GEOLOGICAL SURVEY OF CANADA · 1842 ·

GEOLOGICAL
SURVEY
OF
CANADA

DEPARTMENT OF MINES
AND TECHNICAL SURVEYS

BULLETIN 133

UPPER DEVONIAN STROMATOPOROIDS FROM THE REDWATER REEF COMPLEX, ALBERTA

J. E. Klovan

UPPER DEVONIAN STROMATOPOROIDS FROM SOUTHERN NORTHWEST TERRITORIES AND NORTHERN ALBERTA

C. W. Stearn

Price, $4.50

1966

UPPER DEVONIAN STROMATOPOROIDS

2,000-1965-5345

Chief Scientific Editor
PETER HARKER

Technical Editor
PETER HARKER

Production Editor
MARGUERITE RAFUSE

Printed on ANCASTER BOOK

Set in Times Roman with
20th Century captions by
RYERSON PRESS, TORONTO

Artwork by CARTOGRAPHIC UNIT, GSC

GEOLOGICAL SURVEY
OF CANADA

BULLETIN 133

UPPER DEVONIAN STROMATOPOROIDS FROM THE REDWATER REEF COMPLEX, ALBERTA

By J. E. Klovan

UPPER DEVONIAN STROMATOPOROIDS FROM SOUTHERN NORTHWEST TERRITORIES AND NORTHERN ALBERTA

By C. W. Stearn

DEPARTMENT OF
MINES AND TECHNICAL SURVEYS
CANADA

Available by mail from the Queen's Printer, Ottawa,
from Geological Survey of Canada,
601 Booth St., Ottawa,
and at the following Canadian Government bookshops:

OTTAWA
Daly Building, corner Mackenzie and Rideau

TORONTO
221 Yonge Street

MONTREAL
Æterna-Vie Building, 1182 St. Catherine St. West

WINNIPEG
Mall Center Bldg., 499 Portage Avenue

VANCOUVER
657 Granville Street

or through your bookseller.

A deposit copy of this publication is also available
for reference in public libraries across Canada.

Price $4.50 Catalogue No. M42-133

Price subject to change without notice

ROGER DUHAMEL, F.R.S.C.
Queen's Printer and Controller of Stationery
Ottawa, Canada
1966

PREFACE

Stromatoporoids were important reef-forming and rock-building organisms in Palaeozoic times. Widely distributed and often well-preserved, they are of considerable stratigraphic significance in the chronology of the rocks in which they are fossilized.

Stromatoporoids described in Part II are from Devonian outcrops; those described in Part I are from drill-cores from the Devonian Redwater reef that forms the reservoir of rock of the Redwater oil field, northeast of Edmonton.

The results of these two related studies show how the systematic palaeontologist can provide a link between rocks exposed at the surface and those deeply buried beneath younger sediments.

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

OTTAWA, September 15, 1964

BULLETIN 133—Stromatoporen des Oberdevons aus dem Redwater-Reef-Komplex in Alberta
Von J. E. Klovan

Stromatoporen des Oberdevons aus dem südlichen Teil der Nordwestterritorien und aus dem nördlichen Alberta
Von C. W. Stearn

БЮЛЛЕТЕНЬ 133 — Дж. Э. Клован. Верхнедевонские строматопороиды из комплекса Рэдуатер Риф Альберты.
К. В. Стёрн. Верхнедевонские строматопороиды из юга Северо-Западной территории и Северной Альберты.

CONTENTS

PART I – Upper Devonian Stromatoporoids from the Redwater Reef Complex, Alberta

J. E. Klovan

PART II – Upper Devonian Stromatoporoids from Southern Northwest Territories and Northern Alberta

C. W. Stearn

Illustrations

PART I–UPPER DEVONIAN STROMATOPOROIDS FROM THE REDWATER REEF COMPLEX, ALBERTA

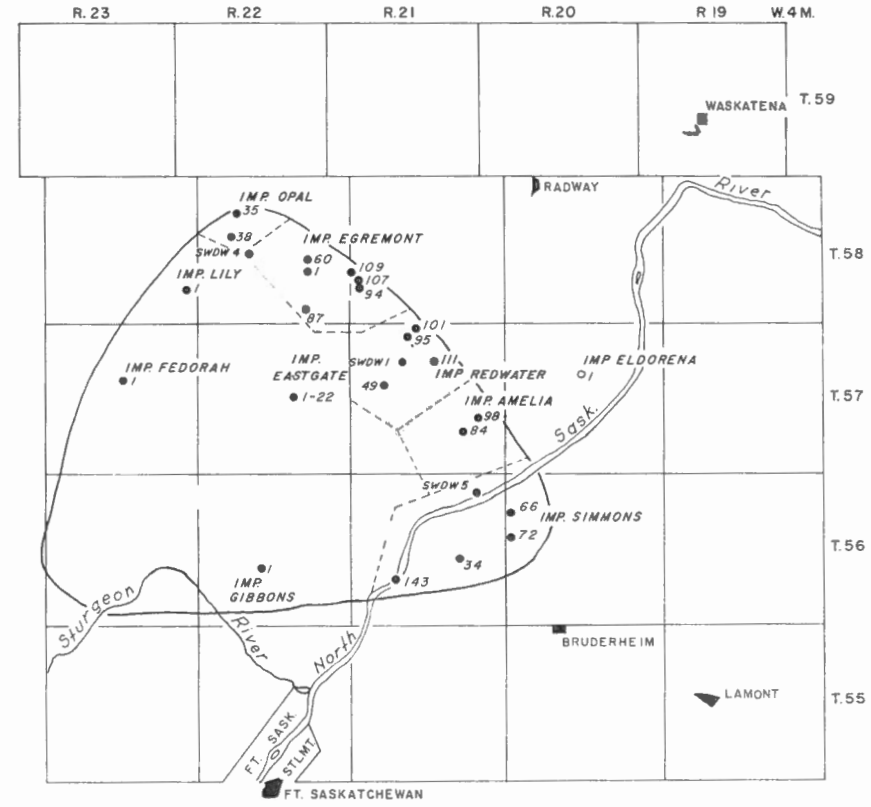
J. E. Klovan

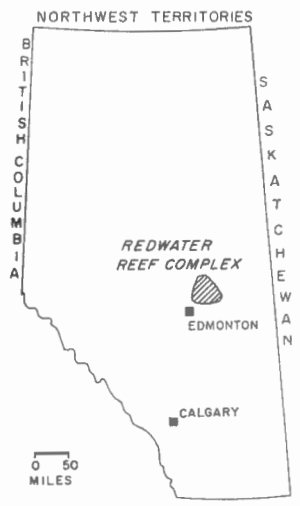
Abstract

Stromatoporoids are the dominant reef builders in the Redwater reef complex, Alberta. Specimens collected from cores of the Upper Devonian Leduc Formation at Redwater field are the subject of this paper. Twenty-seven species are represented comprising thirteen genera. A new stromatoporoid genus, *Euryamphipora,* is described. Six new species are described and illustrated: *Anostylostroma intermedium, Hammatostroma delicatulum, Hammatostroma nodosum, Euryamphipora platyformis, Actinostroma pachypilatum, Actinostroma redwaterense.*

Résumé

Les stromatoporidés sont les principaux organismes constructeurs des récifs du complexe de Redwater en Alberta. Les échantillons recueillis de carottes provenant de la formation Leduc du Dévonien supérieur, au champ Redwater, font l'objet de la présente étude. Vingt-sept espèces y sont représentées, dont treize genres. L'auteur y décrit un nouveau genre de stromatoporidés: *Euryamphipora.* Il y décrit et illustre aussi six nouvelles espèces: *Anostylostroma intermedium, Hammatostroma delicatulum, Hammatostroma nodosum, Euryamphipora platyformis, Actinostroma pachypilatum, Actinostroma redwaterense.*





MILES
0 3 6

LEGEND

- STROMATOPOROID COLLECTING LOCALITY
- GENERAL OUTLINE OF REDWATER REEF COMPLEX.

FIGURE 1.

Location of Redwater Reef Complex

INTRODUCTION

Devonian reefs form the major hydrocarbon reservoirs of western Canada. Although a great deal is known concerning their regional distribution and reservoir properties, surprisingly little has been published on the organisms that were responsible for their development. During a detailed study of the Redwater reef complex (Fig. 1), the writer collected several hundred specimens of stromatoporoids. Because these organisms were the major reef frame builders, a detailed systematic study of them was desirable. Samples were taken from twenty-five well cores. Only four of these wells penetrated the entire 1,100 feet of carbonate; the rest penetrated only the upper 75 to 150 feet of the reef.

The stromatoporoid fauna described here, although large, probably represents only a small proportion of the species actually present in the reef carbonates, owing to poor preservation and a sampling program not expressly designed to give complete representation of the stromatoporoid species.

Appreciation is extended to Dr. J. St. Jean, Jr., University of North Carolina, for guidance through the intricacies of stromatoporoid morphology. He also gave valuable suggestions in the preparation of this report and critically reviewed the section on systematic palaeontology, as did Dr. J. Van Sant and Dr. C. W. Stearn.

METHOD OF INVESTIGATION

The purpose of logging cores from wells penetrating the Redwater reef complex was primarily stratigraphic and not palaeontologic, and the specimens were not collected systematically. More than 500 were taken from several thousand feet of core.

As much of the coenosteum as possible was collected. The overall external morphology was described, and an attempt made to determine if the specimen was in place. A one-to-two-inch cube of the specimen was then cut out with a diamond saw. At least two sides of the cube were carefully oriented so as to conform to longitudinal and tangential sections of the stromatoporoid. These sides were polished, etched, and acetate peels were made of them using the dry-peel technique. The cubes were then filed and if a thin-section was later required, the etched surface was repolished and used.

Acetate peels usually provided sufficient details for identification of species. Their use is advantageous because of the rapidity, low cost, and ease of preparation. Admittedly, peels do not appear to record some of the more subtle microstructures,

such as maculae, but they do show such features as pores, vacuoles, and microlaminae. After several dozen stromatoporoid specimens had been thin-sectioned and identified, most of the others could be assigned to a species by means of peels alone.

In dealing with the large number of specimens, an optical projector was found to be useful in grouping them into their proper species. A thin-section, or peel, can be projected onto a screen while another section is examined under the microscope. In this way, the two specimens can be easily compared.

A simple, and effective, method of photographing the stromatoporoid sections is as follows: A thin-section is placed in a photographic enlarger and projected onto a piece of high contrast bromide paper; the exposed paper is processed in the regular manner to form a negative print; a positive print is then obtained by using the negative print in place of a normal negative in a contact printer, once again using a bromide paper.

This technique is advantageous in that it is rapid, correct exposure and density of the product can be observed almost at once, and practically any feature on the thin-section is reproduced in detail on the photo. However, since no celluloid negative phase is involved, the photographs cannot be readily retouched. This may be an advantage rather than a disadvantage of the method, as the photo is a record of what is on the slide rather than an interpretation of the slide. Considering the obscure and subtle features dealt with in stromatoporoid morphology, any retouching of photographs is undesirable.

STRATIGRAPHY

The Redwater reef complex is one of many Devonian carbonate bodies occurring in the subsurface of western Canada. The entire carbonate unit is referred to the Leduc Formation, and is equivalent to the Cooking Lake, Duvernay, and part of the Ireton Formations in the "off-reef" section (Fig. 2). The entire suite of sediments comprises the Woodbend Group. For ease of discussion, the Leduc Formation at Redwater is arbitrarily divided into the Cooking Lake equivalent, Middle Leduc unit, and an Upper Leduc unit as shown in Figure 3. Most authorities (for example, McLaren, 1956)[1] consider the Leduc Formation to be Upper Devonian (Frasnian).

For details of Devonian stratigraphy in central Alberta, readers are referred to Andrichuk (1958a, b) and Belyea (1952, 1955, 1957, 1960). Klovan (1964) describes the Redwater reef complex in detail and assesses the ecological importance of stromatoporoids.

Important papers dealing with the western Canadian stromatoporoid faunas include Galloway (1960); Stearn (1961, 1962, 1963); Fischbuch (1960, 1962).

[1]Names and/or dates in parentheses are those of *References*, page 32.

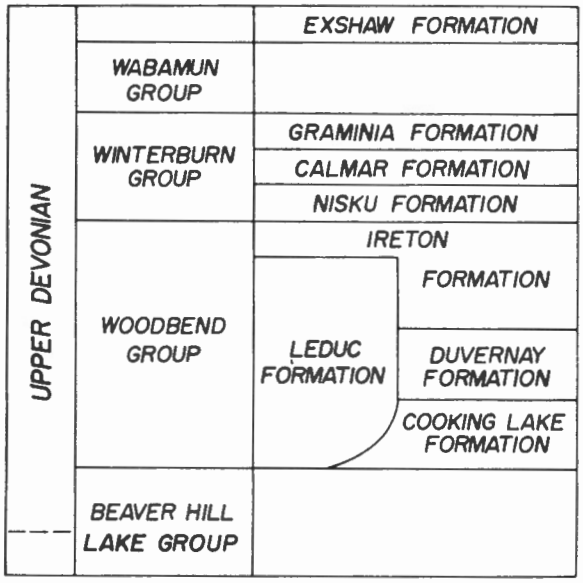


FIGURE 2.

Upper Devonian Stratigraphic Section in Central Alberta

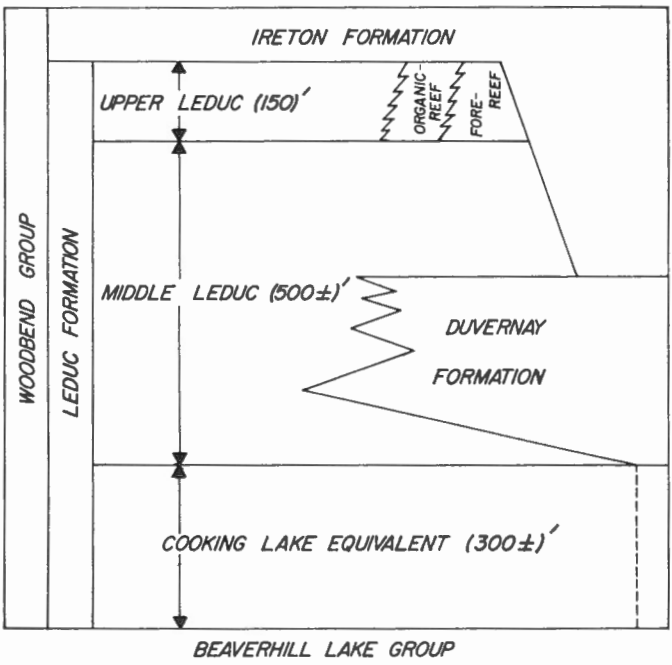


FIGURE 3.

Subdivisions of Leduc Formation

SYSTEMATIC PALAEONTOLOGY

Classification

The classification and terminology of Galloway (1957) are used in the descriptions of the stromatoporoid specimens. In general, his generic diagnoses are followed throughout. It is becoming increasingly apparent that there are serious shortcomings in this classification but sufficient data are not yet available to formulate a better one. The prime difficulty encountered in assigning specimens to a given genus is that in the Redwater specimens, diagenesis has altered the rock to such an extent that the finer details of skeletal microstructure have been obscured or obliterated. Galloway's system of classification is based almost entirely on microstructure on a family and generic level, so that in the present study many specimens have had to be assigned to a genus on grosser features such as the size and distribution of the various skeletal elements. Stearn (1963, pp. 652-653) gave an account of some problems involved in stromatoporoid classification and the writer's views on some aspects of this problem form a part of the discussion of the genus *Euryamphipora* in this paper.

Table I

Location of Wells

Well	No.	Location	K.B.	Top Leduc Formation
Imperial Simmons	72	11-19-56-20 W4	2060	3127
Imperial Simmons	66	11-30-56-20 W4	2050	3137
Imperial Simmons	143	16- 8-56-21 W4	1981	3181
Imperial Simmons	34	11-14-56-21 W4	2050	3143
Saltwater Disposal Well	5	5-36-56-21 W4	1973	3035
Imperial Gibbons	1	2-16-56-22 W4	2144	3483
Imperial Amelia	84	11-11-57-21 W4	1999	3134
Imperial Amelia	98	5-13-57-21 W4	2057	3231
Imperial Redwater	49	11-20-57-21 W4	2068	3166
Imperial Redwater	111	11-27-57-21 W4	2069	3229
Saltwater Disposal Well	1	12-28-57-21 W4	1989	3092
Imperial Redwater	95	11-33-57-21 W4	2067	3181
Imperial Redwater	101	15-33-57-21 W4	2072	3281
Imperial Eastgate	1-22	1-22-57-22 W4	2144	3472
Imperial Fedorah	1	12-22-57-23 W4	2166	3602
Imperial Egremont	94	11- 7-58-21 W4	2084	3187
Imperial Egremont	107	14- 7-58-21 W4	2087	3275
Imperial Egremont	109	4-18-58-21 W4	2087	3314
Imperial Egremont	87	11- 2-58-22 W4	2062	3238
Imperial Egremont	1	3-14-58-22 W4	2084	3222
Imperial Egremont	60	11-14-58-22 W4	2085	3230
Saltwater Disposal Well	4	13-16-58-22 W4	2039	3204
Imperial Opal	38	11-20-58-22 W4	2009	3162
Imperial Opal	35	7-29-58-22 W4	2093	3928
Imperial Lily	1	7-12-58-23 W4	2161	3433

Systematic Descriptions

Each specimen is labelled by the name of the well and subsurface footage at the site of collection. Well locations are listed in Table I and illustrated in Figure 1. All species described are listed in Table II. Occurrences of the species as they are found in the Leduc Formation in the Redwater reef complex are also indicated. Types and figured specimens are in the collections of the Geological Survey of Canada, Ottawa.

Table II

Distribution of Species

	LEDUC FM.			
	Cooking Lake Equiv.	Middle Leduc	Upper Leduc	Duvernay Fm.
Anostylostroma laxum (Nicholson)	X			
Anostylostroma intermedium n. sp.			X	
Atelodictyon cf. *A. stelliferum* Stearn			X	
Stromatoporella cf. *S. subvesiculosa* (Lecompte)			X	
Stromatoporella damnoniensis Nicholson			X	X
Stromatoporella cf. *S. mirabilis* Yavorsky	X			
Hammatostroma cf. *H. albertense* Stearn			X	
Hammatostroma albertense Stearn		X		
Hammatostroma delicatulum n. sp.			X	
Hammatostroma nodosum n. sp.	X			
Euryamphipora platyformis n. gen.	X			
Actinostroma matutinum Nicholson		X	X	
Actinostroma clathratum Nicholson	X	X		
Actinostroma pachypilatum n. sp.		X		
Actinostroma redwaterense n. sp.	X			
Actinostroma cf. *A. crassepilatum* Lecompte		X	X	
Trupetostroma warreni Parks	X	X		
Trupetostroma aff. *T. laceratum* Lecompte			X	
Trupetostroma cf. *T. coalescens* Galloway and St. Jean			X	
Trupetostroma? sp.	X	X		
Ferestromatopora dubia Lecompte	X			
Stromatopora cygnea Stearn	X	X	X	
Syringostroma cf. *S. perfuscum* Galloway and St. Jean		X	X	
Syringostroma? sp.		X	X	
Synthetostroma vesiculosum (Lecompte)	X	X		
Amphipora sp.	X	X	X	X
Stachyodes costulata Lecompte	X	X	X	

Family CLATHRODICTYIDAE Kühn, 1939

Genus *Anostylostroma* Parks, 1936

Type species: *Anostylostroma hamiltonense* Parks, 1936.

Anostylostroma laxum (Nicholson)

Plate I, figures 1a, b

1887. *Clathrodictyon laxum* NICHOLSON, p. 12, Pl. 3, figs. 4, 5.
1936. *Clathrodictyon laxum* Nicholson, PARKS, p. 13, Pl. 1, figs. 1-8; Pl. 2, fig. 4.
1957. *Anostylostroma laxum* (Nicholson), GALLOWAY and ST. JEAN, pp. 116-118, Pl. 5, figs. 2a, b.

Exterior. Description based on one specimen, coenosteum tabular; the fragment is 6 cm thick. Surface smoothly undulose without development of mamelons. Latilaminae are obscure; no astrorhizae are present on the surface.

Vertical section. Coenosteum consists of laminae, pillars, and scattered dissepiments. Laminae are continuous, 0.04 to 0.07 mm thick and regularly spaced with eleven in 5 mm, composed of a single layer of compact, transversely fibrous tissue. Pillars are simple rods and spools, rarely branching upward to form a Y, many are incomplete, about ten in 5 mm, some of the pillars are joined in the interlaminar areas, others are connected by upwardly arched dissepiments. Galleries are rectangular to square.

Tangential section. Pillars are round to oval, 0.08 mm in diameter, in places joined to form a vermicular network; dissepiments commonly join the pillars. Laminae form irregular contours around the section.

Comparisons. The specimen described here seems to be a typical *Anostylostroma laxum* as described by Nicholson and later by Parks; however, the laminae are slightly thicker.

Occurrence. One specimen of this form was collected from the Cooking Lake equivalent unit of the Redwater reef, occurring in a fine argillaceous, skeletal calcarenite at Imperial Eastgate #1-22, 4033′.

Type. Hypotype, GSC No. 19822.

Anostylostroma intermedium n. sp.

Plate I, figures 2a, b

Exterior. Description based on one specimen, coenosteum tabular, 4 cm thick; surface smooth without mamelons. Latilaminae inconspicuous; astrorhizae not developed.

Vertical section. Laminae continuous, generally smoothly curved but may be bent up sharply into folds. Composed of a single layer of compact, transversely

fibrous, and finely porous tissue, 0.01 mm thick, about nine in 5 mm. Pillars are simple rods, many incomplete and joined in the interlaminar space, not forming a distinct knotted structure, about eight in 5 mm, irregular in spacing. Dissepiments are abundant, horizontal to up-arched. Galleries are rectangular and irregular in shape.

Tangential section. Pillars are rare in the section, appearing angular and connected in many places, 0.10 mm in diameter. Laminae form irregular contours and a few broad rings. Dissepiments are seen joining the pillars.

Comparisons. This species is distinguished by its thick, widely and regularly spaced laminae, thick incomplete pillars, and incipient knotted structure. *A. intermedium* probably represents a form intermediate between *Anostylostroma* and *Hammatostroma* in that some pillars are simple Y-shaped spools whereas others branch irregularly to form a knotted structure. It may well prove to be an extreme variant of some other species of one of these genera.

Occurrence. Only one specimen of this species is on hand. It comes from the Upper Leduc of the Redwater reef in a medium-grained, cleanly washed calcarenite of the back-reef facies at Imperial Egremont #1, 3370′.

Type. Holotype, GSC No. 19823.

Genus *Atelodictyon* Lecompte, 1951

Type species: *Atelodictyon fallax* Lecompte, 1951.

Atelodictyon cf. *A. stelliferum* Stearn

Plate I, figures 3a, b

1961. *Atelodictyon stelliferum* STEARN, p. 937, Pl. 105, figs. 6-8.

Exterior. Description based on three specimens; coenosteum massive, up to 15 cm in diameter. Surface smooth and undulose without mamelons. Astrorhizae are small and scattered. Latilaminae are conspicuous from 5 to 10 cm thick. Tubes of *Syringopora* are present in all observed specimens.

Vertical section. Skeleton consists of a fine reticulate pattern of pillars and laminae. Laminae are straight or gently arched, but in places are vague and irregular, sixteen to eighteen in 5 mm, composed of a single layer of transversely fibrous tissue about 0.04 mm thick. The pillars are short and confined to one interlaminar space, commonly superposed, simple rods or spool-shaped. They are variable in width from 0.05 to 0.08 mm, eighteen to twenty in 5 mm. Dissepiments are not developed. No astrorhizal canals are present. Tubes of the tabulate coral *Syringopora* disrupt the structure.

Tangential section. Galleries are irregular in shape and size. Pillars are joined by radial processes to form a vermicular pattern and form areolae. Pillars

are formed of dusty compact tissue, which does not appear to be transversely fibrous. Isolated pillars are oval and 0.08 mm in diameter. Astrorhizae are scattered, central canal 0.25 mm in diameter with bifurcating branches 0.30 mm in diameter.

Comparisons. *Atelodictyon* cf. *A. stelliferum* is similar to the type specimen in most skeletal dimensions. It differs from *A. fallax* Lecompte in having fewer pillars and lacking well-developed mamelons; from *A. strictum* Lecompte in having wider spaced laminae; and from *A. intercalare* Galloway and St. Jean, in lacking the short intercalated pillars and large astrorhizae. Although the development of the astrorhizal system is not so pronounced as in the type species, there is so much similarity that erection of a new species from these specimens appears to be unnecessary.

Occurrence. Only three specimens are assigned to this species. They are all from the Upper Leduc of the Redwater reef and exclusively in the fore-reef facies: Saltwater Disposal Well #1, 3232′, 3237′; Imperial Amelia #84, 3249′.

Type. Hypotype, GSC No. 19824; Saltwater Disposal Well #1, 3237′.

Genus *Stromatoporella* Nicholson, 1886

Type species: *Stromatopora granulata* Nicholson, 1873.

Stromatoporella cf. *S. subvesiculosa* (Lecompte)

Plate I, figures 4a, b

1951. *Clathrodictyon amygdaloides* var. *C. subvesiculosum* LECOMPTE, p. 143, Pl. 18, fig. 3.
1957. *Stromatoporella subvesiculosa* (Lecompte), GALLOWAY and ST. JEAN, p. 145.

Exterior. Description based on six specimens, coenosteum tabular, 6 to 10 cm thick, surface smoothly undulant or with small sporadic mamelons. Latilaminae inconspicuous, 2 to 3 mm thick; astrorhizae absent.

Vertical section. The laminae are 0.09 mm thick, about twenty in 5 mm, they are somewhat discontinuous; composed of one layer of compact, porous tissue with a dusty appearance. Pillars are short and spool-shaped, rarely becoming Y-shaped; composed of transversely fibrous tissue; variably spaced, about nine in 5 mm. Galleries are rectangular; in some specimens they are superposed in many places but do not form pseudozooidal tubes as thin laminae pass through them. Dissepiments are not developed.

Tangential section. The section consists of transversely fibrous laminae and pillars. Pillars are seldom shown individually but form vermiculate patterns. Mamelons, when developed, are wheel-like structures composed of four or five concentric laminae. Astrorhizae and axial canals are not present.

Comparisons. The Redwater specimens correspond in general with the description and figures of Lecompte, and differ only in the lack of well-developed dissepiments.

Occurrence. Specimens assigned to this species occur in the Upper Leduc unit of the Redwater reef. The species is most common in coarse, skeletal calcarenite of the fore-reef and organic-reef facies. The specimens examined were collected from Imperial Egremont #94, 3222′, 3322′; Imperial Redwater #111, 3270′; Imperial Egremont #60, 3254′, 3264′; Imperial Amelia #84, 3175′.

Type. Hypotype, GSC No. 19825; Imperial Egremont #60, 3254′.

Stromatoporella damnoniensis Nicholson

Plate II, figures 1a, b, 2

1886a. *Stromatoporella damnoniensis* NICHOLSON, p. 237, Pl. 8, figs. 3, 4.
1892. *Stromatoporella damnoniensis* Nicholson, NICHOLSON, p. 207, Pl. 27, figs. 8, 9.
1951. *Stromatoporella damnoniensis* Nicholson, LECOMPTE, p. 183, Pl. 25, fig. 8.
1960. *Stromatoporella damnoniensis* Nicholson, GALLOWAY, p. 623, Pl. 71, fig. 4a; Pl. 72, figs. 1a, b.

Exterior. Description based on seventeen specimens, coenosteum varies from small nodules to tabular and encrusting, rarely thicker than 4 cm. Surface undulating and smooth with poorly developed mamelons on a few specimens. Astrorhizae are not well developed. Latilaminae are from 2 to 5 mm thick.

Vertical section. Laminae are thick, 0.10 to 0.15 mm, about eleven in 5 mm, discontinuous with numerous foramina between subjacent galleries yet rarely forming well-defined pseudozooidal tubes. Pillars about the same thickness as the laminae, short, straight, and superposed in many places. Too irregular in distribution to be counted. The galleries comprise about 20 per cent of the section. In places they are small and roundish but in other areas of the slide they coalesce, forming a slightly vermicular pattern. Tabulae and dissepiments absent. Tissue is flocculent, porous, and transversely fibrous.

Tangential section. Tissue occupies an estimated 65 per cent of the section, the dark broad bands indicating the laminae. Galleries are irregular and anastomosing. Pillars are round, about 0.17 mm in diameter between the laminae, but in most places are confluent. A few poorly developed pillars are present in all specimens.

Comparisons. Stromatoporella damnoniensis is characterized by the thick laminae and pillars, coarsely porous tissue and poorly developed astrorhizal system. It agrees very well with the genotype illustrated by Nicholson, however, ring-pillars are not abundant in any of the specimens studied here.

Occurrence. This species is abundant in the Upper Leduc unit. It occurs in the fore-reef and organic-reef facies especially in a fine- to medium-grained

biocalcarenite, which is generally somewhat argillaceous. In the Duvernay Formation, where two specimens were found it occurs in a very argillaceous limestone. Commonly, this species is intergrown with other stromatoporoids, corals and algae. Specimens assigned to this species were collected from Saltwater Disposal Well #1, 3610′, 3527′; Saltwater Disposal Well #5, 3380′; Imperial Egremont #60, 3249′, 3327′; Imperial Egremont #94, 3194′, 3219′, 3322′; Imperial Egremont #107, 3284′; Imperial Redwater #49, 3235′; Imperial Redwater #95, 3235′, 3310′; Imperial Redwater #101, 3318′; Imperial Redwater #111, 3269′, 3270′, 3319′; Imperial Simmons #34, 3275′.

Types. Hypotypes, GSC Nos. 19826, 19827; Saltwater Disposal Well #1, 3610′ and Imperial Redwater #95, 3310′.

Stromatoporella cf. *S. mirabilis* Yavorsky

Plate II, figures 3, 4a, b

1955. *Stromatoporella mirabilis* YAVORSKY, pp. 120-121, Pl. LXIV, figs. 2-5.

Exterior. Description based on thirteen specimens, coenosteum massive, up to 10 cm in diameter. Surface not observed but it is probably covered by low mamelons as shown by broad folds in vertical section. Astrorhizae present on polished surface. Latilaminae inconspicuous, 2 to 3 mm thick.

Vertical section. Laminae and pillars compose the skeleton forming a finely reticulate network. Laminae are continuous and gently curved, twenty-eight to thirty in 5 mm, in places highly compressed, composed of a thin, rather discontinuous dark, medial line, 0.02 mm thick. The medial microlamina appears as bead-like structures within the lamina or as fine threads, and is composed of compact, flocculent tissue. Upper and lower layers of the lamina are about the same thickness as the microlamina giving an average laminar thickness of 0.05 mm; tissue is light and slightly porous. Laminae rise at irregular intervals to form ring-pillars. Pillars are simple rods, superposed, about eighteen in 5 mm, composed of slightly porous tissue, which is the same as that in the upper and lower layers of the laminae. Galleries are square to oval. Numerous astrorhizal canals are present, 0.03 mm in diameter.

Tangential section. Tissue makes up about 60 per cent of the thin-section. Pillars are round to oval, 0.06 mm in diameter, generally joined forming a mosaic pattern. Ring-pillars small and inconspicuous. Galleries are irregular in shape and size, pierced by foraminae. Laminae form circular contours around the mamelons showing as wheel-like patterns 8 mm or less in diameter. Irregular astrorhizae are centred on the mamelons and branch into the intermamelon area, canals are 0.04 mm in diameter.

Comparisons. The specimens are similar to the type described and illustrated by Yavorsky. The only minor differences appear to be in the greater number of astrorhizal canals, and more regular and slightly wider spaced laminae in the type.

Occurrence. Specimens of *Stromatoporella* cf. *S. mirabilis* were found in the Cooking Lake equivalent unit in the Redwater reef associated with a fine-grained, slightly argillaceous skeletal calcarenite. Specimens assigned to this species were collected from Saltwater Disposal Well #1, 4103′, 4151′, 4154′; Saltwater Disposal Well #5, 3803′; Imperial Egremont #1, 4233′; Imperial Opal #35, 4081′, 4329′; Imperial Eastgate #1-22, 3907′, 4034′, 4042′, 4142′, 4188′, 4406′.

Types. Hypotypes, GSC Nos. 19828, 19829; Imperial Eastgate #1-22, 4034′, 4042′.

Genus *Hammatostroma* Stearn, 1961

Type species: *Hammatostroma albertense* Stearn, 1961.

Hammatostroma cf. *H. albertense* Stearn

Plate II, figures 5a, b

1961. *Hammatostroma albertense* STEARN, p. 940, Pl. 106, figs. 2, 4.

Exterior. Description based on three specimens, coenosteum massive or nodular, up to 10 cm in diameter. Surface smooth and undulose, lacking mamelons and astrorhizae. Latilaminae 1 to 3 cm thick.

Vertical section. Laminae continuous, curved, and many are slightly crenulate, in places bending up to almost touch the adjacent lamina; numerous laminae bifurcate; composed of a single layer of tissue that is transversely fibrous and porous, but preservation of tissue is too poor to be certain; 0.1 mm thick about ten to 5 mm. Pillars generally incomplete, joining and branching in the interlaminar area to produce a decidedly knotted structure; complete pillars are inclined to the laminae. Dissepiments form broad arcs, many bifurcate, apparently passing through the pillars; about 0.03 mm thick. Galleries are irregular in form.

Tangential section. Section composed of round pillars, curved dissepiments, and the irregular edges of laminae. Pillars about 0.13 mm in diameter, commonly connected by arcuate dissepiments. Laminae are composed of dark flocculent tissue, which is transected by tubules. Astrorhizae absent.

Hammatostroma cf. *H. albertense* is characterized by thick, irregular laminae and well-developed arcuate dissepiments.

The specimens assigned to this species differ from *H. albertense* in having much better developed dissepiments, but lacking a strong knotted structure. All specimens of *H.* cf. *H. albertense* have a massive or nodular growth form whereas *H. albertense* has a tabular one.

Occurrence. This species has been found only in the Upper Leduc unit of the Redwater reef, but this occurrence is based on the presence of only three specimens. It is associated with a brown, skeletal calcarenite. Specimens assigned to this

species were taken from Saltwater Disposal Well #1, 3230′; Imperial Simmons #72, 3285′; Imperial Egremont #1, 3372′.

Type. Hypotype, GSC No. 19830; Saltwater Disposal Well #1, 3230′.

Hammatostroma albertense Stearn

Plate III, figures 1a, b

1961. *Hammatostroma albertense* STEARN, p. 940, Pl. 106, figs. 2, 4.

Exterior. Description based on five specimens, coenosteum tabular, up to 6 cm thick. Surface smoothly undulant without well-developed mamelons; astrorhizae absent. Latilaminae not apparent.

Vertical section. Laminae continuous, curved, and commonly strongly crenulate, bifurcating laterally; composed of a single layer of porous, transversely fibrous tissue, 0.113 mm thick, about nine in 5 mm. Pillars generally incomplete, forming a well-developed knotted structure in the interlaminar space, complete pillars generally inclined to the laminae. Dissepiments are broad arcs appearing to pass through the pillars, 0.05 mm thick.

Tangential section. Pillars round and closely spaced, commonly producing a vermiform pattern, 0.15 mm in diameter, often connected by arcuate dissepiments. Laminae are transversely fibrous and porous, composed of dark flocculent tissue. Astrorhizae not developed.

Comparisons. Hammatostroma albertense is similar to *Hammatostroma* cf. *H. albertense*. The laminae are thicker and more widely spaced. Dissepiments are not so well developed, but the knotted appearance is more pronounced. Pillars are thicker and tend to form a vermiform pattern. The form of the coenosteum also differs, *H. albertense* having a tabular form whereas *H.* cf. *H. albertense* is generally massive.

Occurrence. This species is confined to the Middle Leduc unit of Redwater reef, in light brown, slightly argillaceous calcarenite. Specimens were collected from Saltwater Disposal Well #4, 3886′, 3892′; Imperial Eastgate #1-22, 4038′, 4068′, 4273.5′.

Type. Hypotype, GSC No. 19831; Saltwater Disposal Well #4, 3892′.

Hammatostroma delicatulum n. sp.

