than greatest width; broadly, deeply sulcate along front margin, frilled. Measurements of holotype and two paratypes: length *40 mm*, 36 mm, 33 mm; width *38 mm*, 36 mm, 31 mm; thickness *23 mm*, 21 mm, 20 mm of which *14 mm*, 14 mm, 13 mm are thickness of brachial valve.

Pedicle valve slightly to moderately arched along mid-line, transversely gently domed with greatest curvature in umbonal region. Sulcus broad, shallow, extending from midlength to front margin, produced into a lingual extension at front margin. Beak broad, pointed, slightly incurved. Foramen large, oval.

Brachial valve moderately convex along mid-line, greatest curvature at midlength, sloping slightly to front margin, sloping steeply toward lateral margins; in some specimens flattening at lateral margin, concave along posterior cardinal angles. Fold broad, defined by slight concavity on sides, but often indistinguishable. Beak concealed.

Costae sharply rounded to angular, increasing by division and implantation, 4 to 5 in 5 mm at front margin. Growth lines usually lacking or not well developed.

Internal structure: Pedicle valve with adductor muscle impressions small, club-shaped, located on median septum, opposite teeth. Diductor impression large, flabellate, 7.5 mm wide, 13 mm long, laterally, moderately depressed, anteriorly level with interior of valves, marked by deep radiating grooves. Muscle scars measured on specimen 36 mm long, 38 mm wide. Vascular trunk well marked, running along lateral margins of muscle scars, continuing anteriorly to within ⅓ distance of front margin where trunk becomes indefinite. Secondary artery branching off vascular trunk opposite base of diductor impressions. Less prominent arteries given off regularly along length of valve. Genital markings not always evident, but when observed have a beaded appearance, in longitudinal rows especially pronounced at midlength between the vascular trunk and muscle impression, more or less concentric around vascular trunk between the trunk and the margins. Median septum a slight ridge. Two broad depressions along center of valve marking primary lamellae.

Brachial valve with adductor impressions not well defined; kidney-shaped, 11.5 mm wide, 9 mm long, divided centrally by median septum, posterior portion of muscle 3 mm from hinge line. Paratype on which measurements made, 33 mm long, 32 mm wide (incomplete). Vascular markings moderated to deep, angular grooves, coalescing from margins toward anterior where about 8 branches join main trunk surrounding muscle impressions.

Genital impressions faint in some, not observed in others.

Remarks: The interior of *Atrypa snakensis* resembles the interior of the lectotype *A. reticularis* (Alexander, 1948, p. 210) more closely than any other *Atrypa* found in Manitoba. The major difference between the two species is the vascular trunk.

In *A. reticularis*, the main trunk begins at the antero-lateral corners of the diductor impressions, whereas in the Manitoba form, the vascular trunk surrounds the muscle area, giving out a major secondary branch opposite the antero-lateral corners of the diductor impressions.

Immature specimens have a small broad shallow sulcus about 1 mm wide in the umbonal region of the brachial valve, and are almost identical to what Kindle (1908, p. 29) calls *Atrypa missouriensis* (Miller) in the Jefferson formation of Montana.

A. snakensis is distinguished from *Atrypa rustica* Stainbrook by its length: thickness relationship; in *A. snakensis*, length: thickness is 2:1, in *A. rustica* the proportions are 3:2. Also *A. rustica* is smaller and the hinge line is shorter. *A. snakensis* differs from *Atrypa rubromitra* Crickmay in not having a flat pedicle valve, and beak not overshadowing umbo of brachial valve but projecting 3.5 mm above hinge line as measured in holotype of *A. snakensis*.

Occurrence: Dawson Bay formation, Localities 4, 5, 6.

Types: Holotype G.S.C. 14821. Paratypes G.S.C. 14822-14826; Hypotypes G.S.C. 14827; M.M.B. 5831, 5836, 5839.

Atrypa sp.

(Pl. 10, fig. 21)

Shell of medium size, shield-shaped, widest slightly anterior to hinge line; hinge line straight, cardinal angles broadly rounded. Measurements: length 18 mm, width 20 mm, thickness of brachial valve 7 mm.

Brachial valve moderately convex along mid-line, greatest curvature posterior to midlength, steeply sloping toward anterior and lateral margins, flattening toward postero-lateral angles. Fold not developed. Beak small, incurved.

Costae narrow, rounded, widely spaced in posterior portion of valve, rarely dividing, 5 in 5 mm measured 15 mm from beak. At this point, implantation occurring between the costae resulting in twice as many costae as in posterior portion, diverging slowly to margins where 7 in 5 mm occur at front margin. Growth lines not developed.

Remarks: Description is based on one large brachial valve embedded in limestone. The species is characterized by the marked difference in number of costae between the umbonal region and the front margin. In this character it resembles *A. varicostata* Stainbrook and *Atrypa trowbridgei* Fenton and Fenton. The specimen differs from *A. varicostata* in shape of shell and in convexity of brachial valve, also in lacking a fold and lamellose growth lines. *Atrypa sp.* differs from *A. trowbridgei* in having a pronounced sudden increase of costae which are narrower and furrows wider, and in absence of growth lamellae.

Occurrence: Souris River formation, Locality 11.

Type: Hypotype G.S.C. 14809.

Genus *Spinatrypa* Stainbrook

Spinatrypa Stainbrook, 1951, Jour. Washington Acad. Sci., v. 41, no. 6, p. 196. *Hystricina* Stainbrook, 1945, Geol. Soc. Amer., Mem. 14, p. 49.

Type species, *Atrypa aspera* var. *occidentalis* Hall, 1858, p. 515, pl. 6, figs. 3a-d.

Spinatrypa mascula (Stainbrook)

(Pl. 10, figs. 20, 22, 23)

Atrypa mascula Stainbrook, 1938, Jour. Paleont., v. 12, no. 3, p. 241, pl. 32, figs. 19-21, 23-25.

Shell medium to large, oval to subquadrate, broadest posterior to midlength; hinge line curved, shorter than greatest width; angles rounded, margins plicate. Measurements of four hypotypes: length 20 mm, 26 mm, 24 mm, 21 mm; width 21 mm, 23 mm, 28 mm, 21 mm; thickness 16 mm, 16 mm, 20 mm, 13 mm.

Pedicle valve slightly to moderately convex in umbonal region, flattening at lateral margins, and having broad shallow sulcus extending from midlength to anterior margin; short lingual extension on some specimens. In young forms, sulcus not developed. Beak stout, incurved over brachial valve. Foramen not always observed.

Brachial valve more convex than pedicle, gibbous in gerontic stage, greatest convexity posterior to midlength; transversely, maximum convexity at median line, subhemispherical in older specimens. Median fold not distinct, in many specimens valve shortened along the front margin due to upturning of pedicle sulcus. Umbonal region prominent, level with or projecting beyond hinge line. Beak completely concealed.

Surface of both valves with coarse, broadly rounded, radiating costae, 1 or 2 in 5 mm at margin. Furrows equal in size to costae in umbonal region, increasing little in width toward margins. Generally the 2 median plications stronger than the others, forming distinct ridges on interior molds of valves. Growth lines strong, forming imbricate structure with costae, occasionally on well preserved specimens, bases of spines 1 mm in diameter.

Internal structure: Dentition not exposed. In pedicle valve, adductor muscle impressions small, subrounded, located below beak, on either side of median line. Diductor muscle scars large, 10 mm wide, 8.5 mm long, deep, especially toward beak. Muscle area outlined by a ridge pronounced posteriorly, fainter anteriorly. Median septum distinct in muscle area. Complete system of vascular impressions poorly defined, extending to margin of valve. Genital markings observed on almost all inner molds. In the brachial valve, adductor impressions sausage-shaped, confined to umbonal region, width of each scar 3.5 mm, length 7.5 mm. Pseudo-septum represented by a ridge with a narrow median furrow. Genital markings in longitudinal rows, large around antero-lateral corners of adductor impressions, small over remainder of valve. Vascular impressions not well marked. Muscle measurements made on hypotype 30.5 mm long, 19 mm wide.

Remarks: Manitoba specimens of *S. mascula* are smaller than those from the Cedar Valley formation of Iowa but agree closely in all other characters.

Immature forms of *S. mascula* and its variety *manitobensis* are much alike. The beak of *S. mascula manitobensis* is more pointed, and the valves are more nearly biconvex than in *S. mascula*.

Occurrence: Dawson Bay formation, Localities 1, 2, 3, 4, 5, 6; Souris River formation, Locality 9—rare.

Types: Hypotypes G.S.C. 14828-14830, 14802; M.M.B. 58171, 58172.

Spinatrypa mascula var. *manitobensis* n. var.

(Pl. 10, figs. 18, 19)

Shell medium, suboval, becoming subquadrate in adult stage, biconvex, brachial valve slightly more convex than pedicle; broadest at midlength; hinge line curved. Dimensions of holotype and three paratypes: length *17 mm*, 17 mm, 15 mm, 13 mm; width *18.5 mm*, 19 mm, 14 mm, 13 mm; thickness *8 mm*, 9 mm, 6 mm, 5.5 mm.

Pedicle valve moderately convex, flattened anteriorly along midline, sloping gradually toward lateral margins. Sulcus not developed. Beak pointed, becoming more incurved with age.

Brachial valve slightly more convex than pedicle valve, flattened at midlength, sloping gradually toward umbo, more rapidly or even geniculate anteriorly. Fold not present. Beak hidden.

Surface of both valves with coarse, broadly rounded costae 2 in 5 mm at anterior margin, increasing by division about 5 mm from margin. Furrows wide and shallow at the margins, narrowing toward the apex. Distinct regularly dispersed growth lines forming nodes at intersection with costae.

Remarks: The resemblance of young forms of *S. mascula* and *S. mascula* var. *manitobensis* has been discussed in the previous description. In mature forms, some individuals may be assigned either to the species or its variety. However, in most cases, the variety can be distinguished by its more pointed beak, the biconvex valves, the absence of fold and sulcus, convexity greatest anterior to midlength in brachial valve, and the plications always numbering 2 in 5 mm.

Spinatrypa rockfordensis (Fenton and Fenton) differs from *S. mascula* var. *manitobensis* in having a more quadrate outline, a less prominent beak and more numerous costae. *S. manitobensis* can be distinguished from *Spinatrypa bellula* (Stainbrook) by its lack of fold and sulcus, no tendency to gibbosity in gerontic specimens, and always having a convex pedicle valve.

Occurrence: Dawson Bay formation, Localities 1, 2, 3, 4, 5, 6; Souris River formation, Locality 9.

Types: Holotype G.S.C. 14831. Paratypes G.S.C. 14832-14835.

Family *SPIRIFERIDAE* King

Genus *Emanuella* Grabau

Emanuella Grabau, 1925, Stratig. China, Peking, pt. 1, 1923-24, p. 192, fig. 130.

Type species, *Spirifer undiferus* var. *takwanensis* Kayser in Richtofen 1883, China, v. 4, p. 86, pl. 11, fig. 1.

Emanuella richardsoni (Meek)

(Pl. 10, figs. 11a-c)

Spirifera (*Martinia*) *richardsoni* Meek, 1868, Trans. Chicago Acad. Sci., v. 1, art. 3, p. 104, pl. 14, figs. 2a-c; Whiteaves, 1891, Canada Geol. Surv., Contrib. Canadian Paleont., v. 1, pt. 3, p. 226; ——, 1892 *ibid.*, v. 1, pt. 4, p. 287, pl. 37, fig. 7.

? *Spirifera* (*Martinia*) *sublineata* Meek, 1868, Trans. Chicago Acad. Sci., v. 1, art. 3, p. 103, pl. 14, figs. 1a-c.

Martinia sublineata Warren, 1944, Trans. Roy. Soc. Canada, sec. 4, ser. 3, v. 38, p. 127, pl. 3, figs. 22-25.

Shell small, unequally biconvex, semicircular to subtriangular, width greater than length, greatest width at midlength; postero-lateral angles well-rounded, hinge line ¾ of total width; mature specimens slightly uniplicate. Dimensions of four hypotypes: length of pedicle valve 9.5 mm, 6 mm, 7 mm, 5 mm; length of brachial valve 8.5 mm, 5 mm, 6 mm, 4.5 mm; width 12 mm, 9 mm, 8 mm, 6 mm; thickness 6.5 mm, 4.5 mm, 5 mm, 3 mm.

Pedicle valve strongly arched, deep, greatest convexity in umbonal region, transversely almost hemispherical. Beak ridges indistinct; beak erect, pointed, extending 1.5 to 2 mm beyond hinge line; foramen hypothyrid. Interarea strongly curved in young specimens, less curved in older specimens. Sulcus not developed, but front margin extending into very short lingual projection on larger specimens.

Brachial valve moderately convex, greatest convexity in umbonal region, flattening toward margins. Beak incurved, extending a short distance beyond hinge line. Fold absent.

Internal structure: Pedicle valve containing only teeth. Brachial valve with 2 converging dental socket plates extending to almost half the length of the specimen. Median septum absent. Several loops of spiralia in well preserved interiors.

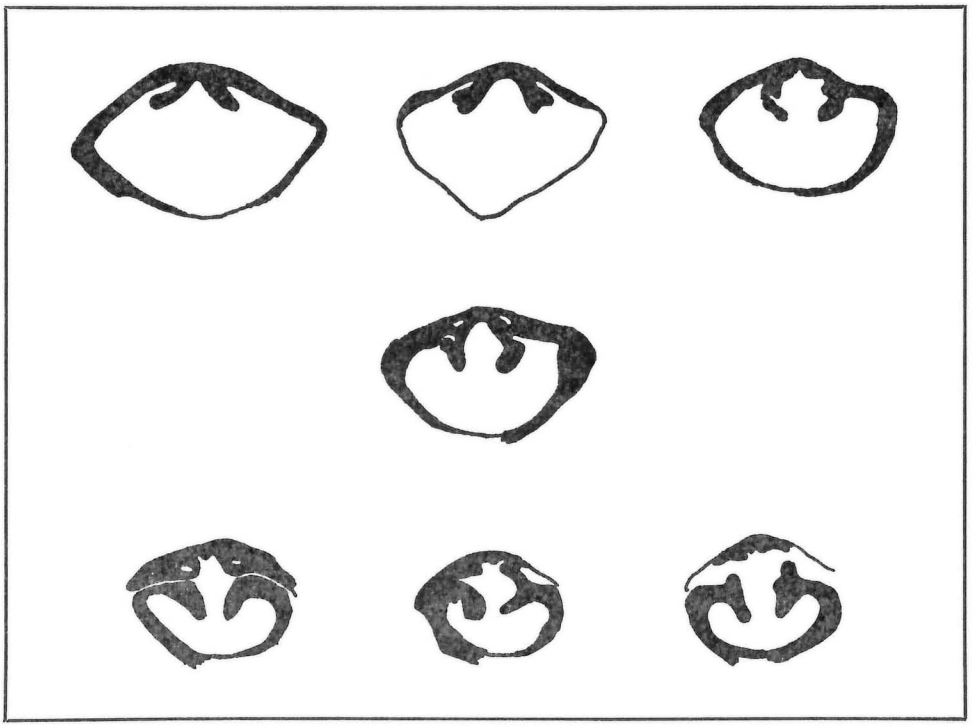

Figure 2

A series of 7 cross-sections of *Emanuella richardsoni* (Meek) (x 5), from Snake Island, Lake Winnipegosis, showing the hinge teeth of the pedicle valve, the median septum and development of dental socket plates of brachial valve.

Surface ornamentation consisting of faint concentric lines, commonly not seen where shell material exfoliated.

Remarks: Meek distinguished *Emanuella sublineata* from *Emanuella richardsoni* by an obscure furrow extending from the beak to the front margin of the ventral valve of *E. sublineata*. Warren has noted this structure in topotypes of both species and thus considered *E. richardsoni* synonymous with *E. sublineata*. The original types of *E. sublineata* are lost and only the holotype of *E. richardsoni* is preserved so that a section of internal structure cannot be made. McLaren (1958, personal communication) believes that *E. richardsoni* and *E. sublineata* are synonymous with *Emanuella meristoides* (Meek) and fall within the range of variation in this species.

Occurrence: Dawson Bay formation, Souris River formation, at all collecting localities, questionably in the Point Wilkins member Locality 11.

Types: Hypotypes G.S.C. 14836-14839. LM24 (Baillie collection).

Subfamily Martiniinae Waggen

Genus *Allanaria* Crickmay

Allanaria Crickmay, 1953, Published by Author, Imperial Oil Ltd., Calgary, Canada, p. 5.

Type species, *Spirifer allani* Warren, 1944, p. 123, pl. 2, figs. 16-18.

Allanaria allani (Warren)

(Pl. 10, figs. 12-17)

Spirifer tullia Hall var. Whiteaves, 1891, Canada Geol. Surv., Contrib. Canadian Paleont., v. 1, pt. 3, p. 224, pl. 32, figs. 2, 2a, b.

Spirifer allani Warren, 1944, Trans. Roy. Soc. Canada, sec. 4, ser. 3, v. 38, p. 123, pl. 2, figs. 16-18.

Allanaria allani Crickmay, 1953, Published by Author, Imperial Oil Ltd., Calgary, Canada, p. 6, pl. 1, figs. 1-12.

Shell medium-sized or smaller, semicircular to subtriangular, unevenly biconvex; width greatest at hinge line or immediately anterior to it; front margin uniplicate, postero-lateral corners angular to rounded. Dimensions of hypotype: length of pedicle valve 17 mm, length of brachial valve 12 mm, width 19 mm, thickness of both valves 11 mm, thickness of pedicle valve 7 mm.

Pedicle valve convex, especially from midlength to umbo; convexity becoming less anteriorly, sloping gradually toward lateral margins, more steeply toward posterior. Sulcus wide, ⅓ of valve, flat-bottomed in older specimens, rounded in younger specimens. Beak high, suberect; cardinal area wider than high, arched backward.

