HINTZE

BRIGHAM YOUNG UNIVERSITY RESEARCH STUDIES

Geology Series Vol. 3 No. 5 July, 1956

A TAXONOMIC STUDY OF THE MISSISSIPPIAN CORALS OF CENTRAL UTAH

by

Del E. Davis

Brigham Young University

Department of Geology

Provo, Utah

A TAXONOMIC STUDY OF THE MISSISSIPPIAN CORALS OF CENTRAL UTAH

A Thesis

Submitted to the

Faculty of the Department of Geology

Brigham Young University

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

by

Del E. Davis

July 1956

ACKNOWLEDGEMENTS

The writer gratefully acknowledges the counsel and advice received from Dr. J. Keith Rigby of the Geology Department of the Brigham Young University in all phases of this research problem.

Thanks are given to Mr. Willis H. Brimhall for his helpful criticism and suggestions relative to the presentation of this thesis. Thanks are also accorded Dr. Kenneth C. Bullock who has read this report.

Appreciation is extended to Mr. Dennis Busch for his companionship in the field and to all of the students who assisted in the field collecting.

Last but by no means least the writer wishes to express his gratitude to his wife Peggy for her understanding, constant encouragement and co-operation throughout the preparation of the manuscript.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

ABSTRACT

The seven stratigraphic sections of Mississippian rocks considered in this thesis are located within an area of twenty-five hundred square miles in central Utah, bounded on the west by Grantsville, Utah, on the north by Timpanogos Cave National Monument, on the east by Provo, Utah, and on the south by Santaquin, Utah.

Thirty-nine species of coral representing fifteen coral genera are recognized in the Mississippian rocks of this region of central Utah. Of the thirty-nine species present, nine species represent the Order Tabulata and thirty species represent the Order Tetracoralla.

Three tentative zones have been erected to assist in the recognition of series time boundaries. A Triplophyllites zone was erected to aid in the recognition of rocks of the Kinderhookian and Osagean series, an Ekvasophyllum-Caninia zone outlines the limits of the Meramacian series, and a Faberophyllum zone characterizes the lower Chesteran series.

Many new forms are believed to be present but further study is necessary to produce a sufficient number of specimens to justify the erection of new genera and species.

INTRODUCTION

PURPOSE

The purpose of this report is to make available information pertaining to the coral faunas of some of the Mississippian rocks of Utah, to provide information which will be useful in the solution of local correlation problems, and to encourage additional detailed work toward zoning the Paleozoic system of rocks in central Utah.

SCOPE OF REPORT

This study is limited to the Mississippian corals collected in seven localities in central Utah, and was made to determine the horizontal and vertical distribution of these forms. A tentative zonation of the Mississippian system is thus made possible.

PREVIOUS WORK

Girty has identified many fossil forms from collections made in mining areas by field parties of the U. S. Geological Survey in central Utah, but he and other early workers did not include descriptions and plates with their faunal lists. Easton and Gutschick (1953) have studied and reported the corals of the Redwall limestone of the Grand Canyon of Arizona, Sloss (1945) has reported on the Mississippian corals of Montana, Easton has studied the Mississippian cuneate corals of Iowa, Indiana, and Missouri, and Parks (1951) has reported some new corals of the Brazier formation (Mississippian) near Logan, Utah.

FIELD WORK

Field collections were made in areas which had been studied and mapped previously by graduate students at the Brigham Young University. The collected formations were subdivided into lower, middle, and upper, the fossils were labeled appropriately as they were collected.

The specimens were secured by systematically traversing a limited portion of the formation. When possible the corals were collected as individuals; when individual collection was impossible, larger blocks were secured for laboratory study.

LABORATORY WORK

In the laboratory, specimens were cut from the blocks by means of a diamond saw and trimmed to a size appropriate for investigation and study. Both transverse and longitudinal sections were made of most specimens, and were studied in thin-section, polished sections, and acetate peels. Acetate peels were made from an acid-etched, polished section after the method of Darrah (1936). All of the above methods proved useful, but polished sections were the most successful. Many of the collected specimens were sufficiently silicified to enable them to be freed from the carbonate matrix by means of dilute hydrochloric acid. The specimens thus secured were studied directly.

LOCATION AND ACCESSIBILITY

The areas which have been studied in this problem are: White Lake Hills, Rock Canyon, American Fork Canyon, Long Ridge, Cedar Valley Hills, and Rattlesnake Spur all in Utah county, and northern Stansbury Mountains in Tooele county (See Fig. 1).

White Lake Hills

Localities in the White Lake Hills are north of the Geneva Steel Company's Keigley Quarry at the south end of West Mountain in the S. E. 1/4 of Section 23, T. 10S., R. 1 E. Salt Lake Base and Meridian. The White Lake Hills are readily accessible from U. S. Highway 91 by proceeding due west from Payson, Utah for approximately four miles.

Rock Canyon

Rock Canyon is located approximately two miles northeast of the Brigham Young University in Section 2, T. 6 S., R. 3 E.

American Fork Canyon

Localities in American Fork Canyon are located near Timpanogos Cave National Monument in the S. W. 1/4 of Section 27, T. 4S., R. 2 E., and are readily accessible from Utah State Highway 80 which extends east from its junction with U. S. Highway 91 approximately 4 miles north of Lehi, Utah.

Long Ridge

The Long Ridge localities are located in West Canyon, 12 miles west of Lehi, Utah, immediately north of Utah State Highway 73, in Sections 18 and 20, in T. 5 S., R. 2 W., and Sections 1 and 12, in T. 4 S., R. 3 W. West Canyon is readily accessible by unimproved county roads which junction with Utah State Highway 73.

Cedar Valley Hills

Localities in the Cedar Valley Hills are on the west side of Lake Mountain in the N. E. 1/4 of Section 32, in T. 7 S., R. 1 W. They are reached by proceeding west from Lehi, Utah on Utah State Highway 68 for approximately 3.5 miles, then south on an oiled road for 1.2 miles, then west on an unimproved road to the collecting area.

Rattlesnake Spur

Rattlesnake Spur is situated in the S. E. 1/4 of Section 1, in T. 9 S., R. 3 W. and is located approximately 2 miles northwest of Allens Tank on Allens Ranch.

Northern Stansbury Mountains

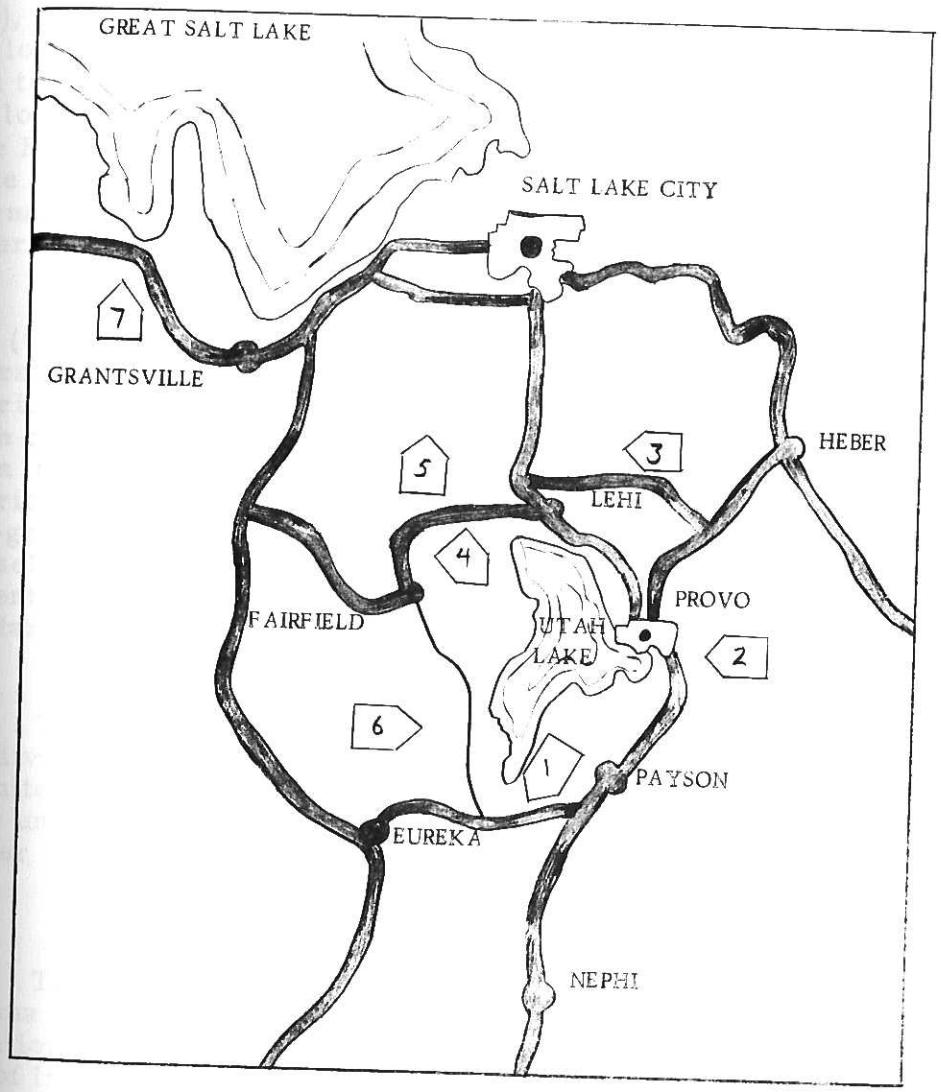
Collections designated as northern Stansbury Mountains were made in and adjacent to the lime quarry in Section 6, of T. 2 S., R. 6W., which is situated 10 miles west of Grantsville, Utah on U. S. Highway 40-50.

STRATIGRAPHY

The ages and formations of the Mississippian System considered in this report are: the Gardner dolomite and the Madison limestone which are Kinderhookian and lower Osagean; The Pine Canyon limestone and the Deseret limestone of upper Osagean and lower Meramacian; The Humbug formation of upper Meramacian; and the Great Blue limestone of lower Chesteran (Geol. Soc. Amer. Bull. Vol. 59). The Manning Canyon shale, overlying the Great Blue limestone, containing the Mississippian-Pensylvanian time boundary was not collected because of its transitional nature, and because the coral faunas of the Great Blue limestone were restricted to the lower parts of the sections in all areas except the northern Stansbury Mountains. In the Rock Canyon section, the most easterly sections collected, no corals were discovered above the Humbug formation.