Plate III, figures 2a, b

Exterior. Description based on one specimen, coenosteum tabular, 10 cm high. Surface smooth and straight, but lower laminae undulate. Astrorhizae and latilaminae absent. Intimately intergrown with *Syringopora.*

Vertical section. Laminae gently curved, continuous, commonly bifurcating laterally, rather thin, 0.06 mm thick, only six to eight in 5 mm; composed of a single layer of transversely fibrous, porous tissue, appears to have a dark line bounding the upper and lower edges of the laminae. Pillars incomplete joining in the interlaminar area forming the characteristic knotted structure, widely spaced, often absent in the interlaminar area. Dissepiments forming broad arcs, not very abundant. Structure interrupted by tabulate tubes of the coral *Syringopora.*

Tangential section. Pillars round, but commonly joined to form a vermiform pattern, 0.09 to 0.11 mm in diameter, rarely connected by dissepiments. Laminae form arcuate or circular patterns as they bend around the ends of tubes of *Syringopora,* against which they may terminate abruptly.

Hammatostroma delicatulum is characterized by its thin, widely spaced laminae and pillars and poorly developed dissepiments.

Occurrence. The one specimen on which this species is based was found in the Upper Leduc of the Redwater reef in a cleanly washed, medium-grained calcarenite: Imperial Opal #38, 3197′.

Type. Holotype, GSC No. 19832.

Hammatostroma nodosum n. sp.

Plate III, figures 3a, b

Exterior. Description based on four specimens, coenosteum tabular, up to 7 cm thick. Surface undulant. Mamelons, astrorhizae, and latilaminae not observed.

Vertical section. Laminae curved and crenulate, commonly incomplete, 0.070 mm thick, about eight in 5 mm; composed of a single layer of transversely fibrous, porous tissue, seldom bifurcating. Pillars are incomplete joining in the interlaminar space to form a very well developed knotted structure, commonly slightly spool-shaped, usually strongly inclined to the laminae. Few flat or broadly arcuate dissepiments apparently passing through the pillars.

Tangential section. Round pillars, vermicular pillars, laminae and dissepiments comprise about 30 per cent of the total area of the thin-section. Pillars occur as discrete round structures, 0.10 mm in diameter and generally forming a vermiculate pattern. The arcuate dissepiments join many of the pillars into an irregular meshwork. Curved ends of laminae form a meandriform pattern.

Comparisons. Hammatostroma nodosum is distinguished from *H.* cf. *H. albertense* and *H. albertense* in having much thinner, more widely spaced laminae, flattened dissepiments, and a better developed knotted structure in the interlaminar spaces. *H. nodosum* differs from *H. delicatulum* in having more pronounced pillars and more irregular laminae.

Occurrence. This species is confined to the Cooking Lake equivalent of the Redwater reef, associated with fine, brown calcarenite, which has many argillaceous partings. Specimens assigned to this species were collected from Saltwater Disposal Well #5, 3916′; Saltwater Disposal Well #4, 4051′, 4084′; Imperial Eastgate #1-22, 4135.5′.

Type. Holotype, GSC No. 19833; Imperial Eastgate #1-22, 4135.5′.

Genus *Euryamphipora* n. gen.

Type species: *Euryamphipora platyformis* n. sp.

Thin, plate-like stromatoporoids in which neither laminae nor pillars are a dominant element, and in which the tissue is transversely fibrous and porous. Large marginal vesicles are present along the top and bottom of the coenosteum formed as a result of overturning or branching of the initial and terminal pillars. The name implies a wide or broad *Amphipora.*

Discussion. The tissue of *Amphipora* collected from the Redwater reef complex does not fully agree with that of the type in that a dark medial line is rarely observed in the pillars and laminae. This medial line may be present in certain parts of the coenosteum but not in others. Yavorsky (1955) defined the genus *Paramphipora* to include the typical *Amphipora* without a medial line. Inspection of Yavorsky's illustrations reveals no significant difference between the two genera; no dark medial line is visible in either of them. The writer feels that diagenetic alteration could easily obliterate this feature and that generic differentiation based on this one feature alone is tenuous. Therefore, the name *Euryamphipora* rather than *Euryparamphipora* has been adopted for the new genus signifying a broad or wide *Amphipora.*

Whether or not a new genus should be erected primarily on the basis of growth form is itself questionable. Many species of coelenterates adopt highly divergent growth forms in response to the contrasting ecological conditions in which they live. No gradations between the caespitose form of *Amphipora* and the tabular habit of *Euryamphipora* have been found. It is felt that the erection of the new genus will be helpful not only in stratigraphic studies, but as an aid in the formulation of a more meaningful classification of the stromatoporoids. If any question may be raised as to the validity of erecting a new genus on the basis of growth form, then certainly the validity of erecting a family on this criterion is also open to doubt.

Galloway (1957) has followed Nicholson in adopting the family Idiostromatidae for essentially caespitose stromatoporoids with an axial tube. Lecompte (1951), on the other hand, did not consider that mode of growth was a significant criterion on which to base a family. He intermixed the massive and tabular stromatoporoids with the dendroid types using the relations between the laminae and pillars and nature of skeletal tissue as the basis for association. Lecompte argued that the axial tube of the dendroid forms was homologous to the astrorhizal tube

of the massive and tabular forms. Thus, Lecompte placed the caespitose genus *Stachyodes* in the family Stromatoporidae, *Idiostroma* in the Syringostromidae, and *Dendrostroma* in the Stromatoporellidae. *Amphipora* was placed in a separate category by itself; it now appears to have a close affiliate. All these dendroid forms were placed in one family by Galloway even though they are vastly different in their skeletal morphology. As different, in fact, as the massive genera differentiated by him into families on the basis of skeletal tissue and internal morphology. The presence of an axial tube does not appear to be a necessity for placement in the Idiostromatidae since one of the genera (*Clavidictyon*) placed in that family does not have this feature. Certain genera of the family Labechiidae also have axial tubes.

There is little question that *Euryamphipora* and *Amphipora* belong together in one family for they are identical in tissue structure, in the relation of the laminae and pillars, both have large marginal vesicles and both possess curved tabulae. They differ radically in their habit of growth and in the fact that one has an axial canal and the other has not. *Euryamphipora* is best placed in the family Clathrodictyidae Kühn. The laminae and pillars are not organized into discrete units as is *Clathrodictyon* itself, and the tissue is similar to that of other genera within that family. The writer is forced to the conclusion that if the genus *Euryamphipora* belongs to the family Clathrodictyidae, then *Amphipora* too should be placed in that category. Alternative views might be that this is a case of parallel evolution or that *Amphipora* and *Euryamphipora* should be placed in a separate family.

The writer agrees with Lecompte that the only essential difference between the dendroid and massive stromatoporoids is one of growth form. Since modern stromatoporoid classification is based on skeletal morphology and nature of the tissue, it is concluded that the family Idiostromatidae is probably superfluous to the classification of the stromatoporoids and that caespitose genera now assigned to that family may be placed in appropriate families along with their massive counterparts.

Euryamphipora platyformis n. sp.

Plate III, figures 4a, b; Plate IV, figures 1-7

Exterior. Description based on four specimens, coenosteum consisting of a flat or curved plate 2 to 3 mm thick, no apparent means of attachment. Surface undulant and without mamelons. Latilaminae and astrorhizae absent.

Vertical section. Coenosteum is composed of an upper and lower wall of transversely fibrous tissue. Walls are of variable thickness but average 0.06 to 0.08 mm. Broad pillars, 0.17 to 0.20 mm thick develop from the outer wall at irregular intervals and either curve over or branch to form horizontal bars or laminae. Large marginal vesicles are thus formed along the periphery of the coenosteum. The laminae are merely the extension of the pillars and are perforated plates. Many laminae are composed of round or oval rods in vertical section. The horizontal

rods vary from 0.16 to 0.23 mm in diameter. There are rarely more than two or three laminae in the entire skeleton. Interlaminar pillars are continuous with the laminae. The transversely fibrous tissue is uniform throughout the skeleton. In some places a faint dark line runs through the centre of the laminae and pillars but this becomes obscure or non-existent within the same coenosteum. The presence or absence of the dark medial line seems to depend on the degree of diagenetic alteration. Vacuoles, pores, and maculae have not been observed in any of the specimens. Galleries are irregular in shape and size, ranging from small circular openings to larger vermicular forms. Some galleries are connected to the marginal vesicles by narrow foraminae. Curved tabulae are rarely found in the galleries and marginal vesicles.

Tangential section. The aspect of the tangential section varies according to where the section is cut. In the interlaminar spaces, the pillars are round, oval, or irregular; near the laminae, they coalesce to form a coarse meshwork with small round galleries between them. Laminae are perforated by small round openings, which are approximately 0.18 mm in diameter. A few galleries are connected. Astrorhizal canals absent.

This species is characterized by its thin tabular growth form, large marginal vesicles, and transversely fibrous tissue. In the two last-mentioned respects, it is indistinguishable from *Amphipora*. The specific term refers to the tabular habit of growth.

Occurrence. *Euryamphipora platyformis* has been encountered in four wells drilled into the Cooking Lake equivalent in the Leduc Formation at the Redwater Field, Alberta. Several specimens were found at Imperial Eastgate #1-22, 4278′; Redwater Saltwater Disposal Well #4, 4103′; Redwater Saltwater Disposal Well #5, 4028′; Imperial Egremont #1, 4233′.

Type. Holotype, GSC No. 19834; Imperial Eastgate #1-22, 4278′.

Family ACTINOSTROMATIDAE Nicholson, 1886

Genus *Actinostroma* Nicholson, 1886

Type species: *Actinostroma clathratum* Nicholson, 1886.

The genus *Actinostroma* has been recently revised by Flügel (1959). Specific assignment has been placed on a more or less quantitative basis. One useful morphologic aspect not so treated by Flügel is the nature of the gallery.

The present writer defines the *gallery index* as the ratio of the gallery height to gallery length. This ratio is very useful in that the value immediately conveys the arrangement of laminae and pillars, for it is evident that a gallery index of one (1) denotes a square gallery, an index greater than one (1) indicates a vertically rectangular gallery, and less than one (1) a horizontally rectangular gallery.

The gallery index may be measured directly or determined from the following formula:

$$\text{G. I.} = \frac{5-[\text{X (No. of pillars in 5 mm)}]}{\text{No. of pillars in 5 mm}-1} \cdot \frac{\text{No. of laminae in 5 mm}-1}{5-[\text{Y (No. of laminae in 5 mm)}]}$$

where: X = pillar thickness; Y = laminar thickness.

The use of the formula is preferred, as it gives an average gallery index based on many individual measurements of skeletal elements. In general, twenty to twenty-five laminae and pillars are measured in each slide and used to compute the averages.

Actinostroma matutinum Nicholson

Plate V, figures 1a, b

1891. *Actinostroma matutinum* NICHOLSON, p. 322, Pl. 9, figs. 1, 2.
1959. *Actinostroma matutinum* Nicholson, FLÜGEL, p. 163.

Exterior. Description based on five specimens, coenosteum massive, largest specimen is more than 20 cm in diameter. Surface is smoothly undulose but lacks well-defined mamelons. Astrorhizae absent. Latilaminae range from 4 to 7 mm thick.

Vertical section. Laminae generally undulatory and may be contorted into broad folds 10 cm wide, composed of a single compact layer of tissue, 0.07 to 0.14 mm thick, average 0.11 mm, twenty to twenty-six in 5 mm, average twenty-two in 5 mm. Pillars long, passing through many laminae, approximately parallel, thirteen to sixteen in 5 mm, average fourteen. Pillars may be slightly curved at the axial parts of the undulations. Galleries are horizontally rectangular with a gallery index ranging from 0.46 to 0.77, average 0.64. Dissepiments absent.

Tangential section. Pillars round, 0.15 to 0.17 mm in diameter, average 0.16 mm, with small central lumen; radial processes are thick, forming an astral meshwork. Astrorhizae absent.

Comparisons. The Redwater specimens assigned to this species are statistically and morphologically close to the type described and illustrated by Nicholson and summarized by Flügel. The type specimen is from the Silurian (?) of Gaspé, Quebec. There appears to be some question as to exactly where it was collected, although the Silurian age of this fossil is reasonably certain. If the present identification is correct, and it certainly appears to be, then one of the oldest known species of *Actinostroma* has a very long range indeed.

Occurrence. This species is found in the Upper and Middle Leduc units of the Redwater reef, associated exclusively with a very coarse grained, skeletal calcarenite. Specimens assigned to this species were collected from Saltwater Disposal Well #1,

3352′; Saltwater Disposal Well #4, 3717′; Saltwater Disposal Well #5, 3366′; Imperial Amelia #98, 3263′; Imperial Egremont #94, 3206′.

Type. Hypotype, GSC No. 19835; Saltwater Disposal Well #4, 3717′.

Actinostroma clathratum Nicholson

Plate V, figures 2a, b, 3a, b

1886a. *Actinostroma clathratum* NICHOLSON, p. 76, Pl. 1, figs. 8-13; Pl. 2, fig. 11.
1886b. *Actinostroma clathratum* Nicholson, NICHOLSON, p. 226, Pl. 6, figs. 1-3.
1889. *Actinostroma clathratum* Nicholson, NICHOLSON, p. 131, Pl. 12, figs. 1-5; Pl. 13, figs. 1, 2.
1890. *Actinostroma clathratum* Nicholson, NICHOLSON, p. 193, Pl. 8, figs. 8a, b.
1951. *Actinostroma clathratum* Nicholson, LECOMPTE, p. 77, Pl. 1, figs. 1-12.
1959. *Actinostroma clathratum* Nicholson, FLÜGEL, p. 129.

Exterior. Description based on twenty-five specimens, coenosteum massive, rarely tabular, up to 13 cm in diameter. The surface may or may not be mamelate; when present, mamelons are small, about 3 mm in diameter, irregularly spaced and not superposed. Latilaminae are 2 to 5 mm thick.

Vertical section. Coenosteum composed of straight, undulose, or slightly crenulated laminae, 0.06 to 0.11 mm thick, average 0.08 mm, twenty to twenty-eight in 5 mm, average twenty-three, may be curved between the pillars. Pillars are long and generally slightly curved, twelve to twenty-three in 5 mm, average eighteen, not regularly spaced. Round astrorhizal canals rare. Galleries are horizontally rectangular with a gallery index ranging from 0.45 to 0.94, average 0.78. Small gastropods are often included in the skeleton framework. Dissepiments absent.

Tangential section. Pillars round, 0.08 to 0.13 mm in diameter, average 0.11 mm, connected by five thin radial rods forming a radial meshwork. Astrorhizae inconspicuous, small, and irregularly distributed.

Comparisons. Specimens assigned to this species show a great deal of variation in respect to skeletal dimensions. They all appear to fall within the limits of *Actinostroma clathratum* Nicholson. On the average, they possess slightly fewer pillars. The pillars are straight and nearly parallel as is typical of the species. It is possible that several separate species make up this group.

Occurrence. This species was found only in the Cooking Lake equivalent and Middle Leduc, associated with an argillaceous, fine biocalcarenite. The massive skeletons often show abraded surfaces. The occurrence of massive stromatoporoids in an argillaceous rock is somewhat unusual. Specimens assigned to this species were collected from Saltwater Disposal Well #1, 3795′, 3855′, 3871′; Saltwater Disposal Well #4, 3710′, 3965′, 4015′, 4045′, 4106′, 4148′, 4169′, 4227′; Saltwater Disposal Well #5, 3483′, 3595′, 3608′, 3870′, 4015′; Imperial Lily #1, 4207′; Imperial Eastgate #1-22, 3713′, 4018′, 4112′, 4207′, 4254′, 4271′, 4343′, 4373′.

Types. Hypotypes, GSC Nos. 19836, 19837; Saltwater Disposal Well #4, 4227′ and Imperial Eastgate #1-22, 4112′.

Actinostroma pachypilatum n. sp.

Plate V, figures 4a, b

Exterior. Description based on seven specimens, coenosteum massive and tabular, generally less than 10 cm in diameter and 5 cm thick. The surface is probably undulose, mamelons may or may not be developed; astrorhizae are distinguished on a polished surface. Latilaminae are from 2 to 5 mm thick.

Vertical section. Laminae straight or undulatory, one specimen showing a broadly folded structure, composed of a single compact layer of tissue 0.07 to 0.11 mm thick, average 0.08 mm, eighteen to twenty-six in 5 mm, average twenty-three. Pillars are short for this genus and are discontinuous in many places, sixteen to twenty-two in 5 mm, average eighteen, composed of compact tissue. Numerous round astrorhizal canals are present, but widely scattered and inconspicuous. The galleries are almost square to vertically rectangular with a gallery index of 0.87 to 1.37, average 1.07, only one specimen showing a value less than 1. Dissepiments appear to be absent.

Tangential section. Pillars round, 0.14 to 0.16 mm in diameter, average 0.15 mm, connected by poorly developed, irregular radial rods, which do not form a neat radial meshwork. Astrorhizae generally well developed, up to 5 mm in diameter, composed of several multiple bifurcating canals about 0.3 mm broad at the base but diminishing in size outward; axial canal is commonly developed, may be accompanied by several auxiliary canals peripheral to it.

Comparisons. This species does not compare with any other published species examined. The thick pillars accompanied by thinner, widely spaced laminae is diagnostic of this species. The well-developed astrorhizal system may also be of specific importance.

Occurrence. A. pachypilatum is found in the Middle Leduc, associated with an argillaceous calcarenite or clean, very fine grained calcarenite, and rarely with coarse, skeletal calcarenites.

Specimens assigned to this species were found at Saltwater Disposal Well #4, 3600′, 3611′, 3747′; Saltwater Disposal Well #5, 3787′, 3980′; Imperial Egremont #1, 3943′; Imperial Gibbons #1, 4100′.

Type. Holotype, GSC No. 19838; Saltwater Disposal Well #5, 3980′.

Actinostroma redwaterense n. sp.

Plate VI, figures 1a, b

Exterior. Description based on one specimen, coenosteum massive, 13 cm in diameter, surface undulose without mamelons or astrorhizae. Latilaminae are spaced 2 to 4 cm apart.

Vertical section. Coenosteum composed of long, broad pillars and thick, widely spaced laminae both consisting of dense, compact tissue. Laminae are straight but may be oblique to the pillars, 0.10 to 0.15 mm thick, average 0.11 mm, seventeen to twenty in 5 mm, average nineteen. Pillars are broad, eleven to fifteen in 5 mm, average thirteen, generally straight increasing by intercalation outward. Several tubes of *Syringopora* are intergrown with the skeleton. Galleries vertically rectangular, with a gallery index averaging 1.39.

Tangential section. Pillars round, 0.22 to 0.31 mm in diameter, average 0.28 mm, may possess a small central lumen; radial arms thick, four to six in number. Astrorhizae absent.

Comparisons. The extremely thick pillars of this species serve to distinguish it from any others. The pillars are generally thicker than *Actinostroma crassepilatum* Lecompte, its nearest ally. The gallery index is also much higher in *A. redwaterense*.

Occurrence. One specimen was found in the Cooking Lake equivalent, associated with a fine-grained, slightly argillaceous calcarenite. This specimen was found at Saltwater Disposal Well #4, 3845′.

Type. Holotype, GSC No. 19839.

Actinostroma cf. *A. crassepilatum* Lecompte

Plate VI, figures 2a, b

1951. *Actinostroma crassepilatum* LECOMPTE, p. 122, Pl. 13, fig. 3.
1959. *Actinostroma crassepilatum* Lecompte, FLÜGEL, p. 137.

Exterior. Description based on five specimens, coenosteum tabular, a fragment is 7 cm thick. Surface is slightly undulatory, no mamelons are present, astrorhizae may or may not be developed. The latilaminae range from 3 to 6 mm thick.

Vertical section. Laminae straight, composed of one layer of compact tissue, 0.07 to 0.12 mm thick, average 0.09 mm, sixteen to twenty-one in 5 mm, average nineteen; pillars are long and broad, extend through many laminae, nine to thirteen in 5 mm, average eleven. Galleries are horizontally rectangular with a gallery index of 0.67, very regular in form. A few upward-arched dissepiments may be present.

Tangential section. Pillars round, 0.19 to 0.27 mm in diameter, average 0.22 mm, connected by four to six thick radial arms forming a radial meshwork. Astrorhizae absent.

Comparisons. The severe recrystallization of most specimens assigned to this species makes precise identification difficult. The figured specimen is practically identical with the form illustrated by Lecompte. *A.* cf. *crassepilatum* is characterized by the thick pillars and thin laminae. The low gallery index serves to distinguish it from *Actinostroma redwaterense*.

Occurrence. Specimens were found in the Upper and Middle Leduc associated with the organic-reef facies or skeletal calcarenite. Saltwater Disposal Well #5, 3431′, 3726′, 3759′; Saltwater Disposal Well #4, 3735′, 3844′.

Type. Hypotype, GSC No. 19840; Saltwater Disposal Well #5, 3431′.

Genus *Trupetostroma* Parks, 1936

Type species: *Trupetostroma warreni* Parks, 1936.

Trupetostroma warreni Parks

Plate VI, figures 3a, b, 4

1936. *Trupetostroma warreni* PARKS, p. 55, Pl. 10, figs. 1, 2.
1957. *Trupetostroma warreni* Parks, GALLOWAY and ST. JEAN, p. 159, Pl. 12, fig. 2.
1960. *Trupetostroma warreni* Parks, GALLOWAY, p. 625, Pl. 72, figs. 4a, b.
1963. *Trupetostroma warreni* Parks, STEARN, p. 658, Pl. 85, figs. 3, 4.

Exterior. Description based on eight specimens, coenosteum massive, some attaining 24 cm in diameter, surface covered by small regularly spaced mamelons from 3 to 5 mm in diameter and rarely exceeding 4 mm high. Astrorhizae are apparent only on polished surfaces. Latilaminae are 3 to 4 mm thick.

Vertical section. The skeleton consists of a loose network of laminae and pillars. Laminae are continuous, with a light median layer and darker upper and lower layers. The median layer is of variable thickness, ranging between 0.016 and 0.03 mm, and is composed of compact tissue. The upper and lower layers are also of variable thickness, ranging from 0 to 0.012 mm, and are composed of compact dusty tissue. The laminae are conspicuous, averaging 0.045 mm thick, twenty-four in 5 mm. Pillars are superposed spools, 0.08 to 0.12 mm, broad at their narrowest parts, and composed of compact tissue, which is light in colour, containing rare round vacuoles; about seventeen in 5 mm. Galleries are square to rectangular with rounded corners, superposed. Astrorhizal canals are common in the sections, round or oval, 0.11 mm in diameter with rare dissepiments. Dissepiments are rare or absent.

Tangential section. Pillars are round or oval, often joined to form a vermiculate pattern. Laminae curve smoothly around the mamelons. Galleries are irregular and about twice as large as the pillars. Astrorhizae are prominent and situated in the centre of the mamelons. Canals are 0.20 mm in diameter and branch regularly.

Comparisons. Specimens from Redwater are similar in overall dimensions to the type described by Parks. The nature of the tissue is not so easily comparable because the Redwater forms do not have the abundant vacuoles characteristic of the type. Due to the poor preservation of the Redwater specimens, this feature may be masked by processes of recrystallization. In all other respects, the specimens may be referred to *Trupetostroma warreni.*

Occurrence. *Trupetostroma warreni* is common in the Cooking Lake equivalent and Middle Leduc at Redwater, associated with a fine-grained, skeletal calcarenite, which is rarely slightly argillaceous. Specimens assigned to this species were collected at Saltwater Disposal Well #1, 3957′, 3966′; Saltwater Disposal Well #4, 3604′, 3606′, 3612′; Saltwater Disposal Well #5, 3903′, 4057′; Imperial Eastgate #1-22, 4222′.

Types. Hypotypes, GSC Nos. 19841, 19842; Saltwater Disposal Well #1, 3966′, 3957′.

Trupetostroma aff. *T. laceratum* Lecompte

Plate VI, figure 5; Plate VII, figures 1a, b

1952. *Trupetostroma laceratum* LECOMPTE, p. 228, Pl. 38, fig. 1.

Exterior. Description based on fourteen specimens, coenosteum probably massive but is usually fragmented. Many specimens are intergrown with the corals *Phillipsastrea* and *Syringopora,* and with other stromatoporoids. The surface may be covered by broad mound-like mamelons 1 cm in diameter at the base, separated from each other by a broad smooth valley. Regularly branching astrorhizae are centred on the mamelons. Latilaminae are conspicuous, 2 to 4 mm thick.

Vertical section. Skeleton composed of pillars and laminae that form a coarse reticulate network. The laminae are continuous, smoothly curving over the mamelons, composed of a thin, light, median microlamina, and a slightly darker upper and lower layer. The microlamina is of variable thickness, about 0.02 mm, the upper and lower layers are also of variable thickness, composed of compact tissue with abundant dark round spots vaguely resembling maculae. Much secondary tissue of a similar composition is present in the galleries. The laminae are 0.12 mm thick, sixteen to twenty in 5 mm. The pillars are spool-shaped and superposed, 0.14 mm broad, fifteen to twenty in 5 mm. Dissepiments are poorly developed. Astrorhizal canals are not prominent.

Tangential section. Tissue comprises about 60 per cent of the section. The pillars are joined to form a compact mosaic with small round to oval galleries, 0.03 mm in diameter. The secondary tissue is compact and vacuolate, dusty in appearance. Astrorhizae form stellate patterns centred at the middle of the mamelons. Canals are 0.065 mm in diameter at the apex of the astrorhizae.

Trupetostroma aff. *T. laceratum* is distinguished by its thick pillars and laminae, vacuolate secondary tissue and well-developed mamelons.

Comparisons. Redwater specimens are similar to the type figured by Lecompte, but the Alberta forms have a wider laminar spacing. (Lecompte found a great deal of variation within this species and the specimens studied here fall well within the limits.) Unfortunately, Lecompte does not describe the nature of

the tissue. The Redwater specimens show a well-defined vacuolate secondary tissue. Astrorhizae are not as prominent as in the type.

Occurrence. *Trupetostroma* aff. *T. laceratum* appears to be confined to the Upper Leduc of the Redwater reef, generally associated with a light, medium- to coarse-grained, skeletal calcarenite. Specimens assigned to this species were found at Imperial Opal #38, 3232′, 3212′; Imperial Redwater #95, 3226′; Imperial Redwater #111, 3288′, 3319′; Imperial Egremont #109, 3237′; Imperial Simmons #66, 3172′; Imperial Simmons #72, 3177′, 3223′, 3268′; Imperial Amelia #84, 3175′; Imperial Egremont #94, 3248′; Imperial Amelia #98, 3235′; Imperial Simmons #34, 3258′.

Type. Hypotype, GSC No. 19843; Imperial Amelia #84, 3175′.

Trupetostroma cf. *T. coalescens* Galloway and St. Jean

Plate VII, figures 2a, b

1957. *Trupetostroma coalescens* GALLOWAY and ST. JEAN, p. 162, Pl. 12, fig. 5.
1960. *Trupetostroma coalescens* Galloway and St. Jean, GALLOWAY, p. 626, Pl. 73, figs. 4a, b.

Exterior. Description based on seven specimens, coenosteum massive, up to 8 cm in diameter. Surface not observed, but is undoubtedly mamelate. Latilaminae inconspicuous 3 to 4 mm thick.

Vertical section. Laminae continuous, smoothly curving over the mamelons, very regularly spaced, average of twenty-seven in 5 mm, contain a conspicuous light, median microlaminae 0.015 mm thick, composed of compact tissue. Laminae average 0.16 mm. The upper and lower layers are composed of compact, dusty, apparently fibrous tissue, which is expanded into the galleries so as to practically fill them. Rare small vacuoles are sometimes observed. This secondary tissue is continuous with the pillars which are short and spool-shaped, regularly superposed, but obscure because they tend to coalesce at their borders. The pillar tissue is slightly lighter in the central part. There are about eighteen pillars in 5 mm. Galleries are small, oval or entirely filled by tissue. Tabulate tubes of *Syringoporella* are present in some specimens. Dissepiments absent.

Tangential section. Pillars are round to oval, and form a vermiculate pattern within the laminae. The skeletal tissue makes up 50 per cent or more of the section. Galleries are irregular in shape and about twice as large as the pillars, which are 0.11 mm in diameter. Astrorhizae are rarely developed.

Comparisons. Redwater specimens are invariably poorly preserved but nevertheless show close affinities to the type specimen described by Galloway and St. Jean. The major differences noted are that the Alberta forms lack the well-developed astrorhizae of the type and have more widely spaced laminae.

Occurrence. *Trupetostroma* cf. T. *coalescens* is present in the Upper Leduc of the Redwater reef and appears to be confined to the fore-reef facies. It occurs

with a medium-grained, skeletal calcarenite. Specimens assigned to this species were found at Imperial Simmons #72, 3182′; Imperial Amelia #84, 3200′; Imperial Egremont #94, 3232′; Imperial Redwater #95, 3248′; Imperial Simmons #66, 3182′, 3186′, 3251′.

Type. Hypotype, GSC No. 19844; Imperial Simmons #72, 3182′.

Trupetostroma? sp.

Plate VII, figures 3a, b, 4a, b

Exterior. Description based on six specimens, coenosteum massive to tabular, up to 10 cm thick. Surface not observed but is strongly mamelate as shown in vertical and tangential sections. Astrorhizae and latilaminae were not observed.

Vertical section. Laminae are 0.10 mm thick, composed of compact tissue with a dark lower and commonly upper microlamina of dark flocculent tissue; sixteen to twenty in 5 mm. The laminae turn sharply to form strongly developed mamelon columns. Pillars are broad and are regularly superposed through many interlaminar spaces. Pillars are a variable number and may increase by intercalation. On the average there are seventeen in 5 mm, 0.12 mm broad. The tissue is compact with numerous round vacuoles, with the dark microlaminar tissue of the laminae commonly forming a sheath around the pillars. In most places on the slide the laminae appear to pass through the pillars but often they do not, in effect the skeletal tissue is partly amalgamated. No evidence of maculae either real or altered was found. The galleries are small and square to oval. Astrorhizal canals are rare. Dissepiments are locally abundant.

Tangential section. The mamelons are small, 3 to 4 mm in diameter and closely spaced. An axial canal 0.25 mm in diameter is located in the centre of each mamelon; astrorhizal canals branching from these are rare. Because of the abundance of mamelons, pillars are rarely seen in cross-section.

Comparisons. The generic position of this group of specimens is in doubt. Some of the pillars appear to be long and others short. It is, therefore, possible that this is a *Taleastroma.* However, no maculae have been observed. The vacuolate tissue and dark microlamina favour its inclusion in *Trupetostroma.*

Occurrence. This species is common in the Cooking Lake equivalent and Middle Leduc of the Redwater complex, associated with a slightly argillaceous biocalcarenite. Saltwater Disposal Well #1, 3795′, 3935′; Saltwater Disposal Well #4, 3819′, 4146′; Saltwater Disposal Well #5, 3780′; Imperial Eastgate #1-22, 4369′.

Types. Figured specimens, GSC Nos. 19845, 19846; Saltwater Disposal Well #1, 3935′, 3795′.

Family STROMATOPORIDAE Winchell, 1867

Genus *Ferestromatopora* Yavorsky, 1955

Type species: *Ferestromatopora krupennikovi* Yavorsky, 1955.

Ferestromatopora dubia (Lecompte)

Plate VIII, figures 1a, b

1952. *Stromatopora dubia* LECOMPTE, p. 279, Pl. 57, figs. 1, 2.
1957. *Ferestromatopora dubia* (Lecompte), GALLOWAY and ST. JEAN, p. 176, Pl. 14, figs. 3a, b, c.

Exterior. Description based on seven specimens, coenosteum consisting of massive heads, up to 10 cm high, but generally only about 6 cm in diameter. Surface smoothly undulose. Astrorhizae only observed on cut surfaces and in thin-section. Latilaminae obscure, about 2 to 5 mm thick.

Vertical section. Laminae 0.08 to 0.12 mm thick, about nineteen in 5 mm, composed of a medial or dark line about 0.15 mm thick surrounded by lighter, coarsely spotted tissue, that may have been maculate before alteration. The pillars are confluent with the laminar tissue, and are spool-shaped and confined to one interlaminar space, about 0.09 to 0.15 mm thick, fifteen to twenty in 5 mm. Dissepiments are common, and tabulae are present in the astrorhizal canals. Galleries are round to vertically rectangular. The astrorhizal canals are conspicuous as elongate galleries and tabulate, vertical tubes.

Tangential section. The pillars are coalescent and anastomosing. Galleries are round to vermicular, skeletal tissue comprises about 70 per cent of the section. Astrorhizae are large, up to 12 mm in diameter and are composed of many complexly branched canals about 0.5 mm in diameter. Tissue is coarsely spotted.

Comparisons. The features of this species are directly comparable to those described by Lecompte (1952, p. 279) for *Stromatopora dubia.* It seems much more similar to the form figured by him than it does to that figured by Galloway and St. Jean (1957).

Occurrence. Specimens assigned to this species were found in the Cooking Lake equivalent of the Redwater reef associated with a brown, slightly argillaceous skeletal calcarenite. Saltwater Disposal Well #1, 3811′, 3886′; Imperial Eastgate #1-22, 3906′, 4074′, 4146′, 4160′, 4168′.

Type. Hypotype, GSC No. 19847; Imperial Eastgate #1-22, 4146′.

Genus *Stromatopora* Goldfuss, 1826

Type series: *Stromatopora concentrica* Goldfuss, 1826.

Stromatopora cygnea Stearn

Plate VIII, figures 2a, b

1960. *Stromatopora* cf. *S. hupschi* (Bargatzky) GALLOWAY, p. 627, Pl. 74, figs. 2a, b.
1963. *Stromatopora cygnea* STEARN, p. 665, Pl. 87, figs. 8, 9; Pl. 88, fig. 1.

Exterior. Description based on eleven specimens, coenosteum tabular or massive. Generally intergrown with other organisms, but may assume an encrusting habit. The surface is undulose and lacks mamelons. Astrorhizae may or may not be developed. Latilaminae are usually closely spaced at 1 mm or less; however, thicker latilaminae may also be observed.

Vertical section. The skeletal tissue represents 60 per cent of the section. The tissue is amalgamated and composed of coarsely spotted tissue, which is the result of altered maculate tissue. Abundant horizontal, clear microlaminae run through the tissue. These microlaminae are very thin, about 0.007 to 0.014 mm thick. The laminae are only developed in some places and are thick, ranging from 0.14 to 0.20 mm. The microlaminae are best developed in the laminae. The pillars are amalgamated with the laminae, and are composed of the same tissue as the laminae, except that the microlaminae are not so well developed. The pillars are about the same thickness as the laminae. In some places they extend for four or five interlaminar spaces, but commonly they are restricted to one interlaminar space. The galleries are either small and round or vermicular. Many long vertical tubes are present in the skeleton. These are of two types, one consisting of superposed or extended galleries and the other the tabulate tubes of *Syringoporella* with which this species is commonly intergrown. Dissepiments absent.

Tangential section. Tissue, which makes up about 75 per cent of the section, is coarsely spotted. Galleries are small and round or vermicular. The small openings are 0.08 to 0.16 mm in diameter. Round tubes 0.75 mm in diameter are abundant, and are the corallites of *Syringoporella.*

Comparisons. This species is very similar to the type specimen described by Stearn (1963) and identical to that described and illustrated by Galloway (1960). The latter was referred to as *Stromatopora* cf. *hupschi* (Bargatzky) but is probably best compared with *S. cygnea.*

Occurrence. This species is found at all levels of the Redwater reef; in the Upper Leduc it appears to be restricted to the fore-reef facies. All occurrences are in slightly argillaceous limestone.

Specimens assigned to this species were found at Saltwater Disposal Well #1, 4035′; Saltwater Disposal Well #4, 3418′, 3431′; Saltwater Disposal Well #5, 3503′; Imperial Egremont #94, 3331′, 3342′; Imperial Egremont #107, 3284′;

Imperial Redwater #95, 3248′; Imperial Redwater #111, 3319′; Imperial Amelia #98, 3235′; Imperial Egremont #60, 3322′.

Type. Hypotype, GSC No. 19848; Imperial Egremont #94, 3342′.

Genus *Syringostroma* Nicholson, 1875

Type species: *Syringostroma densum* Nicholson, 1875.

Syringostroma cf. *S. perfuscum* Galloway and St. Jean

Plate VIII, figures 3a, b, 4a, b

1957. *Syringostroma perfuscum* GALLOWAY and ST. JEAN, p. 202, Pl. 18, figs. 4a, b.

Exterior. Description based on twenty specimens, coenosteum massive, up to 10 cm in diameter, rarely tabular. Surface covered by low mamelons 5 mm high and up to 8 mm in diameter, randomly spaced on the surface. Astrorhizae are well developed on most of the specimens. Latilaminae are regular in thickness at about 3 mm.