Brachial valve slightly convex; convexity greatest at midlength, flattening toward lateral and postero-lateral margins. Fold narrowly triangular in umbonal region, expanding more rapidly anterior to midlength, flattened at front margin. Beak small, projecting above cardinal margin.

Surface ornamentation consisting of 9 to 11 costae on each side of sulcus and fold; fila finely radiating, about 10 to 1 mm. Concentric striae, 5 to 7 in 1mm, not well preserved.

Remarks: Specimens from the quarry west of Winnipegosis (Locality 8) previously identified as *Spirifer* cf. *cardinalis* Belanski (Baillie, 1950, p. 58) are here assigned to *A. allani*. Although *Spirifer cardinalis* and *A. allani* are similar in some respect, they differ in average size of specimens, width: length relationship, convexity of brachial valve, nature of cardinal margins, and width of sulcus at front margin.

The Manitoba specimens closely resemble Crickmay's illustrations of Warren's syntypes of *A. allani* (1953, pl. 1, figs. 6, 7). Specimens from Localities 9 and 11 show surface ornamentation; all specimens from Locality 8 are exfoliated.

Occurrence: Souris River formation, Localities 8, 9, 11.

Types: Hypotypes G.S.C. 14840-14845; M.M.B. 5845; UM5 (Baillie collection).

Family *SPIRIFERINIDAE* Davidson

Genus *Cyrtina* Davidson

Cyrtina Davidson, 1859, Monog. British Carb. Brachiopoda, Paleont. Soc., v. 11, pt. 5, p. 66.

Type species, *Calceola heteroclyta* Defrance, 1824, p. 306.

Cyrtina hamiltonensis Hall

(Pl. 10, figs. 1, 2)

Cyrtina hamiltonensis Hall, 1857, Tenth Rept. State Cabinet, p. 166; Billings, 1861, Devonian Fossils of Canada West, p. 263; Meek, 1867, Trans. Chicago Acad. Sci., v. 1, art. 3, p. 99, pl. 14, figs. 5, 7, 10; Hall, 1867, New York Geol. Surv., Paleontology, v. 4, pt. 1, p. 268, pl. 27, figs. 1-4, pl. 44, figs. 26-33, 38-52; Nicholson, 1874, Rept. Paleont. Prov. Ontario, p. 83; Walcott, 1884, U.S.G.S. Monog. v. 8, p. 147; Kindle, 1901, Indiana Dept. Geol. and Nat. Res. 25th Ann. Rept. for 1900, p. 591.

Shell small to medium for the genus, subpyramidal, unequally biconvex, length almost equal to width, greatest width at midlength; hinge line as long as width, posterior extremities angular. Front margin uniplicate. Shell material punctate. Dimensions of two hypotypes: length 14 mm, 11 mm; width 15.5 mm, 13 mm; thickness 12 mm, 10 mm; length of interarea 8.5 mm, 7.5 mm.

Pedicle valve almost straight from front to beak, steeply sloping from beak to anterior and lateral margins. Sulcus well defined from beak to front margin, forming a prominent lingual extension at the margin. Lateral slopes curving away abruptly from sulcus, 7 to 9 costae on each lateral slope, traversed by faint growth lines. On exfoliated specimens costae still rather distinct. Beak pointed, beak ridges distinct; area large, broadly curved, delthyrium 23 to 25 degrees.

Brachial valve slightly convex, transversely greatest convexity at midlength, sloping gently to margins. Fold distinct, extending from beak to front margin, at front margin ⅓ of width, projecting above general surface only in anterior portion. Seven to eight costae on each lateral slope, present on exfoliated specimens also. Growth lines near front margin.

Remarks: Hall's original description permits great variability of this species. The species is characterized by a hinge line equal to the greatest width, height of area approximately equal to length of brachial valve and 6 to 8 costae on each lateral slope of the valves.

Occurrence: Dawson Bay formation, Localities 2 and 5.

Types: Hypotypes G.S.C. 14846, 14847.

Cyrtina paucicostata n. sp.

(Pl. 10, figs. 3-9)

Shell medium-sized, pyramidal in shape, subquadrate in outline, almost planoconvex; slightly asymmetrical due to the inclination of beak area; length ¾ that of width, greatest width at midlength; hinge line slightly shorter than maximum width; postero-lateral margins broadly convex, front margin broadly uniplicate.

Dimensions of holotype and two paratypes: length *10 mm*, 9 mm, 10 mm; width *14 mm*, 16 mm, 14 mm; thickness *11.5 mm*, 12 mm, 13 mm; length of interarea *11 mm*, 9 mm, ——.

Pedicle valve subpyramidal, broadly curved from front to beak; beak highest point on valve; surface steeply sloping toward all margins, decreasing in intensity toward front. Sulcus broad, well defined, extending from beak to front, deep, angular posteriorly, flattening anteriorly with a moderately long lingual extension. One side of beak usually slightly inclined over the other. Beak ridges well defined; area large, flat, divided into 2 almost right-angled triangles by delthyrium. No deltidium. Costae on pedicle valve not well shown because of exfoliation. Costate impression on each side of sulcus visible near antero-lateral margins in young forms, but disappearing in adults.

Brachial valve depressed convex; transversely greatest convexity in umbonal region; surface flattening toward posterior and lateral margins, gently sloping to front margin where well-defined fold extending from beak to front margin, not elevated above general surface. Costae, 8 to 9 on each lateral slope, usually exfoliated, seen faintly on anterior and lateral margins. Wide furrows on either side of fold deepening toward anterior margin. Costae next to trough strongly impressed on interior of valve. Growth lines apparent near anterior margin.

Internal structure: Both valves papillose except for muscle impression. Brachial valve with bifid cardinal process, small brachiophore, adductor impressions located on fold on either side of narrow median septum; medium septum extending to midlength of valves.

Remarks: In young specimens of *Cyrtina paucicostata* the lingual extension is sharply angular and the pedicle beak may be slightly incurved. Slightly posterior to midlength of some adult specimens, costae bounding the sulcus divide; the inner costae are very weakly developed, becoming indistinct at anterior.

Cyrtina paucicostata differs from *Cyrtina hamiltonensis* Hall by not having costae as well developed and as numerous, by having a flat area, a hinge line shorter than greatest width; also the width in *C. paucicostata* is proportionally greater than length. In the brachial valve of *C. paucicostata*, the lateral slopes are almost flat whereas those in *C. hamiltonensis* are inclined.

C. paucicostata resembles *Cyrtina panda* Meek in the flat interarea, but differs in number of costae on lateral slopes, and absence of fine striae on fold and sulcus.

Occurrence: Dawson Bay formation, Localities 1, 5, 6, 7.

Types: Holotype G.S.C. 14848. Paratypes G.S.C. 14849-14858.

Family *MERISTELLIDAE* Hall and Clarke

Genus *Nucleospira* Hall

Nucleospira Hall, 1859, 12th Rept. New York State Cabinet Nat. Hist., p. 219.

Type species, *Spirifer ventricosa* Hall, 1857, p. 57.

Nucleospira sp.

(Pl. 10, fig. 10)

Shell small, transversely oval, almost round, greatest width slightly anterior to midlength; hinge line short; postero-lateral angles broadly rounded. Dimensions: length 14 mm, width 16 mm.

Pedicle valve moderately convex, greatest rounding at midlength. Beak small, pointed, nearly straight; projecting slightly above hinge line.

Surface covered with papillae which appear to be remains of numerous spinules covering the surface. A few concentric growth lines near margins.

Remarks: Available material consists of one complete pedicle valve which differs from most described species of *Nucleospira* in its comparative flatness. It resembles *Nucleospira concinna* Hall in its large size.

Occurrence: Souris River formation, Locality 9.

Type: Hypotype G.S.C. 14859.

Family *ATHYRIDAE* Phillips

Genus *Athyris* McCoy

Athyris McCoy, 1844, Synopsis Carbonif. Fossils, Ireland, p. 146.

Type species, *Terebratula concentrica* Von Buch, 1833, p. 103.

Athyris vittata Hall is the only definitely recognizable species of *Athyris* in the Point Wilkins member. Additional species of *Athyris* may be represented by unidentifiable fragments.

Athyris vittata Hall

(Pl. 11, figs. 1-3)

Athyris vittata Hall, 1860, 13th Rept. Regents New York State Cabinet Nat. Hist., p. 89; ——, 1867, New York Geol. Surv., Paleontology, v. 4, pt. 1, p. 289, pl. 46, figs. 1-4; White, 1880, 2nd Ann. Rept. Indiana Bureau of Statistics and Geol., p. 502, pl. 4, figs. 8, 9; Whiteaves, 1892, Canada Geol. Surv., Contrib. Canadian Paleont., v. 1, pt. 4, p. 288; Keyes, 1895, Geol. Survey Missouri, v. 5, p. 90, pl. 41, figs. 1a-b.

Athyris fultonensis (Swallow) Kindle, 1900, 25th Ann. Rept. Dept. Geol. and Nat. Res., Indiana, p. 597; Cleland, 1911, Wisconsin Geol. Surv., Bull. 21, p. 83, pl. 14, figs. 1-4.

Shell small to medium in size, biconvex, pentagonal outline in immature forms, posterior margin gently curved; lateral margins rounded; anterior margin gently paraplicate; width exceeding length, greatest width about the middle. Shell thick. Dimensions of three hypotypes: length 16 mm, 13 mm, 11 mm (reconstructed); width 17 mm, 13 mm, 12 mm; thickness 8 mm, 7 mm, 6 mm (all with shell material removed).

Pedicle valve moderately convex from beak to front, with greatest curvature in umbonal region, transversely broadly convex. Sulcus narrow, shallow, broadly rounded, originating posterior to midlength, not always distinguishable in exfoliated specimens. Lingual extension short, broadly rounded. Flanks of umbonal region steeply sloping, convex. Beak extending beyond hinge line about 2 mm and overlapping slightly over brachial valve.

Brachial valve about equal in convexity to pedicle valve, gently convex but increasing in convexity in umbonal region; broadly rounded transversely. Fold wide, gently convex, defined from front margin to midlength by two indistinct broad, shallow lateral grooves. Flanks sloping gradually to margin. Umbonal region somewhat swollen, extending short distance beyond hinge line.

Surface with coarse regular growth lamellae about 5 in 2 mm, becoming somewhat more crowded toward front margin.

Remarks: In young forms of *Athyris vittata*, the fold and sulcus are not well developed, but as the individual matures, the fold and sulcus become wider and better defined. The Manitoba specimens differ from the types in the less sinuate front margin. The sinuosity approaches specimens figured by Cleland (1911, pl. 14, figs. 2-4) from the Devonian of Wisconsin.

Hall first described *A. vittata* from the Cedar Valley limestone near Iowa City, Iowa. In 1867 he extended the range of this species, which he recorded from the Falls of the Ohio, Indiana, and New Buffalo, Iowa. Fenton (1935, p. 114) believes

these lower forms "may be variants of the *Athyris spiriferoides* stock, homeomorphic with *A. vittata.*"

Specimens from Rose Bush Island, Manitoba, are large and do not have a well developed fold and sulcus. These forms may not be conspecific with the forms from Point Wilkins but sufficient material is not available to determine if the differences are environmental or specific.

Occurrence: Dawson Bay formation, Locality 7; Souris River formation, Point Wilkins member, Locality 11; Rose Bush Island, Swan Lake, Manitoba.

Types: Hypotypes G.S.C. 14679, 14860, 14861; M.M.B. 5886, 5888, 5889, 58144.

Order TELOTREMATA PUNCTATA Roger

Family *DIELASMATIDAE* Schuchert

Genus *Cranaena* Hall & Clarke

Cranaena Hall and Clarke, 1893, New York Geol. Surv., Paleontology, v. 8, pt. 2, p. 297, pl. 80, figs. 13-19; text fig. 215.

Type species, *Terebratula romingeri* Hall, 1863, p. 4, pl. 1, figs. 12-17, text fig. 1.

Cranaena cf. *iowensis* (Calvin)

(Pl. 11, fig. 4)

Terebratula (Cryptonella) *iowensis* Calvin, 1890, Iowa State Univ., Lab. Nat. Hist., Bull. v. 1, p. 174, pl. 3, fig. 4.

Shell medium-sized for the genus, subovate, greatest width about midlength, anterior commisure rectimarginate. Dimensions of brachial valve: length 16.5 mm; width 18.5 mm; thickness 4.5 mm.

Brachial valve moderately convex, broadly curved from beak to front margin, almost flat at midlength, transversely gently arched. Anterior and lateral marginal areas rapidly sloping away from central raised portion; posterior margins steeply sloping from umbonal region. Umbo prominent, beak suberect in older specimens, nearly straight in young specimens.

Remarks: Precise specific identification of this form is difficult since only a brachial valve of an adult and 2 immature specimens were collected. The specimens seem to agree most closely with description given by Stainbrook for an immature *Cranaena iowensis* (1941, p. 45). Most other species of *Cranaena* in the size range of the Manitoba specimens are distinctly longer than wide. The three specimens illustrate the gradual incurving of the beak during growth.

Occurrence: Souris River formation, Locality 11; near Steep Rock River.

Types: Hypotype G.S.C. 14885-14887.

Phyllum MOLLUCSA

Class PELECYPODA Goldfuss*

Order PALAEOCONCHA Neumayr

Genus *Phthonia* Hall

Phthonia Hall, 1869, Prelim. Notice Lamellibranch Shells, Albany, New York, pt. 2, p. 70.

Type species, *Cypricardites sectifrons* Conrad, 1842, p. 245, Pl. 13, fig. 8.

Closely allied forms of *Phthonia* were found in Locality 9; however, identification was not possible because of the fragmentary nature of the specimens.

*The classification adopted in this report is one used by Moret (1948, p. 357) and Dechaseaux (1952, p. 225).

Phthonia sp.

(Pl. 11, fig. 5)

Shell small, extremely inequilateral, posterior portion long, anterior portion short; beak located near anterior end, low, not projecting beyond hinge line. Umbonal regions swollen into indistinct ridge extending across half the length of shell. Dorsal margin parallel to ventral margin, posterior margin rounded ventrally, subtruncate dorsally; anterior margin rounded. Transversely, valve regularly convex.

Concentric growth lines prominent near margins. One specimen with faint radiating costae in posterior marginal area. Dimensions: length 9.5 mm (reconstructed), height 4 mm.

Remarks: Description is obtained from internal molds of two left valves. The specimens are placed in genus *Phthonia* on the basis of the radiating costae and the partially truncate partially rounded posterior margin. In shape, the valves most closely resemble *Phthonia sectifrons* Conrad (Hall, 1885, pl. 78, fig. 13) but they are much smaller and the costae are finer.

Occurrence: Dawson Bay formation, Locality 1.

Types: Hypotype 14806, 14807.

Order TAXODONTA Neumayr

Family *LEDIDAE* Adams

Genus *Nuculana* Link

Nuculana Link, 1807 (non-Cossman 1909), Rost. Beschr. Nat. Samml. Univ. Rostock, v. 3, p. 155.

Type species, *Arca rostrata* Link, 1790.

Nuculana cf. *rostellata* (Conrad)

(Pl. 11, fig. 6a-b)

Nuculites rostellata Conrad, 1841, Ann. Rept. Geol. New York, p. 60.

Shell small, elongate, twice as long as high, rounded anteriorly, attenuate posteriorly, beak located in anterior portion. Hinge line long, concavely arched, extending from beak posteriorly across ⅔ the length of the shell. Posterior margin broadly curved, continuous with ventral margin which flattens toward anterior. Anterior margin gently curved toward beak, somewhat angular at contact with ventral margin. Beaks pointed, elevated. Curvature of valves slight, radially subtriangular. Hinge area wide. Dimensions: length 22 mm; height 11 mm, thickness 9 mm.

Remarks: This species is known from one internal mold with a slightly distorted right valve. The form resembles *Nuculana rostellata* (Conrad) in shape but differs in its slightly larger size. Definite identification could not be made because of poor preservation of the specimen.

Occurrence: Dawson Bay formation, Locality 2.

Type: Hypotype G.S.C. 14808.

Order HETERODONTA Neumayr

Family *ASTARTIDAE* Gray

Genus *Cypricardinia* Hall

Cypricardinia Hall, 1859, New York Geol. Surv., Paleontology, v. 3, pt. 1, p. 266.

Type species, *Cypricardinia lamellosa* Hall, 1859, p. 266, pl. 49A, figs. 1a-c.

Cypricardinia sp.

(Pl. 11, figs. 7-8)

Shell small, inequilateral, inequivalved, subelliptical, greater than height, maximum length at about the middle. Umbones narrow, depressed incurved directed forward, located at the front dorsal angle; beaks offset; right beak above left, extending to hinge line; left beak located about middle of valve, stopping short of hinge line. Hinge line curved, extending over a little more than half the height. Dorsal margin broadly curved, continuing to straight posterior margin. Postventral angle subrectangularly rounded, ventral margin almost straight, curving rapidly toward straight margin. Valves strongly convex; right valve with greatest convexity in upper portion of valve, about ⅓ the length from the posterior end, surface sloping rapidly toward dorsal margin, more gradually toward posterior and ventral margins, forming indistinct ridge extending obliquely across more than half the valve. Left valve with greatest convexity in middle anterior third, indistinct ridge extending half way across length of valve, distinct dorsally where surface slopes abruptly, less distinct ventrally where surface is more gently sloping. Surface marked by coarse, low, rounded concentric ridges. Dimensions of one mature and one immature specimen: length 19.5 mm, 11 mm; height 13.5 mm, 9 mm; thickness 10.5 mm, 4 mm.