Gardner Dolomite

The type area for the Gardner dolomite is in the Tintic mining district in Gardner Canyon where it was named and described by Lindgren and Loughlin in 1919. The lower part of the formation is composed largely of dolomite which is fine-grained, somber medium-gray to blue-gray. Some small amounts of chert may be present. Some black, fine-grained, carbonaceous limestone is interbedded in the dolomite. Both the dolomite and the limestone are highly silicious. A black, shaly limestone unit occurs near the top of the formation which contains much pyrite and carbonaceous material. The total thickness ranges from 435 to 700 feet (Lindgren and Loughlin 1919).



INDEX MAP

EXPLANATION

1. White Lake Hills
2. Rock Canyon
3. American Fork Canyon
4. Cedar Valley Hills
5. Long Ridge
6. Rattlesnake Spur
7. Northern Stansbury Mountains

Figure 1

The Gardner dolomite present in the White Lake Hills (White 1954), and in the Cedar Valley Hills (Calderwood 1951), is composed of a lower dark blue-gray dolomite unit and a platy to sub-lithographic, dark to medium blue-gray, thick to thin-bedded limestone upper unit. The lower dolomite unit has a salt and pepper appearance in the White Lake Hills and a sugary texture in the Cedar Valley Hills. In the White Lake Hills the upper unit is platy to sub-lithographic with some alternating dolomite and silicious chert beds. It is a well-bedded fossiliferous limestone in the Cedar Valley Hills.

In American Fork Canyon (Perkins 1955) and at Rattlesnake Spur (Clark 1954), the Gardner dolomite is composed of two units separated by the "Curly Bed" (Lovering 1949). The lower unit in American Fork Canyon is a dark-gray to black arenaceous dolomite which contains some calcite-filled vugs. At Rattlesnake Spur it is a thin to thick-bedded, dark brown to gray-blue limestone. In American Fork Canyon the upper unit of the formation is a thin-bedded, blue-gray limestone which grades from finely-crystalline below to coarsely-crystalline beds above, black to brown chert lenses are present. The upper unit of the Gardner dolomite at Rattlesnake Spur is a dark blue-gray limestone with some finely-crystalline dolomite beds.

The Gardner dolomite in the northern Stansbury Mountains is also divisible into two units. The lower unit is a medium blue, sandy dolomite with a reddish tinge, which contains some cherty beds, the upper unit is a light-gray dolomitic limestone with inter-bedded chert (Heiner 1954).

Madison Limestone

The type area for the Madison Limestone is near Three Forks, Montana where it was described and named by Peale in 1893. The formation is composed of dark, compact, fine-grained, laminated beds of limestone which become blue-gray on a weathered surface. Samples of the formation contain only about ten percent silica (Peale 1893).

In Rock Canyon the Madison limestone is composed of medium gray, thin-bedded, fine-grained shaly, limestone with some dolomitic limestone present (Gaines 1950).

Pine Canyon Limestone

The type area for the Pine Canyon limestone is in the Tintic mining district of central Utah where it was named and described by Lindgren and Loughlin in 1919. The Pine Canyon limestone is composed of two units which alternate at irregular intervals throughout the formation. One unit is a nearly black, thin-bedded, dense limestone, containing much black chert in the form of nodules which approach one foot in diameter. These cherty beds characteristically weather into angular blocks of varying size. The second unit,

commonly found in the upper part of the formation, is a light to medium-gray, medium to coarse-grained, nearly pure limestone with distinct cross-bedding (Lindgren and Loughlin 1919).

The Pine Canyon limestone in the White Lake Hills (White 1954), Cedar Valley Hills (Calderwood 1951), Rattlesnake Spur (Johns 1950), and the northern Stansbury Mountains (Heiner 1954), is composed of medium-gray to blue-gray limestone with some sandy beds and is characterized by the presence of abundant brown to black chert nodules which persist throughout the formation.

Deseret Limestone

The type Deseret Limestone in Dry Canyon of the Ophir mining district near the Deseret Mine was named and described by Gilluly in 1932. The Deseret limestone is composed largely of blue-gray, fine-grained, limestone with varying amounts of black chert in the form of nodules up to three inches in diameter. A few thin beds of sandy limestone and shale are present above a basal bed of black, red weathering shale (Gilluly 1932).

The Deseret limestone, which correlates with the Pine Canyon limestone of the Tintic mining district (Gilluly 1932) occurs in Rock Canyon (Baker 1947, Gaines 1950), and Long Ridge (Gilluly 1932, McFarland 1955). At these localities it is composed of blue-gray limestone and fine-grained dolomitic limestone which contain much black and dark brown chert in the form of bands, nodules, and lenses, the upper part of the formation is less silicious and more calcitic.

In American Fork Canyon the blue-gray limestone of the Deseret contains much dark colored chert but also contains much more dolomite than is customarily present in the Deseret limestone (Gilluly 1932, Baker 1947, Perkins 1955).

Humbug Formation

The Humbug formation, named and described by Tower and Smith in 1897, takes its name from the Humbug Mine in the Tintic mining district. The Humbug formation is composed of fossiliferous limestone with alternating sandy limestone, limy sandstone, and orthoquartzite. Individual beds are not persistant. The limestone ranges from light-gray to blue-gray to blue to black and the sandstone ranges from light-brown to reddish-brown. A light-brown, sandy shale is found at the base of the formation.

The Humbug formation is found in the White Lake Hills (White 1954), in Rock (Gaines 1950), in Long Ridge (McFarland 1955), in the Cedar Valley Hills (Calderwood 1951), in Rattlesnake Spur (Johns 1950), and in the northern Stansbury Mountains (Heiner 1954). It is composed of alternating limestone, sandstone, orthoquartzite,

and small amounts of dolomite at these localities. The limestone is usually blue-gray and may contain some gray to maroon-colored chert and may be arenaceous and cross-bedded in places. The sandstone and quartzite vary from light to dark brown and are fine to coarse-grained. Alternating sandstone and quartzite persist throughout the formation.

The Humbug formation in American Fork Canyon is composed of thin-to-thick-bedded, blue-gray limestone and fine-grained orthoquartzite and sandstone. The limestone and quartzite interfinger and lense out so that individual beds can be traced only with great difficulty (Livingston 1955, Perkins 1955).

Great Blue Limestone

The Great Blue limestone was named in 1894 by Spurr in the Ophir mining district. The formation is composed of a uniformly massive, blue-gray, nearly pure, calcareous limestone which weathers to a pinkish, gray-white. Two persistant carbonaceous and calcareous shale beds are present in the formation, one near the bottom, the other near the top, which are considered to be facies of limestone sedimentation. They usually efferves in dilute acid, the carbonaceous material in the shale is minor. The limestone of this formation shows a very striking thin-bedded to platy appearance before reaching the massive blue limestone above. The thin-bedded to platy appearance is also noticed on weathered surfaces of this massive blue limestone. The weathered limestone has a red and green tint (Spurr 1894).

The Great Blue limestone is exposed in the White Lake Hills (White 1954), in Rock Canyon (Gaines 1950), in the Cedar Valley Hills (Calderwood 1951), in American Fork Canyon (Perkins 1955), in Long Ridge (McFarland 1955), and in the northern Stansbury Mountains (Heiner 1955). It is consistantly a dark blue-gray, thin-bedded to massive, platy, fine-grained, limestone which contains a prominent carbonaceous shale unit (Long Trail shale member) near its base.

SYSTEMATIC PALEONTOLOGY

The specimens herein discussed are in the Brigham Young University Collections and may be referred to by using the locality numbers Y10010 to Y10061 inclusive which have been assigned to this report.

Phylum Coelenterata
Class Anthozoa
Order Tabulata
Family Syringoporidae Milne-Edwards and Haine
Genus Syringopora Goldfuss 1826
Species Syringopora aculeata Girty 1899
Plate 1 Figure 3

1899. Syringopora aculeata Girty, U. S. Geol. Survey, Mon. 32, p. 484
1917. Syringopora aculeata Girty in Ransome, U. S. Geol. Survey Prof. Paper 98, p. 143.
1953. Syringopora aculeata Girty, Easton and Gutschick, Bull. So. Calif. Academy of Sciences, Vol. 52, pt, 1, 1953.

DESCRIPTION: Numberous slender, cylindrical, colonial corals typically without thick walls and with very few lateral processes were collected and studied. The fasciculate corallites are essentially parallel, the theca shows encircling swellings and constrictions which, though shallow, are persistant throughout the length. Lateral processes are present but are widely spaced, when developed they are single, lateral, tubular attachments which are essentially horizontal. Approximately 20 thin and very short septa are present, a reliable count could not be taken because of silicious replacement, 20 septa were counted. The theca is well defined but not thick. The tabulae are recognized as irregularly compressed, excentrically located, concentric ellipses which vary from 7 to 9 in a characteristic transverse section and are extremely closely spaced. In longitudinal section the tabulae occur on both sides of the tubule and occupy about one-third of the diameter. The tabulae are three times as long as thick. The central one-third of the tubule is hollow.

OCCURRENCE: The studied specimens were collected from the lower Gardner dolomite at Rattlesnake Spur, Y10054, the upper Pine Canyon limestone in the Cedar Valley Hills, Y10050; and in the lower Great Blue at Long Ridge, Y10044, (Kinderhookian to lower Chesteran).

DISCUSSION: Syringopora aculeata is identified by its small, cylindrical, fasciculate corallites which are characteristically 1.5 mm. in diameter, and separated by 1.5 to 3 mm. S. aculeata differs from S. surcularia primarily in being smaller in diameter.

Species Syringopora surcularia Girty 1899
Plate 1 Figure 5

1899. Syringopora surcularia Girty, U. S. Geol. Survey, Mon. 32 p. 484.
1953. Syringopora surcularia Girty, Easton and Gutschick, Bull, So. Calif. Academy of Sciences, Vol. 52, pt. 1, 1953.

DESCRIPTION: Eight specimens of this colonial coral were collected and studied. The radially arranged, tubular colonies are typically fasciculate, with cylindrical, sub-parallel corallites 2 to 2.5 mm. in diameter and spaced 2 to 3 mm. apart. The theca is slightly thickened and relatively smooth but marked by small constrictions and irregularities. Lateral cross-connections between the corallites are invariably single and widely spaced. The 24 septs lining the tubules are extremely short. The tabulae are indistinct in longitudinal section due to replacement but can be seen in transverse section as 4 to 8 irregularly spaced, excentrically

located, deformed ellipses concentrically placed in the tubule. In longitudinal section the tabularium occupies one-third of the diameter along each side leaving the remaining one-third on the tubule hollow.