Vertical section. The skeleton is composed of thick, long, closely spaced pillars and obscure, discontinuous laminae with abundant dark, thin dissepiments. The skeleton is a tight meshwork with dominantly vertical elements. The pillars are approximately 0.16 mm thick; sixteen to nineteen in 5 mm. Long, continuous pillars as well as short, superposed pillars are present. The pillar tissue is compact and contains obscure light spots, which may represent an original maculate structure. Laminae are obscure; composed of tissue similar to that forming the pillars but with an occasional dark upper boundary; about 0.13 mm thick; fifteen to eighteen in 5 mm. The laminar and pillar tissue appear to be fused. Thin, dark dissepiments, which are at first easily confused with the laminae, are scattered throughout the section in the interlaminar areas. They are generally concave upward, but a few are arranged angularly. In places the dissepiments rest on the laminae; this gives some of the laminae a dark appearance. The dissepiments are about 0.03 mm thick, and are composed of a single layer of dark flocculent tissue. The galleries are long vertical tubes that commonly contain tabulae in the form of dissepiments; they are superposed. Astrorhizal canals are round or oval openings much larger than the galleries.

Tangential section. The tissue comprises about 70 per cent of the section. Rarely are the pillars distinguishable from the laminae. In the few interlaminar areas observed, the pillars are round to oval, 0.15 mm in diameter. The galleries are small and roundish, but in the interlaminar areas they are continuous and anastomosing. Astrorhizae are centred on the mamelons, with one or more axial tubes at the centre from which arise a complex series of canals, which for the most part branch only once.

Comparisons. The Redwater specimens are not closely comparable to the type described by Galloway and St. Jean; however, they are certainly closely affiliated. The major difference is that the pillars of the Redwater forms are not nearly as thick as those in the type. The overall pattern of the laminae and pillars is the same, and thus the group of specimens is tentatively assigned to this species.

Occurrence. This species is confined to the Upper and Middle Leduc of the Redwater reef, in a cleanly washed calcarenite of varying grain size. It is commonly found in the organic-reef facies. Saltwater Disposal Well #4, 3219′, 3472′, 3659′; Saltwater Disposal Well #5, 3300′, 3361′, 3391′, 3410′; Imperial Egremont #1, 3287′; Imperial Egremont #94, 3309′; Imperial Simmons #34, 3212′, 3236′, 3258′; Imperial Simmons #66, 3296′; Imperial Simmons #72, 3164′, 3268′; Imperial Opal #38, 3168′ 3180′, 3203′; Imperial Lily #1, 3436′; Imperial Egremont #87, 3259′.

Types. Hypotypes, GSC Nos. 19849, 19850; Saltwater Disposal Well #5, 3410′ and Imperial Egremont #1, 3287′.

Syringostroma? sp.

Plate IX, figures 1a, b, 2a, b, 3a, b

Exterior. Description based on twenty-five specimens, coenosteum tabular to mushroom-shaped, very irregular in form from specimen to specimen, rarely found as an encrustation. Surface undulose but lacking regular mamelons. Astrorhizae may or may not be present. Latilaminae varies in thickness from 3 to 5 mm.

Vertical section. The skeleton is composed of very thick, closely spaced pillars with little or no development of any horizontal structures. In all specimens a peculiar process of recrystallization has obscured the structures. Pillars range in thickness from 0.40 mm to 0.25 mm. Only near the latilaminar surfaces is there any clear evidence as to the nature of the galleries. Here they appear to be long vertical tubes apparently lacking tabulae. Elsewhere on the slide, the galleries have been filled in by a dark, flowery arrangement of calcite crystals. There do not appear to be any laminae in the entire structure except for thin, dark, regularly to irregularly spaced lines of dusty material. A few round to oval openings represent the astrorhizal system. The tissue is very dense but does contain a few very fine, round, clear dots that may be extremely fine maculae or vacuoles. This species is commonly intergrown with other stromatoporoids, corals, and algae.

Tangential section. Tissue comprises over 95 per cent of the section. In cross-section the pillars are round, about 0.41 to 0.25 mm in diameter. They are very closely spaced with dark crystalline material filling around them. In general, the section is a mosaic of light pillar material, darker lines of gallery infilling separating them. Astrorhizae are simple with unbranching canals extending from one or more openings at the centre of the astrorhiza.

Comparisons. The generic position of this group of specimens is uncertain. Stearn (1962, 1963) describes and illustrates two new species, *Taleastroma*? *confertum* and *Syringostroma bifurcum*, both of which appear identical to Redwater specimens. The present writer hesitates to refer the specimens to any one species since the generic characters are so obscure and skeletal morphology is of such a wide range. In all specimens there has been considerable alteration of the skeletal tissue, as well as the material in the galleries. The geometric arrangement of the pillars and laminae and the nature of the tissue is therefore problematic. There is a strong pillar system which is characteristic of *Actinostroma* and *Syringostroma*. The laminae do appear to pass through the pillars and no radial arms have been observed on any of the slides. Therefore, the group is tentatively assigned to *Syringostroma*. Perhaps the erection of a new genus for this unusual form would be appropriate.

Occurrence. This species occurs in the Upper and Middle Leduc of the Redwater reef. It is generally found in the fore-reef and organic-reef facies and is invariably associated with a skeletal calcarenite. Saltwater Disposal Well #1, 3424′, 3440.5′, 3444′, 3466′, 3598′, 3743′; Imperial Egremont #60, 3283′, 3284′; Imperial Egremont #94, 3220′, 3227′, 3243′, 3247′, 3262′; Imperial Redwater #95, 3212′, 3259′; Imperial Redwater #101, 3286′, 3311′; Imperial Redwater #111, 3269′, 3305′; Imperial Simmons #34, 3207′; Imperial Simmons #66, 3214′; Imperial Simmons #72, 3165′, 3170′; Imperial Simmons #143, 3187′; Saltwater Disposal Well #5, 3577′.

Types. Figured specimens, GSC Nos. 19851-19853; Imperial Redwater #95, 3212′; Imperial Redwater #101, 3311′, and Imperial Egremont #94, 3220′.

Genus *Synthetostroma* Lecompte, 1951

Type species: *Synthetostroma actinostromoides* Lecompte, 1961.

Synthetostroma vesiculosum (Lecompte)

Plate IX, figures 4a, b

1951. *Syringostroma vesiculosum* LECOMPTE, p. 206, Pl. 32, fig. 3; Pl. 33, figs. 1-4.
1957. *Synthetostroma*? *vesiculosum* (Lecompte), GALLOWAY and ST. JEAN, p. 257.

Exterior. Description based on thirteen specimens, coenosteum massive or tabular, up to 7 cm in diameter. Surface smoothly undulose and without mamelons. Astrorhizae are not apparent. Latilaminae are conspicuous, ranging from 4 to 8 mm thick.

Vertical section. The pillars are the dominant skeletal element. They are long rods passing through several interlaminar spaces, about 0.08 to 0.10 mm broad, variable in spacing but about eighteen to twenty-two in 5 mm. In some parts of the slide the pillars appear to be composed of many superposed pillars with

the thin, dark laminae, passing between them; this, however, is not generally so. Pillar tissue is compact. The laminae appear to be composed of curved dark plates that only form distinct laminae locally. These dissepiments are concave upward in general but may also be flat. They are 0.06 mm thick and are composed of dark flocculent tissue, twenty to twenty-two in 5 mm. Galleries are small and oval to rectangular. Astrorhizal canals up to 0.5 mm in diameter are present as oval to round openings. There is a very strong zonation of the skeleton caused by the presence of the latilaminar boundaries.

Tangential section. Pillars are round and constant in diameter at 0.09 mm. The pillars are closely packed with many of them joining to form a vermicular pattern. The galleries are joined to form anastomosing networks. A few astrorhizal canals are present as short branching canals 0.11 mm in diameter, but are not common.

Comparisons. The well-developed vesicular structure in the Redwater specimens is similar to that described for the type by Lecompte. Galloway and St. Jean (1957, p. 259) consider the specimens figured by Lecompte to be *Synthetostroma.* The writer agrees with that diagnosis. The general geometric arrangement of the laminae and pillars is also similar. The Redwater specimens lack the abundant astrorhizae that appear in the type. As the number of astrorhizae is variable in the group of specimens considered here, specific significance is not placed on this character.

Occurrence. This species is confined to the Cooking Lake equivalent and Middle Leduc of the Redwater reef. It occurs in a variety of lithic types, usually in a slightly argillaceous, skeletal calcarenite. Saltwater Disposal Well #1, 3750′, 3803′, 3901′, 3935′; Saltwater Disposal Well #4, 3921′, 4010′; Saltwater Disposal Well #5, 3830′, 3839′, 3903′; Imperial Eastgate #1-22, 3693′, 4259′; Imperial Egremont #1, 4008′; Imperial Lily #1, 4207′.

Type. Hypotype, GSC No. 19854; Imperial Eastgate #1-22, 4259′.

Family IDIOSTROMATIDAE Nicholson, 1886

Genus *Amphipora* Schulz, 1883

Type species: *Caunopora ramosa* Phillips, 1841.

Amphipora sp.

Plate X, figures 1-6

Discussion. The writer has not studied the many specimens of *Amphipora* from the Redwater reef in sufficient detail to split them into definite species. However, *Amphipora ramosa* Phillips is certainly present in the collection, as well as several other types.

The tissue of the Redwater specimens has been more or less affected by diagenetic alteration. Although the transversely fibrous nature of the tissue remains, the dark medial line within the tissue is obliterated in many places. Within the same coenosteum parts of the tissue have a dark medial line but others do not. Similarly, within the same stratum, some specimens have a dark medial line in their tissue while others do not; the other morphologic features remain constant. Due to these considerations, the writer cannot accept the genus *Paramphipora* Yavorsky, which was set up to include those specimens of *Amphipora* without the dark medial line in the tissue.

Occurrence. *Amphipora* is very abundant in most of the strata in the Cooking Lake equivalent of the Redwater reef. It occurs with other organisms in a fine-grained slightly argillaceous skeletal limestone. In the Upper and Middle Leduc, *Amphipora* is restricted to the back-reef environment, where it is the most abundant and characteristic fossil; in certain strata it occurs to the exclusion of all other organisms.

Types. Figured specimens, GSC Nos. 19855-19858; Imperial Eastgate #1-22, 3919′, 4074′, 4290′ and 3601′.

Genus *Stachyodes* Bargatzky, 1881

Type species: *Stromatopora (Caunopora) vesticillata* McCoy, 1851.

Stachyodes costulata Lecompte

Plate XI, figures 1-6

1952. *Stachyodes costulata* LECOMPTE, p. 309, Pl. 64, fig. 3.

Exterior. Coenosteum cylindrical, up to 2 cm in diameter, rarely observed to branch. Because the specimens are always surrounded in the limestone matrix, the surface characteristics have not been observed.

Discussion. All the specimens of *Stachyodes* from the Redwater complex have been strongly recrystallized so that the nature of the skeletal tissue is not known. The thick pillars and obscure laminae are very similar to that illustrated by Lecompte (1952) for *S. costulata.* There appear to be several varieties of *Stachyodes* in the Redwater complex, but the preservation is so poor that any attempt to split them into definite species would be tenuous at this time. Perhaps with further collecting the specific character of the various types will be defined.

Occurrence. *Stachyodes* is most abundant in the Upper Leduc of the Redwater reef and particularly in the organic-reef and fore-reef facies. It is almost never found in the back-reef facies so that there is a strong tendency for *Stachyodes* and *Amphipora* to occur exclusively of one another. Some strata are composed entirely of *Stachyodes.* These beds are up to 6 inches thick, the fossils forming a mat-like fabric surrounded by clear sparry-calcite, very coarse, calcarenite or green

shaly material. *Stachyodes* is also found in the Cooking Lake equivalent and Middle Leduc levels, particularly in the coarser, well-sorted lithologies.

Types. Hypotypes, GSC Nos. 19859-19862; Saltwater Disposal Well #1, 3350′ and 3353′; Imperial Egremont #1, 4005′; and Imperial Simmons #72, 3192′.

REFERENCES

Andrichuk, J. M.
1958a: Stratigraphy and facies analysis of Upper Devonian reefs in Leduc, Stettler and Redwater areas, Alberta; *Bull. Am. Assoc. Petrol. Geol.*, vol. 41, pp. 1-93.

1958b: Cooking Lake and Duvernay (Late Devonian) sedimentation in Edmonton area of central Alberta, Canada; *Bull. Am. Assoc. Petrol. Geol.*, vol. 42, pp. 2189-2222.

Bargatzky, A.
1881: Die Stromatoporen des rheinisches Devons; *Verhandl. Nathist. Vereins Preuss: Rheinlande Westfalens,* vol. 38, pp. 233-304.

Belyea, Helen R.
1952: Notes on the Devonian system of the north-central plains of Alberta, Canada; *Geol. Surv. Can.*, Paper 52-27.

1955: Cross-sections through the Devonian system of the Alberta plains; *Geol. Surv. Can.*, Paper 55-3.

1957: Correlation of Devonian subsurface formations, southern Alberta; *Geol. Surv. Can.*, Paper 55-38.

1960: Distribution of some reefs and banks of the Upper Devonian Woodbend and Fairholme Groups in Alberta and eastern British Columbia; *Geol. Surv. Can.*, Paper 59-15.

Fischbuch, N. R.
1960: Stromatoporoids of the Kaybob reef, Alberta; *J. Alberta Soc. Petrol. Geol.*, vol. 8, pp. 113-131.

1962: Stromatoporoid zones of the Kaybob reef, Alberta; *J. Alberta Soc. Petrol. Geol.*, vol. 10, pp. 62-72.

Flügel, E.
1959: Die Gattung *Actinostroma* Nicholson und ihre Arten (Stromatoporoidea); *Ann. Nathist. Mus. Wien,* vol. 63, pp. 90-273.

Galloway, J. J.
1957: Structure and classification of the Stromatoporoidea; *Bull. Am. Paleontology,* vol. 37, No. 164, pp. 341-480.

1960: Devonian stromatoporoids from the Lower Mackenzie Valley of Canada; *J. Paleontology,* vol. 34, No. 4, pp. 620-636.

Galloway, J. J., and St. Jean, J. Jr.
1957: Middle Devonian Stromatoporoidea of Indiana, Kentucky and Ohio; *Bull. Am. Paleontology,* vol. 37, No. 162, pp. 29-308.

Goldfuss, A.
1826: Petrefacta Germaniae; List and Francke, Leipzig, 1st ed., p. 21.

Klovan, J. E.
1964: Facies analysis of the Redwater reef complex, Alberta, Canada; *Bull. Can. Petrol. Geol.*, vol. 12, No. 1, pp. 1-100.

Kühn, O.
1939: Eine neue Familie der Stromatoporen; *Zentralbl. Min. Geol. Palaont.*, Abt. B., pp. 338-345.

Lecompte, M.
1951-1952: Les Stromatoporoides du Devonien moyen et Superior du bassin de Dinant; *Inst. Roy. Sci. Nat. Belgique,* Mem. 116, 117, pp. 1-359.

McLaren, D. J.
1956: Devonian formations in the Alberta Rocky Mountains between Bow and Athabasca Rivers; *Geol. Surv. Can.*, Bull. 35 (1955).

Nicholson, H. A.
1875: Descriptions of Amorphozoa from the Silurian and Devonian formations; *Geol. Surv. Ohio*, vol. 2, pt. 2, pp. 245-255.

1886a: On some new or imperfectly known species of stromatoporoids; *Ann. Mag. Natural Hist.*, ser. 5, vol. 17, pp. 225-239.

1886b: On some new or imperfectly known species of stromatoporoids; *Ann. Mag. Natural Hist.*, ser. 5, vol. 18, pp. 8-82.

1887: On some new or imperfectly known species of stromatoporoids; *Ann. Mag. Natural Hist.*, ser. 5, vol. 19, pp. 1-17.

1886c, 1889, 1891a, 1892: A monograph of the British stromatoporoids; *Paleontographical Soc. London,* vols. 39, 42, 44, 46, pts. 1-4, pp. 1-234.

1891b: On some new or imperfectly known species of stromatoporoids; *Ann. Mag. Natural Hist.*, ser. 6, vol. 7, pp. 309-328.

Parks, W. A.
1936: Devonian stromatoporoids of North America; Part 1: *Univ. Toronto Studies,* Geol. Ser. No. 39, pp. 1-125.

Schulz, E.
1883: Die Eifelkalkmulde von Hillesheim. Nebst einen palaeontolog Anhang; *Jahrg. Konigl. Preuss. geol. Landesamstalt und Bergakad.*, for 1882, p. 245.

Stearn, C. W.
1961: Devonian stromatoporoids from the Canadian Rocky Mountains; *J. Paleontology*, vol. 35, No. 5, pp. 932-948.

1962: Stromatoporoid fauna of the Waterways Formation (Devonian) of northeastern Alberta; *Geol. Surv. Can.*, Bull. 92.

1963: Some stromatoporoids from the Beaverhill Lake Formation (Devonian) of the Swan Hills area, Alberta; *J. Paleontology,* vol. 37, No. 3, pp. 651-668.

Winchell, A.
1867: Stromatoporoidae: Their structure and zoological affinities; *Proc. Am. Assoc. Adv. Sci.*, for 1886, vol. 15, pp. 91-99.

Yavorsky, V. I.
1955: Stromatoporoidea Sovetskogo Soyuza: *Trudy Vsesoyuznogo Nauchno-issledovatelskogo Geol. Inst., Minister Geol. i Ochrany Nedr.*, n. ser., vol. 8, pp. 1-173.

1957: ibid., vol. 18, pp. 1-168.

PART II–UPPER DEVONIAN STROMATOPOROIDS FROM SOUTHERN NORTHWEST TERRITORIES AND NORTHERN ALBERTA

C. W. Stearn

Abstract

Stromatoporoids of Frasnian age collected from the Hay River, Twin Falls, Kakisa, and Mikkwa Formations can be divided into a lower *Ferestromatopora parksi* fauna and an upper *Stictostroma maclareni* fauna. In the area studied the lower fauna is particularly characterized by *Ferestromatopora parksi* n. sp., *Actinostroma clathratum* Nicholson, *Atelodictyon stelliferum* Stearn, *Ferestromatopora contexta* Stearn, and *Stromatopora mikkwaensis* n. sp. The upper fauna, which is found in the Kakisa Formation, is characterized by *Stictostroma maclareni* n. sp., *Anostylostroma phricum* n. sp., and *Trupetostroma saintjeani* n. sp. Twenty species of stromatoporoid are described of which eight are new and three are identified provisionally. A single new species of *Anostylostroma (A. phricum), Stictostroma (S. maclareni), Pseudoactinodictyon (P. bullulosum), Stromatopora (S. mikkwaensis),* and *Ferestromatopora (F. parski)* is described. Three new species of *Trupetostroma (T. saintjeani, T. hayense, T. kakisaense)* are also described.

Résumé

Les stromatoporidés du Frasnien provenant des formations Rivière au Foin, Twin Falls, Kakisa et Mikkwa peuvent être divisés en faune inférieure *Ferestromatopora parksi* et en faune supérieure *Stictostroma maclareni.* Dans la région en cause, la faune inférieure est surtout caractérisée par *Ferestromatopora parksi* n. sp., *Actinostroma clathratum* Nicholson, *Atelodictyon stelliferum* Stearn, et les *Stromatopora mikkwaensis* n. sp. La faune supérieure, que l'on trouve dans la formation Kakisa, est caractérisée par *Stictostroma maclareni,* n. sp., *Anostylostroma phricum* n. sp., et *Trupetostroma saintjeani* n. sp. L'auteur décrit vingt espèces de stromatoporidés dont huit sont de nouvelles espèces et trois sont identifiées provisoirement. Une seule nouvelle espèce d'*Anostylostroma (A. phricum),* de *Stictostroma (S. maclareni),* de *Pseudoactinodictyon (P. bullulosum),* de *Stromatopora (S. mikkwaensis)* et de *Ferestromatopora (F. parksi)* est décrite. Sont aussi décrites trois nouvelles espèces de *Trupetostroma (T. saintjeani, T. hayense, T. kakisaense).*

INTRODUCTION

Devonian rocks outcrop extensively south of the headwaters of Mackenzie River west of Great Slave Lake, and in the valley of the lower Peace River of northern Alberta. The Upper Devonian rocks of these two areas are separated by Cretaceous rocks that extend eastward and rest on Middle Devonian rocks near the border of the Shield.

Norris (1963)[1] studied Devonian outcrops on Peace River at Vermilion Chutes and Gypsum Cliffs, and in the region of Waterways, Alberta; Douglas (1959) and Belyea and McLaren (1962) have reported on the Devonian stratigraphy of the region west of Great Slave Lake. Stromatoporoids from these two areas are described in this publication; those from Athabasca and Clearwater Valleys collected by Norris and others have already been described (Stearn, 1962).

STRATIGRAPHY

The Upper Devonian rocks of the two areas from which the fossils described in this report were collected are listed in Table III. Precise correlation between the two areas has not been established, but Norris (1963) believes that the Mikkwa Formation is correlative with the upper part of the Hay River Formation and the Grosmont with the lower part of the Grumbler Group, probably with the Twin Falls Formation. As indicated below, the stromatoporoids suggest that the Mikkwa fauna is closer to that of the Twin Falls Formation than to that of the Escarpment Member.

Stromatoporoids have been recorded from five of the formations. Although Norris records vague traces of stromatoporoids from the Grosmont Formation, none is preserved well enough for identification. Stromatoporoids that can be identified do occur in the two members of the Mikkwa Formation, in the Escarpment Member of the Hay River Formation, in both members of the Twin Falls Formation, and in the Kakisa Formation. The Escarpment Member consists of calcareous mudstones and argillaceous limestones with "strongly bioclastic, biohermal, and biostromal limestone bodies irregularly developed throughout" (Belyea and McLaren, 1962, p. 3). Most of the stromatoporoids collected from this member come from such a bioclastic-biohermal body 16 feet thick that forms Louise Falls on Hay River. The Alexandra Member of the Twin Falls Formation consists

[1]Names and/or dates in parentheses are those of *References*, page 67

Table III

Table of Formations

			NORTHWEST TERRITORIES	NORTHERN ALBERTA	
Upper Devonian Series	Fammenian Stage		Tetcho Formation		
			Trout R. Formation		
	Frasnian Stage	Grumbler Group	Kakisa Formation		
			Redknife Formation	?	
			Tathlina Formation	?	Grosmont Formation
			Twin Falls Formation Upper member Alexandra Member	?	Mikkwa Formation Mottled limestone member Lower limestone member
			Hay R. Formation Escarpment Member Lower member		

of light coloured massive limestones with some bioherms containing stromatoporoids. The unnamed upper member of the Twin Falls Formation consists of "variably bioclastic, reefoid and biostromal limestones with some quartzose sand and silt and some more shaly horizons" (op. cit., p. 4). Stromatoporoids were not collected from the Tathlina and Redknife Formations, which include more terrigenous sedimentary rocks than the formations above and below. Many of the stromatoporoids described in this report come from the Kakisa Formation, described by Belyea and McLaren (1962, p. 7) as "yellowish grey and olive grey, quartzose, silty, dolomitic limestones with argillaceous partings" in which "prominent bioclastic or reefoid biostromes and bioherms composed largely of corals and stromatoporoids may occur at any horizon". Stromatoporoids from the Mikkwa Formation were collected from the area of the confluence of Mikkwa and Peace Rivers close to Vermilion Chutes. The formation is divided into a lower limestone member of dark brown fossiliferous limestone, light grey, cryptograined limestone, yellowish brown fragmental fossiliferous limestone, interbedded argillaceous limestones and green calcareous shales, and an upper mottled limestone member of red mottled, argillaceous limestone. Although stromatoporoids were collected from both members, most of those identified came from the lower member.

STROMATOPOROID FAUNAS

Preservation. Generally the stromatoporoid specimens described in this report are very well preserved. The coenostea are infiltrated with calcite that fills the galleries and no replacement by dolomite or silica was noted. The tissue of the structural elements (laminae, pillars, amalgamate tissue, dissepiments, etc.) is marked by specks less than a micron across or by a darker colour, and the edge of the tissue is sharp with very little diffusion of specks out into the galleries.

The microstructure of the tissue of the stromatoporoids is important in the separation of genera. About a dozen varieties can be recognized (Stearn, 1966) but two are more widespread than the others. Compact tissue in which the minute specks that are the fundamental unit of microstructure are evenly distributed across the tissue is found in such genera as *Actinostroma, Anostylostroma,* and *Trupetostroma.* Cellular tissue in which subspherical vacuities called cellules are distributed throughout the tissue is found in genera such as *Stromatopora, Syringostroma,* and *Parallelopora.* The dark matter that forms the specks in the tissue of all stromatoporoids tends to migrate and to be concentrated during preservation producing a tissue that is filled with dark subspherical masses of specks that are called melanospheres. Melanospheric tissue commonly develops during the preservation of cellular tissue but it may also form in compact tissue, usually only locally. The transformation of cellular tissue into melanospheric tissue is through the increase in size of the cellules until they coalesce and the restriction of the dark specks to the subspherical regions between the cellules is further discussed by Stearn (1965, 1966). Although melanospheric tissue is commonly a good indication that the original microstructure of the stromatoporoid was cellular, it may be misleading.

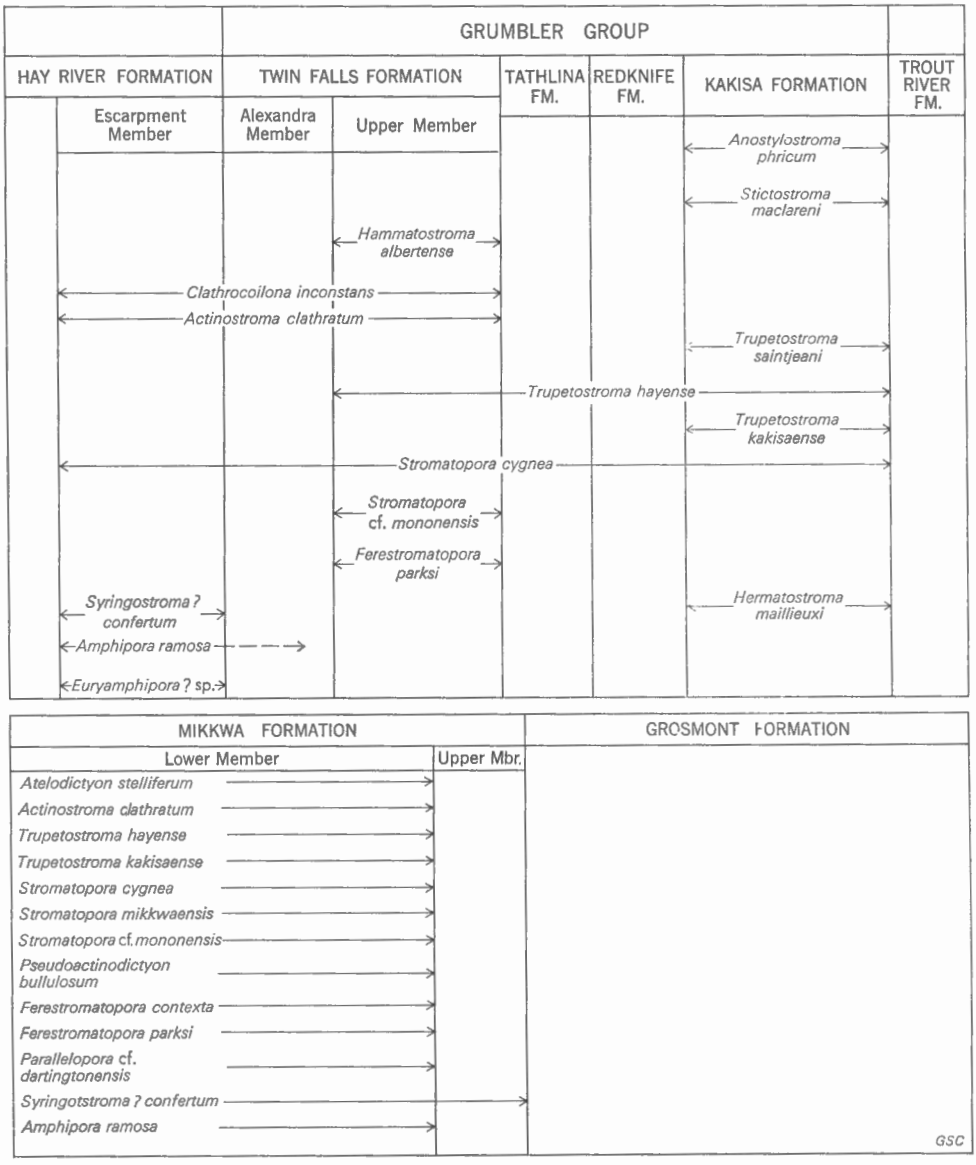
The term 'maculate' was applied by Galloway and St. Jean (1957) to tissues that are here described as cellular and melanospheric. Since the term was applied to two different microstructures, it is not used in this report. St. Jean used the term 'pseudomaculate' for melanospheric tissue developed in compact genera but the term is a subjective one for such tissue can only be distinguished from melanospheric tissue derived from cellular tissue on the basis that the gross structure of the specimen is typical of a genus that is normally compact in tissue.

Stratigraphic distribution. The fauna contains new species and species already described from the Devonian of western Canada. Stromatoporoids of the Fairholme Group that have been recognized in this fauna include *Hammatostroma albertense, Atelodictyon stelliferum, Ferestromatopora parksi* (conspecific with *F. jacquesensis* Stearn 1961, not Galloway 1960) and *Amphipora ramosa.* Species of stromatoporoids described from the Swan Hills reefs, which are also found in the collections from the Upper Mackenzie and Peace River Valleys, include *Clathrocoilona inconstans, Stromatopora cygnea, Ferestromatopora contexta,* and *Syringostroma? confertum.* The fauna of the Waterways Formation has little in common with this one, only the enigmatic species *Clathrocoilona inconstans* and *Syringostroma? confertum.*

The stratigraphic ranges of the species described here are shown in Table IV. A. W. Norris suggests that the Mikkwa Formation should be correlated with the Escarpment Member of the Hay River Formation but the stromatoporoid fauna of the Mikkwa Formation is closer to that of the Twin Falls Formation than to that of the Escarpment Member. The Mikkwa and Twin Falls Formations have the following species in common: *Actinostroma clathratum, Stromatopora* cf. *A. mononensis,*

Table IV

Ranges of Stromatoporoids



Ferestromatopora parksi, and *Stromatopora cygnea.* The Mikkwa Formation and the Escarpment Member have only *Stromatopora cygnea, Actinostroma clathratum,* and *Amphipora ramosa* in common.

The fauna of the Escarpment Member, the Twin Falls Formation, and the Mikkwa Formation may be called the *Ferestromatopora parski* fauna and consists of the following species:

Atelodictyon stelliferum
Hammatostroma albertense
Actinostroma clathratum
Pseudoactinodictyon bullulosum
Trupetostroma hayense
Trupetostroma kakisaense
Stromatopora cygnea
Stromatopora cf. *S. mononensis*
Ferestromatopora contexta
Ferestromatopora parksi
Stromatopora mikkwaensis
Parallelopora cf. *P. dartingtonensis*
Clathrocoilona inconstans
Syringostroma? confertum

The fauna of the Kakisa Formation differs from that of the Twin Falls and Mikkwa Formations and largely consists of species that are newly described herein. This fauna can be called the *Stictostroma maclareni* fauna and consists of:

Anostylostroma phricum
Stictostroma maclareni
Trupetostroma saintjeani
Trupetostroma hayense
Trupetostroma kakisaense
Stromatopora cygnea
Hermatostroma maillieuxi

The species common to the Upper Mackenzie and Peace River areas and the Rockies are all characteristic of the lower or *Ferestromatopora parksi* fauna and occur in the Cairn Formation. The *Stictostroma maclareni* fauna, which should occur at the top of the Southesk Formation according to the correlations of Belyea and McLaren (1962), is unknown as yet in the Rocky Mountains.

Although considerable work has now been done on the stromatoporoids of the Devonian of western Canada, no clear stratigraphic succession of faunas has been established. Each region seems to have a distinctive local group of stromatoporoids that dominate the fauna and a few species from a more widespread suite of species. The species that are widespread in Alberta are:

Anostylostroma vesiculosum Stearn (Cairn-Southesk: Beaverhill Lake)

Hammatostroma albertense Stearn (Cairn-Southesk: mid-Leduc: Twin Falls)

Trupetostroma warreni Parks (Cooking Lake-mid-Leduc: Beaverhill Lake: Kee Scarp)

Atelodictyon stelliferum Stearn (Cairn-Flume: Beaverhill Lake: Mikkwa)

Actinostroma clathratum Nicholson (Hay River-Twin Falls: Cooking Lake-mid-Leduc)

Stachyodes costulata Lecompte (Beaverhill Lake: Kee Scarp: Leduc)

Stromatopora cygnea Stearn (Beaverhill Lake: Leduc: Mikkwa-Kakisa)
Syringostroma? confertum (Stearn) (Leduc: Beaverhill Lake: Mikkwa)
Amphipora ramosa Phillips (Cairn-Southesk-Alexo: Beaverhill Lake-Leduc: Hay River: Waterways)

Uncertainty concerning the ranges of these stromatoporoids precludes a zonation of the Devonian of Alberta on this basis. For further discussion on the stratigraphic value of stromatoporoids the reader is referred to recent publications by Flügel (1962; *see also* the discussion by Lecompte and by Yavorsky, 1962).

SYSTEMATIC PALAEONTOLOGY

Genus *Anostylostroma* Parks, 1936

Type species: *A. hamiltonense* Parks.

Laminae composed of a single layer of compact tissue that in many states of preservation appears to be transversely fibrous. The compact pillars are confined to an interlaminar space and divide at the top either simply or into a network of tissue that spreads on to the under side of the lamina.

Anostylostroma phricum n. sp.

Plate XIV, figures 1-4; Plate XXVI, figure 8

This species is represented in the collections by six specimens. The laminar coenosteum reaches a height of 5 cm. Most of the coenostea are thinner than this, about 3 cm. Upper surface covered with closely spaced mamelons but is not well preserved in the specimens on hand.

Vertical sections show persistent laminae inflected into deep mamelon columns, abundant long dissepiments, and short pillars. The persistent laminae are the most prominent structural elements but may be difficult to distinguish from the larger flat dissepiments. They are composed of a single thin layer of compact tissue but locally an axial light zone is present. Laminae thicken towards the mamelon columns and in the thickened tissue the microstructure becomes granular. They are spaced 2.5 to 5 in 1 mm and are generally about 50 microns thick but may swell to as much as 120 microns. They are conspicuously inflected into well-defined mamelon columns. Foramina are uncommon.

Pillars are short and thin; generally spool-shaped, but a minority divide near the top into a Y-shape, many are incomplete and irregular in form. They are irregularly spaced and may be absent over considerable areas particularly between the mamelon columns. Mamelon columns are a conspicuous part of the structure and are composed of sharply upbent laminae and pillars thickened into flocculent tissue. Dissepiments are common, generally large and gently curved, tending to form short secondary laminae.

Tangential sections show prominent mamelon columns with concentric laminae and central amalgamate structure. Laminae appear much as in vertical section and where they are cut tangentially they show no well-defined pores. The pillars emerge as small dots or vermicular bars between the mamelons. In the axes of mamelons, the pillars are much thickened and join to form an irregular network or amalgamate structure in which the tissue is flocculent. Astrorhizal canals are masked or missing probably because they are deflected downward sharply around the mamelons parallel to the laminae. Some mamelons have a central canal; in others it is missing.

Discussion. This new species is characterized by its high mamelons with thicker tissue in their axes, its abundant dissepiments, and scattered Y-shaped pillars among the simple ones. It resembles *Anostylostroma pulpitense* Galloway and St. Jean in general dimensions but this species has lower columns and lacks dissepiments. It has higher mamelons and more conspicuous dissepiments than *A. columnare* (Parks). It also resembles *A. retiforme* (Nicholson and Murrie) but is distinguished by its conspicuous dissepiments and Y-shaped pillars.

The specific name is derived from the Greek word *phrix* and refers to the rippled appearance of vertical sections.

Occurrence. Confined to the Kakisa Formation. Holotype, GSC No. 18679 from locality 30747. Other localities include 30728, 30733, 30736.

Genus *Stictostroma* Parks, 1936

Type species: *S. mamilliferum* Galloway and St. Jean, 1957.

Coenosteum composed of persistent compact laminae with a central light or dark zone, or line of cellules, and short, spool-shaped, compact pillars confined to a single interlaminar space which do not form ring pillars in tangential section.

Stictostroma maclareni n. sp.