Remarks: In immature forms of *Cypricardinia* sp., length is only slightly greater than the width, and the surface dorsal to umbonal ridge is flat and extends well beyond height of beak; the beaks are offset, the right beak above the left, maximum convexity occurring higher in the right valve, located about the middle of the left valve. Shell is much flatter in immature forms, especially in the posterior region.

The immature form compares most closely with specimens figured by Cooper and Cloud (1938, p. 453, pl. 54, figs. 55, 56, 60) and identified as immature forms of *Cypricardinia* sp. cf. *C. indenta* (Conrad). The Manitoba specimens differ from most other species of *Cypricardinia* in having offset beaks, although the offset beaks are probably due to distortion.

Occurrence: Dawson Bay formation, Localities 1 and 5.

Types: Hypotype G.S.C. 14888, 14889; M.M.B. 5896.

Family *LUCINIDAE* Deshayes

Genus *Paracyclas* Hall

Paracyclas Hall, 1843, Geol. New York, pt. 4, Geol. Surv. 4th District, p. 171.
Type species, *Paracyclas elliptica* Hall, 1843, p. 171, text illust. 67, fig. 2.

Paracyclas elliptica Hall

(Pl. 11, figs. 9, 10)

Paracyclas elliptica Hall, 1843, Geol. New York, pt. 4, Geol. Surv., 4th District, p. 171; text illust. 67, fig. 2; Hall, 1885, New York Geol. Surv., Paleontology, v. 5, pt. 2, p. 440 (partim), pl. 72, figs. 25-26; Whiteaves, 1892, Canada Geol. Surv., Contrib. Canadian Paleont., v. 1, pt. 4, p. 305; La Rocque, 1950, Michigan Univ. Contrib. Mus. Paleont., v. 7, p. 309, pl. 12, figs. 1-7.

Lucina (*Paracyclas*) *elliptica* var. *occidentalis* Hall and Whitfield, 1882, 24th Reg. Rept. New York State Mus. Nat. Hist., p. 189.

Shell equivalve, small to medium, transversely oval in outline, regularly convex with greatest curvature in middle. Hinge line almost straight, shorter than length. Umbones approximately centrally located, small, rising slightly above or level with hinge; slightly to moderately convex. Ventral margin evenly rounded, curving regularly upward toward posterior and anterior margins. Ligamental area narrow.

Surface with concentric ridges of unequal strength. Fine striations on ridges in well-preserved specimens. Dimension of two hypotypes: length 24 mm, 16 mm; height 18 mm, 13 mm; thickness 14 mm, 7 mm.

Remarks: The specific limits of *P. elliptica* Hall are confused. Hall's original definition of *P. elliptica* (1843, p. 171) was brief but Hall believed sufficient for identification among other Corniferous pelecypods. In his great work on the Lamellibranchia, Hall (1885, p. 440) mentioned that the species was "subject to great variation in form from compression." At this time he also placed in synonymy *Lucina* (*Paracylas*) *elliptica* var. *occidentalis* (Hall and Whitfield 1872, p. 189) with *P. elliptica* because he realized that the external features of the varietal form were only in a better state of preservation and not different from the type. He also mentioned "this species has been generally identified with *Lucina proavia* Goldfuss (Petref. Germ., pl. 146, fig. 6, p. 226)." Nevertheless, Hall found enough differences between the two species to retain his as a distinct form. Beushausen (1895, p. 171) also felt that *P. elliptica* was very similar to *P. proavia* and probably conspecific with it. La Rocque (1950, p. 310) examined the holotype of Hall's *P. elliptica* and found it could easily be a young form of *P. proavia.* He considered that "the majority of the specimens identified in North America as *P. elliptica* belong to P. *proavia.*" La Rocque believes the holotype was probably crushed and therefore comparison with it cannot be made satisfactorily.

Nomenclaturally as well as taxonomically this species is confusing. Phillips (1841, p. 35) named a pelecypod *Pullastra elliptica* which De Koninck (1898, p. 85) regarded as a *Paracyclas.* If this be so, then *P. elliptica* Hall is a specific homonym and so is invalid. Williams and Breger (1916, p. 257) suggest that since *Lucina* (*Paracyclas*) *elliptica* var. *occidentalis* is regarded as a synonym of *P. elliptica* thne *P. occidentalis* should be the name adopted for the type species. However, difficulty again arises because Billings (1859, p. 187) named a species *Lucina occidentalis.* Whiteaves (1892, p. 306) felt that *L.* (*Paracyclas*) *occidentalis* Billings and P. *elliptica* Hall were distorted forms of the same species and so placed *P. occidentalis* (Billings) as a variety of *P. elliptica.* If *P. occidentalis* (Billings) is proven to be a synonym of *P. elliptica* Hall then *P. occidentalis* Billings 1858 would be conspecific with Hall's holotype and would have priority over Hall's *P. occidentalis.*

Hall described the species as oval, and his holotype has a height about ¾ that of length. All Manitoba specimens with length: height ratio about 4:3, and low umbones located near center of dorsal portion of valve are placed in species *P. elliptica* Hall.

Occurrence: Dawson Bay formation, Localities 1 and 6, and Bell River.

Types: Hypotypes G.S.C. 14862, 14863; M.M.B. 5874-5878, 5892.

Paracyclas proavia (Goldfuss)

(Pl. 11, figs. 11-13)

Lucina proavia Goldfuss, 1840, Petrefacta Germaniae, v. 2, p. 226, pl. 146, figs. 6a-b.

Paracyclas proavia Beushausen, 1895, Abhandl. der K. Preuss Geol. Landesanstalt, N.F., Heft 17, p. 169, pl. 15, figs. 1-2.

Paracyclas elliptica var. *occidentalis* (Billings) Whiteaves, 1892, Canada Geol. Surv., Contrib. Canadian Paleont., v. 1, pt. 4, p. 305, pl. 39, figs. 7-10.

Specimens referred to *P. proavia* include those whose umbones are centrally located and are oval in shape grading to those whose umbones are posteriorly located and somewhat elliptical in shape. Ornamentation consists of concentric ridges. The species in Manitoba is made up of 3 distinct forms with some gradation between each. The specimens are similar to the hypotypes illustrated by La Rocque (1950, pl. 12, figs. 8, 9) from the Rogers City limestone, but they are usually smaller than the European form.

Form A (Pl. 11, fig. 12): Shell small, oval, rather thin, almost round in outline. Hinge line short, curved; umbones low; margins rounded; regularly convex with greatest curvature below umbonal area. Dimensions: length 20 mm, 22 mm; height 18 mm, 20 mm; thickness 10 mm, 10 mm (surface weathered).

Remarks: Form A is comparable to the typical oval form of the species and is similar to *P. elliptica* var. *occidentalis* (Billings) as illustrated by Whiteaves (1892, pl. 38, fig 7). This form is gradational to *P. elliptica* Hall.

Occurrence: Dawson Bay formation, Localities 5 and 6; Souris River formation, Locality 11.

Type: Hypotype G.S.C. 14864.

Form B (Pl. 11, fig. 13): Shell elliptical in outline, thicker than Form A. Umbones located in anterior portion of valve, ⅓ distance from anterior margin. Hinge line longer than above, still curved. Ventral margin curving slowly to posterior margin, more abruptly toward anterior margin. Dimensions: length 27 mm, 31 mm, 20 mm; height 18 mm, 21 mm, 15 mm; thickness 16 mm (right valve crushed), 13 mm, 11 mm.

Remarks: Form B is similar to that figured by Whiteaves (1892, pl. 39, fig. 10) and referred by him as a distorted *P. elliptica* var. *occidentalis* (Billings). Some specimens are gradational between Form B and *P. elliptica*. Distortion has occurred in some of the specimens.

Occurrence: Dawson Bay formation, Locality 6; Souris River formation, Locality 11.

Type: Hypotype G.S.C. 14865.

Form C (Pl. 11, fig. 11): Shell small, trapezohedroid, according to Whiteaves "obliquely distorted". Hinge line straight, umbone in anterior portion of valve; anterior margin broadly rounded continuing thus to ventral margin, turning abruptly to posterior margin which is almost straight. Dimensions: length 18 mm; height 15 mm; thickness 8 mm.

Remarks: Form C corresponds to the specimen figured by Whiteaves on Pl. 39 fig. 9. This form is almost identical in shape to *Paracyclas lirata* (Conrad); but in Form C the surface ornamentation of subangular ridges marked with finer striations is absent; the ridges are low and ill-defined. This may have been caused by the nature of preservation of the specimens and not because the animal lacked them. The finer striations on prominent ridges are present, however, on specimens identified as *P. elliptica*.

Occurrence: Dawson Bay formation, Locality 6.

Type: Hypotype G.S.C. 14866.

These forms are classified as *P. proavia* because of surface ornamentation, variable outline of shell and low beaks. Form B is the only form that does not seem to belong to this group. Its gradation to *P. elliptica* on the one hand and *P. proavia* on the other necessitates an arbitrary decision into which species it should be placed. In the Manitoba specimens, at any rate, *P. elliptica* appears to be a variety of *P. proavia* since it constitutes only a part of the variability of the group.

Genus *Phenacocyclas* La Rocque

Phenacocyclas La Roque, 1950, Michigan Univ., Contrib. Mus. Paleont., v. 7, p. 312.

Type species, *Phenacocyclas pohli* La Rocque, 1950, p. 316, pl. 13, figs. 4-7; pl. 14, figs. 1-6; pl. 15, figs. 1-7.

Phenacocyclas antiqua (Goldfuss)

(Pl. 11, figs. 14-15)

Lucina antiqua Goldfuss, 1840, Petrefacta Germaniae, v. 2, p. 226, pl. 146, figs. 7a-b.

Paracyclas antiqua Whiteaves, 1892, Canada Geol. Surv., Contrib. Canadian Paleont., v. 1, pt. 4, p. 304, pl. 39, fig 6.

Shell medium in size, equivalved, inequilateral, trapezohedroid, length greater than or equal to height; greatest length at or ventral to the middle. Posterior portion smaller than anterior portion, with a slight sulcus extending from beak to margin; one specimen with a plication located on sulcus. Posterior margin with or without a notch; ventral margin broadly rounded curving acutely toward anterior. Hinge line straight, short, about ½ the length of shell; umbones low, projecting slightly beyond hinge line, moderately convex, well defined on posterior side by the sulcus, regularly convex on anterior side. Anterior surface of valve drawn out and somewhat flattened; one specimen with a slight flexure.

Ornamentation usually absent. One fairly well-preserved specimen with coarse low growth lines disappearing in posterior sulcus. Dimensions of hypotype: length 28 mm, 27 mm (reconstructed), 23 mm; height 23 mm, 25 mm, 21 mm; thickness 12 mm, 12 mm, 9 mm.

Remarks: The specimens described above are referred to *P. antiqua* on the bases of their shape, the posterior sulcus and the ornamentation. They are smaller in comparison to specimen figured by Whiteaves who believed *Phenacocyclas ohioensis* (Meek) was synonymous with *P. antiqua*. The lectotype of *P. ohioensis* is about twice as large as the Manitoba specimens.

Occurrence: Dawson Bay formation, Localities, 3, 5, 6; Souris River formation, Locality 11.

Types: Hypotypes G.S.C. 14890, 14891; M.M.B. 58101, 58102.

Order DYSODONTA Neumayr

Family *PTERIIDAE* Meek

Genus *Aviculopecten* McCoy

Aviculopecten McCoy, 1851, Ann. Mag. Nat. Hist., 2nd. ser., v. 7, p. 171.

Type species, *Aviculopecten plano-radiatus* McCoy, 1851, p. 171.

Aviculopecten cf. *tenuis* Hall

(Pl. 11, fig. 16)

Aviculopecten tenuis Hall, 1884, New York Geol. Surv., Paleontology, v. 5, pt. 1, Plates and Explanations: Pl. 7, figs. 27, 28; *ibid.*, p. 39, pl. 7, figs. 27, 28, pl. 81, fig. 6.

Shell small, slightly oblique, length a little greater than height, greatest breadth slightly below the middle of the shell. Margins regularly rounded, somewhat extended postero-ventrally. Hinge line straight. Dimensions: length 20 mm; height 18 mm; hinge line 15.5 mm.

Left valve moderately convex, greatest convexity in upper portion of valve toward anterior. Beak not extending beyond hinge line, posterior slope rather gentle, separated from the ear by a flattening expressed at the margin by a small sulcus. Posterior ear angular at the extremity, almost as long as posterior margin of valve. Anterior ear small, flat, slightly longer than half the posterior ear, sharply defined from umbo by steeply sloping umbonal side.

Radiating costae of 2 sizes: coarse, low, broadly rounded costae lying side by side toward anterior and posterior margins; as many as 5 costellae between coarse

costae toward ventral margin. About 30 coarse costae present on the valve, 5 on the anterior ear, dying out toward hinge line; costae not distinguished on posterior ear. Six coarse costae in 5 mm present on post ventral area with no fine costae between them. Microscopically fine concentric striae in marginal area. Posterior sulcus with three well-defined growth lines.

Remarks: Only one well-preserved left valve of this species was found. Slight differences between the New York and Manitoba specimens exist. The umbo of Hall's form makes a 90 degree angle with the hinge line; the umbo in the Manitoba specimen is crushed, but is probably inclined anteriorly. Also Hall's illustration (Pl. 7, fig. 27, 28) of the radiating costae shows the costae having wide intercostal furrows without any fine costellae. However, Hall mentions that the specimens are casts of the interior and only in well-preserved specimens can costellae be observed between the costae.

Occurrence: Dawson Bay formation, Locality 1.

Type: Hypotype G.S.C. 14892.

Class GASTROPODA Cuvier

Order AMPHIGASTEROPODES Wenz

Family *PLATYCERATIDAE*

Genus *Ptychospirina* Perner

Ptychospirina Perner, 1907, In Barrande, J. Systéme Silurien du Centre de la Bohême, v. 4, Gasteropodes, tome 2, p. 319.

Type species, *Holopea mima* Perner, 1903, pl. 67, figs. 11-14; 1907, p. 320, text fig. 23.

Ptychospirina differs from the closely allied genus *Platyostoma* in having a higher spire and an elongate aperture. *Platyostoma* has a low spire and an aperture which is more rounded and not as sinuate.

Ptychospirina sp.

(Pl. 12, figs. 1a-c)

Shell medium in size, turbinate, whorls well rounded, sutures moderately deep, body whorl large; base rounded, anomphalous, but with a suggestion of a false umbilicus. Apertures not completely exposed, inner lip buried in matrix; outer lip sinuate, moderately convex forward, becoming deeply concave slightly above mid-whorl then broadly curving forward to a convexity above the base equal to the sinus. Dimensions of two specimens: height 24 mm, 22 mm; width 21 mm, 19 mm, pleural angle about 73 degrees.

Remarks: The species closely resembles *Holopea antiqua* (Vanuxem *in* Hall, 1861, p. 294, pl. 54, fig. 3) in the nature of the whorls but differs in the type of aperture.

Occurrence: Dawson Bay formation, Locality 6.

Type: Hypotype G.S.C. 14893.

Genus *Naticonema* Perner

Naticonema Perner, 1903, In Barrande, J.; Systéme Silurien du Centre de la Bohême, v. 4, Gasteropodes, tome 1, expl. pl. 54.

Type species, *Naticonema similaris* Perner, 1903, expl. pl. 54, figs. 1-3.

Naticonema sp.

(Pl. 12, fig. 2)

Shell medium in size, naticiform, 4 whorls with rounded profile, large body whorl, sutures deep, base rounded, aperture imbedded in matrix. Ornamentation consisting of revolving lirae of variable prominence; stronger lirae usually located at mid-whorl. Dimensions: height about 20 mm; width 23 mm; pleural angle about 110 degrees.

Occurrence: Souris River formation, Locality 9.

Type: Hypotype G.S.C. 14894.

Family *EUOMPHALIDAE* De Koninck

Genus *Straparolus* Montfort

Straparolus Montfort, 1810, Concyliologie systematique, et classification methodique des coquilles; tome 2, Coquilles univalves, non cloisonnées, Paris, p. 174. Type species, *Straparolus dionysii* Montfort, 1810, p. 174.

Straparolus (*Straparolus*) *subtrigonalis* (Whiteaves)

(Pl. 12, figs. 6a-b; Pl. 13, fig. 7)

Euomphalus (*circularis* ? Phillips var.) *subtrigonalis* Whiteaves, 1892, Canada Geol. Surv., Contrib. Canadian Paleont., v. 1, pt. 4, p. 326, pl. 43, fig. 4.

Shell depressed turbinate, spire low, umbilicus wide, shallow. Body whorl transversely subtriangular, flattened above; shoulder and base sub-angular. Aperture subtriangular, narrow at base.

Remarks: Outer volution in specimens collected by the writer are not always twice as broad as high, as described by Whiteaves. Specimens from Locality 9 do not have the subangular shoulder displayed by specimens from other localities; the volutions are convex laterally. A specimen intermediate to the form with rounded lateral surface and the form with compressed lateral surface was found at Locality 5. Specimens which have a weathered spire can easily be distinguished from *Buchelia tyrrelli* (Whiteaves) by the wide shallow umbilicus.

The species is placed in the genus *Straparolus* because of the rounded whorls. *Euomphalus* has a well-marked shoulder in a well-developed angulation.

Occurrence: Dawson Bay formation, Localities 5 and 6; Souris River formation, Locality 9.

Types: Hypotypes G.S.C. 14895, 14896; M.M.B. 58124, 58129.

Genus *Omphalocirrus* Ryckholt

Omphalocirrus Ryckholt, 1860, Jour. de Conchyliologie, ser. 2, v. 4, p. 187.

Type species, *Euomphalus goldfussi* d'Archiac and de Verneuil, 1842, p. 362.

Omphalocirrus ? manitobensis (Whiteaves)

(Pl. 12, figs. 8a-b)

Euomphalus manitobensis Whiteaves, 1891, Trans. Roy. Soc. Canada, sec 4, v. 8, p. 100, pl. 6, figs. 2, 2a, b, 3, 3a.