OCCURRENCE: The specimens studied were collected from the lower Gardner dolomite at Rattlesnake Spur, Y10054; the upper Gardner dolomite in the Cedar Valley Hills, Y10047; The upper Madison limestone in Rock Canyon, Y10033; the upper Gardner dolomite in the northern Stansbury Mountains, Y10011; the middle Pine Canyon limestone at Rattlesnake Spur, Y10057; the upper Humbug formation in the northern Stansbury Mountains, Y10017; and the lower Great Blue limestone in the White Lake Hills, Y10029, (Kinderhookian to lower Chesteran).

DISCUSSION: Syringopora surcularia is characterized by tubular corallites which measure 2 to 2.5 mm. in diameter and have 24 short major septa. It differs from S. aculeata by having larger corallites.

Species Syringopora verticillata Goldfuss 1827
Plate I Figure 2

1876. Syringopora verticillata Goldfuss, Rominger, Michigan Geol. Survey, Vol. 3, p. 80.

DESCRIPTION: One colony of corallites composed of parallel to sub-parallel, cylindrical tubules which average 2 mm. in diameter and are from 2 to 3 mm. apart was collected and studied. The corallites, which have an irregularly contorted theca, are connected at intervals of about 7 mm. by transverse cross-branchings. Usually two or more connections are sent out from a given level, which are rarely horizontal but slope upward or downward to the adjacent corallite. Internally the tubules are filled with funnel shaped tabulae.

OCCURRENCE: The single colony studied was collected from the lower Gardner dolomite at Rattlesnake Spur, Y10054, (Kinderhookian).

DISCUSSION: This form differs from other species of Syringopora in the sloping cross-connections which it possesses.

Species Syringopora perelegans Billings 1876
Plate I Figure 1

1876. Syringopora perelegans Billings, Rominger, Michigan Geol. Survey Vol. 3, p. 82.

DESCRIPTION: The numerous specimens collected and studied are completely silicified tubules, ranging from 1.5 to 2 mm. in diameter. Irregular constrictions mark the theca of the corallites. The cylindrical tubules which are fasciculate, and spaced about 4 mm. apart originate from a base of prostrate tubes. The branchings which are reminescent of that seen in Aulopora continue

to grow vertically in a nearly parallel attitude above an open, reticulate, complex net-work of branched, prostrate tubules. The internal structure has been completely lost by replacement. Cross-branchings were not observed on the vertical tubes.

OCCURRENCE: The specimens were collected from the lower Gardner dolomite at Rattlesnake Spur, Y10054, (Kinderhookian).

DISCUSSION: Syringopora perelegans Billings is characterized by the reticulate, prostrate net-work of tubules and the vertical, parallel to sub-parallel, cylindrical tubules which arise from it. S. perelegans differs from S. aculeata by lacking horizontal cross-branchings, and having the complex, reticulate base beneath the nearly vertical tubules. The internal structures could not be compared due to the degree of silicification in S. perelegans.

Syringopora sp. A
Plate 1 Figure 4

DESCRIPTION: Only one heavily replaced specimen was collected of this probably new species. Superficially it resembles S. surcularia, but exceeds it in size and in the spacing of the corallites. Corallites of Syringopora sp. A are 3 to 3.5 mm. in diameter and are from 5 to 7 mm. apart. No septa were observed, probably due to the degree of silicious replacement. Four to six irregularly spaced, distorted, concentric, elliptical tabulae occupy the tubules. Longitudinally the tabulae overlap so that they completely fill the tubule.

OCCURRENCE: This form was found only in the upper Pine Canyon limestone in the Cedar Valley Hills, Y10050, (lower Meramacian).

DISCUSSION: Although Syringopora sp. A resembles S. surcularia superficially it differs greatly from it in having larger corallites which are extremely widely spaced, and having tabulae which completely fill the tubule.

Syringopora sp. B
Plate 1 Figure 6

DESCRIPTION: Fragments of another species of Syringopora, measuring up to 20 mm. in length were collected from three localities. The complete colony was not observed. The sub-cylindrical tubules are up to 5 mm. in diameter and have a smooth thecal surface. Branchings of the tubules are of the normal budding type and occur at intervals of about 10mm. The internal structure shows a series of 4 or more loosely spaced, excentrically located, deformed tabulae in the form of ellipses. The internal structure was not studied. Septa were not observed.

OCCURRENCE: Specimens of this species were collected from the lower Gardner dolomite in the northern Stansbury Mountains, Y10010; from the upper Gardner dolomite in the White Lake Hills, Y10021; and at Rattlesnake Spur, Y10054, (Kinderhookian and lower Osagean).

DISCUSSION: This form strongly resembles S. surcularia in all features except that it is much larger. The internal structure could not be compared due to excessive replacement by silica.

Family Favositidae Milne-Edwards and Haime
Genus Pleurodictyum Goldfuss 1829
Species Pleurodictyum expansum Easton and Gutschick 1953
Plate 2 Figure 5

1880. Pleurodictyum expansum White 1880
1944. Pleurodictyum expansum Easton, Ill, Geol. Survey Rept. Inv. 97, p. 55 contains prior synonomy.

DESCRIPTION: The four specimens collected are colonial corals, with rectangular to hexagonal corallites, arranged in a radial pattern. The figured colony, measuring 23 mm. in length by 18 mm. in width by 13 mm. thick, is the largest and most completely preserved in the collection. Individual corallites are roughly hexagonal with a calyx measurement which ranges from 4 to 6.5 mm. in diameter. The calyx is deep and steeply tapered with a calyx wall from .6 to .8 mm. thick. The calyx is lined with approximately 30 very short septa. Traces of septa on the rim of the calyx forms faint crenulations. A longitudinal section was not made of this form so the number of tabulae per unit length was not determined.

OCCURRENCE: Specimens were collected from the upper Gardner dolomite of the White Lake Hills, Y10022, Rattlesnake Spur, Y10055, and the northern Stansbury Mountains, Y10011, (lower Osagean).

Family Auloporidae
Genus Aulopora Goldfuss 1829
Aulopora sp.
Plate 2 Figure 6

DESCRIPTION: Several fragments of colonies were collected which are composed of tubules 2 mm. in diameter at their expanded, distal ends. The corallites are conical, horn shaped, tubular expansions which have an essentially smooth theca and have no visible internal structures. The tubules are prostrate, with an upturned calical opening which, after bending to the vertical, ceases to grow. Branching occurs at the basal part of the upturned calyx and may be single or double. The new bud is quite constricted and gradually expands, cone fashion, until a new calyx is formed from which new branching and budding may occur. The growth of the extensions need not always be linear but are often in a random direction resulting in a complex colony of essentially horizontal corallites.

OCCURRENCE: This form was observed in the lower Gardner dolomite at the White Lake Hills, Y10021, (Kinderhookian).

Order Tabulata
Multithecopora sp.
Plate 2 Figure 4

DESCRIPTION: Numerous specimens of this colonical coral composed of reticulate tubules 2 mm. in diameter were collected. There are no horizontal cross-connections between the tubules. Proliferation of the colony is by a budding type of branching, which continues until a complex network of tubules is formed. The budding of a new tubule may be in any direction and from any point on the tubule. Some of the branchings take the form of elongate, greatly tapered, ceratoid tubules while others are cylindrical along their entire length.

OCCURRENCE: Specimens were collected from the lower and upper Gardner dolomite at Rattlesnake Spur, Y10054, and Y10055; from the upper Gardner dolomite at White Lake Hills, Y10022; Cedar Valley Hills, Y10047; and the northern Stansbury Mountains, Y10011, (Kinderhookian and lower Osagean).

Order Tetracoralla
Family Amplexidae Chapman
Genus Amplexus Sowerby 1814
Species Amplexus expansus Easton 1945
Plate 1 Figure 7

1945. Amplexus expansus Easton, Jour. of Paleo., Vol. 19, p. 629.

DESCRIPTION: Numerous silicious, ceratoid to trochoid corals with a slight curvature were collected. The average dimension is about 11 mm. in diameter at the top of the calyx, by 22 mm. in length. The figured specimen is 15 mm. in diameter at the calyx and is 34 mm. in length. Well defined longitudinal grooves and furrows and pronounced circular constrictions and expansions characterize the theca. Major contortions are present near the apical end of the corallite. The distal end of the corallite is broadly expanded. No fossula or axial structure is present in any of the specimens studied.

The calyx is very deep, approximating two-thirds of the length of the corallite, and the calyx wall is very steeply tapered. There are 30 to 34 radially arranged, amplexoid septa of which none reach the axis. No minor septa were observed. The tabulae are steeply inclined at their peripheral limits, the internal attitude of the tabulae was not observed.

OCCURRENCE: The numerous specimens studied were collected from the lower Gardner dolomite in the White Lake Hills, Y10021; and the northern Stansbury Mountains, Y10010; and from the upper Gardner dolomite at Rattlesnake Spur, Y10055, (Kinderhookian to lower Osagean).

DISCUSSION: Amplexus expansus is characterized by the flaring or expansion of the corallite in the distal portions, the irregular contorted appearance of the proximal regions, the flattening of the apical end to accommodate attachment, and the very fine circular striations which can be observed on the theca of specimens which have not been subjected to excessive abrasion.

Species Amplexus genicluatus Worthen 1890
Plate 1 Figure 8

1890. Amplexus geniculatus Worthen 1890.
1945. Amplexus geniculatus Worthen 1890, Easton, Jour. of Paleo., Vol. 19, p. 630.

DESCRIPTION: Five silicified forms were collected which have an average dimension of 10 mm. in diameter at the calyx by 30 mm. in length. The figured specimen measures 10 mm. in diameter at the calyx by 35 mm. in length. The medium sized, slightly curved, cylindrical corallites become strongly curved to geniculate near the apical end. Well defined longitudinal grooves and ridges and circular constrictions and expansions mark the theca. The calyx is very deep, approximating one-third of the length of the corallite. The calyx wall is nearly vertical and is lined with 24 very thin, typically amplexoid septa. No axial structure, minor septa, or fossulae were present in any of the studied specimens. The tabulae are steeply inclined at their peripheral edges, the internal nature of the tabulae was not studied.

OCCURRENCE: The studied forms were collected from the lower Gardner dolomite in the northern Stansbury Mountains, Y10010; the lower and upper Gardner dolomite in the White Lake Hills, Y10021, and Y10022; and the upper Gardner dolomite at Rattlesnake Spur, Y10055, (Kinderhookian and lower Osagean).

DISCUSSION: Amplexus geniculatus is characterized by the medium sized, slender, cylindrical corallites which are usually geniculate near the apical end, and by the prominent well defined longitudinal septal ridges and grooves on the theca. A. geniculatus differs from A. expansus in its smaller number of major septa, in its more cylindrical form, and in its smaller size.