Plate XII, figures 1-4; Plate XIII, figures 1, 2; Plate XXVI, figure 2

This species is represented by six coenostea from five different localities. The coenostea are laminar or encrusting, about 2 mm thick in specimens at hand. The largest is 7 cm across. The surface rises into closely spaced, shallow mamelons.

Vertical sections show prominent continuous laminae and short spool-shaped pillars confined to an interlaminar space. The laminae are about 50 microns thick and generally show a prominent central lighter zone. They do not appear to be transversely porous. In one specimen the laminae are locally thicker and may have two or rarely three lighter zones so that they appear to be stranded. They are gently undulant but not inflected into mamelon columns. Foramina are not common. The laminae are spaced three to four in 1 mm.

Pillars are short, confined to a single interlaminar space, prominently spooled and generally regularly spaced. They are 60 to 100 microns thick and are spaced

3 to 3.5 in 1 mm. A few are incomplete. In some specimens the microstructure of the pillars is compact but in one specimen the flecks are concentrated into melanospheres. Astrorhizal canals are not prominent in vertical section but a few can be identified. Dissepiments are uncommon. Tubes of *Syringopora* are present in two of the specimens.

Tangential sections show the pillars emerging as discrete dots and the dark lines of obliquely cut laminae. The laminae are granular in microstructure. The dots of the pillars are round and are rarely joined to their neighbours. Ring pillars are absent. Astrorhizal canals are not conspicuous and are easily confused in two of the specimens with the tubes of *Syringopora* which penetrate the coenosteum.

Discussion. The short pillars, tripartite laminae and lack of ring pillars place this species in the genus *Stictostroma*. The only other genus in which it might be placed is *Clathrocoilona* Yavorsky which Galloway (1957) distinguishes from *Stictostroma* on the basis that the former has maculate microstructure. Yavorsky himself specifically states that the distinguishing features of his genus are the voids of rounded and elongate form with cross partitions and that the fibre is compact (1931, 1955). Under these circumstances *Clathrocoilona* is interpreted here as a variant of the *Stictostroma* group in which the interspaces are filled with lighter, commonly melanospheric, tissue to form a dense structure. This infilling is not evident in *S. maclareni* although it does show a certain similarity of structure to *Clathrocoilona abeona* Yavorsky, the type species of *Clathrocoilona*.

Stictostroma maclareni has similarities to several species described by Yavorsky as *Clathrodictyon*. Its laminae are more closely spaced than those of *Stictostroma tomiensis* (Yavorsky) and are more persistent than those of *S. teplovensis* (Yavorsky). Comparison with the type species, *S. mamilliferum* Galloway and St. Jean, shows that laminae of *S. maclareni* are more widely spaced.

The species is named in honour of D. J. McLaren of the Geological Survey of Canada.

Occurrence. In the Kakisa Formation at GSC localities 30541, 30659, 30679, 30701, 33550. The holotype (GSC No. 18674) is from GSC locality 30679.

Genus *Hammatostroma* Stearn, 1961

Type species: *Hammatostroma albertense* Stearn, 1961.

Coenosteum composed of persistent laminae and incomplete pillars confined to a single interlaminar space. The laminae are a single layer of transversely fibrous tissue. The pillars arise from the laminae and form a tangled, irregular mass of strands between the laminae composed of compact tissue.

Hammatostroma albertense Stearn

Plate XIII, figure 3, Plate XXVI, figure 3

Stearn, 1961, pp. 940-941, Pl. 106, figs. 2, 4, text-fig. 3.

A single specimen shows a small part of this stromatoporoid associated with *Ferestromatopora parksi* as an encrusting thin skin several laminae thick. Only a small part of the coenosteum is present but the features of the species are evident. Laminae are thick (70 microns), transversely fibrous and widely spaced so that only one or two occur in 1 mm. The pillars do not cross the interlaminar spaces but arise from the laminae and are knotted into an irregular tangled structure between the laminae.

The genus and species have been fully described in the reference cited and the material available from collections under discussion is not good enough to justify further description.

Discussion. Yavorsky (1963, p. 15) discusses the assignment by Stearn of *Clathrodictyon katavense, Stromatoporella undata,* and *Clathrodictyon tschussovense* to *Hammatostroma* and concludes that because the pillar structure of these species is not porous, they should not be referred to his genus *Intexodictyon.* The Silurian *Intexodictyon* Yavorsky and Devonian *Hammatostroma* Stearn seem to have similar structures but differ in microstructure, the first being compact and the second fibrous (*see* Stearn, 1966).

Occurrence. This species is represented by a single specimen from GSC locality 30467 in the upper member of the Twin Falls Formation.

Genus *Clathrocoilona* Yavorsky, 1931

Type species: *Clathrocoilona abeona* Yavorsky, 1931.

Laminae composed of a central light or dark zone clothed in thick, dark tissue that almost fills the interlaminar space restricting the galleries to small circular openings. Pillars are spool-shaped, confined to an interlaminar space and composed of the same tissue.

Clathrocoilona inconstans Stearn

Plate XV, figures 1-3

Stearn, 1962, pp. 15-17, Pl. 7, figs. 1-5; Pl. 8, figs. 6, 7.

The collections contain four specimens. The coenostea show well-defined laminae rising and falling irregularly on weathered surfaces. Mamelons seem to be absent, but the upper surface is not well exposed. Coenostea roughly hemispherical, the largest being 8 cm in diameter.

This organism probably represents a consortium of an alga and a stromatoporoid of the *Clathrocoilona* group, and the variations in its form are probably due to the relative proportions of the two organisms.

Vertical sections show well-defined laminae, generally dark and composed of compact tissue. Primary laminae may be covered with algal material that periodically coated the surface of the coenosteum. From the laminae, various types of vaguely flocculent pillars are suspended. The simplest pillars are short and spool-shaped; the more complex ones have branches and oblique and horizontal segments. In places the pillar tissue may form an amalgamate structure between the laminae. Spacing of the laminae is wide and variable, from 1 to 2.5 per millimetre.

Tangential section cuts the pillars as small dots. The laminae form dark swirling lines, which may, in the darkest spots, show masses of parallel tubules interpreted as of algal origin (*?Girvanella*). Well-defined astrorhizal canals are rare, but some of the larger galleries may represent these canals.

In two of the specimens (from localities 30428 and 30547) this species is intimately associated with, and seems to grade into, a structure composed of intertwined coarse tubes about 300 microns in diameter. In one of these a tetracoral is overgrown by alternating layers of algal material with fine tubes like *Girvanella* and *Clathrocoilona inconstans*. The layers are overlain by a mass of intertwisted coarse tubes that may have been secreted by a worm-like organism.

Occurrence. In the Twin Falls Formation and the Escarpment Member of the Hay River Formation at GSC localities 30428, 30438, 30510, 30514, and 30547.

Genus *Atelodictyon* Lecompte, 1951

Type species: *Atelodictyon fallax* Lecompte, 1951.

Laminae discontinuous in vertical section, composed of a line of granules that may be joined together by lighter coating tissue. Pillars confined to a single interlaminar space, rarely superposed, joined in the laminae by a set of radial processes. Tissue compact.

Atelodictyon stelliferum Stearn

Plate XV, figures 4-6; Plate XXVI, figure 6

Stearn, 1961, p. 937, Pl. 105, figs. 6-8.

Coenosteum hemispherical, in the largest of the five specimens in the collections about 15 cm across and overgrowing a coenosteum of *Ferestromatopora* cf. *contexta*. Surface gently undulant with prominent large astrorhizae.

Vertical sections show grossly persistent laminae and short irregular pillars. The laminae are regularly curved along the periphery of the coenosteum and

bifurcate commonly. Although in gross form they are continuous, in detail they are made up of many small granules. They are thin (about 50 microns) and spaced approximately three in 1 mm but as many as five and as few as two may occur in 1 mm. The pillars are irregular. Many are incomplete and join in the interlaminar space. A few branch upward. Most do not pass directly across the interlaminar space but are curved, branch, and merge with one another. The tissue is compact but may have pigmented spots. Astrorhizal canals are prominently represented by circular holes in the structure or by elongate galleries. No mamelon columns are present. Locally shallow upward inflections of the laminae occur but these are not vertically persistent. Dissepiments are not common but may be scattered through vertical sections.

Tangential sections show pillars emerging as dots that are in most places joined to their neighbours to form a fine network. The laminae are not obvious and are represented by darker zones where a horizontal network is formed by the processes from the pillars. Astrorhizal canals are prominent. The tissue seems to have many circular vacuoles in tangential section but they are not obvious in vertical sections.

Discussion. This species is very widespread in the Devonian of Alberta and has been recorded from the Upper Leduc, Beaverhill Lake, Cairn and Flume Formations, as well as from the Mikkwa Formation.

Occurrence. In the Mikkwa Formation on Peace River at GSC localities 29256, 29265, 46296, 46297, and 46308.

Genus *Actinostroma* Nicholson, 1886

Type species: *Actinostroma clathratum* Nicholson, 1886.

Pillars continuous, long, giving off a set of radial processes at intervals to form the laminae, which may appear in vertical sections to be continuous or broken into segments. Tissue compact.

Actinostroma clathratum Nicholson

Plate XIII, figures 4, 5; Plate XVI, figures 3, 4

Nicholson, 1886, p. 76, Pl. 1, figs. 8-13, Pl. 2, fig. 11.
A. devonense Lecompte (in part), Stearn, 1961, pp. 941-42, Pl. 106, figs. 5, 6.

This species is represented by six coenostea in the collections. Most of the coenostea are subhemispherical masses but one is laminar and about 2 cm thick. The largest of the hemispherical forms is 9 cm high. The surface appears to have been covered with low, small mamelons.

Vertical sections show a well-formed meshwork of long laminae and pillars. The pillars are the most conspicuous element and are thicker than the laminae. They

are composed of compact tissue that is commonly without structure but may have a lighter axis. The pillars are from 110 to 160 microns thick and are spaced from 2 to 3.5 in 1 mm. They range widely in length depending in part on the angle at which they are cut by sections, but several are 7 mm long. The laminae are much thinner (50 to 90 microns). Locally they may be continuous but commonly they break up into segments and granules so that they seem to be perforated by many large foramina. They are spaced about three to four in 1 mm; are compact and without internal structure.

Tangential sections show the pillars emerging as dots about 150 microns across. They commonly have a central darker area. They are joined in zones that define the laminae by delicate connective processes to form a regular network. The laminae thus have the structure typical of the genus. Concentric structures may be present but no mamelon columns. Astrorhizae are missing or only vaguely suggested in the specimens examined.

Discussion. The range of values for the spacing of the structural elements in this species is wide as discussed by Flügel (1959). The marginal position of the specimens from Alberta with respect to these spacing ranges might justify their separation into another species. However, if such a species were erected, well-defined characteristics by which it might be separated from *A. clathratum* would be difficult to designate. The dimensions of species of this genus are summed up by Flügel (op. cit.) in his "Art-Diagram", which for the European specimens is given as (3-6)x(3-5). Flügel (1959, p. 95) defines his species diagram as "Die aus 10 Messungen gewonnenen Extremewerte der Laminae pro 1 mm. werden auf die Abszisse, die der Pfeiler pro 1 mm. auf der Ordinate eines Koordinatesystems aufgetrangen."

The species diagram for the specimens described here is (3-4)x(2.4-3). A comparison of these two sets of figures shows that typical European specimens of this species have pillars and laminae of similar spacing defining square galleries (as the structural elements are approximately of the same thickness), but the specimens described here have pillars spaced more widely than the laminae. The greater thickness of the pillars relative to the European specimens does not make up entirely for their wider spacing; the galleries therefore are wider than high. The specimens identified by Klovan (this bulletin) from the Redwater reef complex of Alberta have a diagram of (4-5.5)x(2.5-4.5). Although the laminae are more closely spaced than those here described, the two groups of specimens are probably cospecific. Yavorsky (1961, pp. 4-6) has pointed out the difficulties of using the species diagram alone for the characterization of species of *Actinostroma.*

The following species of *Actinostroma* have so far been recognized in the Devonian of western Canada:

A. devonense Lecompte—identified by Stearn 1961 from the Cairn and Southesk Formations. Re-examination of the specimens from these formations in the light of further studies suggests that two species were included in the material

described as *A. devonense*. One group with a spacing (5-6.5)x(3) may be a new species, the other with a spacing of (3.5-4.5)x(2.5-3) is similar to the specimens described here as *A. clathratum*. Flügel (1959) places *A. devonense* in synonymy with *A. papilosum* (Bargatzky). Neither of these names now seems appropriate for the specimens from the Cairn and Southesk Formations.

A. tyrrelli Nicholson—Middle Devonian Winnipegosan dolomite of Manitoba and Middle Devonian of Northwest Territories (Galloway, 1960).

A. fenestratum Nicholson—Winnipegosan dolomite of Lake Manitoba. Flügel (1959) believes this is a tabulate coral but the specimen in the Nicholson collection is a stromatoporoid but not a typical *Actinostroma*. It is very poorly preserved.

A. pachypilatum Klovan—Redwater reef complex.

A. cf. *A. crassipilatum* Lecompte—Redwater reef complex.

A. redwaterense Klovan—Redwater reef complex.

A. clathratum Nicholson—Redwater reef complex, Fairholme Group, Northwest Territories.

Occurrence. In the Escarpment Member of the Hay River Formation, in the Twin Falls Formation, and more commonly in the Mikkwa Formation. Collected from GSC localities 29274, 30399, 30535, 46296, and 46304.

Genus *Trupetostroma* Parks, 1936

Type species: *Trupetostroma warreni* Parks, 1936.

Coenosteum composed of persistent three-layered laminae consisting of an axial light or dark zone covered irregularly by thicker tissue and short spool-shaped pillars. The pillars are superposed from one interlaminar space to the next forming with the laminae a grid in vertical section. Laminae pierced by large circular foramina between the pillars or reduced to a network. Tissue of pillars and the outer zone of the laminae is compact but many contain vacuoles.

Trupetostroma saintjeani n. sp.

Plate XVI, figures 1, 2; Plate XVII, figures 1, 2;

Plate XXVI, figure 4

This species is represented by four specimens, which are fragments of coenostea that seem to have been hemispherical and about 5 cm in diameter. One specimen may have been part of a laminar coenosteum about 5 cm thick.

Vertical sections show a grid-like structure of continuous laminae and short pillars that are well superposed in some parts of the structure and poorly preserved in others. Latilaminae about 2 mm thick are present in one specimen and in this

latilaminate part the superposition of pillars is poor. The laminae are undulant and generally persistent. They may be inflected into shallow mamelons and these may be vertically superposed to make shallow, inconspicuous mamelon columns with an axial canal. The laminae are compact, relatively thick (60 to 150 microns, average about 100 microns), spaced 2.5 to 4 in 1 mm. Locally they show an axial light or porous zone.

Pillars are well superposed in most parts of sections and may appear to be continuous through the laminae. In some zones and areas they may appear to be confined to an interlaminar space. They are slightly spool-shaped, expanding against the laminae, spaced from three to five in 1 mm and are about 100 microns thick. The microstructure of the pillars is compact but one specimen shows a series of scattered vacuoles in the pillars.

Astrorhizal canals are rare. Galleries are rounded and superposed. A few dissepiments may be present but they are not a normal part of the structure.

Tangential sections show dot-like pillars and meandering bands of laminae. Laminae are dark bands without structure and not obviously pierced by foramina. The pillars are round, discrete dots between the laminae and rarely join into bars. They merge into the laminae. Astrorhizal canals and concentric patterns in the laminae are poorly developed and may be missing. One specimen shows intergrown tubes of *Syringopora*. In two specimens the pillars show conspicuous vacuoles in tangential section and in one (from locality 30570) they seem to be concentrated near the margins of the pillars.

Discussion. This species is similar to *Trupetostroma laceratum* Lecompte in the general dimensions of the network and the form of the pillars but differs in the almost complete absence of dissepiments and astrorhizal canals. Its distinctive characteristics include the thick laminae, pillars which are superposed or through-going but not as consistently so as in some species, and which are uniformly dot-like in tangential section.

The species is named in honour of Dr. Joseph St. Jean.

Occurrence. In the Kakisa Formation at localities 30674, 30541, 30570, and 31532. Holotype, GSC No. 18685, from locality 31532.

Trupetostroma hayense n. sp.

Plate XVII, figures 3-5; Plate XVIII, figures 1-4

This species is represented in the collections by five specimens. The coenostea of most of the specimens are large and roughly hemispherical, the largest being 9 cm in diameter. Laminae prominently inflected into mamelon columns in polished sections. One specimen is a laminar coenosteum about 2 cm thick.

Vertical sections show a regular network of superposed pillars and laminae, both of which are thin and closely spaced. Primary laminae are very thin (about 10 to 15 microns) but are commonly thickened by secondary tissue to 40 to 50

microns. Where so thickened the laminae show three layers, the middle one may be lighter or darker than the outside layers. They are compact and vacuoles are not conspicuous. The laminae are regular, persistent, slightly undulant, and inflected at wide intervals into shallow mamelon columns. They are closely spaced, an average of six per millimetre, but ranging from four to eight per millimetre. Growth is not latilaminar.

Pillars are generally long and may appear to be continuous through the laminae. In most places, however, the dark axial line of the laminae can be seen to pass through the pillars. The pillars are slender, spool-shaped, and generally well superposed so that they can be followed through many interspaces. These longer pillars are interspersed with others that are superposed over shorter distances. They are spaced three to five in 1 mm and are thin (average 70 microns). Pillars have a compact, flocculent texture but do not seem to have any vacuoles.

Astrorhizal canals are common where the laminae are bent up into mamelon columns. Some of these columns have a vertical axial canal. The structure in the columns is denser than between the columns, and the pillars spray outward from their axes. Dissepiments are common near the columns.

Tangential sections show a wide variation in the form of the pillars. Where cut between the laminae, the pillars are round small dots about 70 microns across or join into irregular bars of vermicular form. Laminae cut tangentially show a loose irregular network with labyrinthine openings between the fibres. Astrorhizal canals radiating from widely spaced (at intervals of about 5 mm) mamelon centres are well developed and branching. The texture of the pillars is compact or somewhat melanospheric.

Discussion. This species is close to *Trupetostroma bassleri* Lecompte, but the pillars do not show the pores described in that species and are only about half their thickness. The thin pillars and the thin, closely spaced laminae are characteristic of this species. Its closest relative in the Devonian rocks of western Canada is *Trupetostroma tenue* Stearn from the Cairn Formation. The pillars of this species, however, are thicker (100 microns) and the laminae are not so closely spaced (four per millimetre). The spacing of the pillars of these two species is similar.

Occurrence. Trupetostroma hayense is known from four localities, two in the Twin Falls Formation, one in the Kakisa Formation, and one in the Mikkwa Formation. The type specimen GSC No. 18688 is from GSC locality 30477 in the upper member of the Twin Falls Formation on Hay River. Other specimens are from the same locality, and from localities 30393, 30679, and 46301.

Trupetostroma kakisaense n. sp.

Plate XIX, figures 1-4

This species is represented by three coenostea. The coenosteum of one specimen is a small irregular nodule about 3 cm in diameter completely overgrown

by *Atelodictyon stelliferum*. The others are small fragments that do not show the surface well. Without doubt the surface rose into high, closely spaced mamelons.

Vertical sections show prominent mamelon columns and a dense structure dominated by irregular pillar-like structural elements. Laminae are rarely well defined, but here and there in the structure regular lines of granules occur that define a highly porous lamina. They are about 70 microns thick and are so widely scattered that an estimate of their spacing cannot be made. Pillars are thick, long, rarely branching, closely spaced in the mamelon columns and spreading outward and upward from their axes, from 100 to 160 microns wide and spaced 2.5 to 3.5 in 1 mm. The microstructure of the pillars is compact with scattered vacuoles not confined to the outer edges. Where thickened in the mamelon columns they may be fibrous. Galleries between the pillars are elongated into pseudozooidal tubes crossed by dissepiments. The dissepiments are the main horizontal structures and are abundant and of low curvature.

Mamelon columns penetrate the whole structure. They have an axial zone that includes several vertical astrorhizal canals. Canals also radiate from the axes but are not conspicuous in vertical sections.

Tangential sections show concentric and radial structures in the mamelon columns that are so sharply set off from other parts of the structure that they resemble separate coenostea of a stromatoporoid-like *Idiostroma*. Between the mamelons, the pillars emerge as irregular dots or more commonly joined to their neighbours to form vermicular bars or locally an irregular network. Astrorhizal canals are common in the axes of the mamelons. The tissue of the pillars is compact but appears to be fibrous and slightly vacuolate in one specimen.

Discussion. By its long compact pillars with scattered vacuoles this species is allied to the genus *Trupetostroma*. In its lack of persistent three-layered laminae and tendency for pillars in tangential section to form a network rather than retain circular individuality, it resembles *Stromatopora*. Although the species is not a typical *Trupetostroma,* it can be placed in no other genus at present.

It is similar to *T. cervimontanum* Stearn in the relationship of dissepiments to laminae but has much higher mamelon columns. It may be distinguished from *T. lecomptei* Stearn by the well-defined laminae of this latter species. Distinguishing features of *T. kakisaense* are the high mamelon columns with upwardly radiating pillars, the paucity of laminae, and persistent pillars.

Occurrence. Holotype, GSC No. 18691, is from GSC locality 30498 in the Kakisa Formation; other specimens from localities 29240 and 29256.

Genus *Pseudoactinodictyon* Flügel, 1958

Type species: *Pseudoactinodictyon juxi* Flügel, 1958.

Coenosteum composed of dissepiments, pillars, and laminae. Dissepiments large, abundant throughout the coenosteum, the most conspicuous horizontal struc-

ture. Pillars both short and long, either round, vermicular, or joining in a network in tangential section. Laminae a single layer, widely spaced, variably developed. Tissue compact.

Flügel established the genus to receive the type species and *Actinodictyon vagans* Parks. Galloway and St. Jean (1957) believe the tissue of this latter species to be maculate and on this basis placed the genus with the family Stromatoporidae although noting its resemblance to *Anostylostroma*. Flügel described the tissue as "gefleckt". The writer has examined Flügel's types of *P. juxi* at the Senckenberg Museum and Parks' type of *P. vagans* at the Royal Ontario Museum. The tissue of these specimens is compact rather than cellular or melanospheric (maculate). The genus is more closely related in this and in gross structure to *Anostylostroma* than to *Stromatopora*.

Pseudoactinodictyon bullulosum n. sp.

Plate XXI, figures 1-3; Plate XXII, figure 4; Plate XXVI, figure 1

The species is represented by three coenostea from the Mikkwa Formation. The holotype is a bun-shaped coenosteum 5 cm thick and 9 cm across. The other specimens are gently curved fragments of smaller size. The surface was apparently smooth.

Vertical sections show prominent long pillars penetrating a mass of small dissepiments with rare persistent laminae. The pillars are irregularly distributed and may be discontinuous. They are composed of light brown compact tissue that may appear to be blotchy in some sections but although the structure is beautifully preserved they do not show cellules or melanospheres. Pillars are the dominant part of structure in which the horizontal elements are almost totally suppressed. The pillars branch and fuse with their neighbours locally. They show a considerable range in thickness (110 to 250 microns, average 150 microns) and spacing (2 to 3.5 per millimetre, average 3). Dissepiments are the dominant horizontal structure. They are closely spaced (6 to 8 per millimetre) and gently convex. The vertically elongate galleries between the pillars resemble pseudozooidal tubes. Laminae are rare in most specimens and are discontinuous and broken into segments. They are composed of the same brown tissue as the pillars and are about 70 microns thick.

Astrorhizal canals are scattered in the structure but are uncommon. No mamelon columns are present.

Tangential sections show an irregular network of fibres with no sign of laminae. The fibres are about 100 microns thick. The tissue is locally granular with irregular spots yet in other places it appears to be compact. A few dissepiments are present. A few astrorhizal canals with tabulae cross some sections. Galleries are labyrinthine.

Discussion. *P. bullulosum* is characterized by abundance of dissepiments, long compact pillars, and rare laminae. It differs from *P. juxi* Flügel in the lack of regular laminae, and in this respect more closely resembles *P. vagans* Parks.

Locally Parks' species shows areas in which laminae are almost entirely missing (for example, *see* his Pl. 18, fig. 3, 1936, but laminae are present in parts of this section). Some sections of *P. bullulosum* show several laminae composed of a line of dark granules but such horizontal structures are sporadic in occurrence in most sections. The pillars of *P. bullulosum* are much longer than those of either *P. norrisi* Stearn or *P. athabaskense* Stearn. Apart from the compact microstructure of the tissue the species shows some resemblance to *Stromatopora mikkwaensis* n. sp. but can be distinguished from it also by the coarser nature of the latter's structure.

The specific name refers to the abundance of dissepiments (*bullula*—Latin for little bubble).

Occurrence. In the Mikkwa Formation (lower member) at GSC localities 46310 and 46320. Holotype, GSC No. 18695, from locality 46310.

Genus *Stromatopora* Goldfuss, 1826

Type species: *Stromatopora concentrica* Goldfuss, 1826.

Coenosteum consists of amalgamate tissue that forms a continuous network in which neither laminae nor pillars are defined in either vertical or tangential section. The structural elements are thick and commonly restrict the galleries to less than half of the space in the coenosteum. Vertical parts of the amalgamate tissue predominate over horizontal ones and the high galleries between them are crossed by dissepiments making pseudozooidal tubes. The tissue is cellular, that is filled with small subspherical vacuities.

Those species with laminae and poorly developed pseudozooidal tubes are here referred to *Ferestromatopora.*

Stromatopora cygnea Stearn

Plate XVIII, figures 5, 6

Stearn, 1963, p. 665, Pl. 87, figs. 8, 9; Pl. 88, fig. 1.

This species is represented in six specimens in the collections. Nearly all are associated with algal layers or layers of other stromatoporoids and some enclose layers of sediment. The growth is usually latilaminate and the surface, which is not exposed in any of the samples, was apparently smooth.

Vertical sections show a very coarse and irregular amalgamate structure of flocculent and melanospheric tissue pierced by round galleries. About 60 per cent of vertical sections is composed of tissue. The rounded galleries tend to be wider than high, and the horizontal elements of the structure are therefore more prominent than the vertical ones. In many places laminae are absent, but locally in most specimens well-defined laminae with an axial light zone appear. No pseudozooidal tubes are present and the pillars, where they can be distinguished in

the amalgamate structure, are confined to an interlaminar space. Dissepiments are not an important part of the structure but may be scattered throughout.

Tangential sections are as variable as vertical ones. Typically they show a coarse network of amalgamate tissue in which individual pillars cannot be distinguished. The coarseness of the network is variable within a single section, and the form of the galleries ranges from circular to labyrinthine. Where laminae and pillars are distinct in the structure, the pillars are cut as individual dots. Astrorhizal canals may be prominent or obscure.

Discussion. The species is highly variable in structure. Within the same coenosteum some parts of the structure recall vertical sections of *Stromatoporella* in showing laminae with an axial light zone. However, tangential sections do not show the ring pillars characteristic of this genus and more closely resemble tangential sections of *Stromatopora.* The microstructure of the species is not clear but appears to be melanospheric in most parts. Although the species resembles *Stromatoporella* and *Clathrocoilona* in those rare parts of the coenosteum that show an axial light zone in laminae, the dominance of amalgamate tissue indicates its closer relationship to *Stromatopora* or *Ferestromatopora.*

Occurrence. This species is widespread in the Devonian of western Canada and has a wide stratigraphic range. From the Kakisa Formation, the Escarpment Member of the Hay River Formation, and the Mikkwa Formation at GSC localities 30657, 31262, 46296, 46297, 46301, and 46320.

Stromatopora mikkwaensis n. sp.

Plate XIX, figure 5; Plate XX, figures 1-4

Eight specimens are known from the Mikkwa Formation near the entry of Mikkwa River. The largest is about 10 cm across and has overgrown a specimen of *Stromatopora cygnea.* Another smaller specimen is overgrown by *Atelodictyon stelliferum.* All have smooth upper surfaces, and broken vertical faces have a dense, even texture with no trace of lamination.

Vertical sections show a delicate amalgamate structure in which vertical elements predominate and persistent horizontal elements are absent. Vertical sections are occupied by about 50 per cent tissue. The vertical elements or pillars are irregular, join with or branch from their neighbours, and are united by short lateral processes of the same material. Locally, but not commonly, these occur at the same level and then form a vague lamina or horizontal fibre. The pillars are 60 to 80 microns thick and are spaced three to four in 1 mm. Locally they are of melanospheric or cellular structure but in other places they appear to be compact. Locally the tissue has a vertically striate appearance.

Dissepiments are common, short, highly convex upward forming pseudozooidal tubes between the pillars. The convex dissepiments with the vertical parts of the amalgamate network resemble an irregularly distributed series of arched windows

on the wall of a building. Astrorhizal canals are common and represented by round holes in the structure.

Tangential sections show a fine network of tissue that contains many cellules and melanospheres. Galleries are round and about 150 microns across. Astrorhizal canals are common but do not obviously radiate from centres.

Discussion. This species is similar in some respects to *Ferestromatopora contexta* Stearn but differs in the prominence of vertical structures, the possession of pseudozooidal tubes, and the suppression of laminae. The whole structure is more open than that of most species of *Stromatopora* and resembles that of some species of *Parallelopora* except that the characteristic microstructure of this genus is not present. As laminae are missing, the specimen cannot be interpreted as a *Trupetostroma*. From described species of *Stromatopora,* these specimens differ in the openness of the structure and the fineness of the pillars. Their closest relative is *Stromatopora longitubulata* Riabinin, but their structure is more delicate and their pseudozooidal tubes not so persistent. The new species shows a gross structure similar to that of *Parallelopora bucheliensis* (Bargatzky) and *P. cambelli* Galloway and St. Jean but its pillars are only about half as thick as those of these species.

Occurrence. From the Mikkwa Formation (lower member) at localities 29256, 46296, 46297, 46301, 46319. Holotype, GSC No. 18693, from locality 46297.

Stromatopora cf. *S. mononensis* Galloway and St. Jean

Plate XXII, figures 1-3

Stromatopora mononensis Galloway and St. Jean, 1957, pp. 178-79, Pl. 15, fig. 1.

This species is represented by three specimens, one from the Twin Falls Formation and two from the Mikkwa Formation. The largest coenosteum is about 12 cm in diameter and globular. Latilamination at various intervals is prominent. The surface rises into low mamelons at intervals of about 2 cm.

Vertical sections show a latilaminate structure of dense tissue cut by closely set, fine laminae. The latilaminae are from 2 to 10 mm thick; the top of each is darker and shows algal structure indicating that periodically, perhaps seasonally, the coenosteum was overgrown by algae. Light brown, finely melanospheric tissue occupies about 80 per cent of vertical sections. It is cut by narrow, horizontal clear zones that divide it into closely spaced laminae (about ten in 1 mm). The laminae are about as thick as the interspaces (i.e., about 50 microns). They are generally of low curvature, but may rise into low, broad domes with sharp downflexures between them, reminiscent of the lamination of some stromatolites. Galleries in the structure are not common, but where vertically aligned they form pseudozooidal tubes about 90 microns across. Other ascending tubes of greater diameter (200 microns) are common and apparently astrorhizal, as they are

crossed by upwardly convex tabulae. Horizontal astrorhizal canals cut at various angles are also common. Dissepiments, other than the curved plates in the tubes, are uncommon.

Tangential sections show a highly irregular network. Latilaminae are defined by dark bands of irregular granular tissue with streaky structure, which is probably of algal nature. The network is formed of light brown melanospheric or cellular fibres, 70 to 100 microns thick. Astrorhizal canals branch throughout tangential sections.

Discussion. The specimens here described resemble *Stromatopora mononensis* Galloway and St. Jean from the Middle Devonian of Indiana in their fine, very closely set laminae, the poor development of their pillars and pseudozooidal tubes, and in their latilaminae. They differ from the Indiana specimens in that their pseudozooidal tubes are not so well developed and therefore the vertical elements or pillars in the structure are less defined, and in that in tangential section the tissue forms a continuous network and no isolated pillars are cut. The specimens from Canada are so close to those described by Galloway and St. Jean as *S. mononensis* that they are provisionally assigned to that species.

Occurrence. In the Twin Falls Formation at GSC locality 30680, and in the Mikkwa Formation (lower member) at GSC localities 46296 and 46298.

Genus *Ferestromatopora* Yavorsky, 1955

Type species: *Ferestromatopora krupennikovi* Yavorsky, 1955.

Coenosteum composed of an irregular network of amalgamate cellular tissue in which horizontal elements are prominent but rarely continuously developed and in which galleries are irregular, oblique, but rarely vertically elongate as in *Stromatopora*. Pseudozooidal tubes missing.

Ferestromatopora contexta Stearn

Plate XXII, figures 5-7; Plate XXVI, figure 5

Stearn, 1963, p. 666, Pl. 88, figs. 3-5.

Four specimens of this species are all from the Mikkwa Formation. The specimens are irregular fragments of hemispherical coenostea that were up to 8 cm in diameter. The coenostea show little trace of latilamination and the surface seems to have been essentially smooth.

Vertical sections show a fine amalgamate network of structural elements in which neither pillars nor laminae can be distinguished. The fibres that make up this woven structure are about 50 microns wide and most are oblique. Rarely a continuous lamina can be traced across a section but in most places the pre-

dominately horizontal aspect of vertical sections is caused by variation in the density of the network in successive zones. About 50 per cent of sections are occupied by tissue. Galleries are highly irregular. Astrorhizal canals are common and are concentrated in vertical sets that form a break in the amalgamate structure but are not marked by an upturning of the horizontal elements in the structure. Dissepiments may be common locally or missing. The microstructure of the tissue appears to be compact in most parts but locally its melanospheric character is marked.

Tangential sections show a fine network in which astrorhizal canals are common. Some of the fibres are cut as irregular dots and vermicular bars but most are joined in tangential section into a network.

This species is more fully described in the reference cited above.

Discussion. Ferestromatopora contexta can be distinguished by its fine, consistently irregular, dominantly horizontal structure. However, it is similar to another stromatoporoid also from the Mikkwa Formation, *Stromatopora mikkwaensis*. These two species share a delicacy of the fibre, parts of *S. mikkwaensis* coenostea where the vertical elements that normally dominate its structure are poorly developed may closely resemble *F. contexta*. The basic similarity of the two species suggests that the absence of vertical structures in *F. contexta* may be only apparent and produced by the obliquity of vertical sections. However, special care was taken in preparing repeated sections from the holotype of *F. contexta* and in none of these were vertical structures like those of *S. mikkwaensis* seen.

Occurrence. From the Mikkwa Formation at GSC localities 29150, 29260, 29269, and 46320. Holotype, GSC No. 16856, from the first of these localities.

Ferestromatopora parksi n. sp.

Plate XXIII, figures 1-6; Plate XXIV, figure 1; Plate XXVI, figure 7

Ferestromatopora jacquensis Galloway (misprint for *F. jacquesensis*), Stearn, 1961, p. 943, Pl. 107, figs. 4, 5.
Ferestromatopora sp., Stearn, 1963, pp. 666-67, Pl. 88, fig. 6.

This species is represented by six specimens from different localities. The coenostea are hemispherical and may be up to 10 cm in diameter. One is intergrown with *Hammatostroma albertense*. The surface was apparently smooth.

Vertical sections show a fine irregular network of amalgamate tissue in which short pillars and definite laminae emerge locally. In much of vertical sections neither pillars nor laminae can be distinguished, and the structure is composed of a fine, open, irregular mesh of tissue. Large holes add to the irregular appearance of this part of the structure and probably represent astrorhizal canals. The fibres are 100 to 150 microns thick and may appear to be finely granular or compact.

Locally the structure becomes more regular. Thin (40 to 50 microns), regularly spaced (five to six in 1 mm), gently curved and laterally impersistent

laminae can be distinguished. In general, they seem to be single layers of tissue, but locally an axial line may appear. Pillars are confined to an interlaminar space and are irregular, branched, and inclined, incomplete and locally spool-shaped. They are about as thick as the laminae and spaced about five in 1 mm. Dissepiments are not common but are scattered in the structure. The microstructure of the tissue is generally compact with isolated areas of melanospheric or cellular tissue.

Tangential sections show an irregular network of fibres. No discrete pillars are visible. The fibres are locally melanospheric. The galleries are highly irregular, rounded, or labyrinthine. Large branching astrorhizal canals up to 0.5 mm across are scattered throughout or radiate from centres.