Omphalocirrus manitobensis Whiteaves, 1892, Canada Geol. Surv., Contrib. Canadian Paleont., v. 1, pt. 4, p. 327, pl. 43, figs. 5-7 (partim).

Conch large, discoidal, spire depressed; umbilicus wide; four volutions rapidly expanding, flattened above; base rounded toward umbilicus, slightly angulated at periphery. Aperture subtriangular to round. Ornamentation consisting of

growth lines curving obliquely and concavely. Operculum calcareous, moderately thick, flat internally, slightly convex externally, circular in outline, multispiral.

Remarks: Specimens collected by the writer agree in description with those first described by Whiteaves from the Manitoba formation. None show the angulated and nodose surface which Whiteaves found in the Winnipegosis *Omphalocirrus* (1892, p. 327). As only internal molds of the Manitoba specimens are found, it is not possible to definitely say the Winnipegosis form is conspecific with the Manitoba form, although the shape of both is very similar. If the two forms are two different species, then the Manitoba form remains *Omphalocirrus manitobensis* by Article 27 of the International Rules of Zoological Nomenclature.

Occurrence: Dawson Bay formation, Localities 1, 4, 5; Souris River formation, Locality 11.

Types: Hypotypes G.S.C. 14897; M.M.B. 58116, 58117, 58134, 58135.

Genus *Mastigospira* La Rocque

Mastigospira La Rocque, 1949, Michigan Univ., Contrib. Mus. Paleont., v. 7, no. 7, p. 114.

Type species, *Hyloithes alatus* Whiteaves, 1892, p. 342, pl. 46, figs. 2-4.

Mastigospira alata (Whiteaves)

(Pl. 12, fig. 7)

Hyloithes alatus Whiteaves, 1892, Canada Geol. Surv., Contrib. Canadian Paleont., v. 1, pt. 4, p. 342, pl. 46, figs. 2-4.

Shell large, nearly straight, narrowly elongate, slowly expanding, transversely subtriangular, with basal angles of triangle broadly alate. Aperture with a broad, deep sinus and a projecting lobe broadly rounded on inner margin and subangular on external margin. Surface markings, lines of growth parallel to outer lip.

Remarks: Surface markings were seen only on specimens studied by Whiteaves. Specimens collected by the writer have the apertural ends broken off and the apical ends terminate with a convex surface which, to La Rocque (1949, p. 114) suggest that the earliest part of the shell was broken off at a point marked by a septum or plug.

This species is one of the few that ranges from the Winnipegosis to the Dawson Bay formation.

Occurrence: Dawson Bay formation, Localities 3, 4, 5, 6.

Types: Hypotypes G.S.C. 14898; M.M.B. 58105, 58107; LM 40 (Baillie Collection).

Order *ARCHAEOGASTEROPODA* Termier & Termier

Family *BELLEROPHONTIDAE* McCoy

Genus *Bellerophon* Montfort

Bellerophon Montfort, 1808, Conch. Syst., v. 1, p. 50.

Type species, *Bellerophon vasulites,* Montfort, 1808, p. 51.

Bellerophon pelops var.

(Pl. 12, figs. 3, 4)

Bellerophon pelops ? Hall var. Whiteaves, 1892, Canada Geol. Surv., Contrib. Canadian Paleont., v. 1, pt. 4, p. 317, pl. 42, figs. 2, 2a, 3; pl. 45, fig. 4.

Shell small to medium, globular to ovoid, deeply involute. Umbilicus not exposed. Aperture laterally, broadly expanded. Anterior margin broadly and moderately sinuate, with the deepest portion a slit extending dorsally as a selenizone, expressed as a narrow slightly elevated flattening, 2 mm in diameter near apertures and without any visible ornamentation except the early portion of adult having a beaded appearance. The surface ornamented with low, broadly rounded ridges, curving upward at the slit band and at the umbilicus, forming broadly convex lines circling around the body; ridges 5 to 6 in 5 mm measured from aperture. Interspaces about equal in width to ridges. Largest specimen with apertural width 20 mm, and total length of shell 21 mm.

Hall (1879, p. 96) stated the callosity and the lip in *Bellerophon pelops* is "a variable feature—being sometimes much thickened and at other times expanded and moderately thickened, scarcely covering the umbilicus." Manitoba specimens that have the exterior preserved do not have a callosity. Whiteaves (1892, p. 318) points out that "the closing of the umbilical cavity on both sides of immature individuals is not caused by a spreading over it of the columellar callus." Also no adult specimens in his illustrations show the closing of the umbilical cavity.

The slit band of *Bellerophon pelops* var. is twice as wide as in *Bellerpohon pelops* and the growth lines are coarser. Internally, the specimens of *B. pelops* var. resemble *Bellerophon maera* Hall but differ in not having any vestige of the postulose striae which is characteristic of the latter species. *B. pelops* var. differs from *Bellerophon perplexa* Walcott in having fewer volutions.

Occurrence: Dawson Bay formation, Localities, 1, 5, 6.

Types: Cotypes G.S.C. 4055, 4057, 4058. Hypotypes G.S.C. 14899, 14900.

Genus *Bucanopsis* Ulrich and Scofield

Bucanopsis Ulrich and Scofield, 1897, Minnesota Geol. Surv., Paleontology, v. 3, pt. 2, pp. 853, 922.

Type species, *Bucanopsis carinfera* Ulrich and Scofield, 1897, p. 925, pl. 62.

Bucanopsis sp.

(Pl. 12, fig. 5)

Shell small, subglobular, involute; whorls expanding rapidly. Umbilicus covered with recrystallized shell material. Aperture expanded laterally but not anteriorly. Anterior margin broadly and shallowly sinuate, with deepest part extending back dorsally as a slit band; slit band low, rounded, about 1.5 mm wide toward aperture, becoming indistinct adaperturally. The remaining surface ornamented by low, broadly rounded revolving lines, 4 in 2 mm, becoming less distinct toward umbilicus, separated by interspaces equal to or broader than lines. No concentric striae of growth preserved on interior mold. Apertural width 12 mm, total length of shell 13 mm.

Remarks: The species is known from one internal mold imbedded in limestone in such a manner that the opening is concealed. Surface ornamentation is reminiscent of *Bucanopsis leda* (Hall).

Occurrence: Dawson Bay formation, Locality 5.

Type: Hypotype G.S.C. 14901.

Family *RAPHISTOMATIDAE* Koken

Genus *Buchelia* Schlüter

Buchelia Schlüter, 1894, Verhandl, Naturhist. Vereines preuss Rheinlande, Westfalens Jahrg., Bonn, v. 51, p. 67.

Type species, *Buchelia goldfussi* Schlüter, 1894, p. 67, pl. 2.

Buchelia tyrrellii (Whiteaves)

(Pl. 13, fig. 6)

Raphistoma tyrrellii Whiteaves, 1892, Canada Geol. Surv., Contrib. Canadian Paleont., v. 1, pt. 4, p. 314, pl. 41, figs. 5, 5a, 6, 6a-b.

Shell with almost flat spire, angular periphery and conical base; imperforate. Slit band on peripheral angulation. Surface smooth except for faint growth lines curving backward to slit band.

Remarks: Almost all the specimens collected are internal casts and do not show the slit band which Whiteaves described.

Occurrence: Dawson Bay formation, Localities 2, 4, 5, 6, Bell River.

Types: Hypotypes G.S.C. 14902, 14903; M.M.B. 58126, 58127, 58130; LM 37, 38 (Baillie Collection).

Family *LOXONEMATIDAE* Koken

Genus *Loxonema* Phillips

Loxonema Phillips, 1841, Figs. and Descr. of Paleozoic Fossils Cornwall, Devon and West Somerset, London, p. 98.

Type species, *Terebra ? sinuosa* J. deC. Sowerby, 1839, p. 619, pl. 8, fig. 15.

Loxonema altivolvis Whiteaves

(Pl. 13, figs. 8a, b)

Loxonema altivolvis Whiteaves, 1892, Canada Geol. Surv., Contrib. Canadian Paleont., v. 1, pt. 4, p. 334, pl. 45, figs. 8, 9.

Shell moderate in size, high-spired, compressed laterally, succeeding volutions higher but not much broader than preceding. Aperture subovate, height exceeding breadth, attenuate above, narrowly rounded below. Surface with fine, slightly flexuous, raised lines of growth.

Remarks: Specimens described by Whiteaves as *L. altivolvis* have been found in almost all localities visited by the writer. Most of the specimens are internal casts, and those with shell material preserved are too badly weathered to show surface ornamentation; also the apices of all the specimens are broken. No additional features to those already described by Whiteaves are found in the writers collection.

All specimens with shell material and most of the internal casts are imperforate. However, one internal cast does not have the umbilicus closed by thickening of the shell.

Occurrence: Dawson Bay formation, Localities 2, 4, 5, 6; Souris River formation, Locality 9.

Types: Hypotypes G.S.C. 14904, 14905; M.M.B. 58119-58123; L.M 32 (Baillie Collection).

Class CEPHALOPODA Cuvier

Flower (1958, personal communication) will describe several Devonian cephalopods from Manitoba in a future publication; consequently only occurrences of these forms are noted herein.

Crytogomphus tyrrelli Flower

Gomphoceras manitobense Whiteaves, 1891 Trans. Roy. Soc. Canada, sec 4, v. 8, p. 102 (partim); 1892, Canada Geol. Surv., Contrib. Canadian Paleont., v. 1, pt. 4, p. 344 (partim).

Occurrence: Souris River formation, Point Wilkins member, Locality 11.

Type: Holotype number not yet designated, G.S.C., (Tyrrell Collection).

Micronoceras cratiforme Flower

Gomphoceras manitobense Whiteaves, 1891. Trans. Roy. Soc. Canada, sec. 4, v. 8, p. 102 (partim); 1892, Canada Geol. Surv., Contrib. Canadian Paleont., v. 1, pt. 4, p. 344 (partim).

Occurrence: Dawson Bay formation, locality given by Tyrrell as "Station 781a, Dawson Bay, Lake Winnipegosis." A record of the station numbers and their localities is not preserved; however, the lithology is distinctly that of the Dawson Bay formation.

"Gomphoceras" manitobense Whiteaves

(Pl. 13, figs. 11-12)

Gomphoceras manitobense Whiteaves, 1891, sec. 4, v. 8, p. 102, pl. 7, figs. 7, 7a (partim); 1892, Canada Geol. Surv., Contrib. Canadian Paleont., v. 1, pt. 4, p. 344 (partim).

Remarks: Specimens from Snake Island are types of this species. The siphuncle in these forms is exogastric but poor preservation prevents observation of possible siphuncular deposits. The aperture is not clearly shown.

Occurrence: Dawson Bay formation, Locality 5.

Types: Holotype G.S.C. 4189. Hypotypes G.S.C. 14906, 14907; M.M.B. 58115.

Michelinoceras ? hindii (Whiteaves)

(Pl. 13, figs. 9, 10)

Actinoceras hindii Whiteaves, 1891, Trans. Roy. Soc. Canada, sec 4, v. 8, p. 101, pl. 6, figs. 4, 4a, 5.

Orthoceras hindii Whiteaves, 1892, Canada Geol. Surv., Contrib. Canadian Paleont., v. 1, pt. 4, p. 344.

Remarks: Two large and two small specimens of this species were examined by the writer. One of the large specimens has been compressed into an elliptical outline.

Occurrence: Dawson Bay formation, Localities 3, 4, 5.

Types: Cotypes G.S.C. 4191, 4196. Hypotypes G.S.C. 14908, 14909; M.M.B. 58111, 58112; LM 42 (Baillie Collection).

MOLLUSCA INCERTAE SEDIS

Genus *Tentaculites* Schlotheim

Tentaculites Schlotheim, 1820, Die Petrefakt., p. 377.

Type species, *Tentaculites scalaris* Schlotheim, 1820, p. 377.

Tentaculites parvulus Whiteaves

(Pl. 13, fig. 13)

Tentaculites parvulus Whiteaves, 1898, Canada Geol. Surv., Contrib. Canadian Paleont., v. 1, appendix, p. 427, fig. 5.

Shell straight, tapered, with 7 degree apical angle, 8 mm in length, expanding in width from 0.4 to 0.9 mm. Annulation fine, low, broadly rounded, closely spaced at apical end becoming wider apart at anterior, 10 in 1 mm at apical end, 5 to 6

in 1 mm at anterior end; usually broader than interspaces. Interspaces shallow. Finer ornamentation lacking. Some annulations slightly oblique, especially toward anterior end.

Remarks: Only one example, broken anteriorly, was found. The small size and closely and regularly spaced annulation distinguish this species from most others in the genus. *Tentaculites fragilis* Fenton and Fenton (1924, p. 193) is similar to if not conspecific with *T. parvulus*. Both species are small, and have regularly and irregularly spaced annulations. The only apparent difference is that *T. fragilis* commonly has transverse striae on the annulations. This may reflect better preservation or a true specific character.

The type of *T. parvulus* cannot be located.

Occurrence: Souris River formation, Locality 9.

Types: Hypotype G.S.C. 14803.

Phylum ARTHROPODA

Class TRILOBITA Walch

Family *PROETIDAE* Hawle and Corda

Genus *Proetus* Steiniger

Proetus Steiniger, 1831, Bemerkungen uber die Verteinerungn welche im uebergangs —Gegirge der Eifel, p. 29.

Type species, *Calymene concinna* Dalman, 1826, p. 234.

Proetus manitobensis n. sp.

(Pl. 13, figs. 1-5)

Proetus mundulus Whiteaves, 1892, Canada Geol. Surv., Contrib. Canadian Paleont., v. 1, pt. 4, p. 350 (partim).

Cranidium moderately convex, flattened posteriorly and sloping downward abruptly in front glabellar region; frontal area flat with a broad reflexed border extending from glabella; glabella subtriangular, rounded at anterior angle; dorsal furrow shallow but distinct posteriorly, deeper in anterior portion. Three pairs of glabellar furrows increasing in intensity posteriorly, the 2 anterior furrows of about the same length, located opposite anterior ends of eyes, extending obliquely from the sides $\frac{1}{3}$ distance into glabella; the second furrow somewhat more deeply impressed than the first; third furrow deep, curving broadly and extending backwards to join occipital furrow, thus forming a pair of glabellar lobes opposite the end of the occipital ring, and forming the posterior portion of the eyes laterally. Occipital furrow straight, narrow, more impressed than glabellar furrows; occipital ring broad, flat, short, slightly over $\frac{2}{3}$ the basal width of the glabella. Fixed cheeks rather deeply concave below eyes, downsloping; eyes extending from postero-lateral corners of glabella to little over $\frac{1}{2}$ the length of glabella. Rim around free cheeks broad and either flat or slightly upturned, extending posteriorly as a short flat genal spine, $\frac{1}{2}$ the length of the free cheek. Eyes prominent, raised well above general surface.

Pygidium about $\frac{1}{3}$ wider than long, axis elevated, tapered to a blunt end at border, with 15 to 16, rarely 14 or 17, segments; pleural lobes convex, with 10, rarely 9 or 11, pleural segments. Border broad, slightly rounded, reflexed.

Surface granulose except for smooth border having 4 or 5 striations located on lateral slopes in both cephalon and pygidium.

Measurements of cranidium of holotype and cheeks and pygidium of paratypes:

CRANIDIUM			
Length	3.0 mm		
Greatest width of glabella	1.9 mm		
Length of glabella	2.1 mm		
Width of border	0.5 mm		
FREE CHEEK			
Length	3.2 mm	5.5 mm	
Width	2.0 mm	4.0 mm	
Length of genal spine	1.6 mm		
PYGIDIUM			
Length	5.0 mm	8.5 mm	13 mm
Width	7.0 mm	11.5 mm	16 mm
Length of axis	4.0 mm	7.0 mm	
Greatest width of axis	3.0 mm	2.0 mm	
Width of axis (posterior border)	1.7 mm	1.1 mm	

Remarks: Description is based on 2 cranidia, 4 free cheeks, and over 25 pygidia. Specimens from the Dawson Bay formation identified as *Proetus mandulus* by Whiteaves are *P. manitobensis*. *P. manitobensis* is distinguished from *P. mandulus* by its larger size, more abundant segments on the axis and pleuron of the pygidium, broader border, and the fine striations located on the lateral slopes of the border. *P. manitobensis* has a genal spine; the character of the genal angle and presence of genal spine are unknown in *P. mundulus*.

P. manitobensis is similar to *P. haldemani* Hall in the shape and structure of the glabella and outline of facial suture. It differs from *P. haldemani* in having genal spines, a glabella extending to cephalon border and the pygidium having more segments than usually present in *P. haldemani*.

Occurrence: Dawson Bay formation, Localities 1, 2, 3, 4, 5, 6, 7.

Types: Holotype G.S.C. 14910. Paratypes G.S.C. 14911-14916. Hypotype G.S.C. 4119-4122.

SUMMARY STATEMENT

Seventy species and varieties of fossils have been identified from the Manitoba group. Of the 27 coelenterates identified, 22 are corals occurring in the *Schizophoria iowensis* and the *Atrypa bremerensis* zones. Only *Coenites hadrus* n. sp. occurs in all the zones of the Dawson Bay. Although the corals are the most varied of all the groups they are not the most abundant. The 5 species of *Atrypa* and 2 forms of *Spinatrypa* are the most abundant and characteristic forms of the Manitoba group. Of the 7 species of pelecypods, *Paracyclas elliptica* Hall, *Paracyclas proavia* (Goldfuss) and *Phenacocyclas antiqua* (Goldfuss) are common; the other 4 species are extremely rare. Five of the 9 species of gastropods are present in the *Atrypa bremerensis* zone; the remaining 4 species are uncommon in the Manitoba group. The trilobite *Proetus manitobensis* n. sp. occurs throughout the Dawson Bay formation.