Species Amplexus dilatatus Easton 1945
Plate 1 Figure 9

1920. Caninia n. sp. Weller, 1920, Ill. Geol. Survey Bull. 41, pp. 170-173.
1945. Amplexus dilatatus Easton, Jour. of Paleo. Vol. 19, p. 628.

DESCRIPTION: Four silicified specimens were collected and studied which have an average dimension of 8 mm. in diameter at the calyx by 23 mm. in length. The corallites are small, curved, trochoid to ceratoid, with thecal wrinkles. Faint longitudinal straitions (probably the external manifestations of septal ridges and furrows) are present. Circular constrictions and expansions are

marked in the ceratoid, apical portion of the corallite and are less marked in the trochoid area near the calyx. Faint spines are present on the theca near the apex in the ceratoid area.

The calyx is deep and steep walled, occupying approximately one-third of the length of the corallite. The calyx is lined with 25 notably thin major septa which extend about one-half of the distance to the axis. The minor septa correspond in number to the major septa but are short. The theca is very thick and appears to have grown over the calyx giving it extra thickness. Tabulae were not observed.

OCCURRENCE: The four specimens studied were collected from the lower Gardner dolomite in the White Lake Hills, Y10021, (Kinderhookian).

DISCUSSION: Amplexus dilatatus is characterized by its small to medium size, gently curved cone shape, the development of minor septa and the presence of sparse spines in the apical part of the corallite. A. dilatatus differs from the other Amplexus species studied in the possession of thecal spines, minor septa, and in lacking a geniculate form and in lacking excessive expansion in the region of the calyx.

Family Hapsiphyllidae Grabau
Genus Hapsiphyllum Simpson 1900
Species Hapsiphyllum sp. A.
Plate 4 Figure 5

DESCRIPTION: This genus is represented in the collection by a single, small specimen encased in dense limestone. The corallite in the cut section measures 7 mm. in diameter. The length is unknown. The calyx was not observed. The cardinal fossula is elongate, reaching the axis. The cardinal septum is very short. The counter cardinal septum is shorter than the adjacent major septa and does not reach the axis. The cardinal lateral septa are long and form the walls of the fossula.

There are 24 major septa present with their axial ends fused and expanded to form a heavy axial structure. The minor septa are usually one-third as long as the major septa and are fused at their axial ends to the adjacent major septa. Tabulae and dissepiments were not observed.

OCCURRENCE: The single specimen collected and studied was taken from the lower Pine Canyon limestone in the White Lake Hills, Y10023, (upper Osagean).

Genus Triplophyllites Easton 1944
Species Triplophyllites (Triplophyllites) ellipticus White 1862
Plate 4 Figure 6

1865. Zaphrentis elliptica White, Boston Soc. Nat. Hist. Proc. Vol. 9 p. 31.

1951. Triplophyllites (Triplophyllites) ellipticus White, Easton, Jour. of Paleo. Vol. 25, p. 393 contains prior synonomy.

DESCRIPTION: The thirteen specimens of this small, gently curved, trochoid, solitary coral which were collected have dimensions of 8 to 12 mm. in diameter and from 15 to 26 mm. in length. The figured specimen is 10 mm. in diameter at the top of the calyx by 22 mm. in length. The corallites may be compressed parallel to or perpendicular to the cardinal fossula which is located on the side of convex curvature. The theca is marked with very faint longitudinal ridges and furrows and with distinct, but minor constrictions and expansions throughout the length of the corallite.

The calyx is deep with steep walls and nearly flat floor. The cardinal fossula is narrow at the theca but expands toward the axis. Alar fossulae are obscure. The fossular wall is formed by the fused ends of the major septa. The cardinal septum is distinguishable with difficulty from the adjacent major septa. There are 34 major septa excluding the cardinal and the counter cardinal septa, with an equal number of very short minors which are extremely thin. The cardinal quadrants have 8 major septa, the counter quadrants have 9 major septa.

OCCURRENCE: Specimens of this species were collected from the lower and upper Gardner dolomite in the northern Stansbury Mountains, Y10010, and Y10011; the upper Gardner dolomite in the White Lake Hills, Y10022; and the lower Humbug formation in the Cedar Valley Hills, Y10052, (Kinderhookian to upper Meramacian).

DISCUSSION: Triplophyllites ellipticus is characterized by the septal count in each quadrant at a given diameter and by having a fossula formed by the fused ends of the major septa.

Species Triplophyllites (Homalophyllites) reversus Worthen 1890
Plate 4 Figure 11

1889. Zaphrentis reversa Miller, North American Geology and Palaeontology, p. 210, (nomen nudum).
1951. Triplophyllites (Homalophyllites) reversus Easton, Jour. of Paleo. Vol. 25, p. 398.

DESCRIPTION: A single, medium sized gently curved to nearly straight, specimen of this coral was collected. The corallite is compressed parallel to the cardinal fossula. The theca shows distinct longitudinal str ions which correspond to the internal septa, and widely spaced minor constrictions and expansions along the length of the corallite, the figured specimen measures 18 by 22 mm. at the calyx and is 45 mm. in length, with the apical tip missing. The calyx appears to have been very deep with moderately steep walls, but erosion has beveled the calyx wall until this can only be a supposition.

The cardinal fossula is prominent, deep and expanded greatly at the axis. The fossular wall is formed by the fused ends of the major septa. Alar fossulae are well defined. The cardinal septum

extends along the floor of the fossula to the axis but is very short above the fossular floor. The counter septum is slightly longer than the adjacent major septa. There are 50 major septa, 10 of which are in each cardinal quadrant, and 14 major septa in the left counter quadrant and 16 major septa in the right counter quadrant. Minor septa are present only in the counter quadrants and there occur as very short septal ridges or swellings.

OCCURRENCE: The single specimen studied was collected from the lower Gardner dolomite in the northern Stansbury Mountains, Y10010, (Kinderhookian).

DISCUSSION: Triplophyllites reversus is identified by its high number of major septa and their characteristic placement in the various quadrants, and by the presence of minor septa in the counter quadrants only.

Species Triplophyllites (Homalophyllites) subcrassus Easton and Gutschick 1953

Plate 4 Figure 14

1953. Triplophyllites (Homalophyllites) subcrassus Easton and Gutschick, Bull. So. Calif. Academy of Sciences, Vol. 52, pt. 1, 1953.

DESCRIPTION: Numerous specimens of this small, gently curved, cone-shaped, solitary coral were collected. The corallites may be compressed parallel or perpendicular to the cardinal fossula which is located on the side of convex curvature, and range in size from 6 mm. in diameter and 12 mm. in length to 12 mm. in diameter by 22 mm. in length. The figured specimen measures 10 by 11 mm. in diameter at the top of the calyx and is 22 mm. long.

The theca is marked with faint longitudinal ridges and furrows and with distinct constrictions and expansions along the entire length of the corallite. The corallites are essentially a straight conical form but with considerable curvature in the apical region.

The calyx is deep and may be compressed parallel to or perpendicular to the cardinal fossula. The walls of the calyx are nearly vertical and may or may not be thickened. The calyx floor is flat. The cardinal fossula broadens toward the axis. The cardinal septum is very short through continuous along the floor of the fossula. The counter septum is distinguishable only with difficulty from the adjacent major septa. Alar fossulae are absent. There are 28 major septa excluding the cardinal and counter cardinal septa, 7 are found in each quadrant. In slightly larger specimens 8 major septa are found in each quadrant. The major septa may be dilated peripherally but become thin toward the axis. The minor septa equal the majors in number but are only about one-half as thick.

OCCURRENCE: This species occurs in the upper Gardner dolomite in the northern Stansbury Mountains, Y10011; and in the Cedar

Hills, Y10047; and in the upper Madison limestone in Rock Canyon, Y10032, (lower Osagean).

DISCUSSION: This species is characterized by the presence of 7 major septa in each quadrant, and by minor septa which are one-half as thick as the majors. T. subcrassus differs from T. paucicinctus in being somewhat smaller and possessing major septa which are more slender, and which do not form a marked sclereotheca.

Species Triplophyllites (Homalophyllites) paucicinctus
Easton and Gutschick 1953
Plate 4 Figure 13

1953. Triplophyllites (Homalophyllites) paucicinctus Easton and Gutschick, Bull. So. Calif. Academy of Sciences Vol. 52, pt. 1, 1953.

DESCRIPTION: Numerous small to medium sized, trochoid to ceratoid, solitary coral of this species were collected and studied. The calicies are generally nearly circular but may be compressed parallel to the cardinal fossula which lies on the side on convex curvature. The specimens, with the exception of three incomplete silicified forms, were encased in dense limestone preventing an accurate length measurement to be made. The specimens range in size from 12 mm. to 26 mm. in diameter. One incomplete silicified fragment with a diameter of 24 mm. is 38 mm. long. The figured specimen is 19 mm. in diameter at the calyx and is 15 mm. in length with the apical end broken off at a diameter of 12 mm.

The theca may be very thick and is marked with faint longitudinal straitions and circular constrictions and expansions. The calyx is moderately deep, with gently sloping walls, and may be divided into three unequal areas by the cardinal and alar fossulae. The cardinal fossula, on the side of convex curvature, is prominent, deep and tapers broadly toward the axis beyond which it extends slightly. The alar fossulae are prominent. The cardinal septum is short but continuous along the peripheral edge of the fossula. The septa are radially arranged when the corallite is not compressed. There are 46 major septa with an equal number of minor septa which are one-fourth the length of the majors, and about one-half as thick. There are 11 major septa in each quadrant. Some specimens show the major septa in the cardinal quadrants to be expanded so that they almost touch. In the counter quadrants the septa are thinner and crowding does not exist.

OCCURRENCE: This species occurs in the upper Madison limestone in Rock Canyon, Y10032; in the lower Pine Canyon limestone in the White Lake Hills, Y10023; in the middle Pine Canyon limestone in the Cedar Valley Hills and in Rock Canyon, Y10049, and Y10035; and in the upper Pine Canyon limestone in the White Lake Hills, and the Cedar Valley Hills, Y10025; Y10050, (Osagean to middle Meramacian).

DISCUSSION: Triplophyllites paucicinctus is characterized by a very deep calyx which may be divided into three unequal areas by the cardinal and alar fossulae, by a thickened theca, by the presence of 11 major septa in each quadrant. The major septa in the cardinal quadrants may be expanded to give a crowded appearance, and the minor septa which are one-fourth the length of the majors and one-half as thick. T. paucicinctus differs from other species of this genus by its thickened theca, the triparate arrangement of the deep fossula, and the crowded arrangement of the major septa in the cardinal quadrants.