Discussion. Although the specimens are finer in fibre and somewhat closer in mesh than those described as *F. jacquensis* (sic) from the Cairn and Flume Formations (Stearn, 1961), they are believed to be conspecific. Neither group of specimens seems now to be conspecific with *F. jacquesensis* described by Galloway from the Middle Devonian of the Lower Mackenzie Valley. Through the kindness of Joseph St. Jean Jr., I have been able to examine one of the slides on which Galloway based his species (slide 307-82 in the collection at the University of North Carolina) and to verify that it is different from the specimens described here. The coarser nature of the fibres of *F. jacquesensis,* its lack of prominent astrorhizal canals, and greater regularity of its structure separate it from *F. parksi.* The new species differs from *F. contexta* in its greater irregularity of structure, its sporadic development of pillars and laminae, and its more prominent astrorhizal canals. *Ferestromatopora parksi* resembles *Ferestromatopora* sp. described by Stearn (1963) from the Swan Hills area, Alberta, but in the latter the laminae do not appear although parts of the structure are identical. The material from Swan Hills is so limited that a definite determination is not possible.

Occurrence. From the Mikkwa and Twin Falls Formations at GSC localities 29148 (east bank Athabasca R., 6 mi NW Waterways Wharf), 30467, 30525, 46296, 46297, 46308. Holotype, GSC No. 15323, illustrated by Stearn (1961); another section illustrated here (Pl. XXIV, fig. 1).

Genus *Hermatostroma* Nicholson, 1886

Type species: *Hermatostroma schlüteri* Nicholson, 1886.

Coenosteum composed of distinct pillars and laminae forming a grid in vertical section. The laminae have a continuous axial microlamina and a lighter discontinuous coating of tissue spreading from the pillars. Pillars spool-shaped, interrupted by the laminae but accurately superposed. Both pillars and laminae are covered with peripheral membranes or by a series of marginal vesicles or vacuoles along the edges of the galleries.

Hermatostroma maillieuxi (Lecompte)

Plate XXIV, figures 3, 4

Trupetostroma maillieuxi Lecompte, 1952, pp. 237-239, Pl. 43, figs. 2, 3; Galloway, 1960, p. 626, Pl. 73, figs. 3a, b.

This species is represented by a single specimen from the Kakisa Formation. The coenosteum is a laminar fragment about 3 cm thick and 6 cm square. The surface is not exposed.

Vertical sections show a coarse grid of vertical pillars and thick discontinuous laminae. The laminae are undulant, generally discontinuous, but some may be traced for considerable distances across sections. They are bent up at wide intervals into slight inflections where the tissue is irregular. The laminae are compact and do not show any internal structure. They are 100 to 150 microns thick. Foramina in the laminae are abundant.

The pillars are the most prominent element of the structure. They are long, and in places where dissepiments are the principal horizontal structures they are continuous over several interlaminar intervals. In other places where the laminae are well developed they seem to be superposed and are not continuous through the laminae. Their central part is compact and may have a few vacuoles or melanospheres. The central part is bordered by a line of small cysts enclosing a clear space about 40 microns wide. This line of cysts is not equally developed on all pillars but occurs here and there in the coenosteum. The pillars are spaced 2.5 to 3.5 per millimetre and are 100 to 200 microns thick. In places the structure becomes amalgamate.

Astrorhizal canals are common and appear in vertical section as slightly larger than normal galleries. Mamelon columns are absent or poorly developed. Dissepiments are abundant and locally replace the laminae as the dominant horizontal structure. In these parts the gross structure is not unlike that of *Stromatopora* with pseudozooidal tubes cut by dissepiments.

Tangential sections show pillars cut as dots or irregular bars and the laminae as sheets of granular tissue pierced by round foramina. The cross-sections of the pillars may be dot-like, they may be joined to their neighbours to form bars of irregular shape, or locally they may merge into an irregular network. They are composed of honey-brown tissue in which are suspended a few darker granules. The pillars are surrounded by a circle of small cysts. The astrorhizal system of canals is well developed and radiates from domes in the laminae.

Discussion. Lecompte (1952) discusses the transition from *Trupetostroma* to *Hermatostroma* and notes that this species is among the transitional forms. To the writer, the well-developed marginal cysts in this species, and also on similar species such as *T. porosum* Lecompte, make its reference to *Trupetostroma* inappropriate. Certainly the large vacuoles in the genotype, *T. warreni* Parks, are not analogous to the marginal cysts of *T. maillieuxi* Lecompte or to those of species

of *Hermatostroma*. The specimen from the Kakisa Formation seems to have the same characteristics as those described by Lecompte and Galloway.

Occurrence. From the Kakisa Formation at GSC locality 30683.

Genus *Parallelopora* Bargatzky, 1881

Type species: *Parallelopora ostiolata* Bargatzky, 1881.

Coenosteum composed of amalgamate tissue in which the vertical elements or pillars are long and continuous. Microlaminae and dissepiments may be present. Tissue coarsely cellular with a tendency for the cellules to be arranged in vertical series and to approach the thickness of the pillars in diameter, reducing the pillars to a network of strands, rods, and subspherical bodies of dark tissue.

Parallelopora cf. *P. dartingtonensis* (Carter)

Plate XXIV, figure 5; Plate XXV, figure 4

Stromatopora elegans Carter, 1879, p. 263 (not *S. elegans* Rosen).
Stromatopora dartingtonensis Carter, 1880, p. 346, Pl. 18, figs. 1-5.
Parallelopora dartingtonensis (Carter), Nicholson, 1891, pp. 199-202, Pl. IV, fig. 1; Pl. XXIV, figs. 13-15; Pl. XXV, figs. 1-3.

This species is represented by a single coenosteum which is irregular in form and about 6 cm in diameter. The surface is not well exposed, but seems to have risen into prominent mamelons spaced at intervals of about 1 cm. The growth is not markedly latilaminate.

Vertical sections show a neat grid of continuous laminae and through-going pillars. The laminae are thin, delicate, and persistent. They are deeply inflected into mamelon columns and in no parts of sections are they 'horizontal'. Laminae are composed of a fine line of granules about 30 to 40 microns thick, forming a single layer. They are pierced by many foramina. They are spaced four in 1 mm but range from 3.5 to 4.5. Pillars are also thin (from 40 to 90 microns), and are spool-shaped between the laminae. Many are confined to a single interlaminar space, but a considerable number are superposed or continuous through several interlaminar spaces. They are spaced about three in 1 mm. The pillars are composed of tissue marked by melanospheres about 20 microns across, which locally are joined in vertical lines.

Astrorhizal canals with large tabulae are scattered through the structure. Most of the galleries are subrounded and many are superposed. Dissepiments are common, scattered irregularly in the structure and covering foramina in the laminae. Mamelon columns conspicuous.

Tangential sections are marked by radiating pillars and concentric laminae around conspicuous mamelon centres. The laminae are porous and composed of masses of melanospheres. These are joined to their neighbours to form a crude

network which is clothed in light brown tissue. The pillars emerge as round dots in the restricted areas between the mamelon columns and join with each other to form irregular bars and vermiform shapes. The pillars are composed of many small melanospheres set in light brown clothing tissue. Astrorhizae are associated with the mamelon centres but are not conspicuous.

Discussion. *P. dartingtonensis* does not closely resemble the type species *P. ostiolata*. The microstructure characteristic of the genus is not well shown either by the specimens described here or by Nicholson's specimens from South Devon. Carter's types have not been located, but the specimens described by Nicholson, which are topotypes from the Pit Park Quarry, Dartington, were examined for comparison. The microstructure of these specimens, like that of most specimens from Devon, is obscured by recrystallization and now is blotchy or cloudy with some concentrations of darker matter. Specimens from Teignmouth that Nicholson assigned to this species are not conspecific with the topotypes. *P. dartingtonensis* should be removed from the genus *Parallelopora*, but, as long as its microstructure remains obscure, it cannot reliably be placed in another genus. The laminar spacing of the specimen from Alberta is about the same as the topotypes but the pillars are not so closely set.

Occurrence. From the Mikkwa Formation (lower member) at GSC locality 29265.

Genus *Syringostroma* Nicholson, 1875

Type species: *Syringostroma densum* Nicholson, 1875.

Coenosteum composed of amalgamate, cellular tissue in which pillars and laminae are distinct. Thick laminae marked by thin light or dark microlaminae. Some pillars short, others long, thick, cylindrical and pass through many laminae.

Syringostroma? confertum (Stearn)

Plate XXV, figures 1, 2

Taleastroma? confertum Stearn, 1962, pp. 10-11, Pl. 5, figs. 1-3.

This species is represented by two specimens from the Mikkwa Formation and one from the Hay River Formation. One is a thin lamina about 2.5 mm thick between layers of *Alveolites* and *Stromatoporella* sp. Another is a dense bulbous hemisphere 6 cm high showing conspicuous latilamination at about 5 mm intervals.

Vertical sections in the hemispherical specimen show a very dense structure occupied about 90 per cent by tissue. The pillars are nearly everywhere contiguous and galleries are missing. Each pillar consists of a spray-like series of bundles of calcite fibres that bend outward to merge with the fibres of adjacent pillars. Although the axes of pillars are distinguishable, their borders are difficult to place.

About five pillars occur in 1 mm, and they are about 200 microns thick. The structure also has a vague lamination at right angles to the pillars but discrete laminae were not seen and the spacing of the laminar structure cannot be measured.

Scattered in the coenostea are round holes about 200 microns across, which are astrorhizal canals. Around them the fibrous calcite is coarser and the water-jet structure may be marked. Here it seems to be related to recrystallization outward from an opening.

Tangential sections show a blotchy tissue that occupies almost the whole area of the sections. Where preservation is good the fine radially fibrous structure of the pillars may be evident. Astrorhizal canals are widely scattered, crossed by plane tabulae, radiating from centres, branching, with transversely fibrous walls.

The laminar coenosteum is considerably more open than that described above and is only 80 per cent occupied by tissue. Galleries and thin laminae are locally present between the pillars.

Discussion. This species is widespread in the Upper Devonian rocks of Alberta. Its affinities are still in doubt but now seem to be closer to *Syringostroma* than to *Taleastroma*. The spray pattern of the pillar fibres may represent the spray pattern of aligned maculae described by Galloway (1957) for *Syringostroma*. One of the specimens shows better astrorhizal canals than specimens described formerly and dispels doubts that this species is a stromatoporoid.

Occurrence. At GSC locality 46296 in the lower member of the Mikkwa Formation, at localities 29243 in the upper member of the same formation, and from 31264 in the Escarpment Member of the Hay River Formation.

Genus *Amphipora* Schulz, 1883

Type species: *Caunopora ramosa* Phillips, 1841.

Coenosteum columnar, rarely branching, with or without an axial canal, consisting of an amalgamate network of compact tissue, which commonly is fibrous. Laminae cannot be distinguished and pillars diverging outward and upward from the axis are obscure and irregular. Some coenostea have marginal cysts of the same tissue.

Amphipora ramosa (Phillips)

Plate XXIV, figure 2

Caunopora ramosa Phillips, 1841, p. 19, Pl. 8, fig. 22.

Specimens of this species are uncommon in the collections examined and have been found at only four localities.

The specimens show all the features of this much described species including its axial canal, amalgamate zone of tissue surrounding it, and variable marginal

vesicles. The average diameter of eight specimens measured is 2.0 mm, and the average diameter of their axial canals is 0.4 mm.

Occurrence. At GSC localities 30440 (Escarpment Member, Hay River Formation), 46301, 46308, 46319 (lower member, Mikkwa Formation).

Genus *Euryamphipora* Klovan, 1966

Type species: *Euryamphipora platyformis* Klovan, 1966.

"Thin, plate-like stromatoporoids in which neither laminae nor pillars are a dominant element, and in which the tissue is transversely fibrous and porous. Large marginal vesicles are present along the top and bottom of the coenosteum formed as a result of overturning or branching of the initial and terminal pillars." (Klovan, this report, p. 14.)

Euryamphipora? sp.

Plate XXIV, figures 6, 7; Plate XXV, figure 3

This species is represented by a single sample containing several specimens from the Escarpment Member of the Hay River Formation. The specimen consists of several plate-like masses about 2 mm thick embedded in fossiliferous bioclastic limestone.

Vertical sections. The plates are composed of irregular porous fibres that form an amalgamate network with irregularly shaped galleries. The fibres appear to be granular and to have minute tubes (10 to 20 microns) branching in every direction throughout. No pillars or laminae can be distinguished. The round shape of some of the galleries in vertical sections suggests that they are astrorhizal canals. At the top of the coenosteum one or two thin (about 25 microns) laminae occur with irregularly distributed pillars of about the same width that seem to swell and branch upward. In two of the specimens a clear space filled with crystalline calcite overlies the regular laminae and may represent a zone of marginal vesicles.

Tangential sections. The tissue shows a variety of patterns in tangential sections. Small dots about 150 microns across may appear and locally they may be joined into irregular vermiform bars. In other places the tangential section seems to cut a horizontal structure, and a very thick network of tissue pierced by round foramina is shown. Astrorhizal canals crossed by tabulae traverse the structure radiating from centres. The tissue is blotchy and penetrated by minute canals, which locally seem to surround blebs of tissue that are more densely pigmented. These circular blebs are about 80 microns across.

Discussion. The genus *Euryamphipora* has been established in another part of this bulletin for plate-like stromatoporoids with the internal structure of *Amphipora.* The specimens described here differ from *Euryamphipora platyformis* Klovan in the nature of the tissue which is not transversely fibrous but seems to be porous, the

absence of well-developed marginal vesicles, the well-developed astrorhizal canals, and the presence of a thin, regular lamina or laminae at the top of coenostea. Until further material is available the specimens are provisionally referred to Klovan's genus.

Occurrence. From the Escarpment Member, Hay River Formation, at GSC locality 30440.

FOSSIL LOCALITIES

Vermilion Chutes Area, Peace River

Collections by A. W. Norris, 1956. (*See* Norris, 1963, pp. 132-136)

GSC Locality	*Stratigraphic Unit*	*Location*
29150	'Lower Limestone' Member of Mikkwa Formation	Station 45NB, 17.7-22 feet above river level.
29240	'Lower Limestone' Member of Mikkwa Formation	Station 45NBa, 6 feet above river level.
29243	'Upper Mottled Limestone' Member of Mikkwa Formation	Station 28NB, from resistant falls-forming unit about 12 feet thick.
29256	'Lower Limestone' Member of Mikkwa Formation	Station 44NB, 0-3.5 feet above river level.
29260	'Lower Limestone' Member of Mikkwa Formation	Station 45NBa, 7.5 feet above river level.
29265	'Lower Limestone' Member of Mikkwa Formation	Station 45NBb, 6.5 feet above river level.
29269	'Lower Limestone' Member of Mikkwa Formation	Station 49NB, 8.7 feet above river level.
29274	'Lower Limestone' Member of Mikkwa Formation	Station 45NB, from about 8 feet above river level.

South of Mackenzie River Between Hay and Liard Rivers

Unless otherwise stated, collections were made by D. J. McLaren, 1957. (*See* Douglas, 1959; Belyea and McLaren, 1962)

GSC Locality	
30393	Twin Falls Formation; 9 miles south of crossing of Mackenzie Highway over creek that drains Heart Lake, and 13 miles west of Escarpment Lake.
30399	Escarpment Member, Hay River Formation; scarp 4 miles northwest of Desmarais Lake.
30428	Escarpment Member, Hay River Formation, 50 feet below top; Hay River left bank at Twin Falls Creek.
30438	90 feet below loc. 30428.

30440 Biostrome in Escarpment Member, Hay River Formation; this unit forms the Louise Falls; Hay River left bank at Twin Falls Creek.

30467 Twin Falls Formation, 40 feet below long covered interval; 1 mile upstream from second island above Alexandra Falls, Hay River.

30477 Same as loc. 30467, 30 feet below covered interval.

30498 Reef in Kakisa Formation; Blackstone River, 13 miles upstream.

30510 Upper member of Twin Falls Formation, 50 feet above base; 3 miles southwest of Alexandra Falls, between road and river.

30513 Heart Lake Reef; Mackenzie Highway 12 miles northwest of junction with Hay River Highway.

30514 Heart Lake Reef; Porcupine Falls on Beaver Creek.

30525 Upper Member, Twin Falls Formation, 45 feet below covered interval; 1 mile upstream from second island above Alexandra Falls, Hay River.

30535 Upper Member, Twin Falls Formation, highest bed below long covered interval; 1¾ miles above second island above Alexandra Falls, Hay River.

30541 Kakisa Formation; Middle Kakisa River, above main rapids.

30547 Lower part of Twin Falls Formation?; Lower Kakisa River, 1 mile upstream from road bridge.

30570 Kakisa Formation; pavement 5½ miles northeast of Rabbit Lake.

30657 Kakisa Formation, top beds; south shore of Deep Lake, ½ mile west of stream entrance.

30659 Kakisa Formation; east arm, south shore of Deep Lake.

30674 Kakisa Formation; Trout River, above second falls. D. J. McLaren, 1957.

30679 Kakisa Formation, 10-20 feet below top, "tufa beds" (immediately below Whittaker's "submarine unconformity"); Coral Falls, Trout River.

30680 Twin Falls Formation, isolated outcrop; 10 miles west-northwest of Kakisa road crossing.

30683 Kakisa Formation, top beds; above Coral Falls, Trout River.

30701 Kakisa Formation; south side of Deep Lake, east arm.

30728 Kakisa Formation; at main falls on Middle Kakisa River.

30733 Kakisa Formation; Middle Kakisa River, below mouth of Gull Creek. D. J. McLaren, 1957.

30736 Reef in Kakisa Formation; below falls on Middle Kakisa River.

30747 Kakisa Formation; Upper rapids, Middle Kakisa River.

31262 Escarpment Member of Hay River Formation, talus; Hay River near junction of Mackenzie and Hay River Highways. P. Harker, 1957.

31264 Middle part of Escarpment Member, Hay River Formation, the lowest horizon with stromatoporoids on Hay River; Hay River near junction of Mackenzie and Hay River Highways. P. Harker, 1957.

31332 Alexandra Member of Twin Falls Formation, lowest beds; Hay River, left bank, just below Alexandra Falls. P. Harker, 1957.

31532 Kakisa Formation; pavement, north of Foetus Lake. D. F. Stott, 1957.

33550 Kakisa Formation, 8 feet below top; north side of small lake, 6 miles southeast of Two Islands Lake. D. K. Norris, 1957.

Near Mouth of Mikkwa River, Northern Alberta

Collections by A. W. Norris, 1961. (*See* Norris, 1963, for location of station numbers)

GSC Locality	*Stratigraphic Unit*	*Location*
46296	'Lower Limestone' Member of Mikkwa Formation	South end of station 48NB, 9.8-11.1 feet above river level.
46297	'Lower Limestone' Member of Mikkwa Formation	East end of outcrop of station 49NB, 1.5-10 feet above river level.
46298	'Lower Limestone' Member of Mikkwa Formation	East end of outcrop of station 49NB, 10-11.4 feet above river level.
46301	'Lower Limestone' Member of Mikkwa Formation	West end of station 46NB, 9.6-13.9 feet above river level.
46304	'Lower Limestone' Member of Mikkwa Formation	North bank of Mikkwa River 0.25-0.3 mile upstream from upper end of station 49NB, 3.1-11 feet above river level.
46308	'Lower Limestone' Member of Mikkwa Formation	South end of station 48NB, 4.2-5.6 feet above river level.
46310	'Lower Limestone' Member of Mikkwa Formation	South bank of Mikkwa River between 0.1-0.2 mile above upper end of outcrop at station 49NB, between 2-8.2 feet above river level.
46311	'Upper Mottled Limestone' Member of Mikkwa Formation	South bank of Peace River near station 37NB, from near base of massive falls—forming unit about 12 feet thick.
46319	'Lower Limestone' Member of Mikkwa Formation	South bank of Mikkwa River, between 0.4-0.5 mile above upper end of outcrop at station 49NB, 3-8.5 feet above river level.
46320	'Lower Limestone' Member of Mikkwa Formation	Station 45bNB, 2.4-12.4 feet above lower river level.

REFERENCES

Belyea, Helen R., and McLaren, D. J.
1962: Upper Devonian formations, southern part of Northwest Territories, northeastern British Columbia, and northwestern Alberta; *Geol. Surv. Can.*, Paper 61-29.

Carter, H. J.
1879: On the structure of Stromatopora; *Ann. Mag. Natural Hist.*, ser. 5, vol. 4, pp. 253-265.

1880: On *Stromatopora dartingtonensis* n. sp. with the tabulation in the larger branches of the astrorhizae; *Ann. Mag. Natural Hist.*, ser. 5, vol. 6, pp. 339-347.

Douglas, R. J. W.
1959: Great Slave and Trout River map-areas, Northwest Territories; *Geol. Surv. Can.*, Paper 58-11.

Flügel, E.
1958: Artenrevision von *Actinostroma* Nicholson (Stromatoporoidea); *Anz. Ak. Wien, math.-naturw. Kl.,* No. 4, pp. 1-5.

1959: Die Gattung *Actinostroma* Nicholson und ihre Arten (Stromatoporoidea); *Ann. Nathist. Mus. Wien,* vol. 63, pp. 90-273.

1962: Der Biostratigraphishe Wert der Stromatoporen im Silur und Devon; 2nd Int. Arbeitstagung Uber Die Silur-Devon Grenze, Bonn-Bruxelles 1960, pp. 80-86.

Galloway, G. G.
1957: Structure and classification of the Stromatoporoidea; *Bull. Am. Paleontology,* vol. 37, No. 164, pp. 341-480.

1960: Devonian stromatoporoids from the Lower Mackenzie Valley of Canada; *J. Paleontology,* vol. 34, pp. 620-636.

Galloway, G. G. and St. Jean, J. Jr.
1957: Middle Devonian Stromatoporoidea of Indiana, Kentucky, and Ohio; *Bull. Am. Paleontology,* vol. 37, No. 162, pp. 24-308.

Klovan, J. E.
1966: Upper Devonian stromatoporoids from the Redwater reef complex, Alberta, Canada; *Geol. Surv. Can.,* Bull. 133, Part I.

Lecompte, M.
1951-1952: Les stromatoporoides du Devonien moyen et superieur du Bassin de Dinant; *Inst. Roy. Sci. Nat. Belgique,* Mem. 116 (1951), pp. 1-215; Mem. 117 (1952), pp. 216-369.

Nicholson, H. A.
1886, 1889, 1891, 1892: A monograph of the British stromatoporoids; *Paleontographical Soc. London,* vols. 39, 42, 44, 46, pp. 1-234.

Norris, A. W.
1963: Devonian stratigraphy of northeastern Alberta and northwestern Saskatchewan; *Geol. Surv. Can.,* Mem. 313, pp. 1-168.

Parks, W. A.
1936: Devonian stromatoporoids of North America; *Univ. Toronto Studies,* Geol. Ser. No. 39, pp. 1-125.

Phillips, J.
1841: Figures and descriptions of the Palaeozoic fossils of Cornwall, Devon, and West-Somerset; London.

Stearn, C. W.
1961: Devonian stromatoporoids from the Canadian Rocky Mountains; *J. Paleontology,* vol. 35, pp. 932-948.

1962: Stromatoporoid fauna of the Waterways Formation (Devonian) of northeastern Alberta; *Geol. Surv. Can.,* Bull. 92, pp. 1-23.

1963: Some stromatoporoids from the Beaverhill Lake Formation (Devonian) of the Swan Hills area, Alberta; *J. Paleontology,* vol. 37, pp. 651-668.

1965: Maculate microstructure in the Stromatoporoids; *Geol. Soc. Amer.,* Spec. Paper 82, p. 194.

1966: The microstructure of Stromatoporoids; *Palaeontology,* vol. 9, pp. 74-124.

Yavorsky, V. I.
1931: Some Devonian stromatoporoids from the outskirts of the Kuzbetsk Basin and Urals; *Bull. Geol. Prosp. Service U.S.S.R.,* vol. 49, No. 4, pp. 87-93.

1955: Stromatoporoidea Sovetskogo Soyuza, pt. 1, Tr. Vsesoyuz; *Nauchno-issledov. Geol. Inst.,* Minist. Geol. Okhr. Nedr., n. ser., vol. 8, pp. 1-173.

1957: ibid., pt. 2, vol. 18, pp. 1-78.

1961: ibid., pt. 3, vol. 44, pp. 1-64.

1963: ibid., pt. 4, vol. 87, pp. 1-93.

1962: Some results of a study of the stromatoporoids of the U.S.S.R.; *Paleontological J.,* vol. 1, pp. 19-30. (Translations in the files of the Geological Survey, Canada.)

PLATES I TO XXVI

PLATE I

(All figures x 10)

Figure 1. *Anostylostroma laxum* (Nicholson) (Page 6)

a. vertical section; and,

b. tangential section.

Hypotype, GSC No. 19822; Imperial Eastgate #1-22, 4033'.

Figure 2. *Anostylostroma intermedium* n. sp. (Page 6)

a. vertical section showing incipient knotted structure in the interlaminar areas; and,

b. tangential section.

Holotype, GSC #19823; Imperial Egremont #1, 3370'.

Figure 3. *Atelodictyon* cf. *A. stelliferum* Stearn (Page 7)

a. vertical section showing irregular pillars; and,

b. tangential section showing areolate pattern of the pillars.

Hypotype, GSC No. 19824; Saltwater Disposal Well #1, 3237'.

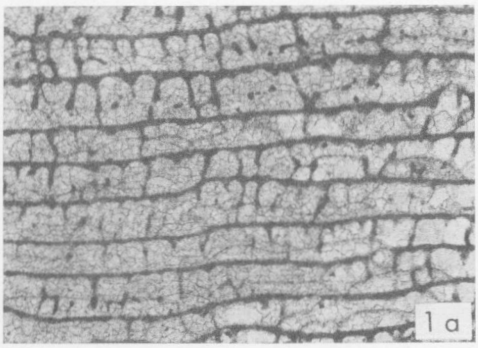
Figure 4. *Stromatoporella* cf. *S. subvesiculosa* (Lecompte) (Page 8)

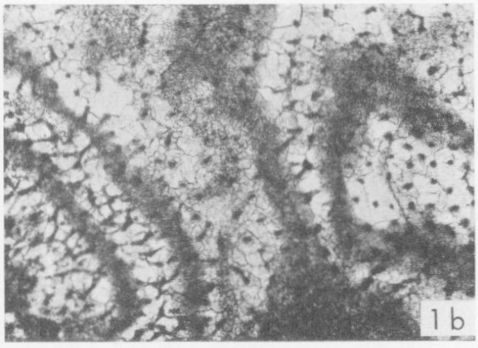
a. vertical section; and,

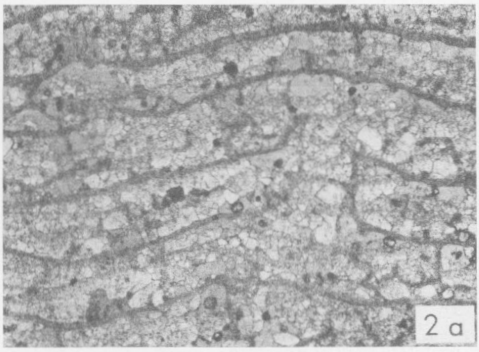
b. slightly oblique tangential section.

Hypotype, GSC No. 19825; Imperial Egremont #60, 3254'.

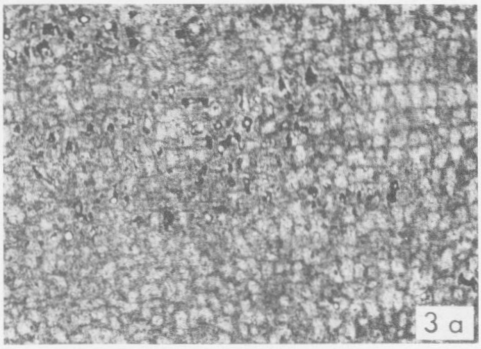
PLATE I

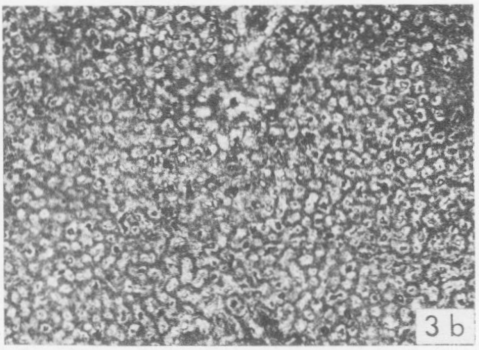

1 a

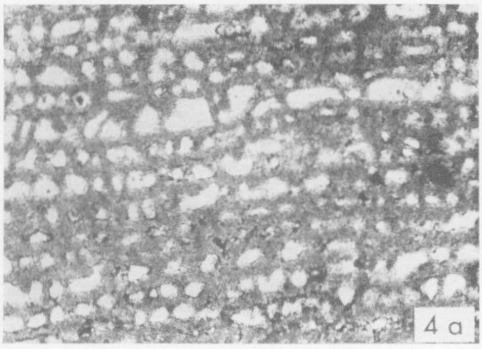

1 b


2 a


2 b


3 a


3 b


4 a

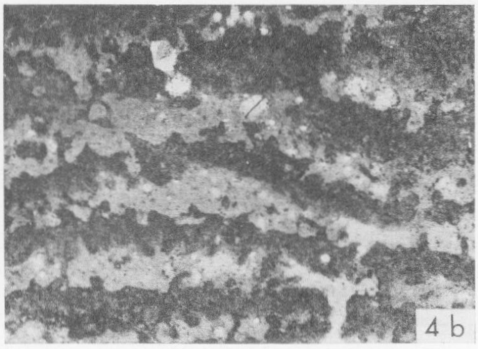

4 b

PLATE II

(All figures x 10)

Figures 1, 2. *Stromatoporella dammoniensis* Nicholson (Page 9)

1a. vertical section; and,

1b. tangential section through two mamelons.
Hypotype, GSC No. 19826; Saltwater Disposal Well #1, 3610′.

2. vertical section showing well-developed fibrous tissue of the laminae.
Hypotype, GSC No. 19827; Imperial Redwater #95, 3310′.

Figures 3, 4. *Stromatoporella* cf. *S. mirabilis* Yavorsky (Page 10)

3. tangential section in an intermamelon area.
Hypotype, GSC No. 19828; Imperial Eastgate #1-22, 4034′.

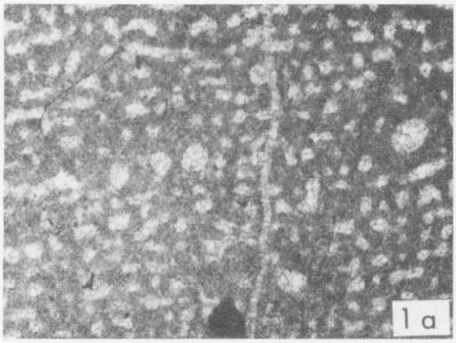
4a. vertical section showing the fine granular medial microlaminae; and,

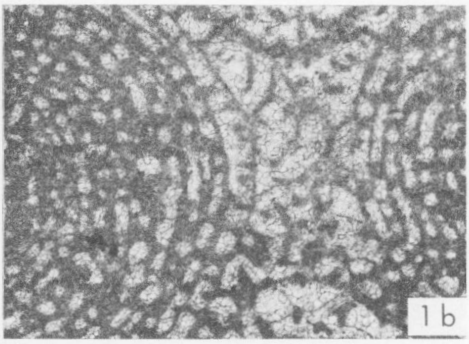
4b. tangential section through a mamelon.
Hypotype, GSC No. 19829; Imperial Eastgate #1-22, 4042′.

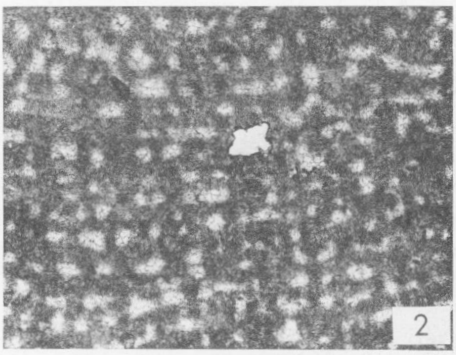
Figure 5. *Hammatostroma* cf. *H. albertense* Stearn (Page 11)

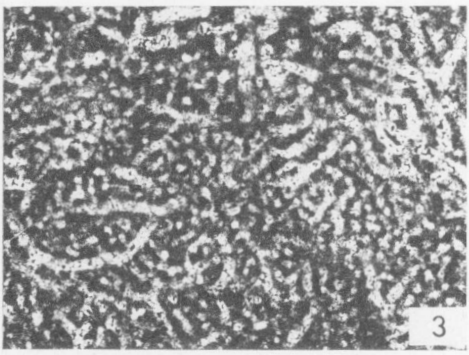
a. vertical section showing the abundant dissepiments and thick irregular laminae; and,

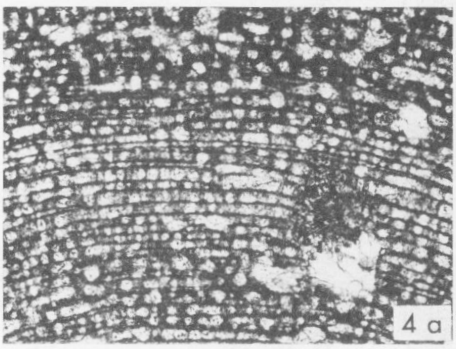
b. tangential section.
Hypotype, GSC No. 19830; Saltwater Disposal Well #1, 3230′.

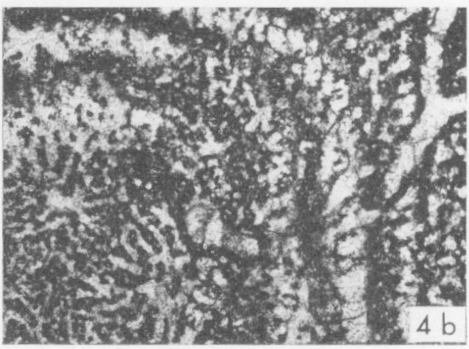

1 a

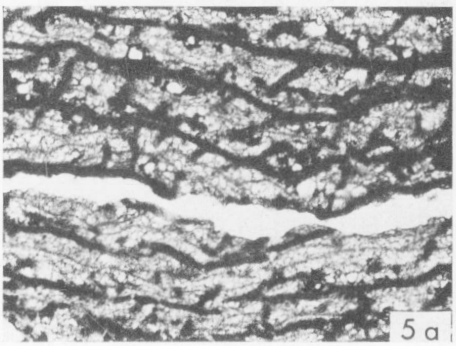

1 b


2


3


4 a


4 b


5 a

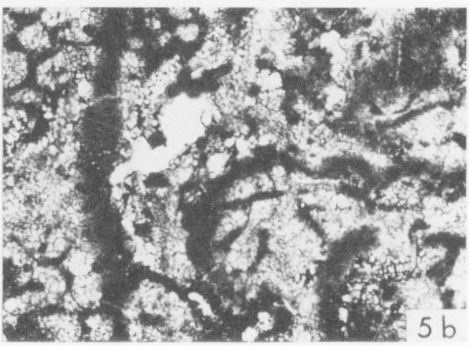

5 b

PLATE III

Figure 1. *Hammatostroma albertense* Stearn (Page 12)

a. vertical section, x10; and,

b. tangential section, x10.

Hypotype, GSC No. 19831; Saltwater Disposal Well #4, 3892′.

Figure 2. *Hammatostroma delicatulum* n. sp. (Page 12)

a. vertical section showing the thin, irregular laminae and numerous dissepiments, x10; and,

b. tangential section, x10.

Holotype, GSC No. 19832; Imperial Opal #38, 3197′.

Figure 3. *Hammatostroma nodosum* n. sp. (Page 13)

a. vertical section showing the highly developed "knotted" structure in the interlaminar areas, x10; and,

b. tangential section, x10.

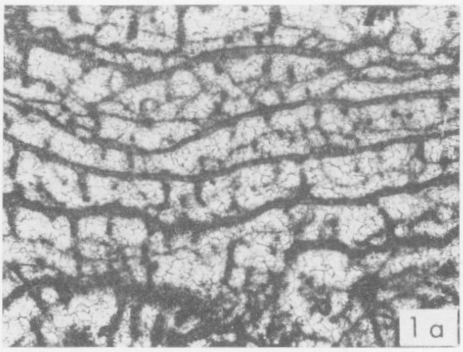
Holotype, GSC No. 19833; Imperial Eastgate #1-22, 4135.5′.