The most useful forms in stratigraphic correlation are the Atrypids and most of the Dawson Bay formation has been zoned on their abundant occurrence. Another brachiopod, *Allanaria allani* (Warren) is a diagnostic species of the Souris River formation. The trilobite *Proetus manitobensis* is indicative of the Dawson Bay formation. Other forms are not sufficiently common or are too long ranging for use in correlation.

The study of the fauna has revealed that correlation between the Cedar Valley formation (late Middle Devonian) of Iowa and the Dawson Bay formation is probable. The Souris River formation is clearly correlative with the Waterways formation of Alberta, as has been previously supposed. Future research, focusing from the outcrop area, will determine whether the zones proposed for the Manitoba group are continuous into the subsurface.

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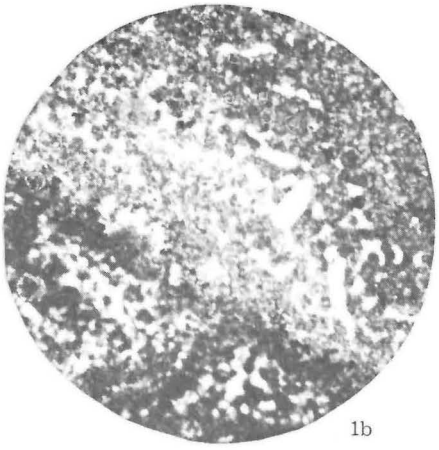
PLATE 1

1a



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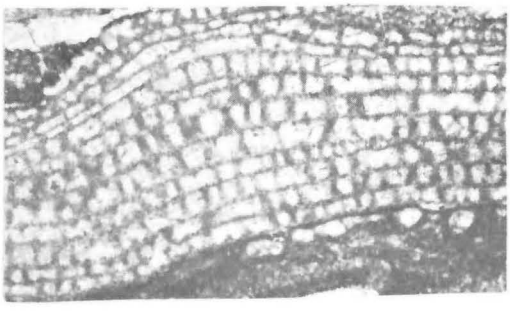

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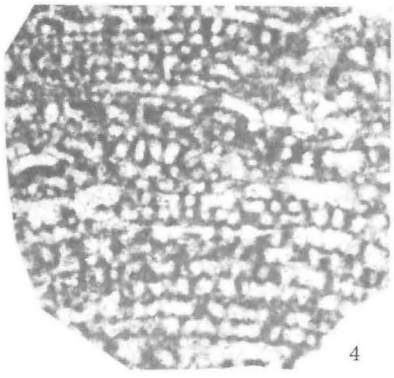

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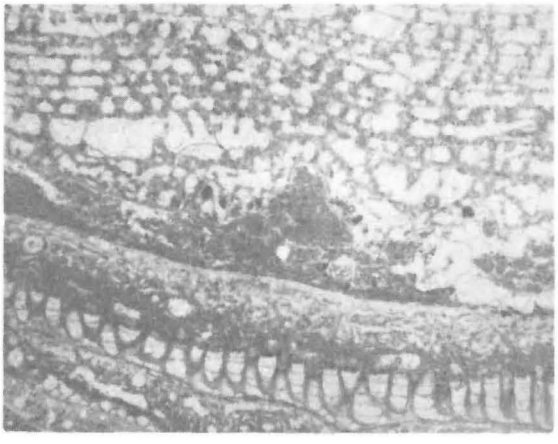


3

STROMATOPOROIDEA

EXPLANATION OF PLATE 1

Page

Anostylostroma bailliei n. sp. 27

1a-b (a) Vertical section, x 7 showing low mamelon and spool-shaped pillars. (b) Tangential section, x 7, showing round and vermicular pillars and radiating astrorhizal tubes. Holotype G.S.C. 14767a. Dawson Bay formation, Locality 5.

2 Vertical section, x 7, showing slightly undulating laminae, spool and Y-shaped pillars. Paratype G.S.C. 14768a. Dawson Bay formation, Locality 5.

3 Vertical section, x 7, showing closely spaced undulating laminae; coenosteum encrusted with other growth including *Cyphotrypa whiteavesi* n. sp. in lower part of figure. Paratype G.S.C. 14769a. Dawson Bay formation, Locality 5.

Stromatoporella sp. 28

4 Vertical section, x 7, showing curved laminae and short pillars. Hypotype G.S.C. 14867a. Dawson Bay formation, Locality 5.

EXPLANATION OF PLATE 2

Page

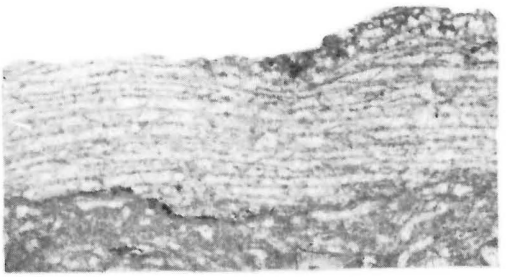
Gerronostroma cf. *gromotuchense* Yavorsky 28

1a-b (a) Vertical section, x 7, showing thin closely spaced laminae, superposed pillars and curved dissepiments. Hypotype G.S.C. 14776a. (b) Tangential section, x 7, showing elongate pillars and anastomosing galleries. Hypotype G.S.C. 14776b. Souris River formation, Locality 8.

Ferestromatopora convergens n. sp. 29

2a-b (a) Tangential section, x 7, showing tissue with galleries and large astrorhizal canals. (b) Vertical section, x 7, showing laminae separated by dark microlaminae, round galleries and astrorhizal canals with tabulae. Paratype G.S.C. 14770b. Dawson Bay formation, Locality 5.

3a-b (a) Vertical section, x 7, showing light laminae and dark microlaminae, fibrous tissue and large galleries. (b) Tangential section, x 7, showing tissue, large galleries and astrorhizal canals. Holotype G.S.C. 14868a. Dawson Bay formation, Locality 5.



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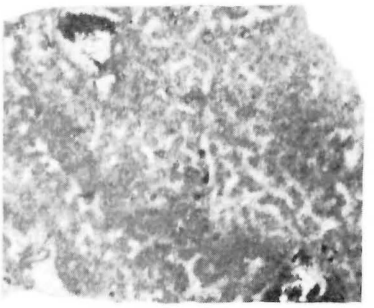

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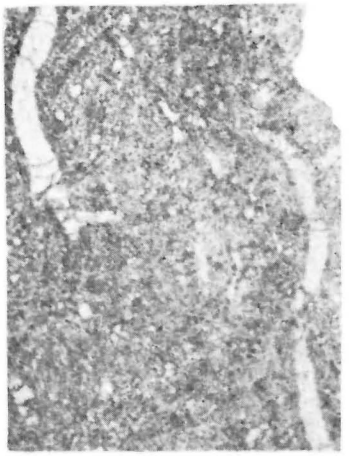

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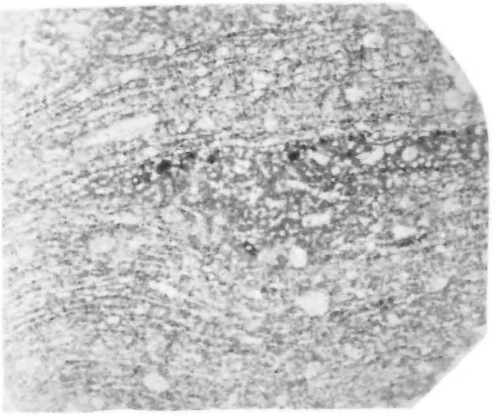

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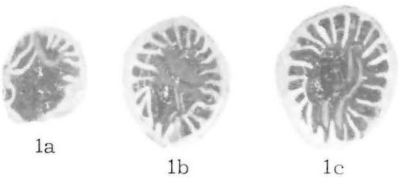
3a

3b

STROMATOPOROIDEA

PLATE 3



1a 1b 1c

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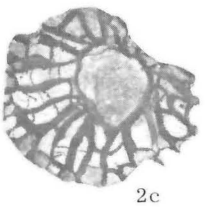
1d 1e



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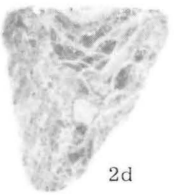

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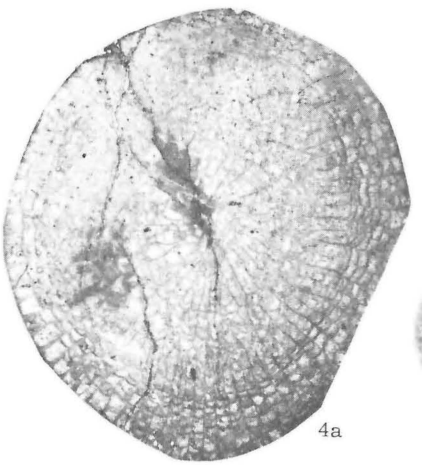

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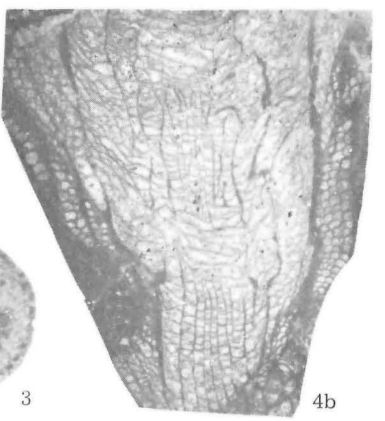

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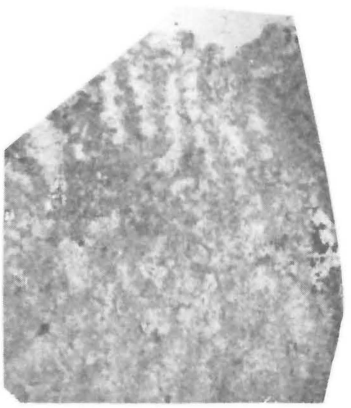

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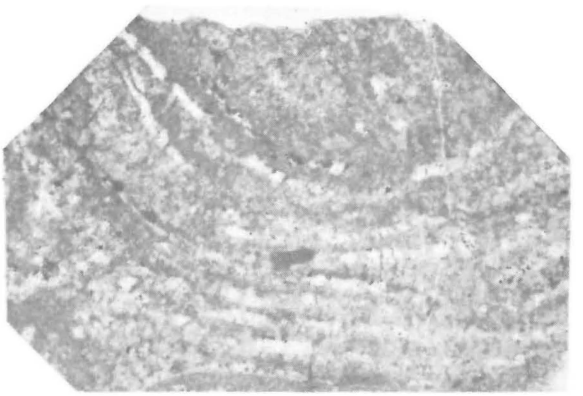


5b

COELENTERATA

EXPLANATION OF PLATE 3

Page

Amplexiphyllum salinensis n. sp. 30

1a-e Transverse section, x 1.3, of successive growth stages from the nepionic to the ephebic stage. Retouched photograph. Holotype G.S.C. 14771a (figs. a-c), G.S.C. 14771b (figs. d-e). Dawson Bay formation, Locality 2.

Buschophyllum minutum n. sp. 31

2a-d View of calyx (a) and exterior (b) of corallum, x 0.7, showing thick septa and cardinal fossula. Holotype G.S.C. 14772. (c) Transverse section, x 1.4, showing coarse septa. Retouched. Holotype G.S.C. 14772a. (d) Longitudinal section of arched tabellae and dissepiments. Holotype G.S.C. 14772c. Dawson Bay formation, Locality 2.

3 Transverse section, x 1.4, showing thick rhopaloid septa, dividing at periphery; tetrameral symmetry indistinct. Paratype G.S.C. 14773a. Dawson Bay formation, Locality 2.

Bethanyphyllum praecursor (Frech) 32

4a-b (a) Transverse section, x 1.4, showing thin radially arranged septa. Hypotype G.S.C. 14775c. (b) Longitudinal section, x 1.4, with wide tabularium composed of complete and incomplete tabulae and narrow dissepimentarium with globose dissepiments. Hypotype G.S.C. 14775b. Dawson Bay formation, Locality 2.

Idiostroma sp. 30

5a-b (a) Tangential section, x 7, showing concentric laminae. (b) Vertical section, x 7, showing arched laminae and a few thick pillars. Hypotype G.S.C. 14869a. Dawson Bay formation, Locality 2.

EXPLANATION OF PLATE 4

Page

Bethanyphyllum cf. *praecursor* (Frech) 32

1 Corallum, x 0.7, showing deep, bell-shaped calyx. Hypotype G.S.C. 14871. Dawson Bay formation, Locality 2.

2a-b (a) Longitudinal section, x 1.4, showing dissepimentarium composed of globose dissepiments and tabularium composed of tabellae. Hypotype G.S.C. 14870a. (b) Transverse section, x1.4, showing thin septa extending almost to axis. Hypotype G.S.C. 14870b. Dawson Bay formation, Locality 2.

Ceratophyllum ? sp. 33

3a-e Transverse serial sections, x 1.4, showing development of septa, (a) section 1 mm above apical end, (b) 4 mm above apical end, (c) 5 mm above apical end. Hypotype G.S.C. 14872g. (d) 7 mm above apical end. Hypotype G.S.C. 14872f. (e) Sectioned above base of calyx showing weakly carinate septa. Hypotype G.S.C. 14872c. Dawson Bay formation, Locality 2.

Breviphyllum waskasense (Whiteaves) 33

4a-c (a-b) View of immature corallum, x 0.7, showing wrinkled epitheca and calyx with steep walls. (c) Longitudinal section showing narrow dissepimentarium and widely spaced tabulae in tabularium. Hypotype G.S.C. 14777a. Dawson Bay formation, Locality 2.

5 Longitudinal section of adult, x1.4, with wide tabularium and horizontal tabulae, dissepimentarium with numerous globose dissepiments. Hypotype G.S.C. 14778a. Dawson Bay formation, Locality 2.

Breviphyllum cf. *richardsoni* (Meek) 34

6a-c (a) View of corallum, x 0.7, showing *Aulopora conferta* Winchell and budding of daughter corallite. Hypotype G.S.C. 14779. (b) Longitudinal section, x1.4, showing narrow dissepimentarium, and tabularium with some complete tabulae. Hypotype G.S.C. 14779c. (c) Tangential section, x 1.4, showing thin septa extending to axis. Hypotype G.S.C. 14779d. Dawson Bay formation, Locality 2.

Kunthia ? *petraioides* (Whiteaves) 35

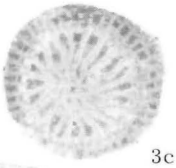
7a-b (a) Longitudinal (polished) section showing two rows of globose dissepiments and beginning of tabularium. (b) View of corallum, x 0.7, showing basal expansion. Hypotype G.S.C. 14781. Dawson Bay formation, Locality 2.

8 View of corallum, x 0.7, with *Plexituba contexta* Stainbrook (G.S.C. 14879) attached to the side. Hypotype G.S.C. 14780. Dawson Bay formation, Locality 2.

1

3a

3b



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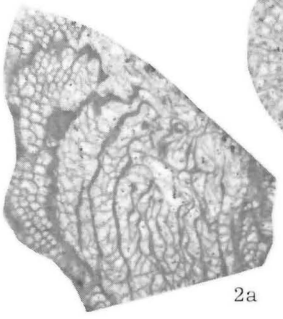

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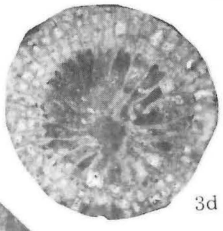

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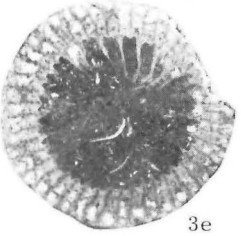

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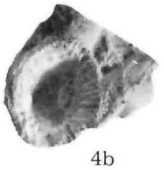

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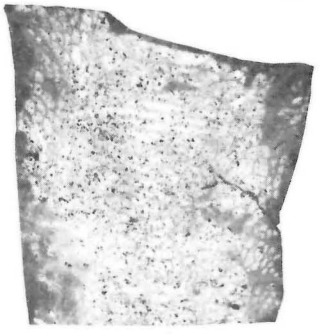

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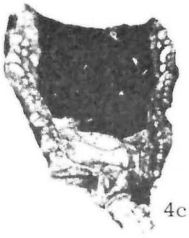

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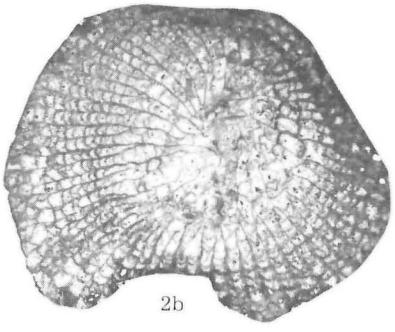

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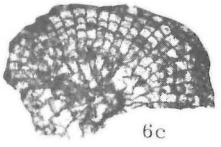

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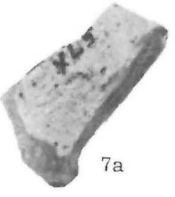

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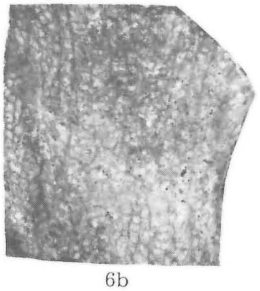

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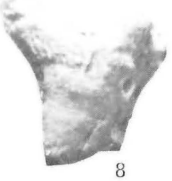

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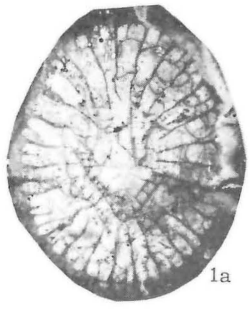