Species Triplophyllites (Homalophyllites) compressus Milne-Edwards 1857

Plate 4 Figure 1

1857. Zaphrentis compressa Milne-Edwards, Historie Naturelle des Coralliaires au Polypes Proprement Dits, Atlas, pl. G1.

1951. Triplophyllites (Homalophyllites) compressus Milne-Edwards 1857, Easton, Jour. of Paleo. Vol. 25, p. 399, contains the complete synonomy.

DESCRIPTION: Numerous small, gently curved, trochoid to cone-shaped, solitary corals were collected and studied. The corallites have an average diameter of 5 mm. and length of 12 mm., and may be compressed parallel to the cardinal fossula. The figured specimen measures 7 mm. by 6 mm. in diameter at the calyx and is 16 mm. in length. The theca is marked with faint longitudinal ridges and furrows which correspond to the septa. Irregular compressions and expansions are present on the thecal surface of the corallite. The gentle curving of the corallite is most pronounced in the apical area.

The calyx is deep with steeply sloping walls, and flat floor. A prominent cardinal fossula of uniform width is located on the side of convex curvature and extends beyond the axis. The fused ends of the major septa form the fossular wall. The cardinal septum is very short but persists to the axis along the floor of the fossula. The counter septum is slightly longer and higher than the adjacent major septa at the axis but is indistinguishable from them otherwise. There are 22 major septa, excluding the cardinal and counter cardinal septa, with an equal number of short minor septa present. Four major septa occur in each cardinal quadrant and 7 major septa occur in each counter quadrant. Alar fossulae are usually absent.

OCCURRENCE: This species was collected from the lower and upper Gardner dolomite in the northern Stansbury Mountains, Y10010, and Y10011, (Kinderhookian and lower Osagean).

DISCUSSION: Triplophyllites compressus is characterized by 22 major septa of which 4 are located in each cardinal quadrant and 7 in each counter quadrant, by a counter septum which is slightly longer and higher than the adjacent majors, and by a fossula which

extends beyond the axis. T. compressus differs from T. compressus var. lanceolatus in having two more major septa and a fossula which extends beyond the axis.

Species Triplophyllites (Homalophyllites) compressus Var. lanceolatus Worthen 1890
Plate 4 Figure 2

1890. Zaphrentis lanceolatus Worthen, Geol Survey Ill. Vol. 8. p. 67.
1941. Triplophyllites (Homalophyllites) compressus var. lanceolatus Worthen 1890, Easton, 1951, Jour. of Paleo. Vol. 25, p. 401 contains complete synonomy.

DISCUSSION: Triplophyllites compressus var. lanceolatus possesses essentially the same characteristics and morphological features as have been described for T. compressus with the exception that each counter quadrant possesses 6 major septa while T. compressus has 7 major septa, and the parallel sided cardinal fossula reaches only to the axis and not beyond it as is the case with T. compressus.

OCCURRENCE: This common form was found in the upper Gardner dolomite in the northern Stansbury Mountains, Y10011, (lower Osagean).

Species Triplophyllites compressus var. A
Plate 4 Figure 8

DISCUSSION: The variety designated as Triplophyllites compressus var. A has essentially the same size, characteristics, and morphological features as have been described for T. compressus except that each counter quadrant possesses 8 major septa as compared to 7 found in T. compressus and 6 found in T. compressus var. lanceolatus, and that the calyx walls appear to be more steeply inclined making possible a more expansive, level calical floor.

OCCURRENCE: Triplophyllites compressus var. A occurs in the upper Gardner dolomite in the northern Stansbury Mountains, Y10011, (lower Osagean).

Triplophyllites sp. A
Plate 4 Figure 12

DESCRIPTION: Five medium sized, uniquely formed specimens of this possibly new species were collected and studied. The corallites have an average diameter of 18 mm. and a length of 26 mm. The figured specimen is 21 mm. in diameter and is 29 mm. in length. The corallites possess an extremely flared calyx which tapers rapidly to a very sharp apical end. The nearly smooth theca displays the irregular constrictions and expansions typical of the genus Troplophyllites. The circular calyx is shallow with gently sloping walls.

The prominent cardinal fossula, located about 40 degress from the side of concave curvature, is deep, wide, becoming considerably expanded axially, reaches beyond the axis. The fossular

wall is formed by the fused ends of the major septa. The cardinal septum is short but persists to the axis along the floor of the fossula. The counter septum is lower and shorter than the adjacent major septa. The alar pseudo-fossulae are prominent. The alar septa are very short.

The 42 major septa are arranged so that 9 fall into each cardinal quadrant and 12 fall into each counter quadrant. The alternating minor septa are about one-third as long as the major septa and are equally as thick at the periphery of the calyx. No tabulae were observed.

OCCURRENCE: These forms were collected from the middle Humbug formation at White Lake Hills, Y10027, (upper Meramacian).

DISCUSSION: Triplophyllites sp. A most closely resembles T. persimilis Easton and Gutschick, except that it is larger, has more major septa, and displays an expanded cardinal fossula.

Triplophyllites sp. B
Plate 4 Figure 10

DESCRIPTION: The four specimens of this new species, though strongly resembling Triplophyllites sp. A of this paper in most details, is slightly smaller. The figured specimen however is 20 mm. in diameter at the top of the calyx by 29 mm. in length. The 42 major septa are arranged so that 10 fall into each cardinal quadrant and 11 fall into each counter quadrant. The major septa are thickened, while the alternating minor septa are very short and about one-half as thick as the majors.

OCCURRENCE: This form was collected from the middle Humbug formation at White Lake Hills, Y10027, (upper Meramacian).

DISCUSSION: Triplophyllites sp. B differs from Triplophyllites sp. A in the possession of thickened major septa arranged 10 in each cardinal and 11 in each counter quadrant, and by having short minor septa one-half as thick as the major septa.

Family Caniniidae Hill
Genus Caninia Michelin 1840
Species Caninia sp. B of Parks 1951

DESCRIPTION: The seven specimens of this species collected and studied are extremely poorly preserved and the structural detail is greatly obscured by replacement. The corallites were generally encased in dense limestone, though fragments were studied which protruded from the matrix. Average specimens are about 20mm. in diameter with the length unknown, due to their fragmental condition in the preserved form.

The external characters of the corallites are notably irregular, for the theca has been completely lost through erosion or poor preser-

vation. The calyx was not observed, but it is believed to be very deep (see discussion). Approximately 46 thickened major septa are present and all project one-half the distance to the axis. No minor septa were observed. Steeply inclined, elongate dissepiments are prominent and occupy the peripheral one-third of the eroded corallite. The thickness of the dissepimentarium is unknown because of the eroded condition of the specimens. Tabulae are prominent, being generally nearly horizontal except at their junction with the dissepimentarium where they dip down sharply.

OCCURRENCE: The specimens studied were collected from the lower Gardner dolomite of Rattlesnake Spur, Y10054; the middle and upper Pine Canyon limestone of the Cedar Valley Hills, Y10049 and Y10050, (Kinderhookian to lower Meramacian).

DISCUSSION: The deep calyx is believed to be present because transverse sections through various specimens show the major septa fail to reach the axis and no axial structure was observed. Failure of the tabulae to remain intact after death of the animal may also be the cause of the hollow, deep calyx.

Caninia sp. B of Parks is characterized by the presence of 46, thickened, major septa at a diameter of 34 by 44 mm., by complete, horizontal tabulae which dip downward at their junction with the dissepimentarium, by a dissepimentarium which occupies roughly one-third of the diameter, and the absence of minor septa. Caninia sp. B of Parks differs from Caninia sp. A of this paper by its larger size and more numerous major septa. This form is not figured because of its poor state of preservation.

Caninia sp. A
Plate 4 Figure 7

DESCRIPTION: A single, highly compressed specimen of unknown length which measures 13 by 21 mm in diameter was collected and studied. The corallite is severely eroded and the theca is completely lost. The 46 major septa are somewhat expanded and reach three-fourth of the distance to the axis. No minor septa were observed. A longitudinal section reveals a very thin dissepimentarium composed of numerous minute dissepiments. The true thickness of the dissepimentarium is unknown because of erosion. The closely packed tabulae exhibit a tent-like appearance at the axis but become roughly horizontal and then dip sharply at the peripheral reaches of the tabularium.

OCCURRENCE: The single specimen studied was collected from the upper Madison limestone in Rock Canyon, Y10033, (Osagean).

DISCUSSION: The identifying features of Caninia sp. A are 46 somewhat expanded major septa which reach three-fourths of the distance to the axis, a very thin dissepimentarium composed of numerous dissepiments, and closely packed tent-shaped tabulae

which dip sharply at their peripheral limits. Caninia sp. A differs from Caninia sp. B of Parks by possessing longer major septa, a narrower dissepimentarium composed of smaller dissepiments and closely packed tent-shaped tabulae which dip at their junction with the dissepimentarium. It differs from Caninia sp. C of this paper by possessing fewer major septa and by being more compressed.

Caninia sp. C
Plate 4 Figure 15

DESCRIPTION: The three specimens studied are very poorly preserved, ceratoid to sub-cylindrical, solitary corals, the corallites are gently compressed, with a diameter of about 15 by 18mm. and unknown length, although the figured specimen is 63 mm. long it is incomplete. No minor septa were observed but 38 to 40 expanded major septa are present. The internal structure could not be studied due to the extreme degree of silicification.

OCCURRENCE: The three specimens studied were collected from the upper Madison limestone in Rock Canyon, Y10033; and the upper Gardner dolomite in the northern Stansbury Mountains, Y10011, (Osagean).

DISCUSSION: Caninia sp. C was erected largely on its reduced number of major septa.

Family Clisiophyllidae Nickolson and Thompson
Genus Faberophyllum Parks 1951
Species Faberophyllum araneosum Parks 1951
Plate 3 Figure 4

1951. Faberophyllum araneosum Parks, Jour. of Paleo. Vol. 25, p. 178.

DESCRIPTION: The six specimens collected and studied are large, gently curved, trochoid to sub-cylindrical, solitary corals. The one specimen not completely encased in dense limestone is incomplete, but measures 31 mm. by 36 mm. in diameter and is 46 mm. in length. Other sawed specimens have diameter dimensions of 22 mm. by 30 mm., 29 mm. by 38 mm., and 24 mm. by 33 mm. The figured specimen is 30 mm. by 37 mm. in diameter and of unknown length. The corallites are gently compressed parallel to the fossula which lies on the side of convex curvature. Faint longitudinal ridges and furrows which correspond to the septa, and circular irregularities in the form of compressions and expansions characterize the external surface of the theca.