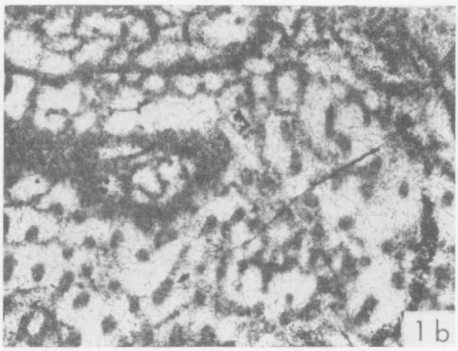
Figure 4. *Euryamphipora platyformis* n. gen., n. sp. (Page 15)

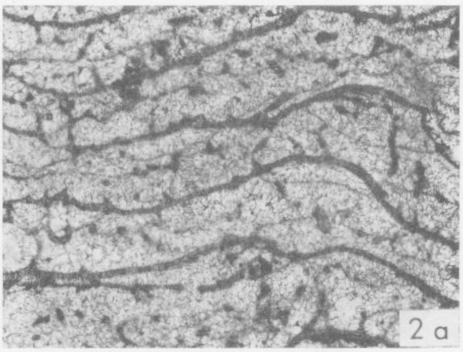
a. corner view of a core showing the tabular nature of the coenosteum, x1; and,

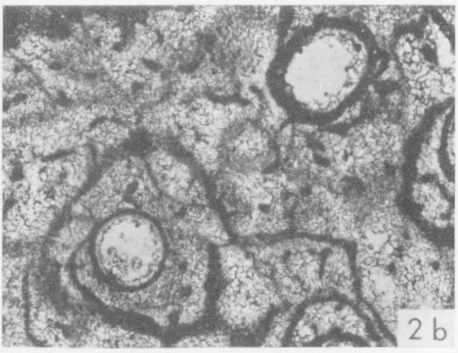
b. polished section showing the undulating nature of some of the specimens. Compaction has been responsible for much of the bending of the coenostea.

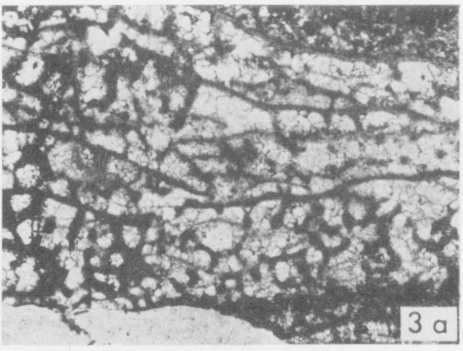
Holotype, GSC No. 19834; Imperial Eastgate #1-22, 4278′.

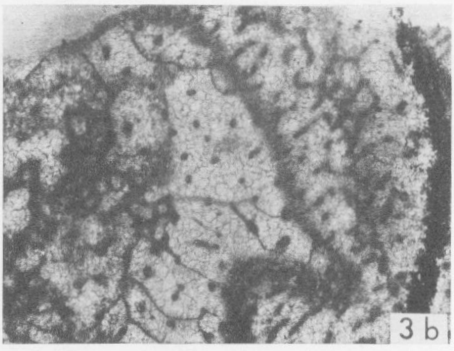

1 a

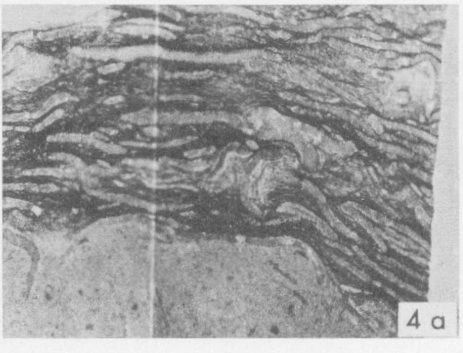

1 b


2 a


2 b


3 a


3 b


4 a

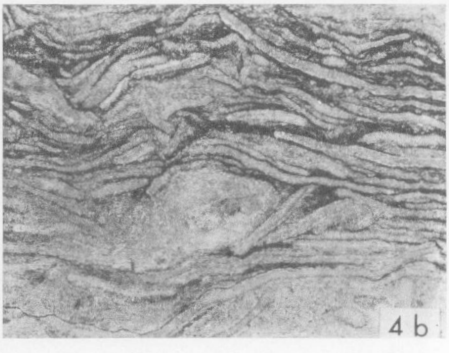
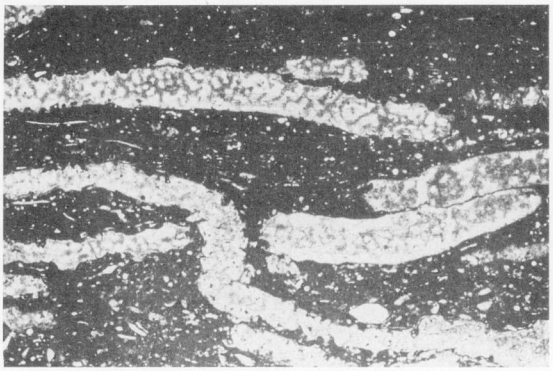

4 b

PLATE IV

Figures 1-7. *Euryamphipora platyformis* n. gen., n. sp. (Page 15)

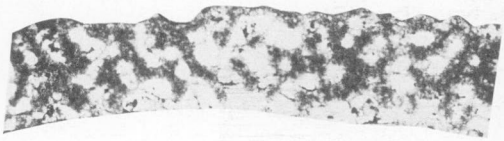
1. vertical section of holotype, GSC No. 19834, x5;
2-4. vertical sections of holotype showing marginal vesicles, dissepiments, and fibrous aspect of tissue, x14: note that a dark medial line is present in some parts of the laminae and pillars;
5. tangential section of holotype through a lamina, x14;
6. tangential section of holotype, cutting bottom part of lamina, x14; and,
7. tangential section of holotype, through an interlaminar area showing the round nature of the pillars, x14.

Imperial Eastgate #1-22, 4278'.

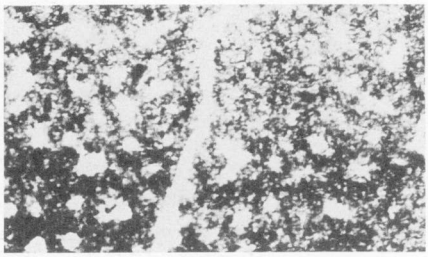


1

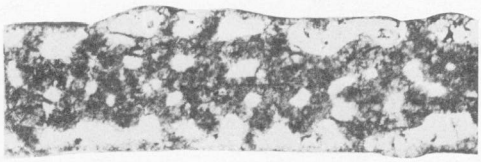
2



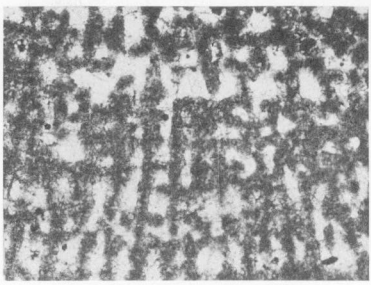
3



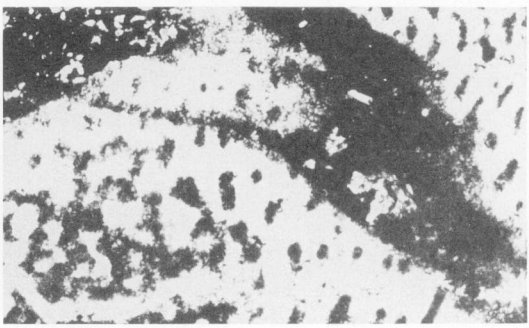
5



4



6



7

PLATE V

(All figures x 10)

Figure 1. *Actinostroma matutinum* Nicholson (Page 17)

a. vertical section; and,

b. tangential section.

Hypotype, GSC No. 19835; Saltwater Disposal Well #4, 3717′.

Figures 2, 3. *Actinostroma clathratum* Nicholson (Page 18)

2a. vertical section; and,

2b. tangential section through a mamelon.

Hypotype, GSC No. 19836; Saltwater Disposal Well #4, 4227′.

3a. vertical section of a specimen showing thicker pillars than those in Figure 2: all gradations between the two exist; and,

3b. tangential section.

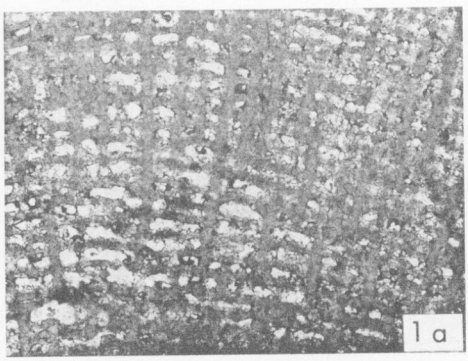
Hypotype, GSC No. 19837; Imperial Eastgate #1-22, 4112′.

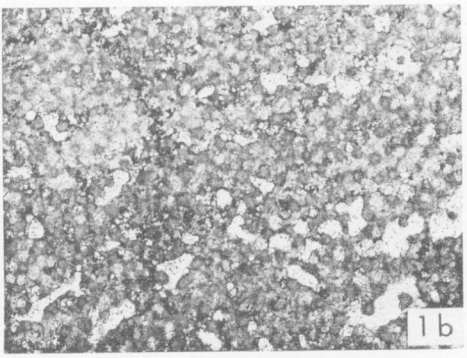
Figure 4. *Actinostroma pachypilatum* n. sp. (Page 19)

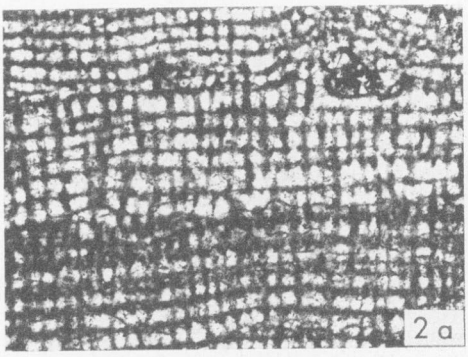
a. vertical section; and,

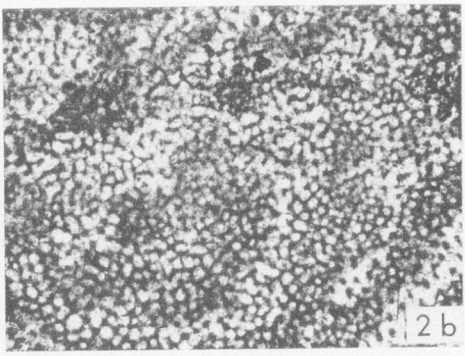
b. tangential section.

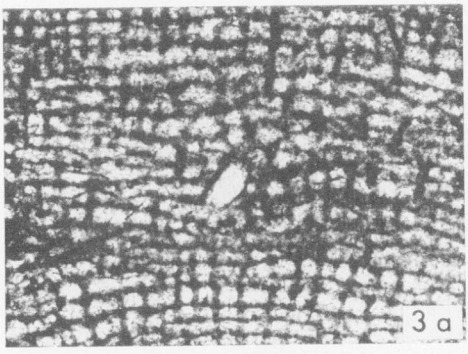
Holotype, GSC No. 19838; Saltwater Disposal Well #5, 3980′.

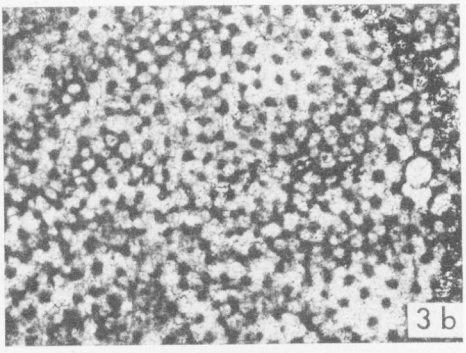

1 a


1 b


2 a


2 b


3 a


3 b


4 a

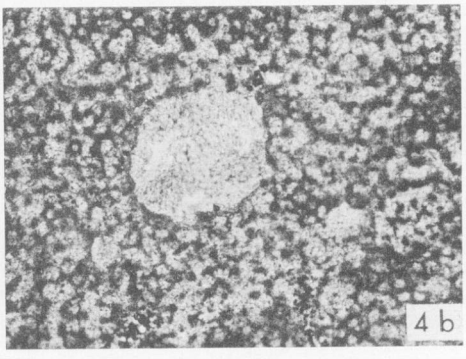

4 b

PLATE VI

(All figures x 10)

Figure 1. *Actinostroma redwaterense* n. sp. (Page 19)

a. vertical section showing the extremely thick, continuous pillars; and,

b. tangential section showing the central lumen in the pillars.

Holotype, GSC No. 19839; Saltwater Disposal Well #4, 3845′.

Figure 2. *Actinostroma* cf. *A. crassepilatum* Lecompte (Page 20)

a. vertical section; and,

b. tangential section.

Hypotype, GSC No. 19840; Saltwater Disposal Well #5, 3431′.

Figures 3, 4. *Trupetostroma warreni* Parks (Page 21)

3a. vertical section; and,

3b. tangential section.

Hypotype, GSC No. 19841; Saltwater Disposal Well #1, 3966′.

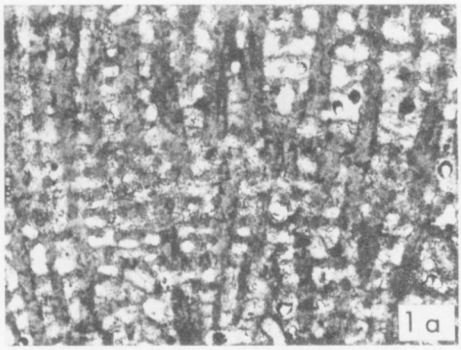
4. vertical section showing the superposed pillars and light median microlaminae.

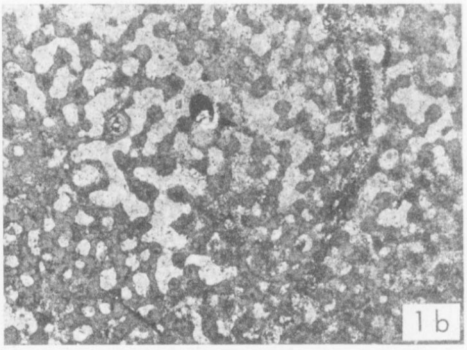
Hypotype, GSC No. 19842; Saltwater Disposal Well #1, 3957′.

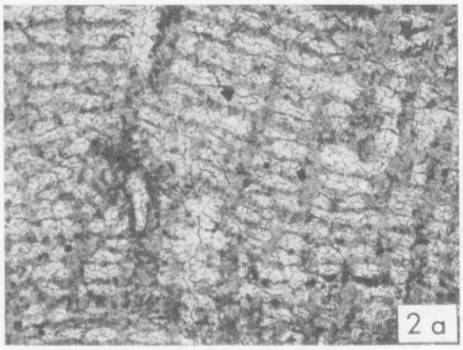
Figure 5. *Trupetostroma* aff. *T. laceratum* Lecompte (Page 22)

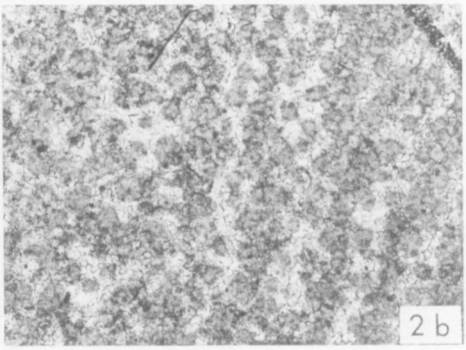
a. vertical section showing the abundant secondary tissue.

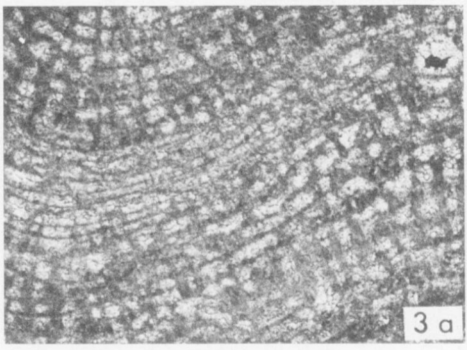
Hypotype, GSC No. 19843; Imperial Amelia #84, 3175′.

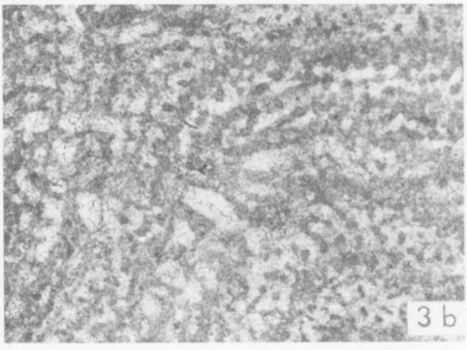

1 a

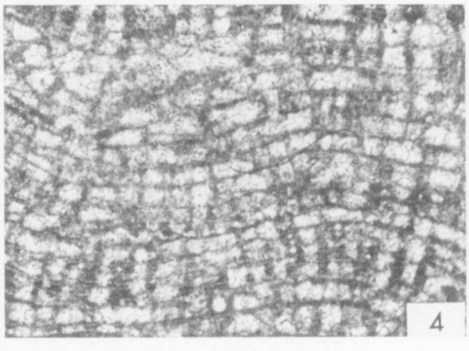

1 b


2 a


2 b


3 a


3 b


4

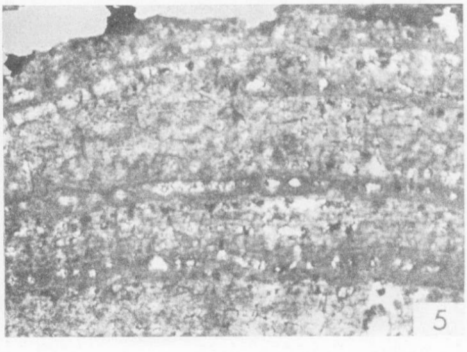

5

PLATE VII

(All figures x 10)

Figure 1. *Trupetostroma* aff. *T. laceratum* Lecompte (Page 22)

a. vertical section showing the stout, superposed pillars; and,

b. tangential section.

Hypotype, GSC No. 19843; Imperial Amelia #84, 3175′.

Figure 2. *Trupetostroma* cf. *T. coalescens* Galloway and St. Jean (Page 23)

a. vertical section showing the pronounced light median microlaminae and abundant secondary tissue: vacuoles are apparent in some of the pillars: tabulate tube of *Syringoporella* in lower left; and,

b. tangential section.

Hypotype, GSC No. 19844; Imperial Simmons #72, 3182′.

Figures 3, 4. *Trupetostroma*? sp. (Page 24)

3a. vertical section; and.

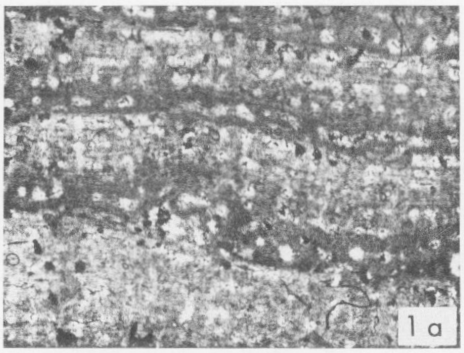
3b. tangential section showing the vacuolate tissue.

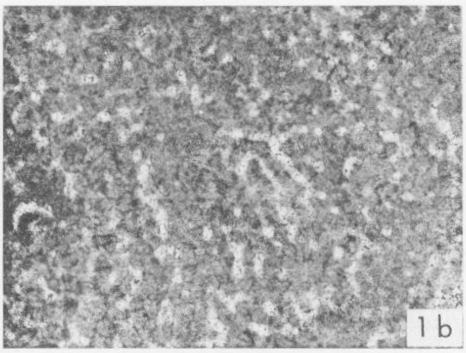
Figured specimen, GSC No. 19845; Saltwater Disposal Well #1, 3935′.

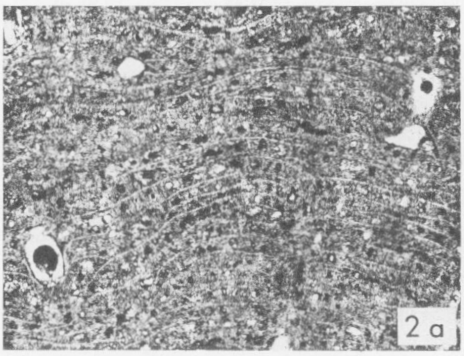
4a. vertical section; and.

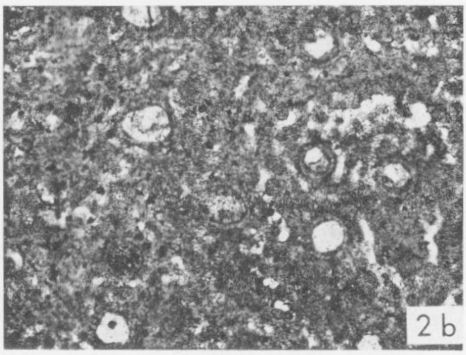
4b. tangential section.

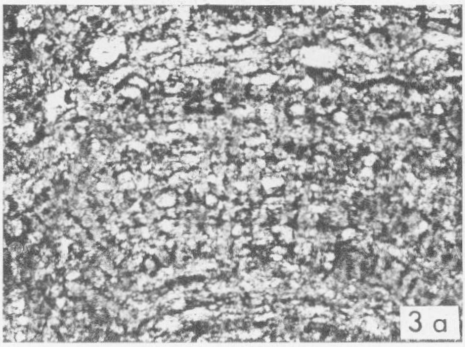
Figured specimen, GSC No. 19846; Saltwater Disposal Well #1, 3795′.

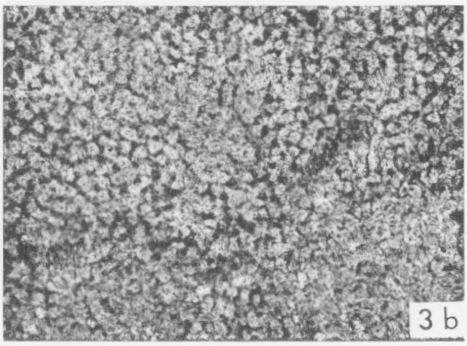

1 a

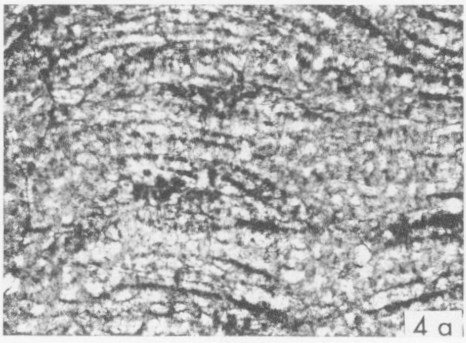

1 b


2 a


2 b


3 a


3 b


4 a

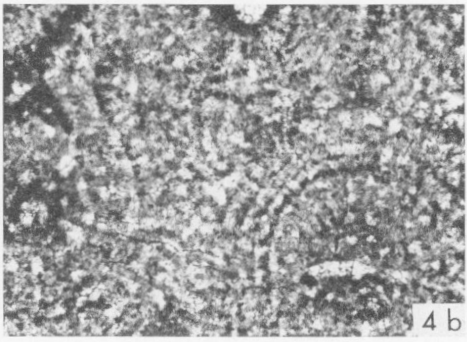

4 b

PLATE VIII

(All figures x 10)

Figure 1. *Ferestromatopora dubia* (Lecompte) (Page 25)

a. vertical section; and,

b. tangential section.

Hypotype, GSC No. 19847; Imperial Eastgate #1-22, 4146′.

Figure 2. *Stromatopora cygnea* Stearn (Page 26)

a. vertical section showing the maculate tissue and thin, clear microlaminae running through the tissue; and,

b. tangential section with several tubes of *Syringoporella* exposed.

Hypotype, GSC No. 19848; Imperial Egremont #94, 3342′.

Figures 3, 4. *Syringostroma* cf. *S. perfuscum* Galloway and St. Jean (Page 27)

3a. vertical section showing long and short pillars; and,

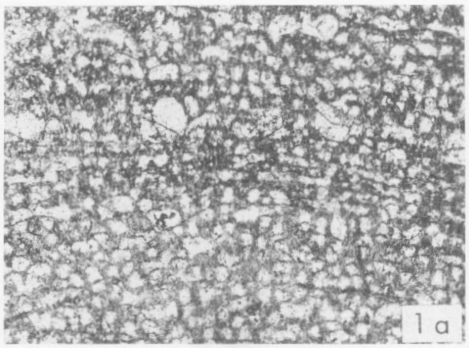
3b. tangential section.

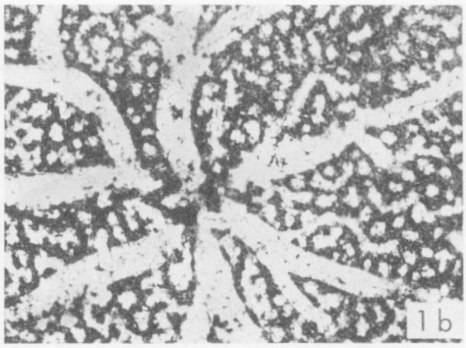
Hypotype, GSC No. 19849; Saltwater Disposal Well #5, 3410′.

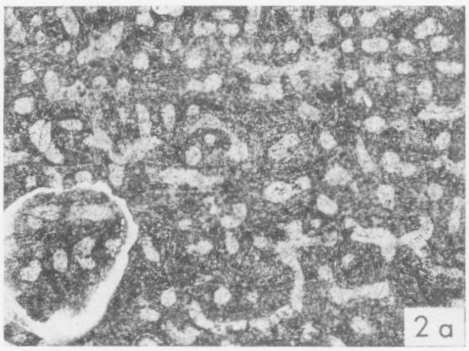
4a. vertical section; and,

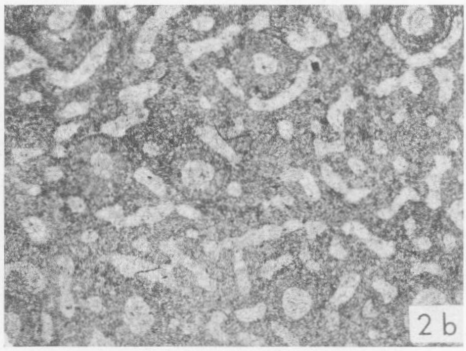
4b. tangential section.

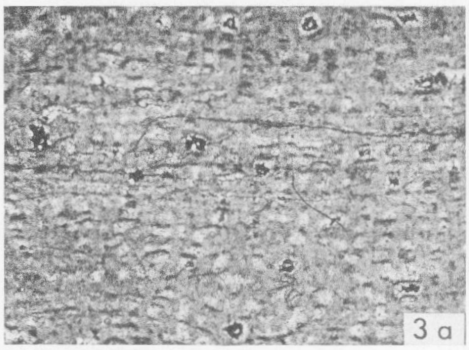
Hypotype, GSC No. 19850; Imperial Egremont #1, 3287′.

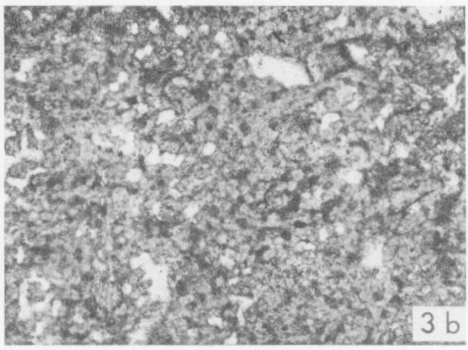

1 a

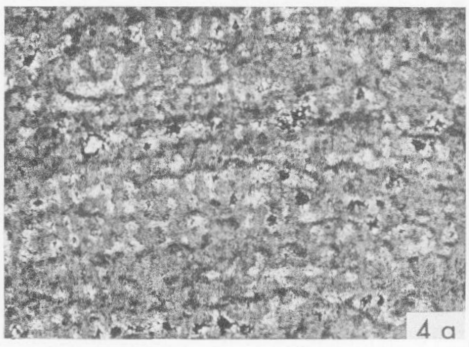

1 b


2 a


2 b


3 a


3 b


4 a

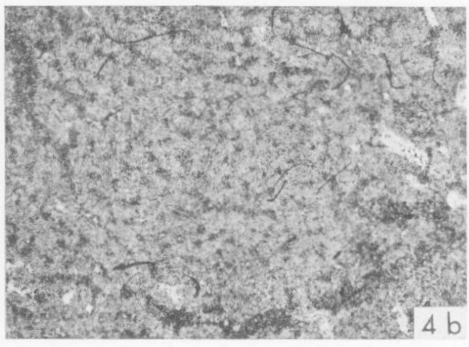

4 b

PLATE IX

(All figures x 10)

Figures 1-3. *Syringostroma*? sp. (Page 28)

1a. vertical section showing long pillars with a suggestion of laminae passing through the pillars: the "feathery" calcite crystals filling galleries are especially well developed in the lower left part of the picture; and,

1b. tangential section.

Figured specimen, GSC No. 19851; Imperial Redwater #95, 3212'.

2a. vertical section; and,

2b. tangential section.

Figured specimen, GSC No. 19852; Imperial Redwater #101, 3311'.

3a. vertical section showing much broader pillars than those in 1a: all gradations between the two are present in the suite of samples; and,

3b. tangential section.

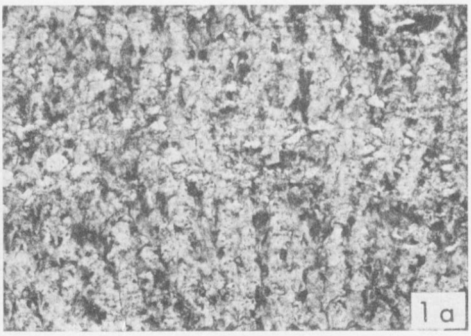
Figured specimen, GSC No. 19853; Imperial Egremont #94, 3220'.

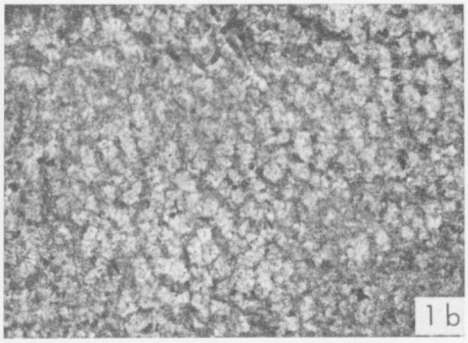
Figure 4. *Synthetostroma vesiculosum* (Lecompte) (Page 29)

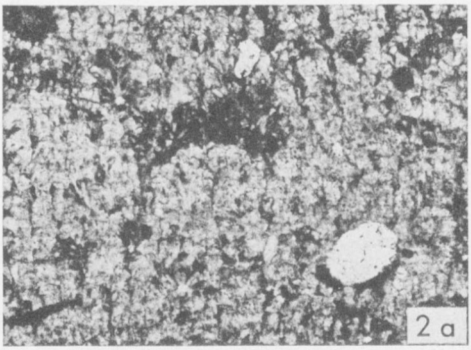
a. vertical section; and.

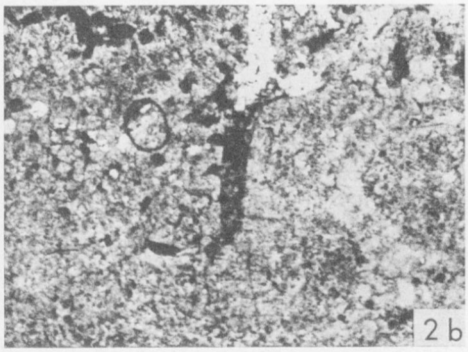
b. tangential section.

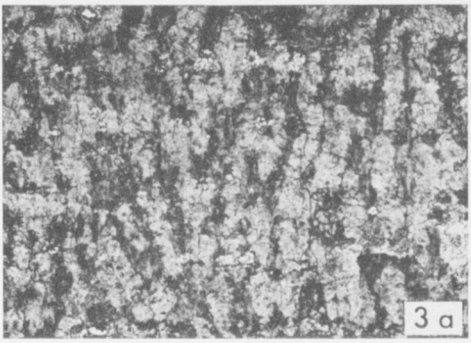
Hypotype, GSC No. 19854; Imperial Eastgate #1-22, 4259'.

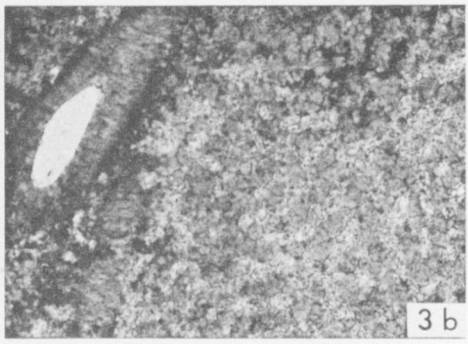

1 a

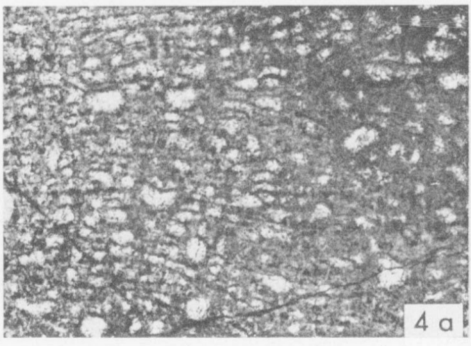

1 b


2 a


2 b


3 a


3 b


4 a

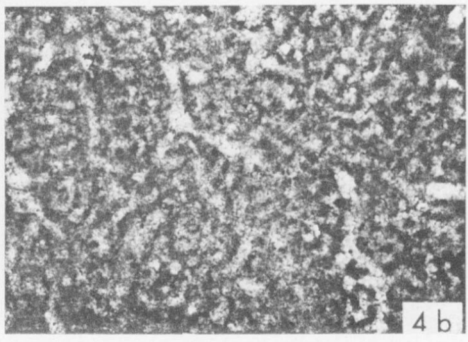

4 b

PLATE X

Figures 1-6. *Amphipora* sp. (Page 30)

1. a specimen showing a branching coenosteum, x5. Of the many hundreds of specimens observed in the Redwater reef, this was the only one seen to branch.
2. enlargement of one of the stalks in Figure 1, x10.

Figured specimen, GSC No. 19855; Imperial Eastgate #1-22, 3919′.

3. several specimens cut transversely, x5.

Figured specimen, GSC No. 19856.

4. longitudinal section of one of the specimens in Figure 3: note the lack of well-developed marginal vesicles, x5.

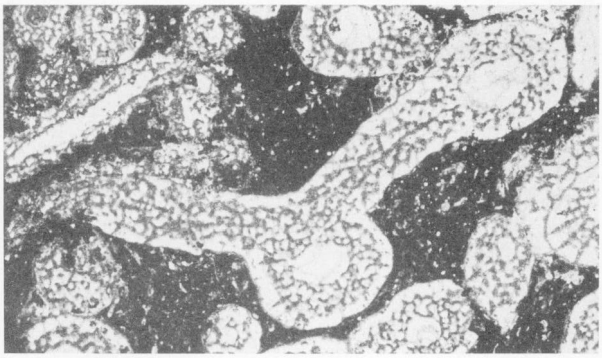
Figured specimen, GSC No. 19856a; Imperial Eastgate #1-22, 4290′.

5. longitudinal section of a specimen showing a well-developed central canal and marginal vesicles, x5.

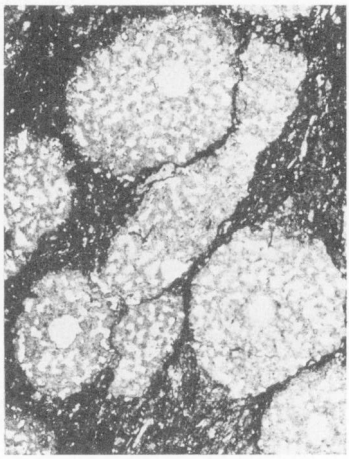
Figured specimen, GSC No. 19857; Imperial Eastgate #1-22, 3601′.

6. tangential section of a specimen, x12: note the fibrous nature of the tissue and the presence in places of a dark medial line within the tissue.

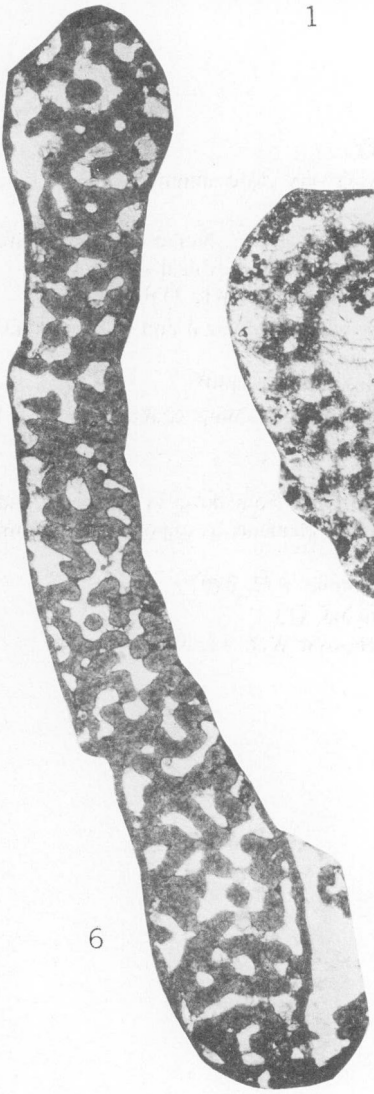
Figured specimen, GSC No. 19858.