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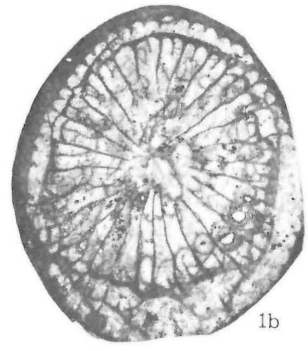

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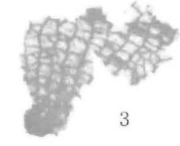

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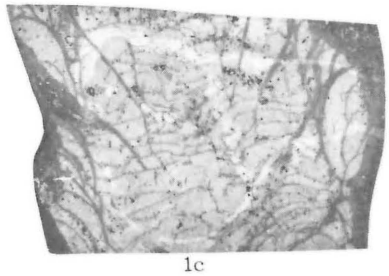

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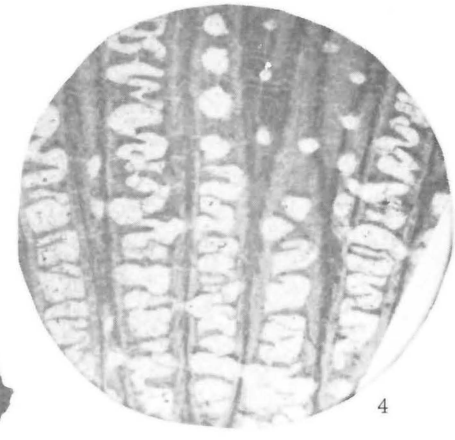

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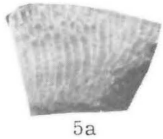

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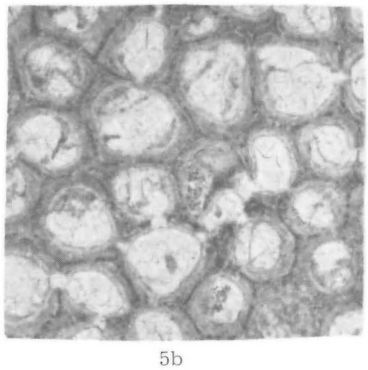

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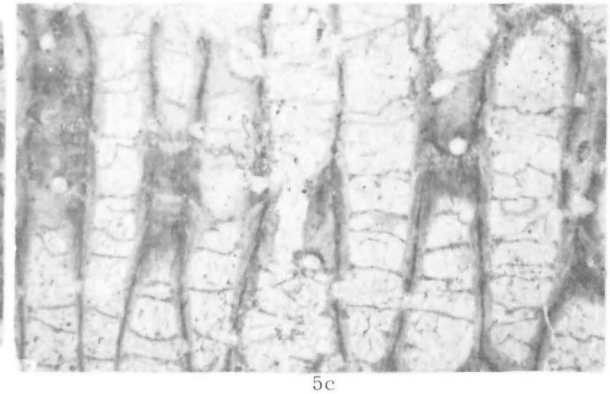


5c

ANTHOZOA

EXPLANATION OF PLATE 5

Page

Tabulophyllum gallina n. sp. 35

1a-c (a) Transverse section, x 1.4, showing attenuate septa extending to ¾ distance from axis. Holotype G.S.C. 14782d. (b) Transverse section, x 1.4, taken 15 mm above previous one, showing retreat of septa from periphery forming lonsdaleioid dissepimentarium. Holotype G.S.C. 14782b. (c) Longitudinal section, x 1.4, showing dissepimentarium with few large globosed dissepiments and tabularium with few widely spaced tabulae. Holotype G.S.C. 14782a. Dawson Bay formation, Locality 5.

Hexagonaria cf. *arctica* (Meek) 36

2 Transverse and oblique polished section, x 0.7, of colony in encrusting mass. Hypotype G.S.C. 14873. Dawson Bay formation, Locality 5.

Favosites cf. *hamiltoniae* Hall 38

3 Longitudinal section, x 1.4, showing abundant complete tabulae. Hypotype G.S.C. 14874a. Dawson Bay formation, Locality 5.

Favosites gibsoni Parks 38

4 Longitudinal section, x 7, showing corallites with abundant squamulae. Holotype 942 U.H. Royal Ontario Museum.

Favosites pachymuralis n. sp. 38

5a-c (a) Longitudinal polished section, x 0.7, showing uniserial arrangement of mural pores. Holotype G.S.C. 14875. (b) Tangential section, x 7, showing wall structure and squamulae projecting into lumen. Holotype G.S.C. 14875c. (c) Longitudinal section, x 7, showing wall structure, squamulae, tabulae and mural pores. Holotype G.S.C. 14875b. Dawson Bay formation, Locality 5.

Thamnopora dumosa var. *tabulata* n. var. 39

6a-b (a) Oblique section, x 1.4, showing wall structure. (b) Transverse section, x 1.4, showing radiating corallites with tabulae. Holotype G.S.C. 14783a. Dawson Bay formation, Locality 2.

EXPLANATION OF PLATE 6

Page

Thamnopora cervicornis (DeBlainville) 39

1a-b (a) View of corallum, x 0.7, showing the two different sizes of corallites. Hypotype G.S.C. 14784. (b) Transverse section, x 1.4, showing vertical corallites in center becoming horizontal to surface. Hypotype G.S.C. 14784a. Dawson Bay formation, Locality 2.

Thamnopora polyforata (Schlotheim) 40

2a-b (a) Vertical section, x 1.4, showing corallites expanding toward surface and numerous tabulae. Hypotype G.S.C. 14785a. (b) View of corallum, x 0.7, showing large corallites. Hypotype G.S.C. 14785. Dawson Bay formation, Locality 2.

Trachypora cf. *neglecta* (Rominger) 41

3a-b (a) View of corallum, x 0.7, showing rim around corallites. Hypotype G.S.C. 14788. (b) Oblique section, x 1.4, showing wall structure and expanding corallites. Hypotype G.S.C. 14788a. Dawson Bay formation, Locality 2.

Alveolites multiperforatus Salée 41

4a-b (a) Vertical section, x 7, showing numerous tabulae in corallites. Hypotype G.S.C. 14787a. (b) Vertical polished section, x 1.4, showing uncompressed growth of corallites. Hypotype G.S.C. 14787. Dawson Bay formation, Locality 2.

Coenites hadrus n. sp. 42

5 Corallum, x 0.7, showing unusually large corallites and numerous mural pores. Paratype G.S.C. 14790. Dawson Bay formation, Locality 2.

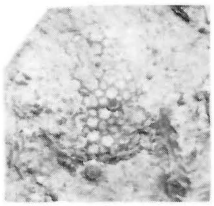
6a-d (a) Vertical polished section, x 0.7, showing expanding corallites. (b) View of corallum, x 0.7, showing small corallites. Holotype G.S.C. 14789. (c) Longitudinal section, x 1.4, showing few tabulae, corallite walls perforated by mural pores. (d) Enlargement of longitudinal section, x 7, showing wall structure. Holotype G.S.C. 14789a. Dawson Bay formation, Locality 2.

Coenites hadrus n. sp. 42

7 Corallum, x 0.7, showing tapering and rounding of stem extremity. Paratype G.S.C. 14791. Dawson Bay formation, Locality 2.

8 Corallum, x 0.7, showing type of branching. Paratype G.S.C. 14792. Dawson Bay formation, Locality 2.

9a-b Transverse and tangential section, x 1.4, showing wall structure. Paratype G.S.C. 14793a. Dawson Bay formation, Locality 2.



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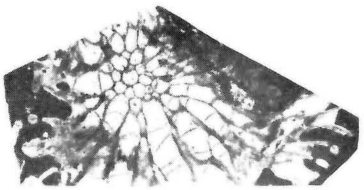

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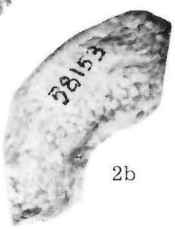

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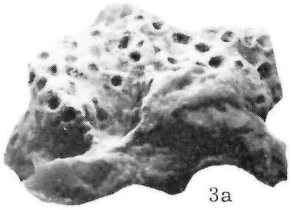

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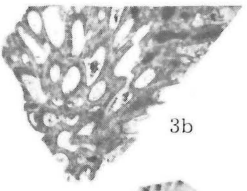

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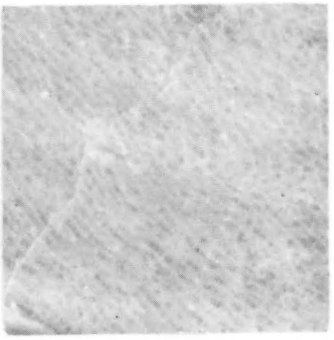

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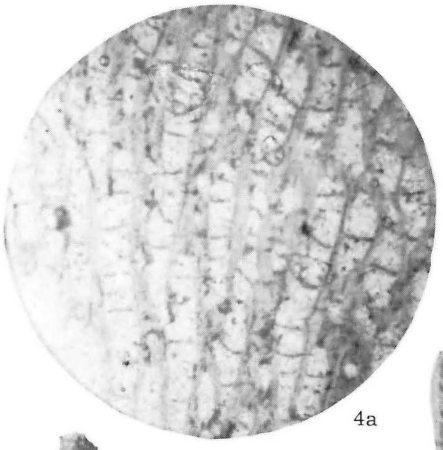

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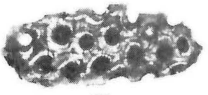

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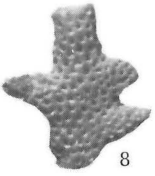

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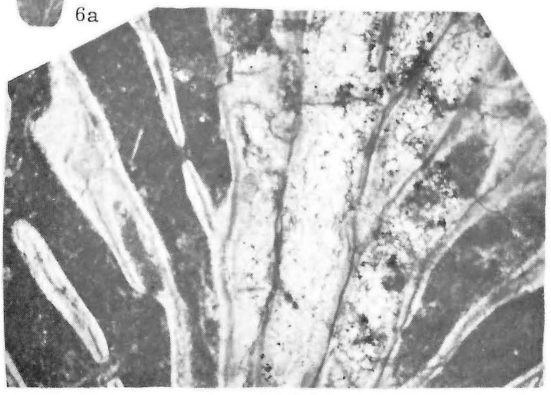
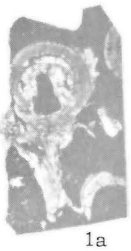


6d

TABULATA

PLATE 7



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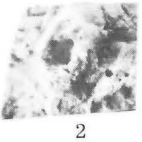

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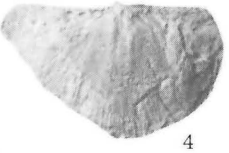

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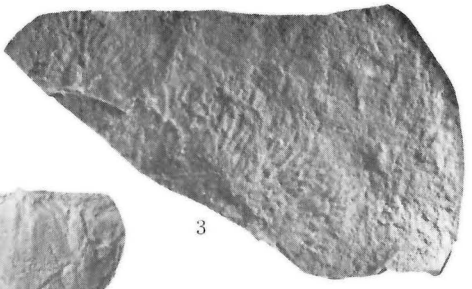

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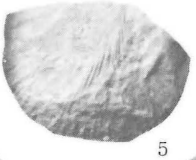

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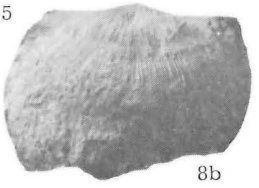

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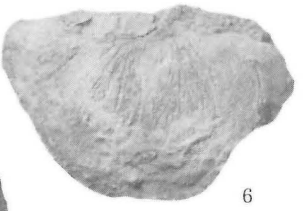

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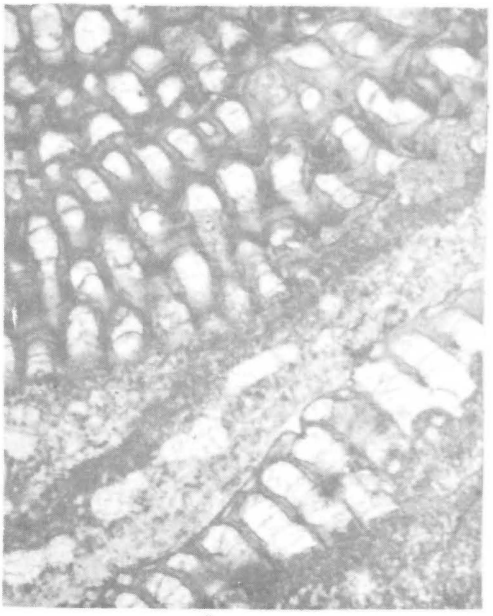

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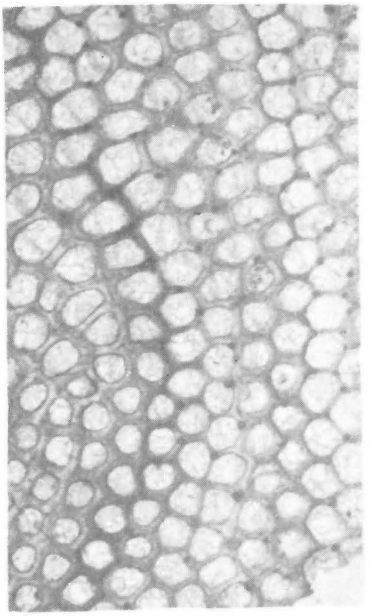


9b

COELENTERATA, BRACHIOPODA, BRYOZOA

EXPLANATION OF PLATE 7

Page

Aulocystis flabellata (Greene) 43

1a-b (a) Tangential and longitudinal section, x 1.4, showing walls composed of cysts. Hypotype G.S.C. 14794a. (b) View of corallum, x 0.7. Hypotype G.S.C. 14794. Dawson Bay formation, Locality 2.

Plexituba contexta Stainbrook 44

2 Corallites, x 1.4, erect, with deep calyx. Hypotype G.S.C. 14878. Dawson Bay formation, Locality 2.

Aulopora sp. 44

3 View of corallum, x 0.7, showing repent colony. Hypotype G.S.C. 14876. Dawson Bay formation, Locality 7.

Stropheodonta cf. *littletonensis* Stainbrook 46

4 Pedicle valve, x 0.7, showing outline. Hypotype G.S.C. 14882. Souris River formation, Locality 9.

5 Pedicle valve, x 0.7, showing costae. Hypotype G.S.C. 14883. Souris River formation, Locality 9.

6 Pedicle valve, x 0.7, showing grooved muscle scars. Hypotype G.S.C. 14881. Souris River formation, Locality 9.

Reptaria stolonifera Rolle 45

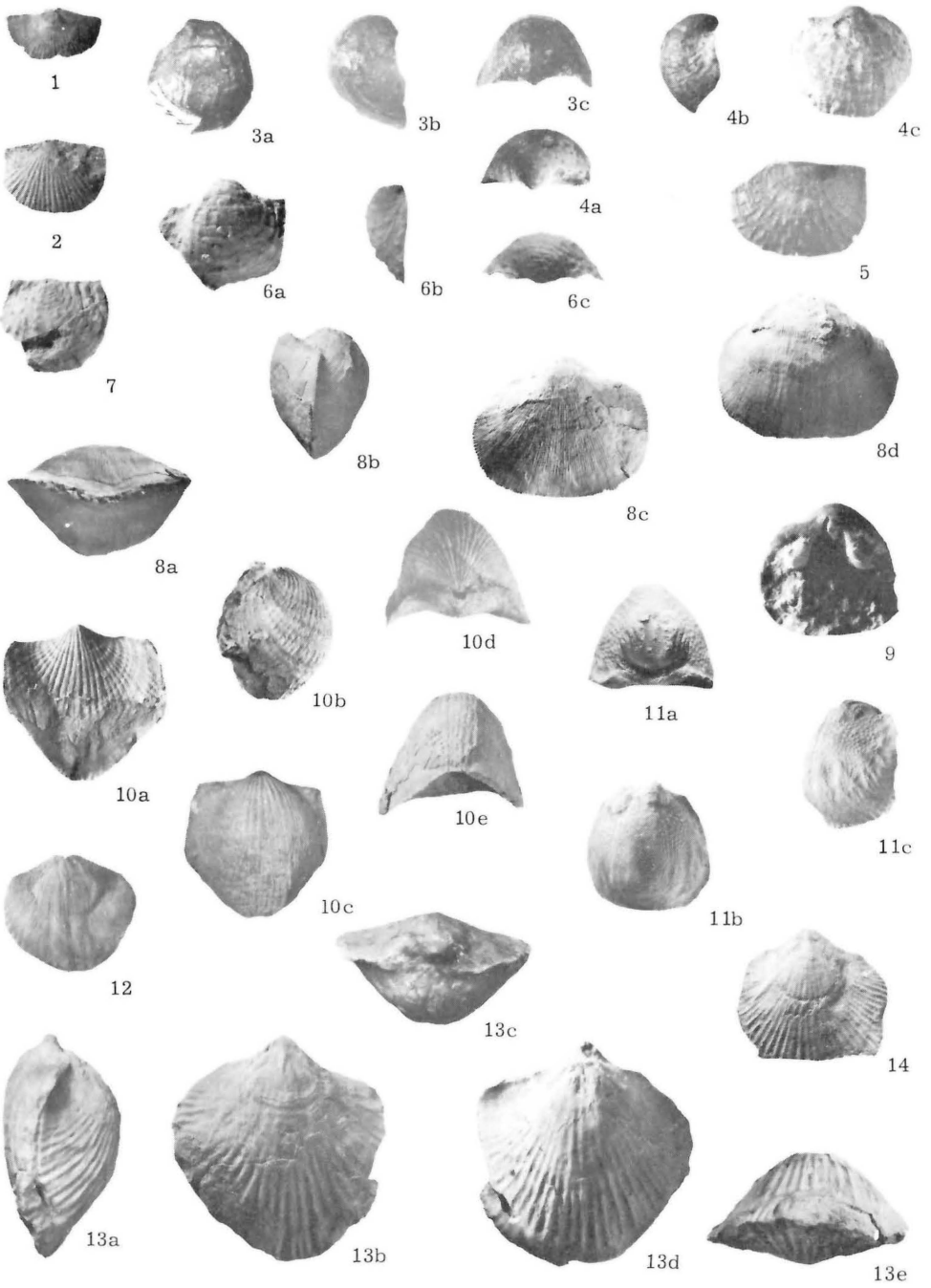
7 Drawing of zoarium, x 2.5, showing manner of budding and branching. Hypotype G.S.C. 14796. Dawson Bay formation, Locality 6.