The calyx was not observed due to encasement of the specimens in dense limestone. The prominent, narrow, cardinal fossula is closed by the fused ends of the pinnate septa which surround it, otherwise the septa are radially arranged. The 60 to 64 major septa which are present may or may not reach the axis. The minor septa equal the number of majors but are only one-half as long. An axial structure may or may not be present. When one is present the

septa reach only three-fourths of the radius on the corallite. The cardinal septum is short, while the counter septum is only three-fourths as long as the adjacent septa. Alar septa equal the adjacent major septa in length. The dissepimentarium occupies one-half of the radius. The dissepiments are steeply inclined, flattened, elongate, and number 5 to 7 in a 5 mm. distance. The tabulae are steeply upturned at the periphery of the tabularium, otherwise they are nearly horizontal. When an axial structure is present, the tabulae show a turbulent arrangement in the axial area.

OCCURRENCE: The specimens were collected from the lower Great Blue limestone at Long Ridge, Y10044; and from the middle Great Blue limestone in the northern Stansbury Mountains, Y10019, (lower Chesteran).

DISCUSSION: Faberophyllum araneosum is characterized by a diameter dimension ranging from 28 to 35 mm. and the possession of 60 to 64 major septa at these dimensions. F. araneosum differs from F. occultum by being smaller in diameter and from F. pisgahense in being larger and possessing more major septa. The specimens at hand differ from the material described by Parks in being generally smaller and in possessing a fewer number of major septa, and in not possessing pronounced axial structures.

Species Faberophyllum occultum Parks 1951
Plate 3 Figure 7

1951. Faberophyllum occultum Parks, Jour. of Paleo. Vol. 25, p. 177.

DESCRIPTION: The two specimens studied are large solitary corals, one of which is a completely silicified fragment measuring 40 by 50 mm. at the calyx. The figured specimen was encased in dense limestone and measured 42 by 44 mm. in diameter where it was cut. The length of the specimens is not known. The character of the theca of the specimens at hand is unknown for it is silicified and eroded into the dissepimentarium. The corallites are sub-cylindrical with the cardinal fossula on the side of convex curvature, and may be compressed parallel to the fossula.

The calyx is shallow with gently sloping walls. A contorted axial structure composed of the attenuated ends of some of the major septa is present. The prominent cardinal fossula does not reach the axis and is closed by the ends of the pinnate major septa which lie adjacent to it. Sixth-one to 69 major septa are present. The septa are radially arranged except around the fossula where they are pinnate. The major septa generally reach only three-fourths of the radius. The minor septa, which equal the majors in number, extend only one-third of the radius. The cardinal septum is short. The counter septum is shorter than the adjacent major septa. The alar septa are equal in length to the adjacent major septa. The dissepimentarium occupies approximately one-half of the radius. The dissepiments are elongate ovals and are steeply inclined. The tabulae are incomplete and extend horizontally across the tabularium to

become steeply upturned at their peripheral limits so that they merge with the dissepiments. The tabulae number 5 to 7 in a 5 mm. distance, but are more numerous at the periphery of the tabularium.

OCCURRENCE: The two specimens collected were taken from the middle Great Blue limestone in the northern Stansbury Mountains, Y10019, (Chesteran).

DISCUSSION: Faberophyllum occultum is characterized by its large size (40 to 50 mm. in diameter), and the possession of 61 to 69 major septa at this dimension. F. occultum differs from F. araneosum in being larger and from F. pisgahense in being larger and possessing more major septa. The F. occultum described by Parks did not reach the size observed in this report though the septal counts in both reports correspond favorably. The numerous tabulae at the periphery of the tabularium as reported by Parks was also observed by the writer in the present study.

Species Faberophyllum pisgahense Parks 1951
Plate 3 Figure 5

1951. Faberophyllum pisgahense Parks, Jour. of Paleo. Vol. 25, p. 179.

DESCRIPTION: The four specimens collected and studied are medium sized, gently curved, trochoid to sub-cylindrical, solitary corals. Three specimens are completely silicified and measure 24 by 33 mm. in diameter at the calyx by 68 mm. in length, 25 by 26 mm. at the calyx by 41 mm. in length with the apical end broken at a diameter of 18 mm. The figured specimen was encased in dense limestone and measured 28 by 34 mm. where it was cut, the length of this specimen could not be determined. The calyx is shallow with gently sloping walls. A weak axial structure projects slightly above the floor of the calyx. The cardinal fossula is prominent but narrow and reaches nearly to the axis.

The 59 to 64 major septa, although generally radially arranged tend to form palmate groups at their axial ends, and are pinnate around the fossula. The major septa do not reach the axis but the palmate ends of groups extend to the axis and form the weak axial structure which is present. The cardinal septum is short while the counter and alar septa are indistinguishable in length from the adjacent major septa. A dissepimentarium occupies about one-third of the radius. The dissepiments are closely spaced and steeply inclined. Tabulae were not observed due to the highly replaced condition of the sectioned specimens.

OCCURRENCE: The four specimens studied were collected from the middle Great Blue limestone in the northern Stansbury Mountains, Y10019, (Chesteran).

DISCUSSION: Faberophyllum pisgahense is readily identified by its septal count of 59 to 64 major septa at a diameter of about 28 mm. F. pisgahense is the smallest of the Faberophyllum studied in

this report. F. pisgahense differs from F. occultum and F. araneosum in diameter size, in number of major septa found at an average diameter, and in the possession of major septa which tend to form palmate groups with attenuated ends. The F. pisgahense of this paper tends to be slightly larger on the average than those described by Parks although the septal count in specimens of both studies correspond favorably.

Genus Ekvasophyllum Parks 1951
Species Ekvasophyllum inclinatum Parks 1951
Plate 3 Figure 1

1951. Ekvasophyllum inclinatum Parks, Jour. of Paleo. Vol. 25, p. 175.

DESCRIPTION: The general appearance of the numerous silicified and non-silicified specimens which were collected and studied was that of medium sized, gently curved, trochoid, solitary corals with 40 to 47 radially arranged major septa. The silicified forms had an average size of 20 by 22 mm. in diameter at the top of the calyx by 40mm. in length. The cut sections average 20 mm. in diameter. The figured specimen, being slightly compressed perpendicular to the fossula, measures 23 by 25 mm. in diameter at the top of the calyx and is 45 mm. in length.

The theca is thin, rough, and marked with faint longitudinal ridges and furrows which correspond to the major septa. At irregular intervals the theca is contorted by prominent constrictions and expansions suggesting a varied growth pattern. The figured specimen shows a deep, nearly circular calyx with gently sloping walls. The fossula is prominent, deep, and on the side of convex curvature. The alar fossulae are prominent, and nearly at right angles to the cardinal fossula. A rounded columella projects from the floor of the calyx becoming highly compressed parallel to the cardinal fossula at its distal end.

There are 40 to 47 major septa present, which are radially arranged except around the cardinal fossula where they are pinnate. The major septa extend to the axis. The cardinal septum is very short. The counter septum extends to the axis and may be attached to the columella. Minor septa alternate with the majors but are only one-fourth as long. The alar septa are the same length as the adjacent major septa. Nine major septa are present in each cardinal quadrant, with 11 major septa in each counter quadrant. Dissepiments and tabulae were not observed.

OCCURRENCE: The numerous specimens collected were found in the lower Pine Canyon limestone in the White Lake Hills, Yl0023; in the Upper Pine Canyon limestone in the Cedar Valley Hills, Yl0050; in the lower Humbug formation in the Cedar Valley Hills, Yl0051; in the middle Humbug formation in the White Lake Hills, Yl0017; in the lower Great Blue limestone at Long Ridge, Yl0044; and in the middle Great Blue limestone in the northern Stansbury Mountains, Yl0019, (lower Meramacian to middle Chesteran).

DISCUSSION: The species Ekvasophyllum inclinatum is characterized by possessing 40 to 47 major septa at a diameter of about 20 mm., and by displaying a rounded columella which becomes greatly compressed at its distal extremity. The Ekvasophyllum inclinatum of Parks seems to be slightly smaller than the similar form in the present study although they both display the same number of major septa. E. inclinatum differs from E. turbineum by being smaller in size and having a reduced number of major septa.

Species Ekvasophyllum turbineum Parks 1951
Plate 3 Figure 2

1951. Ekvasophyllum turbineum Parks, Jour. of Paleo. Vol. 25, p. 175.

DESCRIPTION: The numerous silicified and non-silicified forms which were collected and studied were medium sized, gently curved, trochoid to sub-cylindrical, solitary corals, with 50 to 56 radially arranged major septa. The silicified forms have a diameter dimension ranging from 15 by 18 mm. to 25 by 30 mm. with the average form being 24 to 26 mm. in diameter. The average length of the forms studied is about 52 mm. The cut specimens average 23 mm. in diameter. The length of these was unknown due to encasement in dense limestone. The figured specimen measures 21 by 28 mm. in diameter at the calyx by 64 mm. in length.

The theca is approximately 2 mm. thick on the cut specimens while the silicified specimens lack the theca. On the latter specimens a rough zone of dissepiments is exposed. Irregular expansions and constrictions are visible throughout the length of the specimens. The calyx may be deep or may be shallow and in most specimens is compressed parallel to the cardinal fossula. The columella which projects from the floor of the calyx is rounded to oval at the base becoming very compressed parallel to the cardinal fossula at its distal end. The cardinal fossula is prominent, deep, and on the side of convex curvature. The cardinal septum is very short. The counter septum may reach the axis and may be attached to the columella. Alar fossulae may be prominent in some specimens and usually are nearly at right angles to the cardinal fossula.

There are 50 to 56 major septa at a diameter of 25 mm. The major septa are radially arranged except adjacent to the cardinal fossula where they are pinnate. The major septa reach to the axis while the minor septa are only about one-third as long as the majors. Both major and minor septa are of equal thickness. The alar septa are as long as the adjacent major septa. There are 10 major septa in each cardinal quadrant and 16 major septa in each counter quadrant. The zone of dissepimentation occupies approximately one-fourth of the radius. The dissepiments are small, compress, elongate, and steeply inclined. The closely spaced tabulae are sharply upturned at their peripheral limits becoming nearly horizontal medially and become upturned in the axial region forming the solid, rod-like columella.

OCCURRENCE: The numerous specimens collected were secured from the lower and upper Pine Canyon limestone in the White

Lake Hills, Y10023 and Y10024; the upper Humbug formation in the northern Stansbury Mountains, Y10017; the lower Great Blue limestone at Long Ridge, Y10044; and the middle Great Blue limestone in the northern Stansbury Mountains, Y10019, (lower Meramacian to Chesteran).