1



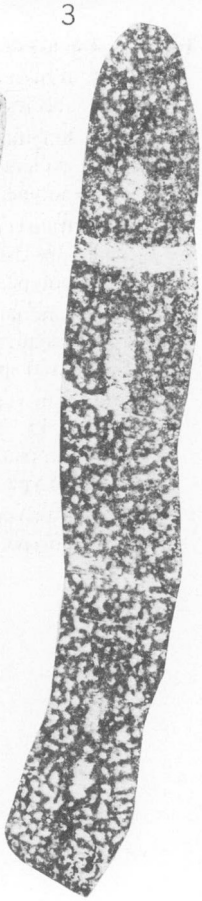
3



6

2

5



4

PLATE XI

Figures 1-6. *Stachyodes costulata* Lecompte (Page 31)

1. transverse section of a specimen showing very close affinities with the type species, x5.
2. longitudinal section of specimen in Figure 1, x5. Numerous canals are evident and are thought to represent a modified astrorhizal system.

Hypotype, GSC No. 19859; Saltwater Disposal Well #1, 3350′.

3. transverse section of a form with only one central canal and much secondary tissue in the galleries, x5.

Hypotype, GSC No. 19861; Imperial Egremont #1, 4005′.

4. random sections through a rock specimen containing coarse, well-sorted fragments of *Stachyodes* and corals, x2.

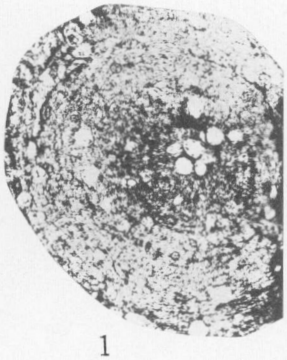
Figured specimen, GSC No. 19863.

5. transverse section of a form slightly different from those in Figures 1 and 3, x5. Note the dominance of the vertical elements as opposed to the thin laminae.

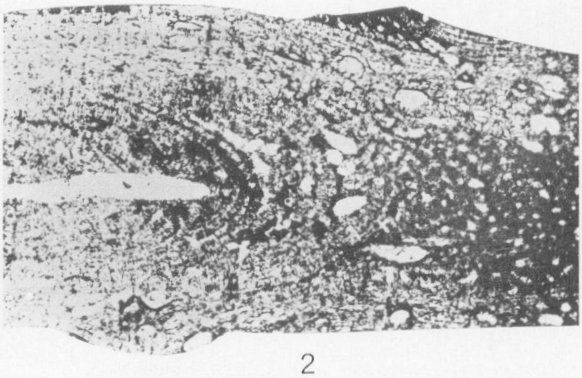
Hypotype, GSC No. 19862; Imperial Simmons #72, 3192′.

6. transverse section showing nature of tissue, x12.

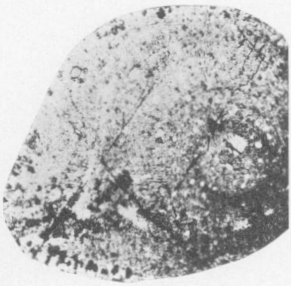
Hypotype, GSC No. 19860; Saltwater Disposal Well #1, 3353′.



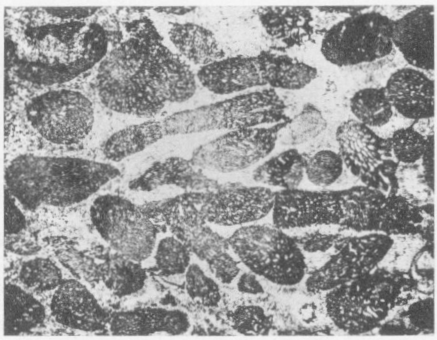
1



2

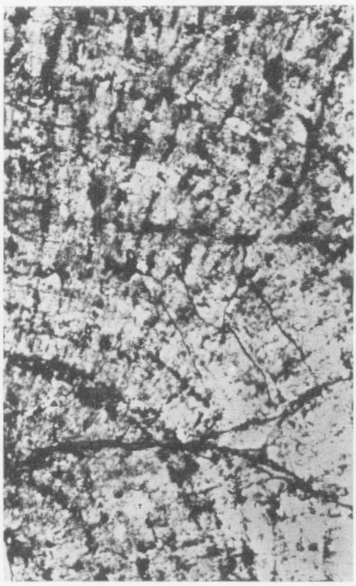


3



4

5



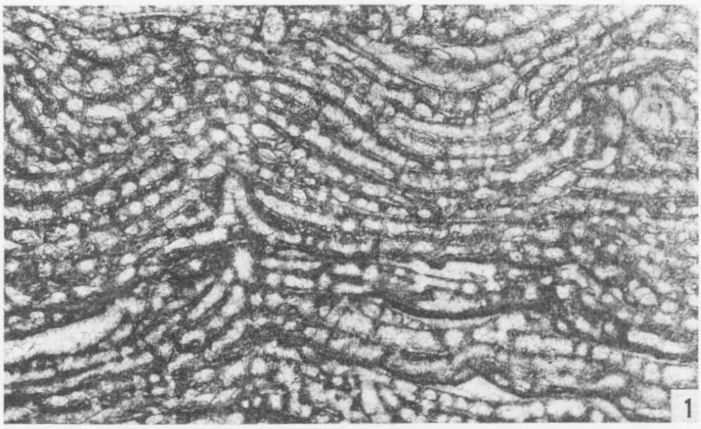
6

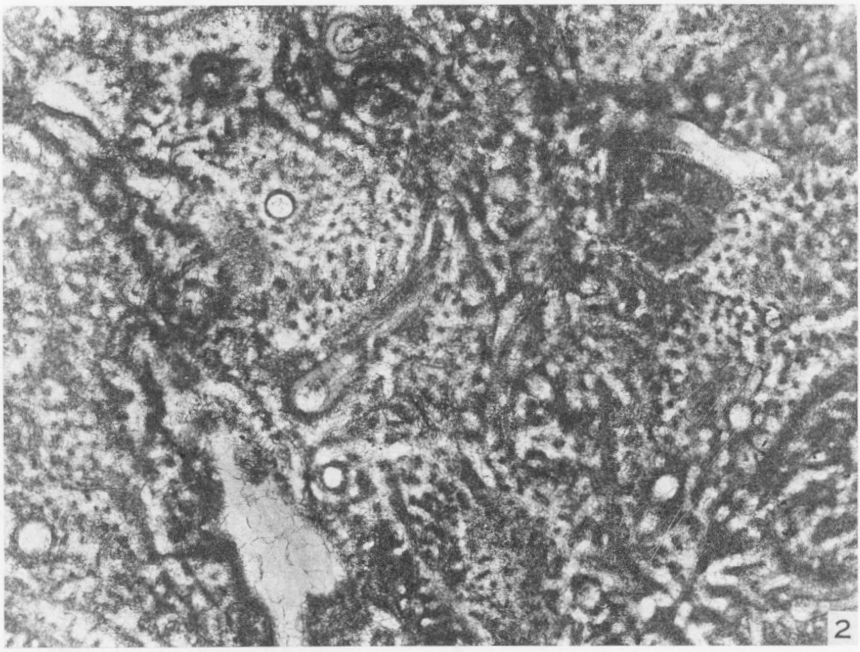
PLATE XII

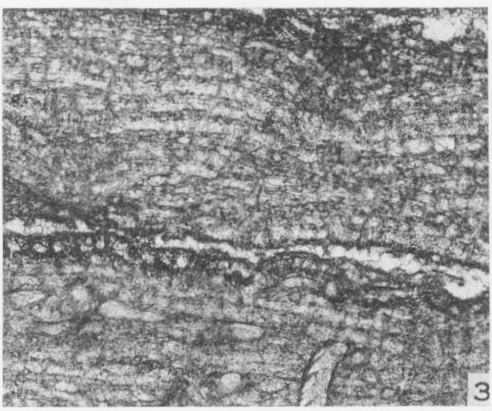
Stictostroma maclareni n. sp. (Page 43)

Figures 1, 2. Vertical and tangential sections of the holotype, GSC No. 18674a and b, x10, loc. 30679; the tangential section shows tubes of *Syringopora*.

Figures 3, 4. Vertical and tangential sections of a paratype, GSC No. 18675a and b, x10, loc. 30648.


1


2


3

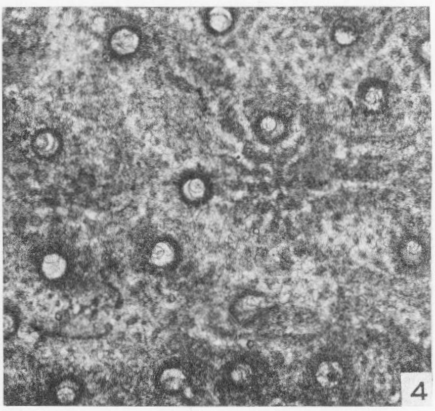

4

PLATE XIII

Stictostroma maclareni n. sp. (Page 43)

Figure 1. Vertical section of a paratype, GSC No. 18676a, x10, loc. 30701.

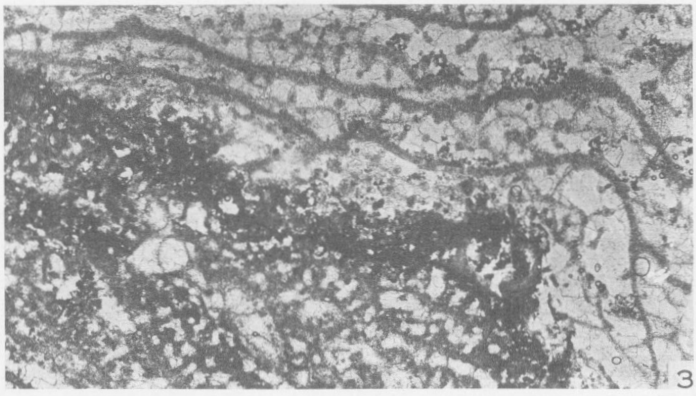
Figure 2. Tangential section of a paratype, GSC No. 18712b, x10, loc. 30659; showing linear structures attributed to algae.

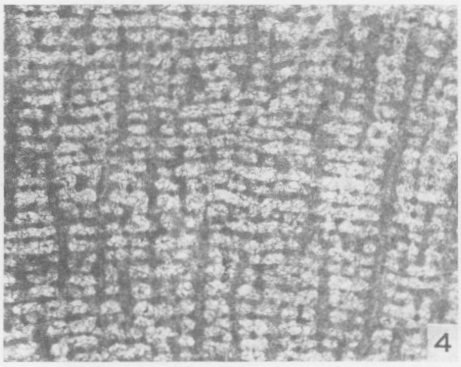
Figure 3. *Hammatostroma albertense* Stearn and *Ferestromatopora parksi* n. sp. (Page 45)
Vertical section of the hypotype, GSC No. 18677, x10, loc. 30467.

Figures 4, 5. *Actinostroma clathratum* Nicholson. (Page 47)
Vertical and tangential sections of a hypotype, GSC No. 18678a and b, x10, loc. 30399; showing discontinuous laminae.


1


2


3


4

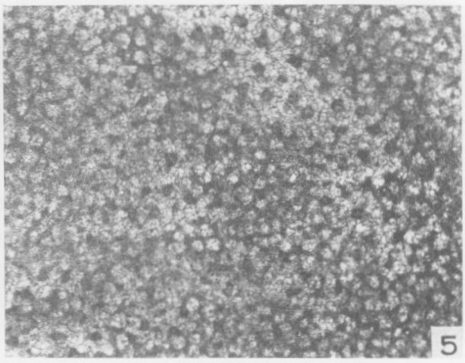

5

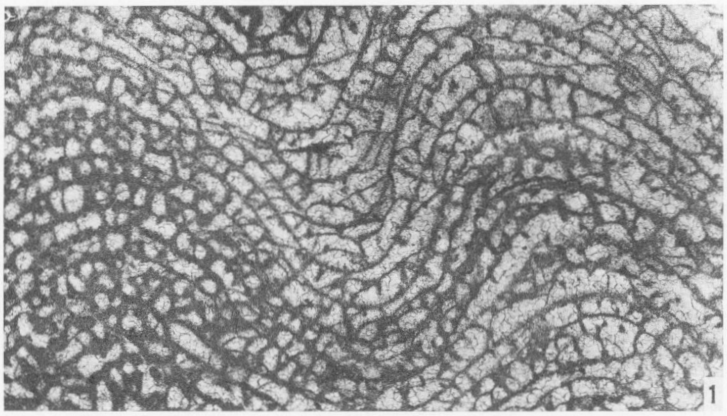
PLATE XIV

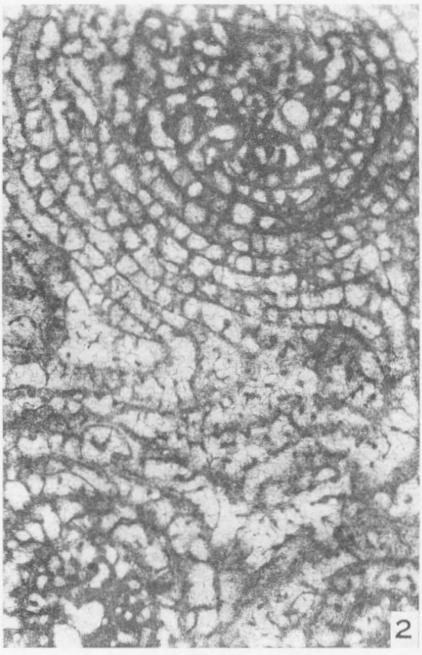
Anostylostroma phricum n. sp. (Page 42)

Figures 1, 2. Vertical and tangential sections of the holotype, GSC No. 18679a and b, x10, loc. 30747.

Figure 3. Tangential section of paratype, GSC No. 18680b, x10, loc. 30728.

Figure 4. Vertical section of a paratype, GSC No. 18681a, x10, loc. 30736.


1


2


3

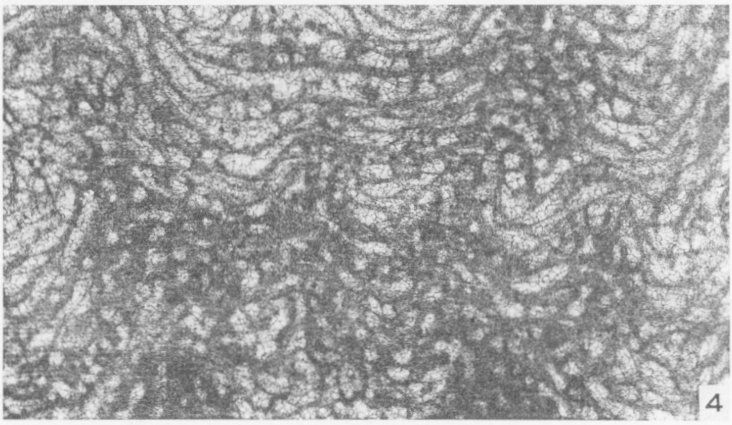

4

PLATE XV

Clathrocoilona inconstans Stearn. (Page 45)

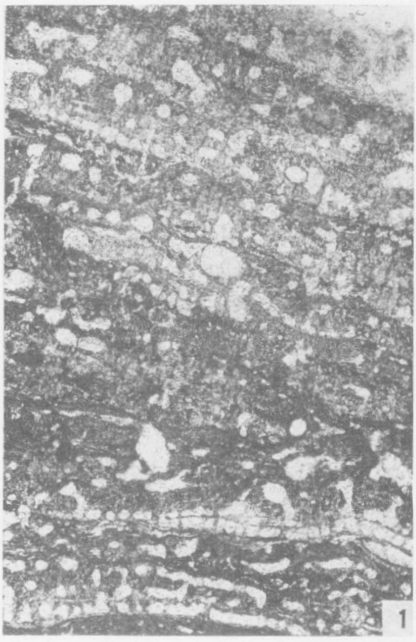
Figure 1. Vertical section of a hypotype, GSC No. 18682a, x10, loc. 30438.

Figures 2, 3. Vertical and tangential sections of a hypotype, GSC No. 18713a and b, x10, loc. 30514.

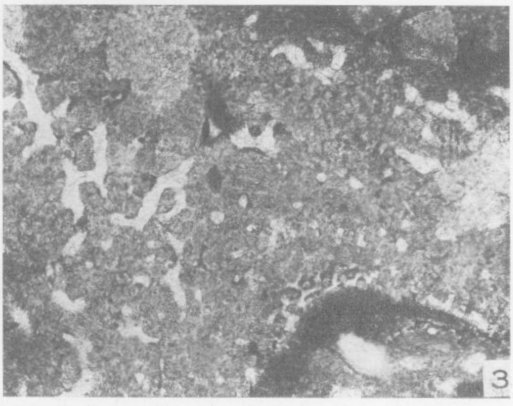
Atelodictyon stelliferum Stearn. (Page 46)

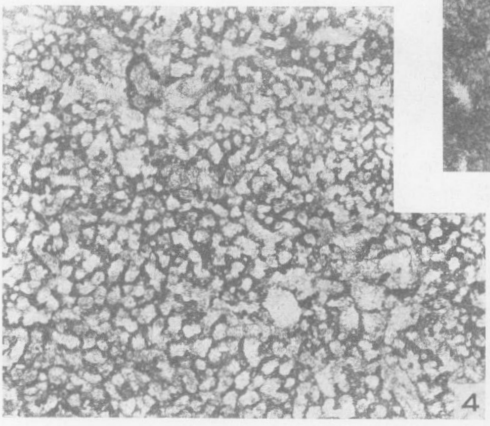
Figures 4, 5. Tangential and vertical sections of a hypotype, GSC No. 18683a and b, x10, loc. 29256.

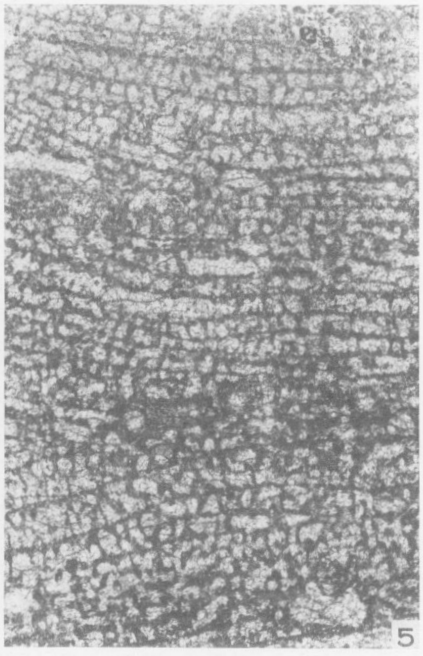
Figure 6. Vertical section showing the abrupt edge of a coenosteum of a hypotype, GSC No. 18684a, x10, loc. 46297.


1


2


3


4


5

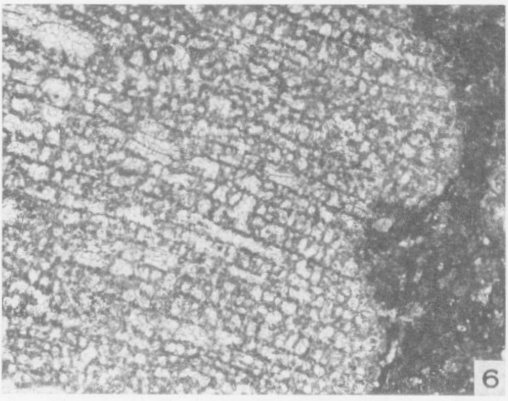
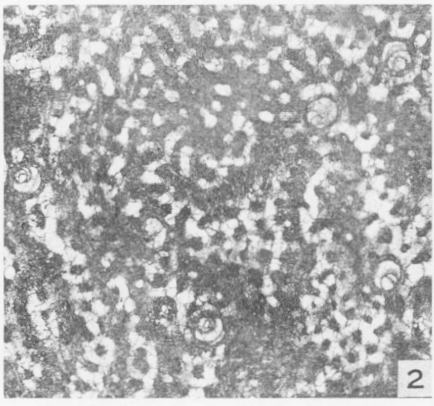

6

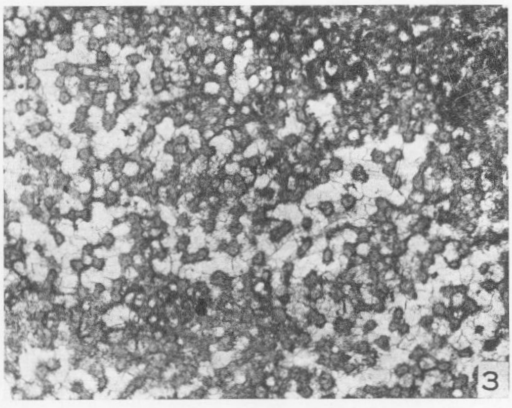
PLATE XVI

Figures 1, 2. *Trupetostroma saintjeani* n. sp. (Page 49)
Vertical and tangential sections of the holotype, GSC No. 18685a and b, x10, loc. 31532.

Figures 3, 4. *Actinostroma clathratum* Nicholson. (Page 47)
Tangential and vertical sections of a hypotype, GSC No. 18686b and a, x10, loc. 30535.


1


2


3

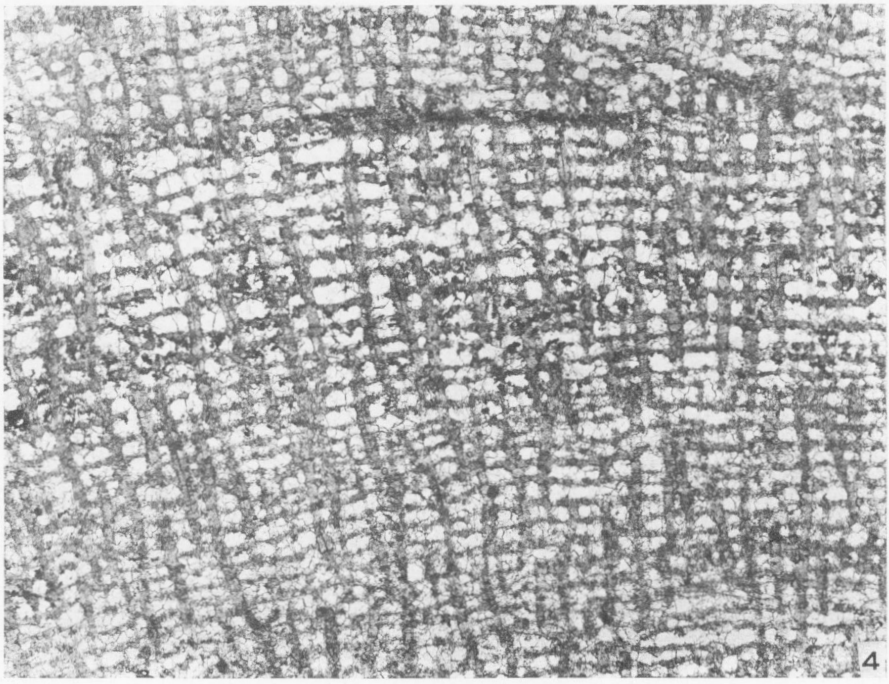

4

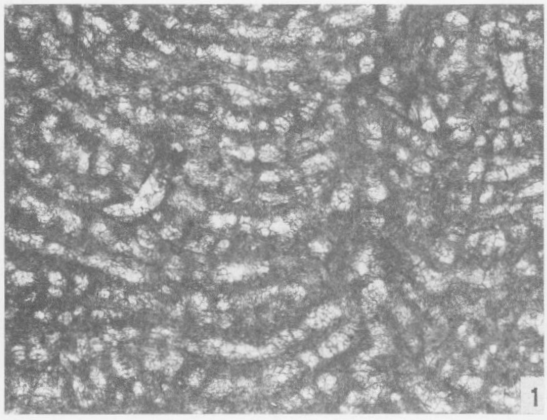
PLATE XVII

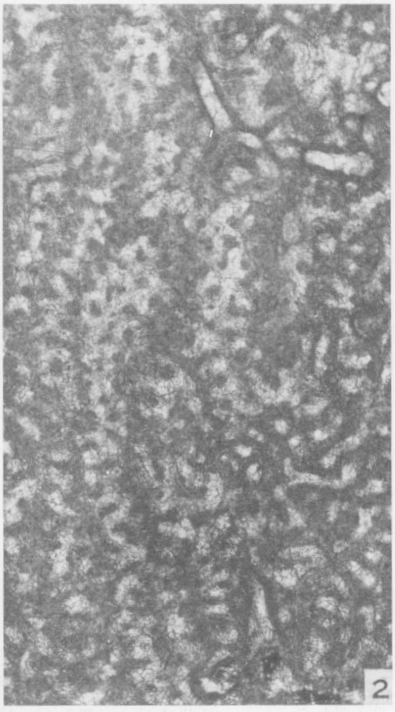
Figures 1, 2. *Trupetostroma saintjeani* n. sp. (Page 49)
Vertical and tangential sections of a paratype, GSC No. 18687a and b, x10, loc. 30674.

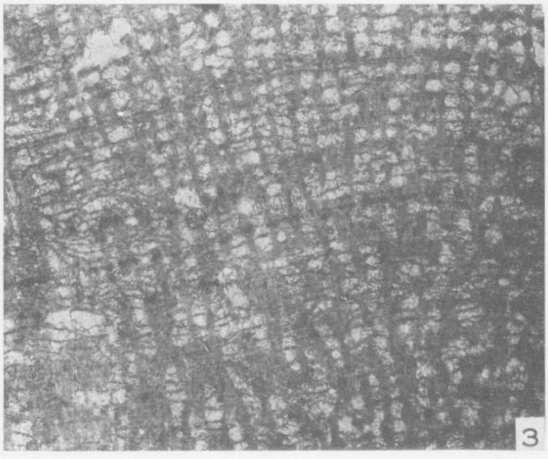
Trupetostroma hayense n. sp. (Page 50)

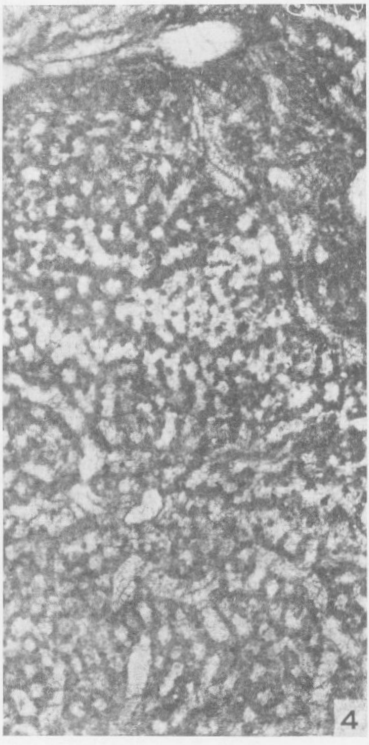
Figures 3, 4. Vertical and tangential sections of the holotype, GSC No. 18688a and b, x10, loc. 30477.

Figure 5. Vertical section of a paratype, GSC No. 18689a, heated to bring out contrasts in tissue, x10, loc. 30393.


1


2


3


4

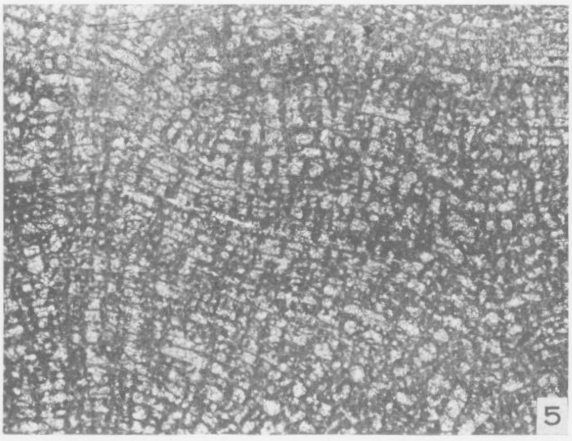

5

PLATE XVIII

Trupetostroma hayense n. sp. (Page 50)

Figure 1. Vertical section of the holotype, GSC No. 18688c, x3, loc. 30477.

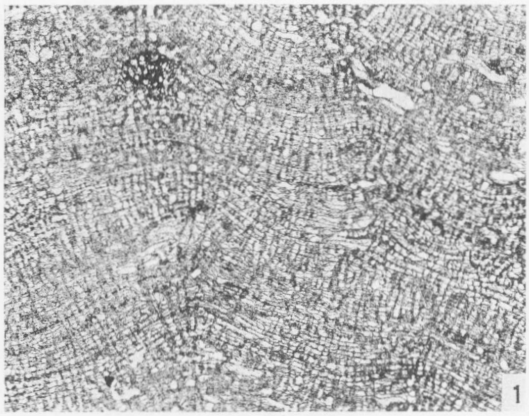
Figures 2, 3. Tangential and vertical sections of a paratype, GSC No. 18689c and d, x10, loc. 30393.

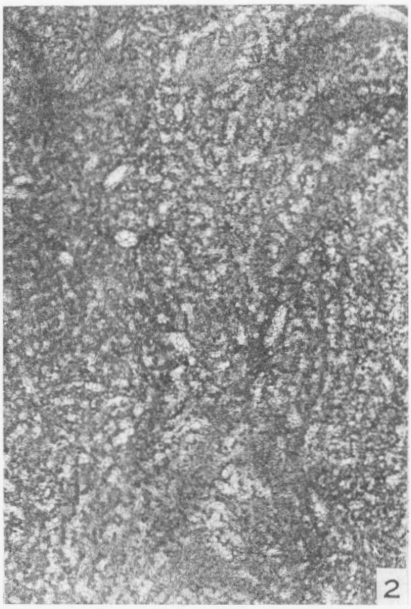
Figure 4. Tangential section of a paratype, GSC No. 18690b, x10, loc. 30679.

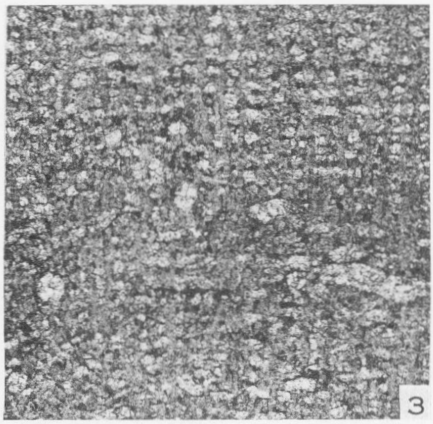
Stromatopora cygnea Stearn (Page 54)

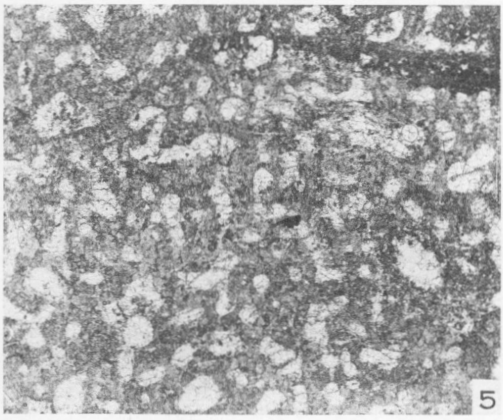
Figure 5. Vertical section of a hypotype, GSC No. 18701a, x10, loc. 46301.

Figure 6. Vertical section of a hypotype, GSC No. 18711a, x3, loc. 46296.


1


2


3


5


4

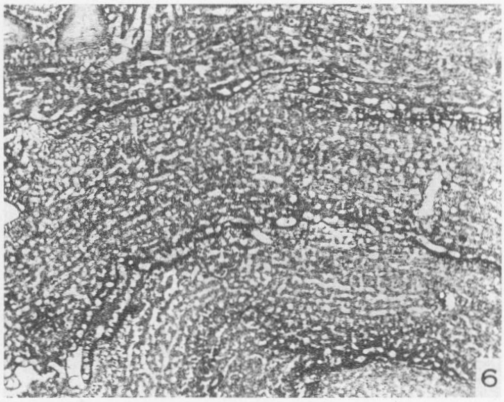

6

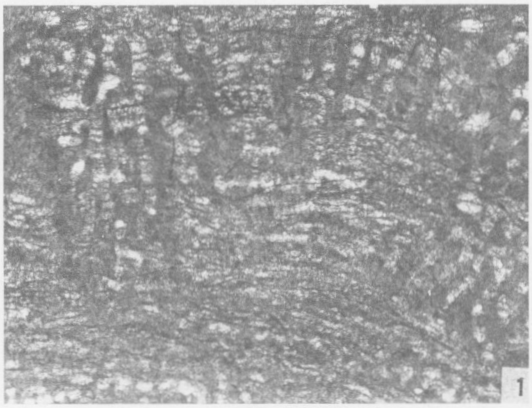
PLATE XIX

Trupetostroma kakisaense n. sp. (Page 51)

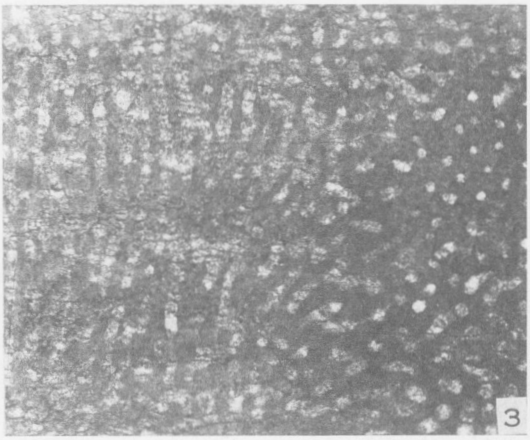
Figures 1, 3, 4. Two vertical sections and a tangential section of the holotype, GSC No. 18691a, b and c, x10, loc. 30498.

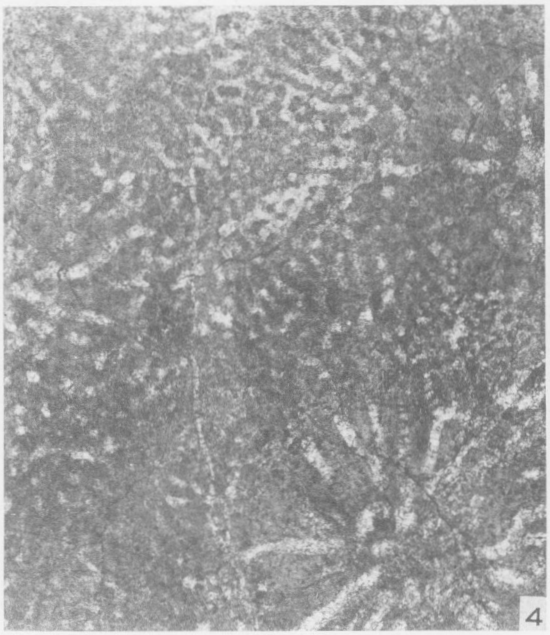
Figure 2. Vertical section of a paratype, GSC No. 18692a, x10, loc. 29256.

Figure 5. *Stromatopora mikkwaensis* n. sp. (Page 55)
Vertical section of the holotype, GSC No. 18693a, x10, loc. 46297.