Stropheodonta sp. 46

8a-b (a) Lateral view, x 0.7, showing curvature of pedicle valve. (b) Pedicle valve, showing outline and costae. Hypotype G.S.C. 14884. Souris River formation, Locality 9.

Cyphotrypa whiteavesi n. sp. 45

9a-b (a) Longitudinal section, x 14, showing zooecia with thick walls and fine diaphragms. Upper portion showing oblique zooecia. (b) Tangential section, x 14, showing polygonal zooecia with large acanthopores. Holotype G.S.C. 14880. Dawson Bay formation, Locality 5.



BRACHIOPODA

EXPLANATION OF PLATE 8

Page

Chonetes aurora Hall 47

1 Pedicle valve, x 1.4, showing outline and costae. Hypotype G.S.C. 14798. Dawson Bay formation, Locality 5.

2 Pedicle valve, x 1.4, showing outline of shell and faint concentric wrinkles on costae. Hypotype G.S.C. 14797. Dawson Bay formation, Locality 4.

Productella spinulicosta Hall 49

3a-c (a) Pedicle valve, showing outline of shell and several spine bases. (b) Lateral view showing curvature of pedicle valve. (c) Posterior view showing thickness of pedicle valve. Holotype 1794, New York State Museum.

Productella concentrica (Hall) 48

4a-b (a) Posterior view showing transverse curvature of pedicle valve. (b) Lateral view showing curvature of pedicle valve along midline. (c) Pedicle valve showing outline and spine bases of shell. Cotype of *Productella shumardiana* (Hall) 6441/2. American Museum Natural History.

Productella pyxidata Hall 49

5 Brachial valve showing outline and spine bases on shell. Cotype of *Productella shumardiana* (Hall) 6441/1 AMNH.

Productella concentrica (Hall) 48

6a-c (a) Pedicle valve showing outline and ornamentation of shell. (b) Lateral view showing curvature of pedicle valve along midline. (c) Posterior view showing transverse curvature of pedicle valve. Hypotype G.S.C. 14801. Dawson Bay formation, Locality 6 (upper).

7 Brachial valve showing outline and ornamentation of valve. Hypotype G.S.C. 14799. Dawson Bay formation, Locality 6 (upper).

Schizophoria iowensis (Hall) 49

8a-d (a) Anterior view showing transverse curvature of shell, uniplicate front margin. (b) Right lateral view showing curvature of shell along midline. (c) Pedicle valve showing outline and ornamentation of valve. (d) Brachial valve showing outline of valve and interior with vascular markings. Hypotype G.S.C. 14804. Dawson Bay formation, Locality 5.

9 Pedicle interior showing strong dental lamellae. Hypotype G.S.C. 14805. Dawson Bay formation, Locality 2.

Atrypa bremerensis Stainbrook 51

10a-e (a) Pedicle valve partially exfoliated. (c) Brachial valve showing outline. (b, d, e) Lateral, posterior and front views showing extreme gibbosity of brachial valve. Hypotype G.S.C. 14811. Dawson Bay formation, Locality 5.

11a-c Interior of brachial valve. (a) Posterior view showing grooved adductor muscle impressions. (b) Brachial valve showing position of adductor scars and genital and vascular markings. (c) Lateral view showing gibbosity of adductor muscle impressions, genital impressions and vascular markings. Hypotype G.S.C. 14810. Dawson Bay formation, Locality 5.

12 Interior of pedicle valve showing large flabellate diductor muscle scars with small adductor scars located within posterior portion of diductors, genital markings, and impression of first ascending lamellae. Hypotype G.S.C. 14812. Dawson Bay formation, Locality 5.

EXPLANATION OF PLATE 8 (Continued)

Page

Atrypa manitobensis n. sp. 52

13a-d (a) Lateral view showing curved lateral margin and outline of shell along midline. (b) Pedicle valve showing outline of valve and impression of coarse costae on interior. (c) Posterior view showing transverse curvature of pedicle and brachial valves. (d) Brachial valve showing outline and pointed beak of pedicle valve. (e) Front view showing slight plication of front margin. Holotype G.S.C. 14813. Dawson Bay formation, Locality 2.

14 Pedicle valve of small specimen showing outline of valve and coarse costae. Paratype G.S.C. 14816. Dawson Bay formation, Locality 2.

EXPLANATION OF PLATE 9

Page

Atrypa independensis Webster 53

1a-c (a) Pedicle valve, showing outline, costae and growth lamellae. (b) Brachial valve showing outline and ornamentation of valve. (c) Lateral view showing curvature along midline. Hypotype G.S.C. 14817. Souris River formation, Locality 11.

2a-c (a) Pedicle valve and (b) brachial valve, showing outline and ornamentation of shell. (c) Lateral view of specimen with slightly distorted pedicle valve at front margin. Hypotype G.S.C. 14818. Souris River formation, Locality 8.

3a-b (a) Pedicle valve showing exterior ornamentation. (b) Brachial interior showing grooved adductor muscle scars, and vascular impressions. Hypotype G.S.C. 14820. Dawson Bay formation, Locality 6 (upper).

4 Pedicle interior showing numerous genital markings. Hypotype G.S.C. 14819. Souris River formation, Point Wilkins member, Locality 11.

Atrypa snakensis n. sp. 54

5a-b (a) Pedicle interior showing flabellate diductor scar, vascular markings and impression of first ascending lamellae. (b) Brachial interior showing grooved adductor impression and vascular markings. Hypotype G.S.C. 14827. Dawson Bay formation, Locality 6 (upper).

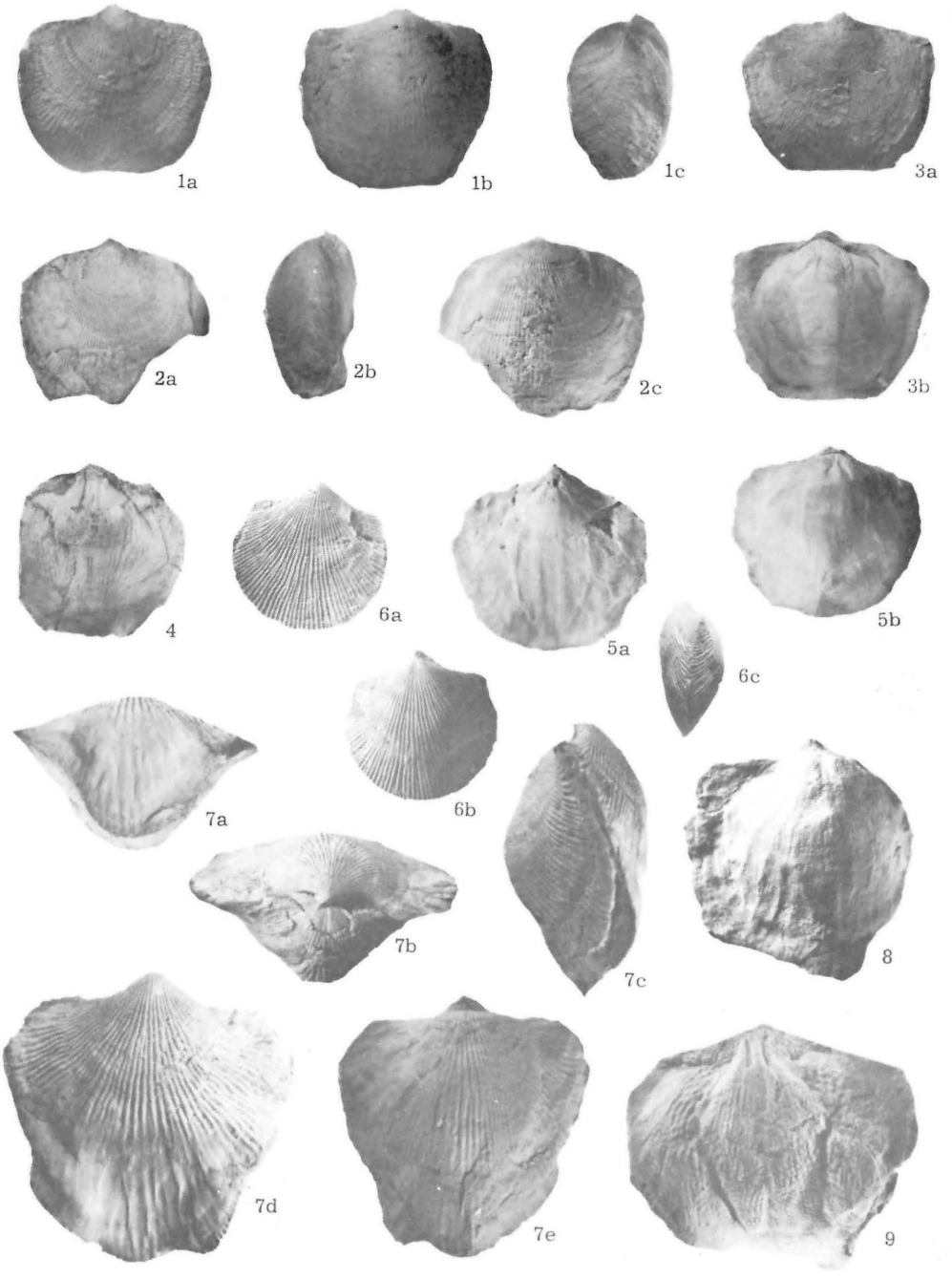
6a-c Immature specimen (a) pedicle valve, (b) brachial valve, (c) lateral view showing prominent beak and biconvexity of valves. Paratype G.S.C. 14826. Dawson Bay formation, Locality 5.

7a-e (a) Front view showing deep sulcus on pedicle valve. (b) Posterior view showing beaks and hinge line. (c) Lateral view showing prominent beak, curvature of lateral margin and midline. (d) Pedicle view showing outline of valve, shell material partially exfoliated showing vascular impressions. (e) Brachial valve showing outline of valve and prominent pedicle beak. Holotype G.S.C. 14821. Dawson Bay formation, Locality 5.

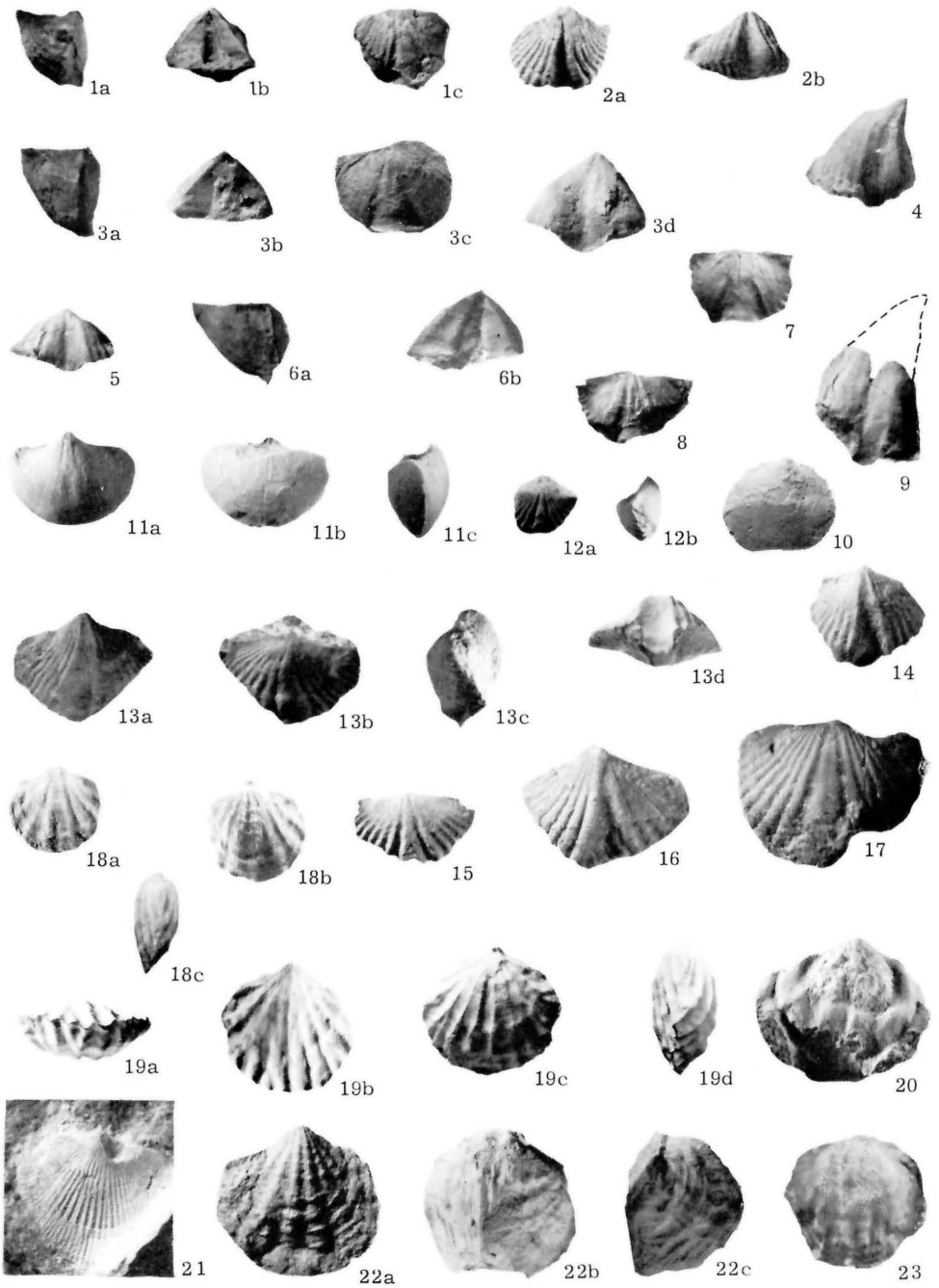
Atrypa snakensis n. sp. 54

8 Brachial interior showing vascular impression and faint adductor impression. Paratype G.S.C. 14825. Dawson Bay formation, Locality 6 (upper).

9 Pedicle interior showing flabellate diductor impressions, deep grooves marking main vascular trunk, and genital markings. Paratype G.S.C. 14824. Dawson Bay formation, Locality 5.



ATRYPA



BRACHIOPODA

EXPLANATION OF PLATE 10

Page

Cyrtina hamiltonensis Hall 60

1a-c (a) Lateral view showing flat interarea. (b) Posterior view showing large interarea and delthyrium. Hypotype G.S.C. 14847. Dawson Bay formation, Locality 5.

2a-b (a) Pedicle valve showing outline of valve and sulcus. (b) Front view showing uniplicate margin, deep sulcus on pedicle valve and indistinct fold on brachial valve. Hypotype G.S.C. 14846. Dawson Bay formation, Locality 2.

Cyrtina paucicostata n. sp. 60

3a-d (a) Lateral view showing flat interarea, steeply curved pedicle valve, almost flat brachial valve. (b) Posterior view showing striate interarea, delthyrium covered. (c) Brachial valve with fold defined by two deep grooves. (d) Front view showing uniplicate front margin, pointed beak. Holotype G.S.C. 14848. Dawson Bay formation, Locality 5.

4 Pedicle valve showing slightly inclined pointed beaks. Paratype G.S.C. 14855. Dawson Bay formation, Locality 2.

5 Front view showing deep sulcus and weak costae on lateral slopes. Paratype G.S.C. 14849. Dawson Bay formation, Locality 5.

6a-b (a) Lateral view showing flat interarea and weak costae on lateral slopes. (b) Posterior view showing straight hinge line, large interarea and delthyrium. Paratype G.S.C. 14852. Dawson Bay formation, Locality 5.

7 Brachial valve with fold defined by depression; median septum extending from hinge to midlength. Paratype G.S.C. 14854. Dawson Bay formation, Locality 5.

8 Brachial valve with depressions on either side of fold and flanked by large costa impression. Paratype G.S.C. 14853. Dawson Bay formation, Locality 5.

9 Pedicle valve showing sulcus with lingual extension. Paratype G.S.C. 14850. Dawson Bay formation, Locality 6 (lower).

Nucleospira sp. 61

10 Pedicle valve showing outline of valve and pointed beak. Hypotype G.S.C. 14859. Souris River formation, Locality 9.

Emanuella richardsoni (Meek) 57

11a-c Exfoliated specimen of (a) pedicle valve, (b) brachial valve, (c) lateral view showing outline and curvature of valves. Hypotype G.S.C. 14836. Dawson Bay formation, Locality 6.

(*Continued on p. 102*)

EXPLANATION OF PLATE 10 (Continued)

Page

Allanaria allani Warren 59

12a-b Young specimen showing (a) brachial valve and (b) lateral view. Hypotype G.S.C. 14841. Souris River formation, Locality 8.

13a-d (a) Pedicle valve showing outline of valve, sulcus and ornamentation. (b) Brachial valve showing low fold, straight hinge line, interarea. (c) Lateral view showing lateral margin, prominent beak of pedicle valve with curved interarea. (d) Front view showing uniplicate front margin. Hypotype G.S.C. 14840. Souris River formation, Locality 8.