DISCUSSION: Ekvasophyllum turbineum is recognized by its 50 to 56 major septa at a diameter of about 25 mm., and by the presence of a rounded rod-like columella, which becomes compressed parallel to the cardinal fossula at its distal end. The E. turbineum of Parks and the presently considered species compare favorably on nearly all points. E. turbineum may be differentiated from E. inclinatum by its larger size and greater number of major septa and by the larger, more elongate columella which it possesses. Parks found E. inclinatum and E. turbineum separated stratigraphically while in the present study these two species were found to occupy similar stratigraphic horizons in widely separated localities.

Ekvasophyllum sp. A
Plate 3 Figure 3

DESCRIPTION: Three silicified, medium sized, gently curved, trochoid, solitary corals with radially arranged septa were collected and studied. These forms characteristically possess a laterally compressed columella, and a prominent cardinal fossula located on the side of convex curvature. The specimens are nearly circular in outline at the calyx. The figured specimen measures approximately 18 mm. in diameter at the top of the calyx, by 35 mm. in length. Other specimens are 20 mm. in diameter by 31 mm. in length, and 15 mm. in diameter by 33 mm. in length. The silicified forms studied have had the theca around the calyx rim eroded away. The thecal surface below the calyx is marked by faint longitudinal ridges and grooves which correspond to the septal and inter-septal areas. Irregular constrictions are visible on the surface of the theca. The calyx is shallow with a prominent, compressed columella projecting from its floor. The columella is rounded to oval at the base, becoming highly compressed at its distal end.

The cardinal fossula is prominent, deep and on the side of convex curvature. The cardinal septum is extremely short or may be absent in the upper one-half of the corallite. The counter septum may be attached to the columella. Alar fossulae are absent. There are 48 to 50 major septa present in the three specimens collected. The major septa are radially arranged except adjacent to the cardinal fossula where they are pinnate. The major septa reach the columella. The minor septa, which equal the majors in number, are extremely short and thin. The alar septa are approximately one-half as long as the adjacent major septa. There are 10 major septa in each cardinal quadrant and 13 major septa in each counter quadrant. Neither a dissipimentarium nor a tabularium were observed.

OCCURRENCE: All three of the specimens studied were collected from the lower Gardner dolomite in the northern Stansbury Mountains, Y10010, (Kinderhookian).

DISCUSSION: This possibly new species of Ekvasophyllum is characterized by possessing 48 to 50 major septa at an average diameter of about 18 mm., the presence of very short, thin minor septa, and the possession of 10 major septa in the cardinal quadrants and 13 major septa in the counter quadrants. The columella of Ekvasophyllum sp. A is larger, and more rounded than E. inclinatum, and is smaller and much less compressed than in E. turbineum. Ekvasophyllum sp. A is smaller and shorter than either of the other species of Ekvasophyllum studied in this report and possesses a septal count which falls between that of E. inclinatum and E. turbineum. The very thin and short minor septa found in Ekvasophyllum sp. A differs markedly from the longer ones of the other two species of Ekvasophyllum studied here. The low stratigraphic position of Ekvasophyllum sp. A is a striking divergence from the higher positions which E. inclinatum and E. turbineum occupy in this paper.

Genus Turbophyllum Parks 1951
Species Turbophyllum multiconum Parks 1951
Plate 3 Figure 6

1951. Turbophyllum multiconum Parks, Jour. of Paleo. Vol. 25, p. 176.

DESCRIPTION: Six large, trochoid, solitary corals which are gently curved to sub-cylindrical and have 56 to 72 radially arranged septa were collected. In addition, five specimens encased in dense limestone were sawed for study. The silicified forms have an average diameter of 25 by 28 mm. and are 50 mm. in length. The cut specimens have an average diameter of 25 by 30 mm. and one incompletely exposed specimen encased in the limestone is 59 mm. in length. The figured specimen is 32 by 36 mm. in diameter and is 35 mm. long with the apical end broken at a diameter of 19.5 mm.

The theca is eroded from the silicified specimens exposing a dissepimentarium composed of small dissepiments. The corallites are generally compressed parallel to the cardinal fossula which is located on the side of convex curvature. The calyx is shallow with gently sloping walls. An acro-columella projects slightly above the calyx floor. The prominent, deep cardinal fossula does not reach the axis. The 61 major septa in the figured specimen reach the axis and are radially arranged except around the fossula where they are pinnate. The minor septa, which alternate with the major septa are approximately one-half as long and one-half as thick as the major septa. A zone of narrow, steeply inclined dissepiments reach axially slightly more than one-half of the radius. The upturned axial edges of the tent-shaped tabulae form an acro-columella. The distal edges of the tabulae are steeply upturned where they intersect the disseptimentarium.

OCCURRENCE: The collected specimens were secured from the upper Humbug formation, and from the middle Great Blue limestone in the northern Stansbury Mountains, Y10017, and Y10019, (upper Meramacian to lower Chesteran).

DISCUSSION: Turbophyllum multiconum is characterized by the presence of 56 to 72 major septa at a diameter of about 26 to

30 mm., and the possession of an acro-columella formed by tent-shaped tabulae. T. multiconum differs from Ekvasophyllum turbineum by being larger, possessing more major septa, and by displaying an acro-columella rather than an oval to strongly compressed, rod-like columella.

Turbophyllum sp. A
Plate 4 Figure 9

DESCRIPTION: The single, heavily eroded specimen collected and studied was a large, silicified, gently curved, trochoid, solitary coral, with the septa radially arranged. The corallite is compressed parallel to the prominent cardinal fossula which is located on the side of convex curvature. The specimen measures 22 by 31 mm. in diameter at the top of the abraded calyx and is 25 mm. long, being broken at a diameter of 19 by 23 mm. The estimated length would be in access of 50 mm. The calyx is shallow with gently sloping walls. A hollow ovate pseudocolumella projects slightly above the calyx floor. A prominent, deep, cardinal fossula, located on the side of convex curvature, reaches nearly to the axis. The cardinal septum is very short. The counter and alar septae are shorter than the adjacent major septa, which are radially arranged except around the cardinal fossula where they are pinnate.

The 62 major septa, at a diameter of 27 mm., reach the axis where they take on a curved pattern and form a hollow pseudocolumella. The minor septa, which alternate with the major septa, extend less than one-fourth of the radius. They usually do not extend beyond the narrow dissepimentarium which occupies one-fourth of the radius. The presence of tabulae was not determined due to the poorly preserved condition of the specimen.

OCCURRENCE: The single specimen studied was collected from the lower Gardner dolomite in the northern Stansbury Mountains, Y10010, (Kinderhookian).

DISCUSSION: The specimen Turbophyllum sp. A is characterized by the presence of 62 major septa at a diameter of about 25 mm. and by the possession of a pseudo-columella. Turbophyllum sp. A resembles T. multiconum in size and number of major septa, but differs from it in the possession of a hollow pseudo-columella formed by the curved axial ends of the major septa as opposed to an acro-columella in T. multiconum formed by the steeply inclined axial ends of tent-shaped tabulae. The dissipimentarium in Turbophyllum sp. A is wider than that found in T. mulitconum. The minor septa in Turbophyllum sp. A are longer than those of T. multiconum.

Family Cyathaxonidae Milne-Edwards and Haime
Genus Cyathaxonia Michelin 1847
Species Cyathaxonia minor Weller 1909
Plate 4 Figure 3

1909. Cyathaxonia minor Weller, Geol. Soc. Amer. Bull. Vol. 20, p. 270

DESCRIPTION: A single, slightly curved to straight specimen was collected. The corallite was very small, measuring 4 mm. in diameter at the top of the calyx by 1.5 mm. in length. The corallite exhibits prominent longitudinal striations corresponding in number to the septa. The apical end is twisted and slightly flattened to permit attachment.

The calyx is very deep. A prominent columella in the form of a slightly compressed, smooth, tapering boss which broadens toward the bottom projects from the calyx floor. Thirteen major septa with and equal number of minor septa are present. All of the septa are the same length at the rim of the calyx. Only 7 of the major septa reach the columella. The remaining major septa curve to intersect adjacent majors which in turn intersect the columella. The minor septa are very short, but are as thick as the majors at the theca. The fossula is wide and on the side of convex curvature. The cardinal septum is thicker than the other major septa. The cardinal septum is extremely short in the fossula but reaches the columella at the bottom of the calyx.

OCCURRENCE: The single very small specimen studied was collected from the lower Pine Canyon limestone in the White Lake Hills, Y10023, (upper Osagean).

DISCUSSION: The very small size, prominent columella, 13 major septa present, 7 of which reach the columella, and the inter section of the longer major septa by the less persistant major septa distinguishes this form from other members of the genus.

Family Lithostrotiontidae Grabau
Genus Diphyphyllum Lonsdale 1845
Species Diphyphyllum inconstans Easton and Gutschick 1953
Plate 2 Figure 2

1922. Diphyphyllum sp. Girty in Noble U. S. Geol. Survey Prof. Paper 131-B p. 56.
1953. Diphyphyllum inconstans Easton and Gutschick, Bull. So. Calif. Academy of Sciences, Vol. 52, pt. 1, 1953.

DESCRIPTION: The two specimens collected are encased in dense limestone. The corallites of these colonial corals are phaceloid, with parallel to sub-parallel arrangement, and are contorted by minor constrictions and expansions. Distinct longitudinal ridges and furrows are present on the theca. In the two colonies studied, the corallites were 9 to 11 mm. in diameter, and spaced up to 4 mm. apart. The length of the corallites is unknown for only broken fragments were observed. The 28 major septa extend axially about one-half the radius. An equal number of very thin minor septa are present which are about one-half as long as the major septa. The inner wall, formed by the down dipping peripheral ends of the tabulae, is indistinct and discontinuous. The tabulae are generally horizontal except at their peripheral limits where they dip down sharply and in the axial area where they are discontinuously upturned to form a non-persistant axial structure. There are 5 to 8 tabulae in a vertical

distance of 5 mm. The dissepimentarium is narrow and composed of narrow to oval, steeply inclined dissepiments which are usually in a single, rarely in double series. There are 5 to 8 dissepiments in a vertical distance of 5 mm.

OCCURRENCE: The collected specimens occur in the middle Pine Canyon limestone and in the upper Humbug formation in the northern Stansbury Mountains, Y10013, and Y10017, (upper Meramacian).

DISCUSSION: Diphyphyllum inconstans is characterized by the presence of 28 major septa in a corallite about 10 mm. in diameter and by the presence of a discontinuous columella formed by the up-turned ends of the tabulae, and by the presence of an indistinct, discontinuous inner wall. D. inconstans differs from D. mutabile in its larger size, larger number of major septa, and discontinuous columella formed by tabulae which are up-turned at irregular intervals.