1


2


3


4

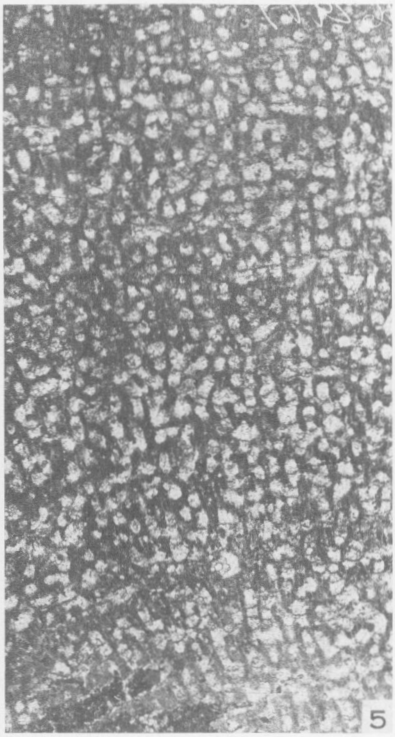

5

Plate XX

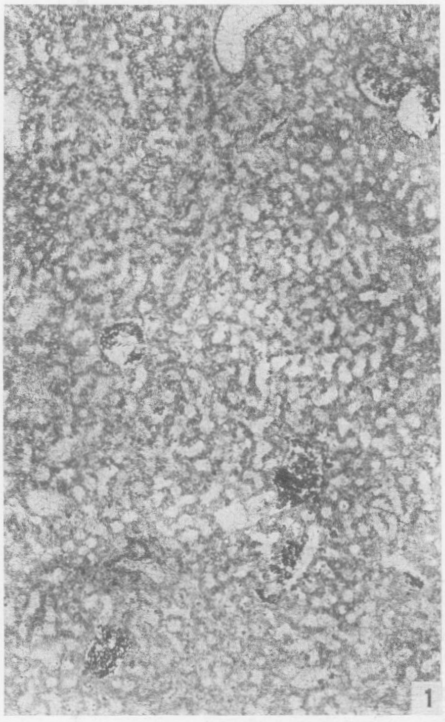
Stromatopora mikkwaensis n. sp. (Page 55)

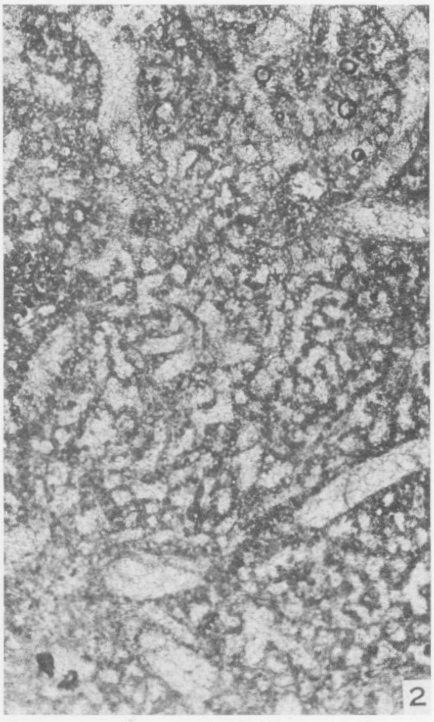
Figure 1. Tangential section of the holotype, GSC No. 18693b, x10, loc. 46297.

Figure 2. Tangential section of a paratype, GSC No. 18694b, x10, loc. 29256.

Figure 3. Vertical section of a paratype, GSC No. 18694a, x3, loc. 29256.

Figure 4. Vertical section of a paratype, GSC No. 18811a, x3, loc. 46296.


1


2


3

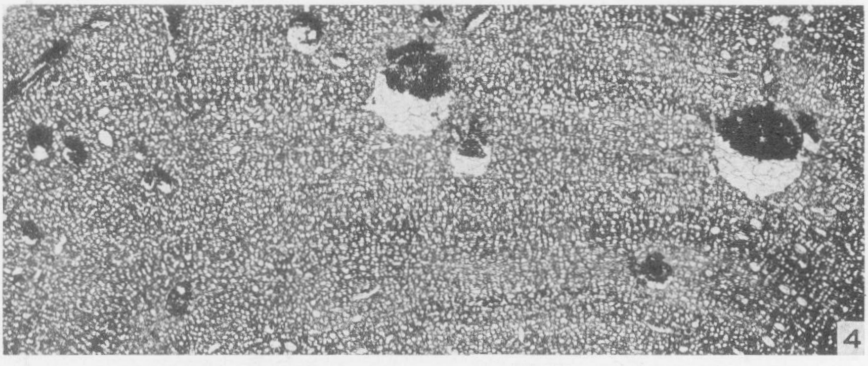

4

PLATE XXI

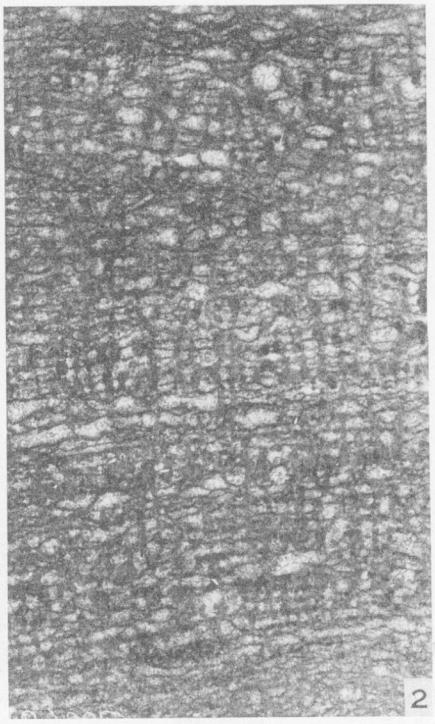
Pseudoactinodictyon bullulosum n. sp. (Page 53)

Figure 1. Vertical section of the holotype, GSC No. 18695a, x10, loc. 46310.

Figure 2. Vertical section of a paratype, GSC No. 18696a, showing laminae better developed, x10, loc. 46320.

Figure 3. Vertical section of a paratype, GSC No. 18697a, x10, loc. 46310.


1


2

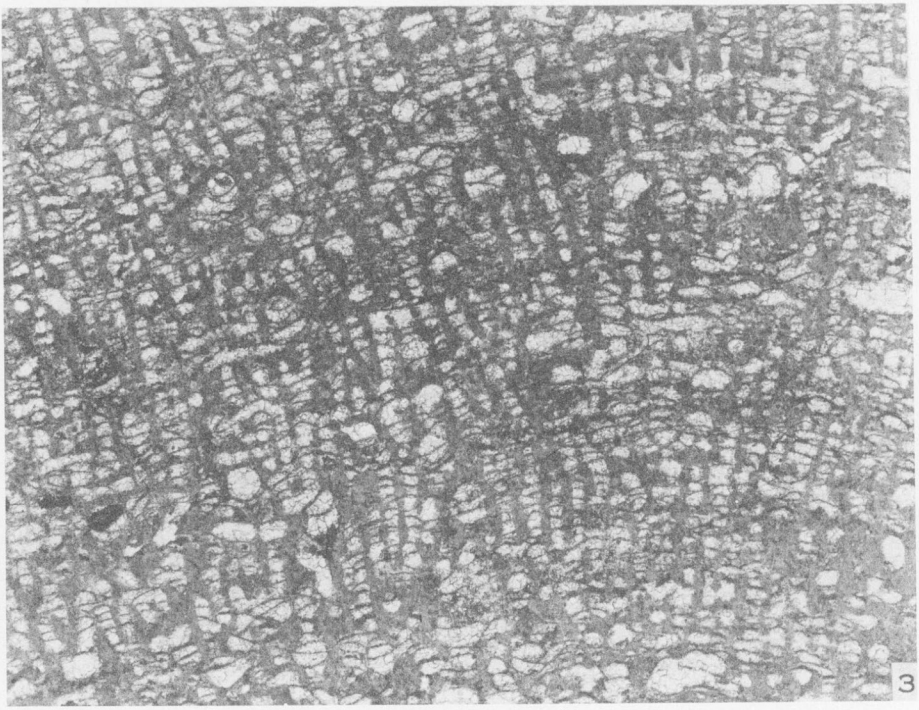

3

PLATE XXII

Stromatopora cf. *S. mononensis* Galloway and St. Jean (Page 56)

Figure 1. Vertical section of a hypotype, GSC No. 18698a, x10, loc. 30680.

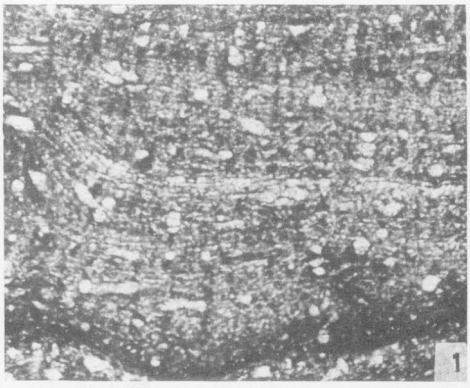
Figures 2, 3. Tangential and vertical sections of a hypotype, GSC No. 18699b and a, x10, loc. 46298.

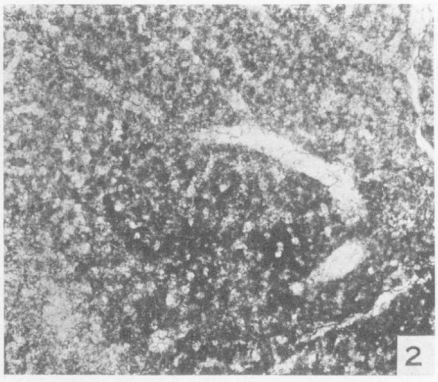
Figure 4. *Pseudoactinodictyon bullulosum* n. sp. (Page 53)
Tangential section of the holotype, GSC No. 18695b, x10, loc. 46310.

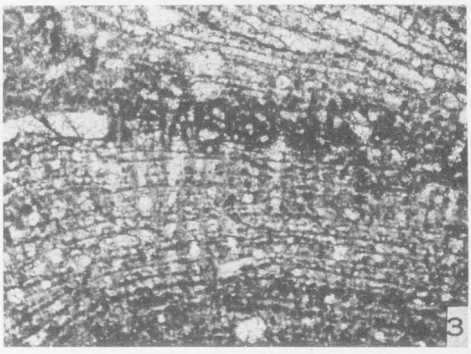
Ferestromatopora contexta Stearn (Page 57)

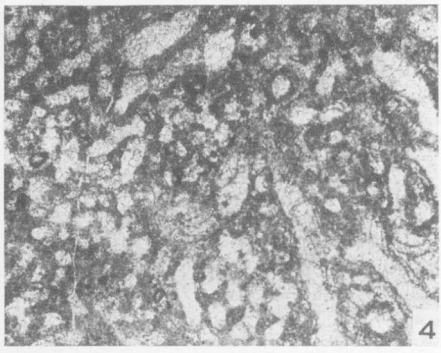
Figure 5. Vertical section of a topotype, GSC No. 18700a, x10, loc. 29150.

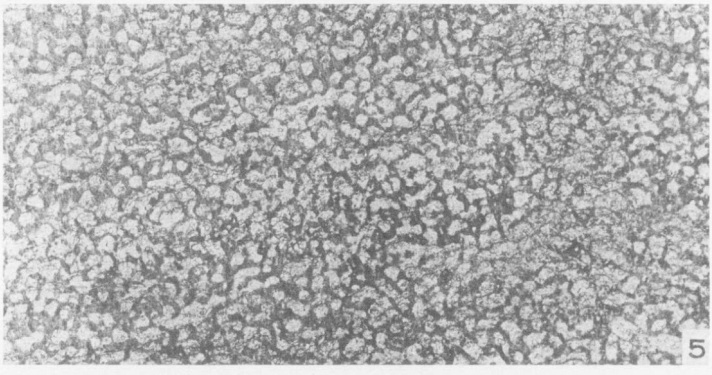
Figures 6, 7. Tangential and vertical sections of a hypotype, GSC No. 18701a and b, x 10, loc. 46320.

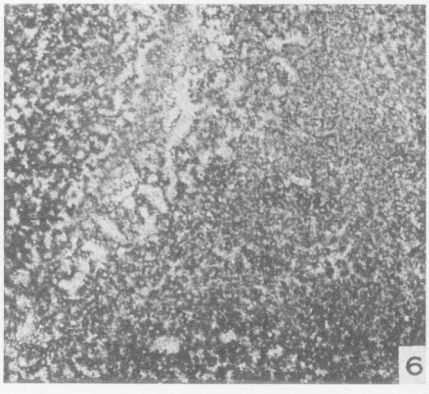

1


2


3


4


5


6

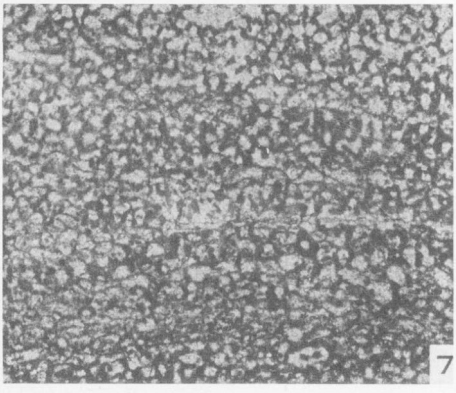

7

PLATE XXIII

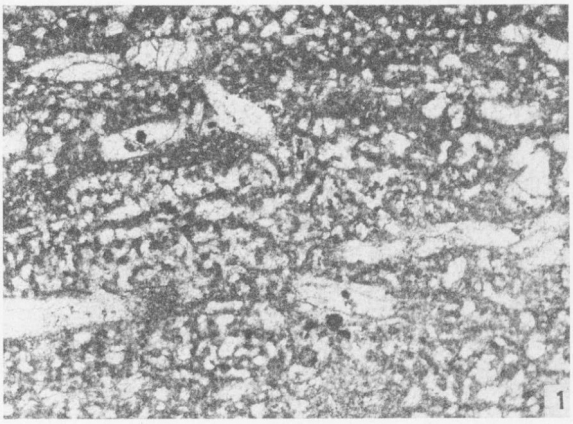
Ferestromatopora parksi n. sp. (Page 58)

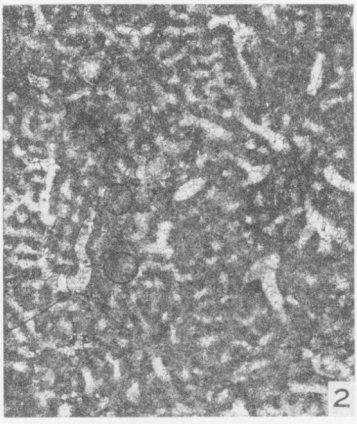
Figures 1, 2. Vertical and tangential sections of a hypotype, GSC No. 18702a and b, x10, loc. 29148.

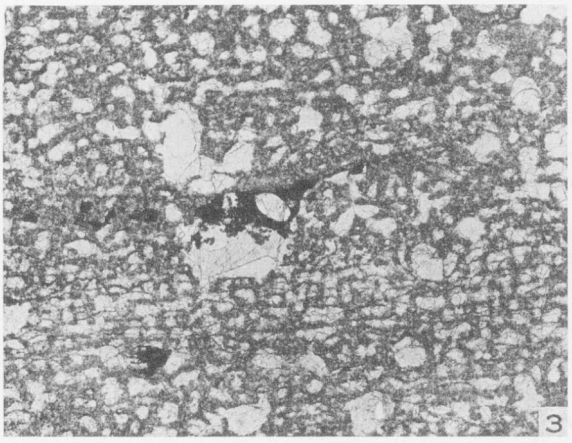
Figures 3, 4. Vertical and tangential sections of a hypotype, GSC No. 18703a and b, x10, loc. 30525.

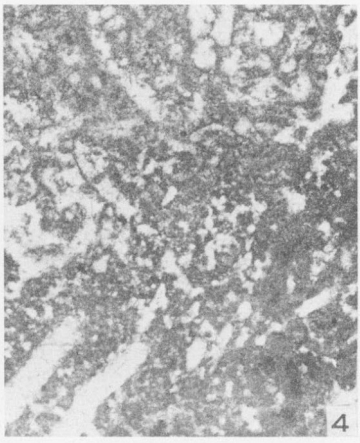
Figure 5. Vertical section of the holotype, GSC No. 15323c, x3.

Figure 6. Vertical section of a hypotype, GSC No. 18704a, x10, loc. 46297.


1


2


3


4


5

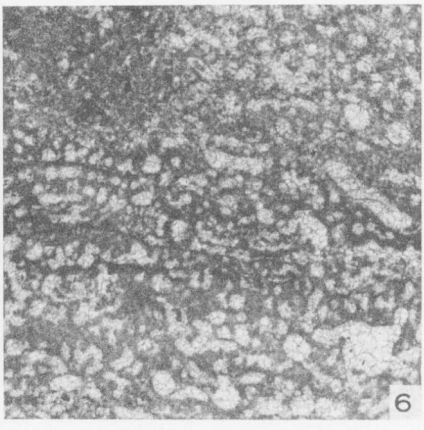

6

PLATE XXIV

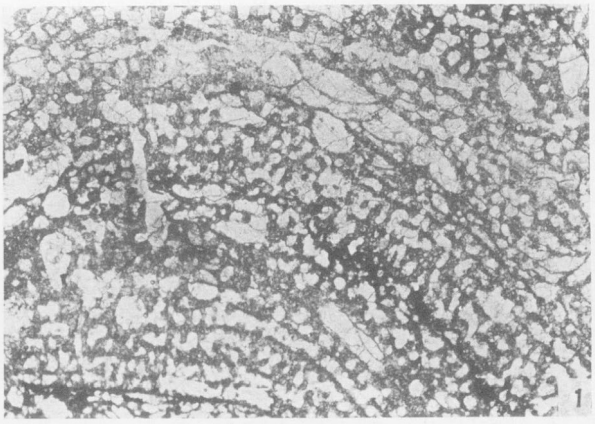
Figure 1. *Ferestromatopora parksi* n. sp. (Page 58)
Vertical section of the holotype, GSC No. 15323c, x10.

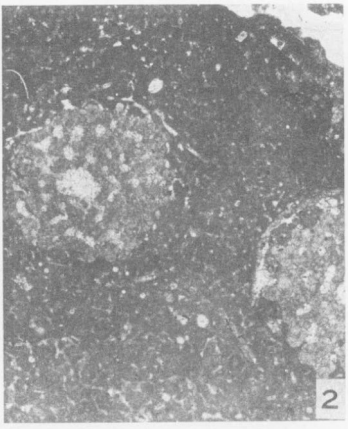
Figure 2. *Amphipora ramosa* (Phillips) (Page 63)
Cross-sections of a hypotype, GSC No. 18705, x10, loc. 30440.

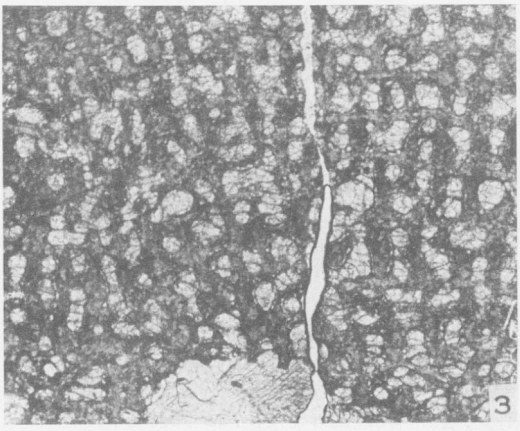
Figures 3, 4. *Hermatostroma maillieuxi* (Lecompte) (Page 60)
Vertical and tangential sections of a hypotype, GSC No. 18706a and b, x10, loc. 30683.

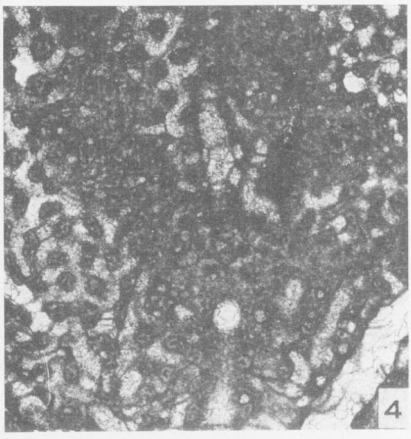
Figure 5. *Parallelopora* cf. *P. dartingtonensis* (Carter) (Page 61)
Tangential section of the hypotype, GSC No. 18707b, x10, loc. 29265.

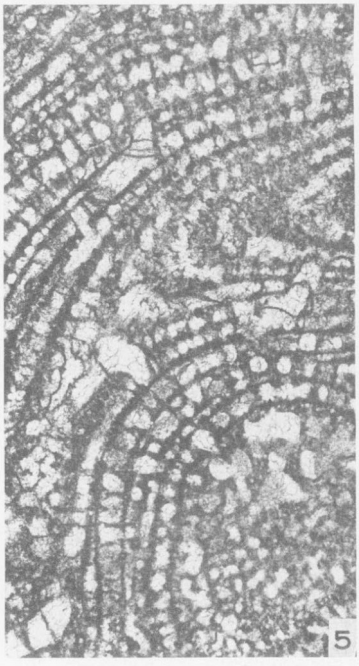
Figures 6. 7. *Euryamphipora*? sp. (Page 64)
Vertical and tangential sections of a hypotype, GSC No. 18708a and b, x10, loc. 30440.


1


2


3


4


5


6

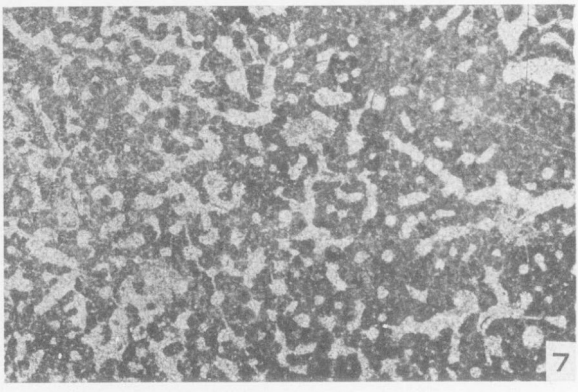
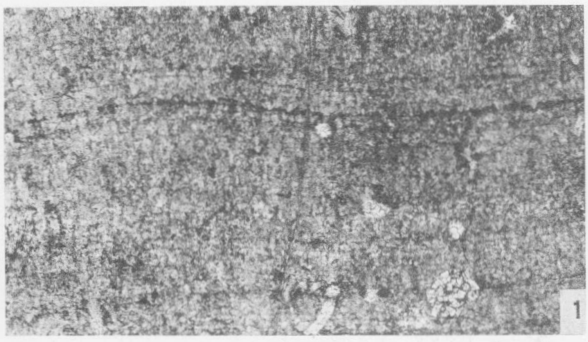

7

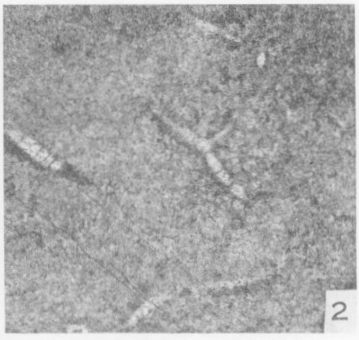
PLATE XXV

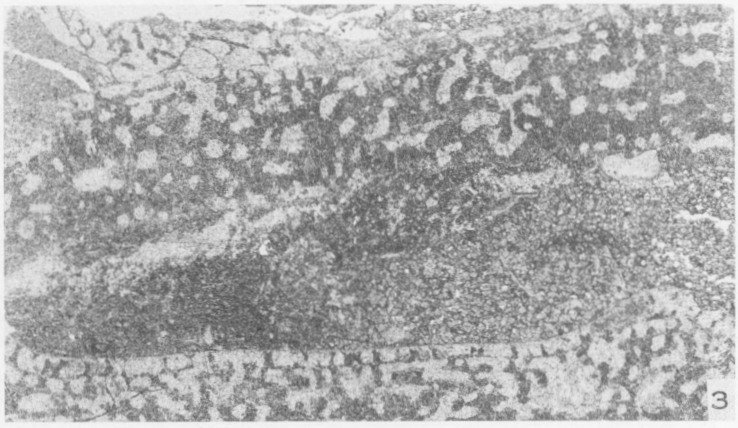
Figures 1, 2. *Syringostroma*? *confertum* (Stearn) (Page 62)
Vertical and tangential sections of a hypotype, GSC No. 18709a and b, x10, loc. 46296.

Figure 3. *Euryamphipora*? sp. (Page 64)
Vertical section of a hypotype, GSC No. 18708c, x10, loc. 30440.

Figure 4. *Parallelopora* cf. *P. dartingtonensis* (Carter) (Page 61)
Vertical section of the hypotype, GSC No. 18707a, x10, loc 29265.


1


2


3

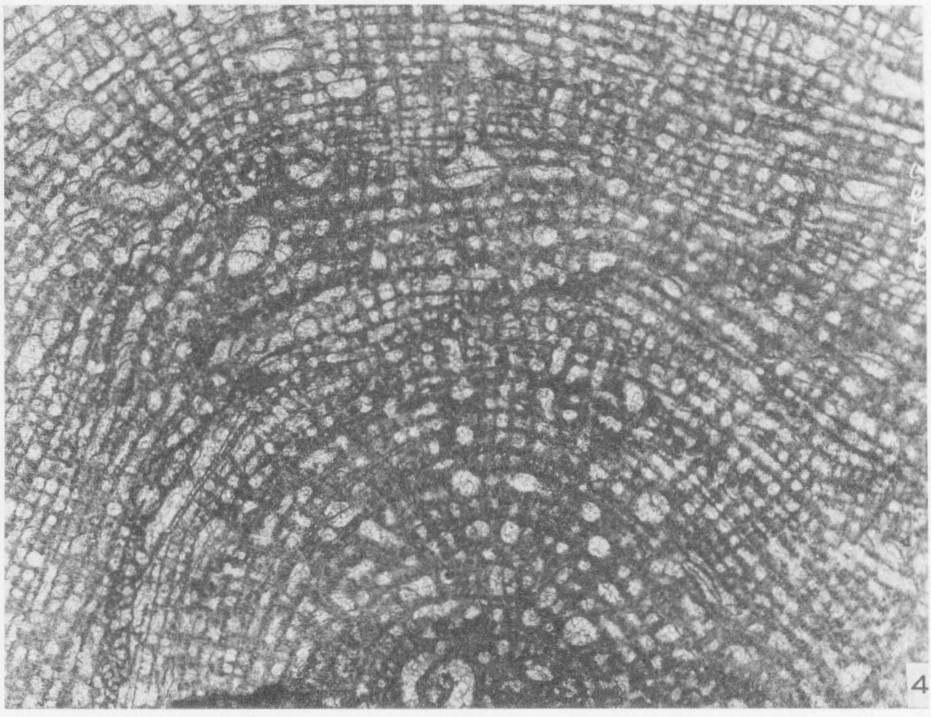

4

PLATE XXVI

Microstructures of Stromatoporoids

(All figures x50)

Figure 1. *Pseudoactinodictyon bullulosum* n. sp. (Page 53)
Vertical section of paratype, GSC No. 18697a, loc. 46301, showing compact pillars and dissepiments.

Figure 2. *Stictostroma maclareni* n. sp. (Page 43)
Vertical section of the holotype, GSC No. 18674a, loc. 30679, showing laminae with median light zone.

Figure 3. *Hammatostroma albertense* Stearn (Page 45)
Vertical section of the holotype, GSC No. 15318, showing fibrous laminae.

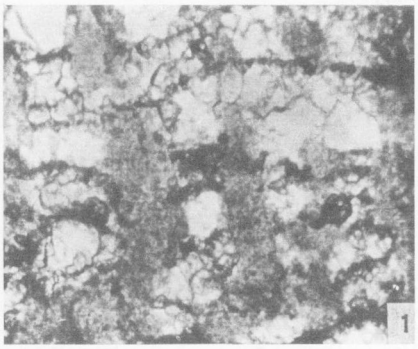
Figure 4. *Trupetostroma saintjeani* n. sp. (Page 49)
Vertical section of the holotype, GSC No. 18685a, loc. 31532, showing vacuolate tissue.

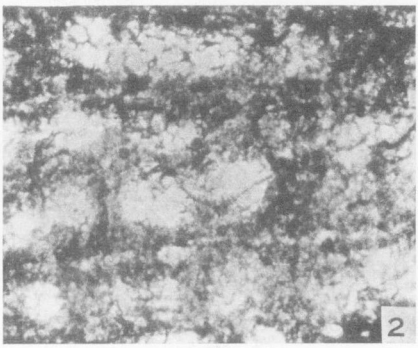
Figure 5. *Ferestromatopora contexta* Stearn (Page 57)
Tangential section of the holotype, GSC No. 16856, loc. 29150, showing melanospheric tissue.

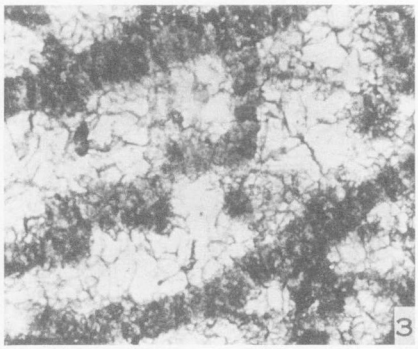
Figure 6. *Atelodictyon stelliferum* Stearn (Page 46)
Vertical section of a hypotype, GSC No. 18683b, loc. 29256, showing two laminae composed of lines of granules and irregular, compact pillar tissue.

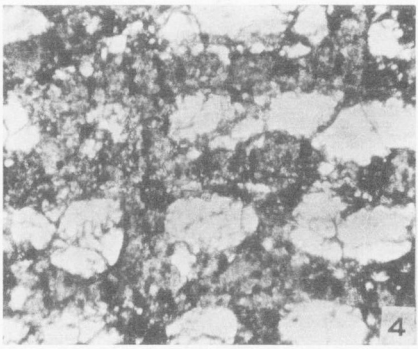
Figure 7. *Ferestromatopora parksi* n. sp. (Page 58)
Vertical section of a hypotype, GSC No. 18702a, loc. 29148, showing obscurely melanospheric tissue.

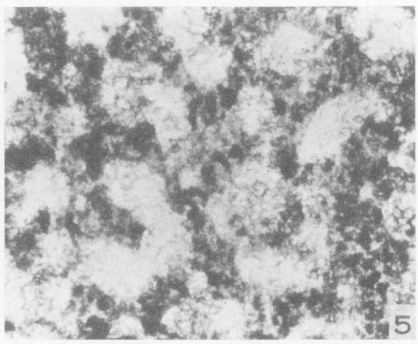
Figure 8. *Anostylostroma phricum* n. sp. (Page 43)
Vertical section of the holotype, GSC No. 18679a, loc. 30747, showing compact laminae and pillars.

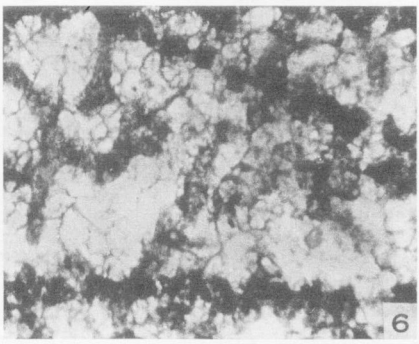

1

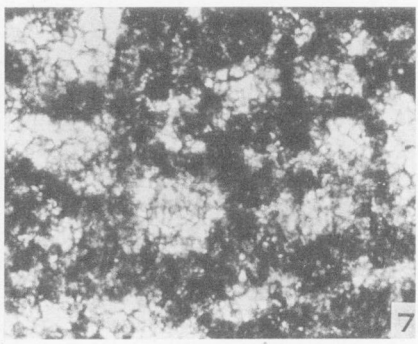

2

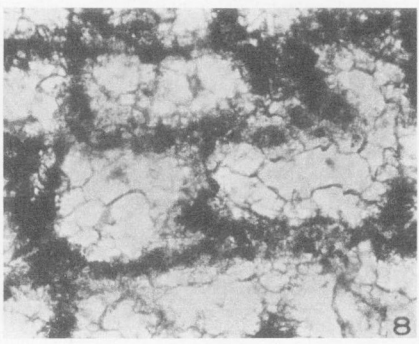

3


4


5


6


7


8

BULLETINS

Geological Survey of Canada

Bulletins present the results of detailed scientific studies on geological or related subjects. Some recent titles are listed below:

105 Diabase-gabbro sills and related rocks of Banks and Victoria Islands, Arctic Archipelago, *by* R.L. Christie, 1964 (75 cents)

106 Surficial geology, Nichicun-Kaniapiskau map-area, Quebec, *by* O. L. Hughes, 1964 ($1.10)

107 Miospores, Mississippian Horton Group, eastern Canada, *by* Goeffrey Playford, 1963 ($2.50)

108 Ordovician stratigraphy of northern Hudson Bay Lowland, Manitoba, *by* S. J. Nelson, 1964 ($1.30)

109 Devonian miospores from the Ghost River Formation, Alberta, *by* D.C. McGregor, 1964 ($1.30)

110 Stratigraphy of the Devonian Miette Reef Complex and associated strata, eastern Jasper National Park, Alberta, *by* E. W. Mountjoy, 1966 ($3.00)

111 Geology, geochemistry, and origin of the lead-zinc-silver deposits of the Keno Hill—Galena Hill area, Yukon Territory, *by* R. W. Boyle, 1965 ($6.50)

112 Groundwater resources of the Lachine-Saint Jean area, Quebec, *by* R. A. Freeze, 1964 ($1.00)

113 The polarographic determination of aluminum in rocks, *by* Marilyn Levine, 1964 ($1.50)

114 Fauna of the Devonian Horn Plateau Formation, District of Mackenzie, *by* D. J. McLaren and A. W. Norris, 1964 ($3.25)

115 Chemical analyses of Canadian rocks, minerals, and ores, by J. A. Maxwell, *et al.*, 1965 ($6.50)

116 Lower Jurassic and Bajocian ammonoid faunas of northwestern British Columbia and southern Yukon, by Hans Frebold, 1964 ($2.00)

117 Canadian fossil Ostracoda: some Silurian species, *by* M. J. Copeland, 1964 ($1.25)

118 Hydrogeochemistry of uranium in the Bancroft-Haliburton region, Ontario, *by* J. A. Chamberlain, 1964 ($1.00)

119 The Jurassic faunas of the Canadian Arctic, Cadoceratinae, *by* Hans Frebold, 1964 ($2.50)

120 *Thorsteinssonoceras*, a new craspeditid ammonite from the Valanginian of Ellesmere Island, Arctic Archipelago, *by* J. A. Jeletzky, 1965 ($1.50)

121 Surficial geology Cornwall and St. Lawrence Seaway project areas, *by* J. Terasmae, 1965 ($2.50)

122 Glacial Lake McConnell and the surficial geology of parts of Slave River and Redstone River map-areas, District of Mackenzie, *by* B. G. Craig, 1965 ($1.00)

123 Latest Lower Triassic ammonoids from Ellesmere Island and northeastern British Columbia, *by* E. T. Tozer, 1965 ($2.00)

124 The structure and metamorphism of Mesa Lake map-area, Northwest Territories, *by* J. V. Ross ($1.00) (In press)

125 Stratigraphy of the Rocky Mountain Group in the southeastern Cordillera of Canada, *by* D. K. Norris, 1965 ($2.75)

126 Feldspar and quartz phenocrysts in the Shingle Creek porphyry, British Columbia, *by* H. H. Bostock, 1966 ($2.00)

127 Ordovician Ostracoda from Lake Timiskaming, Ontario, by M. J. Copeland, 1965 ($2.00)

128 Upper Volgian (latest Jurassic) ammonites and buchias of Arctic Canada, *by* J. A. Jeletzky, 1966 ($2.00)

129 Structural evolution and plutonism in Valhalla gneiss complex, British Columbia, *by* J. E. Reesor, 1965 ($3.25)

130 The copper content of Canadian Shield rocks, Red Lake-Lansdowne House area, northwestern Ontario, *by* R. F. Emslie and R. H. C. Holman (90 cents), (In press)

131 The Permian ammonoids of Arctic Canada, *by* W. W. Nassichuk, W. M. Furnish, and B. F. Glenister, 1965 ($2.00)

132 The Cretaceous Smoky Group, Rocky Mountain Foothills, Alberta and British Columbia, *by* D. F. Stott ($3.75) (In press)

133 Upper Devonian stromatoporoids from the Redwater Reef Complex, Alberta, *by* J. E. Klovan; Upper Devonian stromatoporoids from southern Northwest Territories and northern Alberta, *by* C. W. Stearn 1966 ($4.50)

134 Contributions to Canadian palaeontology: Part I Trilobites from Upper Silurian rocks of the Canadian Arctic Archipelago, *Encrinurus* (*Frammia*) and *Hemiarges;* Part II Ordovician and Silurian tabulate corals *Labyrinthites, Arcturia, Troedssonites, Multisolenia,* and *Boreastor*; Part III A new species of *Hemicystites, by* T. E. Bolton, and G. Winston Sinclair, 1965 ($2.50)

135 Type lithostrotionid corals, Mississippian of western Canada, *by* E. W. Bamber, 1966 ($1.50)

136 Surficial geology of Dawson, Larsen Creek, and Nash Creek map-areas, Yukon Territory, *by* P. Vernon and O. L. Hughes, 1966 ($1.00)

137 A geochemical method of correlation for the Lower Cretaceous strata of Alberta, *by* E. M. Cameron, 1966 ($1.35)

138 Reconnaissance of the surficial geology of northeastern Ellesmere Island, Arctic Archipelago, *by* R. L. Christie, ($1.65) (In press)

139 Groundwater studies in the Assiniboine River drainage basin, *by* Peter Meyboom, Pt. I, 1966 ($2.00)

140 Silurian brachiopods and gastropods of southern New Brunswick, *by* A. J. Boucot, *et al.* ($3.00) (In press)