14 Pedicle view showing sulcus and lateral costae. Hypotype G.S.C. 14842. Souris River formation, Locality 8.

15 Brachial valve showing indistinct fold. Hypotype G.S.C. 14843. Souris River formation, Locality 8.

16 Pedicle valve, x 1.4, showing concentric striae on valve. Hypotype G.S.C. 14844. Souris River formation, Locality 9.

17 Brachial valve, x 1.4, showing fine concentric striae on valve. Hypotype G.S.C. 14845. Souris River formation, Locality 9.

Spinatrypa mascula var. *manitobensis* n. var. 56

18a-c Young form (a) pedicle valve showing prominent beak, coarse costae. (b) Brachial valve showing outline and open delthyrium. (c) Lateral view showing biconvexity, and pointed beak. Paratype G.S.C. 14832. Dawson Bay formation, Locality 6 (lower).

19a-d (a) Front view showing front margin. (b) Pedicle valve. (c) Brachial valve. (d) Lateral view showing outline and convexity of valves. Holotype G.S.C. 14831. Dawson Bay formation, Locality 6 (lower).

Spinatrypa mascula (Stainbrook) 55

20 Pedicle interior showing large flabellate diductor impression surrounded by deep groove. Hypotype G.S.C. 14830. Dawson Bay formation, Locality 6.

22a-c (a) Pedicle valve showing costae and imbricate growth lines. Hypotype G.S.C. 14802. Dawson Bay formation, Locality 5. (b) Brachial valve showing gibbosity of umbonal region so that brachial beak hidden. (c) Lateral view showing gibbosity of brachial valve. Hypotype G.S.C. 14829. Dawson Bay formation, Locality 3.

23 Brachial interior showing genital pores and vascular markings. Hypotype G.S.C. 14828. Dawson Bay formation, Locality 6.

Atrypa sp. 55

21 Brachial valve showing increase of costae slightly anterior to midlength. Hypotype G.S.C. 14809. Dawson Bay formation, Locality 11.

EXPLANATION OF PLATE 11 *(on page 105)*

Page

Athyris vittata Hall 62

1a-c (a) Pedicle valve showing vascular markings. (b) Brachial valve showing prominent beak. (c) Lateral view showing convexity of valves. Hypotype G.S.C. 14679. Souris River formation, Point Wilkins member, Rose Bush Island, Swan Lake, Manitoba.

2a-c (a) Pedicle valve showing coarse growth lamellae. (b) Lateral view showing convexity of valve and ornamentation. (c) Brachial valve showing outline of valve. Hypotype G.S.C. 14861. Souris River formation, Point Wilkins member, Locality 11.

3 Pedicle valve showing outline and faint sulcus. Hypotype G.S.C. 14860. Souris River formation, Point Wilkins member, Locality 11.

(Continued on p. 104)

EXPLANATION OF PLATE 11 (Continued)

Page

Cranaena cf. *iowensis* (Calvin) 63

4a-b (a) Brachial interior showing outline of valve. (b) Lateral view of brachial valve showing convexity and faint growth lines. Hypotype G.S.C. 14887. Souris River formation, near Steep Rock River.

Phthonia sp. 64

5 Side view of right valve showing part of the outline and surface ornamentation. Hypotype G.S.C. 14806. Dawson Bay formation, Locality 1.

Nuculana cf. *rostellata* (Conrad) 64

6a-b (a) Side view of left valve showing outline. (b) Anterior view showing subtriangular outline. Hypotype G.S.C. 14808. Dawson Bay formation, Locality 2.

Cypricardinia sp. 65

7a-b (a) Side view of right valve, x 1.4, showing surface ornamentation. (b) Antero-dorsal view, x 1.4, showing slightly offset beaks. Hypotype G.S.C. 14888. Dawson Bay formation, Locality 1.

8a-c (a) Side view of right valve showing outline. (b) Side view of left valve showing outline and indistinct surface ornamentation. (c) Antero-dorsal view showing slightly offset beaks. Hypotype G.S.C. 14889. Dawson Bay formation, Locality 5.

Paracyclas elliptica Hall 65

9a-b (a) Dorsal view showing slightly distorted left valve. (b) Side view of right valve showing outline and surface ornamentation. Hypotype G.S.C. 14862. Dawson Bay formation, Locality 6 (upper).

10a-b (a) Dorsal view showing slight distortion. (b) Side view of left valve showing elliptical outline and surface ornamentation. Hypotype G.S.C. 14863. Bell River.

Paracyclas proavia (Goldfuss) 66

11 Form C. Side view of right valve showing subquadrate outline and indistinct surface ornamentation. Hypotype G.S.C. 14866. Dawson Bay formation, Locality 6 (upper).

12a-b Form A. (a) Side view of right valve showing outline. (b) Dorsal view with beaks poorly developed. Hypotype G.S.C. 14864. Dawson Bay formation, Locality 5.

13a-b Form B. (a) Right valve showing elliptical outline, beak in anterior portion of valve and surface ornamentation. (b) Dorsal view showing hinge line. Hypotype G.S.C. 14865. Dawson Bay formation, Locality 6 (upper).

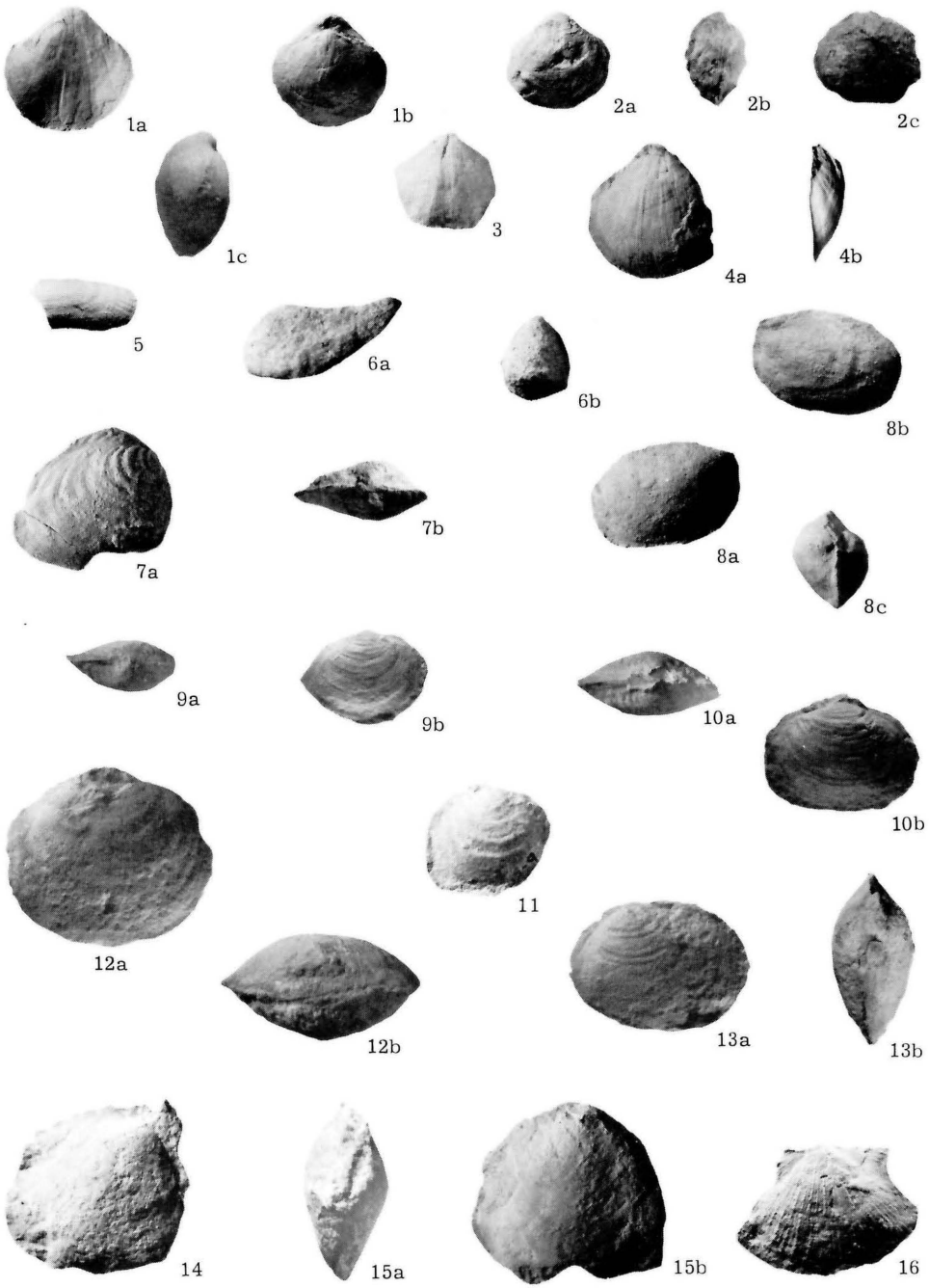
Phenacocyclas antiqua (Goldfuss) 68

14 Side view of right valve showing postero-dorsal sulcus and outline. Hypotype G.S.C. 14891. Dawson Bay formation, Locality 3.

15a-b (a) Side view of left valve showing posterior sulcus. (b) Dorsal view showing indistinct hinge line. Hypotype G.S.C. 14890. Dawson Bay formation, Locality 6 (upper).

Aviculopecten cf. *tenuis* Hall 68

16 Side view left valve showing large angular posterior ear and small flat anterior ear. Hypotype G.S.C. 14892. Dawson Bay formation, Locality 1.



BRACHIOPODA and PELECYPODA


1a


1b


1c


2


4

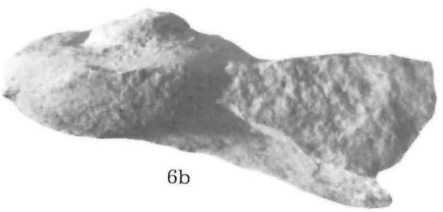

5


3


7a


6a


7b


6b


7c


8a


8b

GASTROPODA

EXPLANATION OF PLATE 12

Page

Ptychospirina sp. 69

1a-c (a) Inclined view showing outline of outer lip. (b) Side view showing outline of shell, height of spires. (c) Side view showing apertural openings and rounded anomphalus base. Hypotype G.S.C. 14893. Dawson Bay formation, Locality 6 (upper).

Naticonema sp. 70

2 Side view showing rounded whorls and ornamentation consisting of lirae. Hypotype G.S.C. 14894. Souris River formation, Locality 9.

Bellerophon pelops var. 71

3 Back view showing outline and surface ornamentation. Hypotype G.S.C. 14899. Dawson Bay formation, Locality 6 (upper).

4 Back view of immature specimen showing surface ornamentation. Hypotype G.S.C. 14900. Dawson Bay formation, Locality 1.

Bucanopsis sp. 72

5 Back view showing outline and surface ornamentation. Hypotype G.S.C. 14901. Dawson Bay formation, Locality 5.

Straparolus (*Straparolus*) *subtrigonalis* (Whiteaves) 70

6a-b (a) Top view showing coiling. (b) Side view showing low spire and subtriangular aperture. Hypotype G.S.C. 14895. Dawson Bay formation, Locality 5.

Mastigospira alata (Whiteaves) 71

7a-c (a) End view showing triangular outline with basal angles more alate than apical angle. (b) Side view showing slightly curved shell. (c) Top view showing basal alations projecting beyond shell and V-shaped aperture. Hypotype G.S.C. 14898. Dawson Bay formation, Locality 3.

Omphalocirrus ? *manitobensis* (Whiteaves) 70

8a-b (a) Top view, x 0.4, showing coiling. (b) Bottom view, x 0.4, showing wide umbilicus. Hypotype G.S.C. 14897. Dawson Bay formation, Locality 5.

EXPLANATION OF PLATE 13

Page

Proetus manitobensis n. sp. 75

1 Top view of cephalon, x 3.5, showing glabella with three glabellar furrows. Holotype G.S.C. 14910. Dawson Bay formation, Locality 1.

2 Top view of free cheek, x 2.3, showing striations on border and broken genal spine. Paratype G.S.C. 14912. Dawson Bay formation, Locality 6 (lower).

3 Top view of free cheek, x 3, showing genal spine. Paratype G.S.C. 14911. Dawson Bay formation, Locality 4.

4 Top view of pygidium, x 1.7, showing outline, blunt axis and broad border. Paratype G.S.C. 14913. Dawson Bay formation, Locality 4.

5a-b (a) Right side view, x 1.4, showing height of axis above pleural lobe. (b) Top view of pygidium, x 1.4, showing blunt axis and pleuron. Paratype G.S.C. 14914. Dawson Bay formation, Locality 5.

Buchelia tyrrelli (Whiteaves) 73

6a-b (a) Top view, x 0.7, showing coiling. (b) Side view, x 0.7, showing flat spire, angular periphery, and conical base. Hypotype G.S.C. 14902. Dawson Bay formation, Bell River.

Straparolus (Straparolus) subtrigonalis (Whiteaves) 70

7 Bottom view showing round base, wide umbilicus. Hypotype G.S.C. 14896. Dawson Bay formation, Locality 5.

Loxonema altivolvis Whiteaves 73

8a-b (a) Side view, x 0.7, showing aperture and anomphalus base. (b) Side view showing high spire. Hypotype G.S.C. 14905. Dawson Bay formation, Locality 5.

Michelinoceras ? hindii (Whiteaves) 74

9 Side view, x 0.7, showing slightly curved sutures. Hypotype G.S.C. 14909. Dawson Bay formation, Locality 5.

10a-b (a) Top view, x 0.7, showing elliptically compressed shell. (b) Side view, x 1, showing curved sutures. Hypotype G.S.C. 14908. Dawson Bay formation, Locality 5.

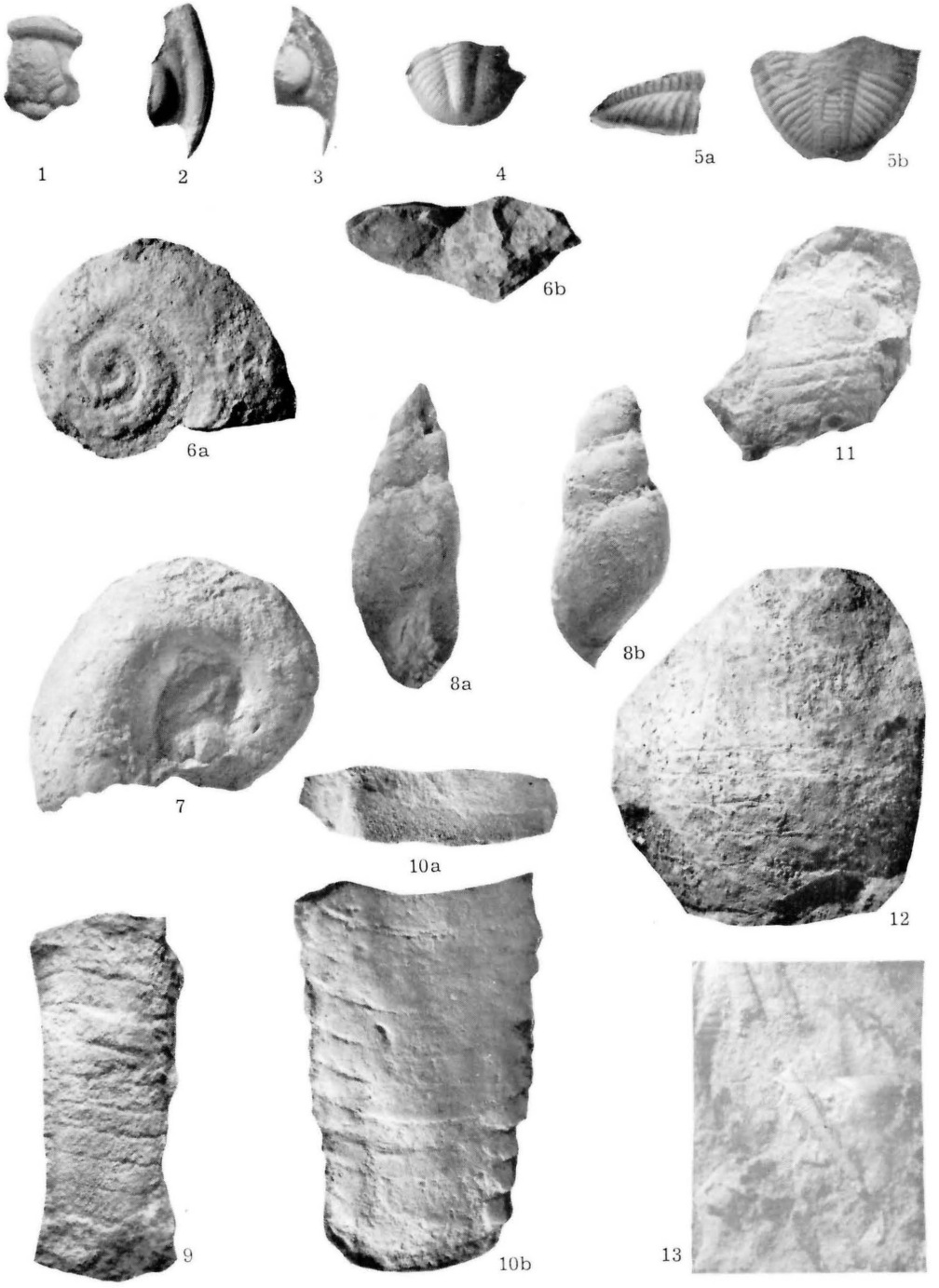
"Gomphoceras" manitobensis Whiteaves 74

11 Side view, x 0.7, showing partial outline of shell, and body chamber. Hypotype G.S.C. 14907. Dawson Bay formation, Locality 5.

12 Side view, x 0.4, imbedded in matrix showing straight sutures and body chamber. Hypotype G.S.C. 14906. Dawson Bay formation, Locality 5.

Tentaculites parvulus Whiteaves 74

13 Side view, x 2, showing annulation. Hypotype G.S.C. 14803. Souris River formation, Locality 9.



TRILOBITA and MOLLUSCA