Diphyphyllum sp. A
Plate 2 Figure 1

DESCRIPTION: A single colonial coral made up of parallel to sub-parallel corallites was studied. The specimen was encased in dense limestone which obscured the external features of the corallites. The phaceoloid corallites vary from 4 to 12 mm. in diameter and are spaced from 2 to 3.5 mm. apart. The length of the corallites is unknown because all of the studied material was broken. The 25 major septa enter about one-third of the radius from the theca. Minor septa were not observed. A columella was not observed. The tabulae which occur 6 to 8 in a vertical distance of 5 mm. are generally horizontally arranged except at their peripheral limits where they dip sharply down-ward. An inner wall, which corresponds to the sharply depressed tabulae ends, is poorly defined and incompletely developed along the axial ends of the major septa. The tabularium occupies two-thirds of the diameter of the corallite. The peripheral dissepimentarium is narrow, composed of narrow to oval, steeply inclined, dissepiments which are usually in a single, rarely in two series and are 6 in number in a vertical distance of 5 mm.

OCCURRENCE: The single specimen studied was collected from the middle Deseret limestone in Rock Canyon, Y10035, (lower Meramacian).

DISCUSSION: Diphyphyllum sp. A is characterized by the presence of 25 major septa at a diameter of about 8 mm., the absence of a columella, and minor septa. Diphyphyllum sp. A differs from D. mutabile in its larger size, lack of minor septa, and shorter major septa. Diphyphyllum sp. A differs from D. inconstans in having fewer major septa, in being generally larger in size, and in the lack of an axial structure.

Genus Lithostrotion Fleming 1828
Species Lithostrotion proliferum Hall
Plate 2 Figure 3

1942. Lithostrotion proliferum Hall, Kelly, Jour. of Paleo. Vol. 16, p. 359.

DESCRIPTION: The four, phaceoloid to ceriod, colonial corals collected and studied have corallites which are arranged subparallel to radially. The theca is irregularly contorted by circular constrictions and expansions. Faint longitudinal furrows and ridges which probably correspond to the major septa, are visible on the thecal surface. The corallites range from 4 to 10 mm. in diameter, their length is unknown.

The calyx is deep, with nearly vertical walls. A distinct, compressed, styliform columella, which appears to be an expansion of the counter septum, projects from the flat floor of the calyx. The 26 major septa reach the axis from the thecal wall. An equal number of minor septa are extremely short and much thinner than the major septa. The tabulae are steeply inclined and tent-shaped so that there is a continuous, steep slope from the columella to the periphery of the tabularium. The tabulae bend sharply upward where they contact the columella and dip down sharply where they meet the dissepimentarium. The dissepimentarium is narrow and is composed of dissepiments which are generally small and of several series.

OCCURRENCE: The forms studied were collected from the lower Gardner dolomite in the northern Stansbury Mountains, Y10010; the lower Pine Canyon limestone in the White Lake Hills, Y10023; and the upper Humbug formation in the northern Stansbury Mountains, Y10017, (Kinderhookian to upper Meramacian).

DISCUSSION: Lithostrotion proliferum is characterized by possessing 26 major septa at a diameter of about 10 mm., extremely short minor septa, a styliform columella and tabulae which are very steeply inclined and lap up against the columella. L. proliferum differs from L. whitnevi by possessing a solid columella, more major septa, thinner minor septa and tabulae which are tent-shaped and slope constantly throughout their length.

Species Lithostrotion whitneyi Meek 1877
Plate 2 Figure 7 and 8

1877. Lithostrotion whitneyi Meek 1877, U. S. Geol. Survey West 100th Mer. Wheeler, Vol. 4.
1942. Lithostrotion whitneyi Kelly, Jour of Paleo. Vol. 16, p. 359.

DESCRIPTION. Eight specimens of this ceriod to phaceoloid, colonial coral were collected and studied. The colonies are generally ceriod and plocoid but some fascicilate phaceoloid colonies were collected. The corallites are generally parallel and measure from 5 to 9 mm. in diameter, their length is unknown because of the broken character of the material at hand.

The theca shows faint longitudinal striations, which correspond to the septa, and irregular constrictions. The calyx is deep with nearly vertical walls. The 16 major septa project to the axis. The minor septa, which alternate with the major septa, are only one-half as

thick and are very short. The tabulae are sharply up-turned at the axis and form a hollow acro-columella which projects above the flat calyx floor. The tabulae become nearly horizontal at their median expanse and then dip sharply downward at the peripheral limits of the tabularium. Short incomplete tabulae may also be present which dip continuously to the periphery of the tabularium. The dissepimentarium is narrow, composed of dissepiments which are generally small, highly arched to oval, and are in several series.

OCCURRENCE: The studied specimens were collected from the upper Gardner dolomite, the lower Pine Canyon limestone, and the lower and upper Humbug formation in the northern Stansbury Mountains, Y10001, Y10012, Y10015, and Y10017, (upper Osagean to upper Meramacian).

DISCUSSION: Lithostrotion whitneyi is characterized by the possession of 16 major septa at a diameter of about 8 mm., a hollow acro-columella, and short minor septa which are one-half as thick as the major septa. Lithostrotion whitneyi differs from L. proliferum by possessing a hollow acro-columella, less steeply inclined tabulae, and thicker minor septa.

Family Undetermined
Genus Rotophyllum Hudson 1942
Species Rotophyllum rushianium densum Carruthers
Plate 4 Figure 4

1906. Densiphyllum Vaughan 1906, p. 318.
1908. Densiphyllum rushianium Vaughan 1908 p. 458, 1915 p. 35.
1910. Zaphrentis costata McKoy, Wilmore 1910, p. 551, Booker and Hudson 1926, p. 424.
1924. Zaphrentis sp. aff. A. nodosa Smyth, Garwood and Goodyear, 1924.
1944. Rotophyllum cf. R. densum Carruthers, Hudson 1944, Jour. of Paleo. Vol. 18, p. 358.

DESCRIPTION: Two specimens were collected. The corallites are small, gently curved, trochoid, solitary corals. The figured form measures 9 mm. in diameter by approximately 20 mm. in length, the other specimen is 8 mm. in diameter and of unknown length due to encasement in dense limestone. The calyx is deep, the theca is thickened. Eighteen, thickened major septa and an equal number of very short minor septa are present. The major septa meet at the axis to form a massive stereocolumn which occupies approximately one-half of the diameter of the corallite. The cardinal fossula is wide. The cardinal septum does not intersect the axial structure. Both specimens were encased in dense limestone, consequently the external features were not studied.

OCCURRENCE: The specimens collected came from the lower Pine Canyon limestone in Rattlesnake Spur, and the White Lake Hills, Y10056, and Y10023, (upper Osagean).

DISCUSSION: Rotophyllum rushianium densum is characterized by a massive stereocolumn which occupies about one-half of the diameter of the corallite, very short minor septa, a prominent, wide fossula bisected by a cardinal septum which does not reach the axis, and a thickened theca. R. densum is smaller than R. rushianium, possesses fewer septa, has a shorter counter septum, and has no alar fossulae.

STRATIGRAPHIC CONCLUSIONS

Thirty-nine coral species representing fifteen genera were recognized in the Mississippian rocks in the central Utah region during this study. Of the total number of species recognized, seventeen are present in the Kinderhookian series, fourteen occur in the lower Osagean rocks, eight occur in the upper Osagean rocks, twelve are known from lower Meramacian rocks, nine are present in the upper Meramacian rocks and ten species occur in the lower Chesteran rocks. In most cases the species are not confined to a single series but are present through several. Several forms, however are restricted to rocks of a single series.

Abundant occurrence of species of Triplophyllites in the Gardner dolomite enables the establishment of a Triplophyllites zone which includes both Kinderhookian and Osagean rocks. The presence of Kinderhookian rocks may be determined when Triplophyllitids are found associated with Syringopora verticillata, S. perelegans, and Amplexus dilatatus. The latter forms are restricted to the lower Gardner dolomite or its equivalents. The Triplophyllites zone is useful in recognizing lower Osagean rocks when Multithecopora sp. and Pleurodictyum expansum are found associated with it. Upper Osagean rocks may be recognized when Cyathaxonia minor, Rotophyllum densum, and Hapsiphyllum sp. A are associated with Lithostrotion proliferum, and L. whitneyi.

The Ekvasophyllum-Caninia zone is characteristic of the Meramacian series in the Gardner Basin. The association of Diphyphyllum sp. A and D. inconstans with Caninia sp. A and sp. C of this paper and Caninia sp. B of Parks characterize lower Meramacian rocks, while Turbophyllum multiconum associated with Ekvasophyllum trubineum and E. inclinatum characterize the upper Meramacian rocks.

The Faberophyllum zone is diagnostic of lower Chesteran rocks for Faberophyllum araneosum, F. occultum, and F. pisgahense are restricted to these rocks in the present study and are associated with Ekvasophyllum inclinatum and E. turbineum which persist into this stratigraphic zone.

The stratigraphic zones established by Parks (1951) in the Brazier basin are probably confined to that depositional area. Many forms recognized in the present study have been previously reported by Parks but their time stratigraphic relationships do not necessarily correspond in the separate basins. In the present study a well defined Triplophyllites zone appears at the base of the Mississippian rocks, while in the area reported by Parks the Triplophyllites zone is near the top of the system. In the Parks study the Ekvasophyllum inclinatum zone, the lowest coral zone established by him, appears near the middle of the Brazier formation with E. turbineum appearing above it in the Faberophyllum zone. In the present study E. inclinatum and E. turbineum appear together in the upper Osagean rocks and again in the middle Meramacian rocks, continuing into the lower Chesteran rocks. Both the Parks study and the present paper show the Faberophyllum zone to be relatively high in the Mississippian section, however. The Caninia zone in the present study is found in the lower middle of the Mississippian system while in the Parks paper Caninia appears in a zone near the top of the system. Multithecopora sp., an abundant form in the lower Osagean series, was not reported in Parks' study. One form of Lithostrotionella was reported by Parks to be associated with the E. inclinatum zone. In the present study forms of Lithostrotion persist intermittantly throughout the Mississippian system, as do species of Syringopora.

Precise correlation between these two basins of deposition (the Brazier Basin of the Parks study and the Madison Basin where the present study has been conducted) on the basis of corals is difficult because of differing conditions of sedimentation.

ECOLOGIC CONCLUSIONS

The coral specimens collected include both solitary and colonial forms. In general these forms were randomly placed horizontally and vertically so that a bioherm was not encountered and only rarely were the forms grouped so that a faunal zone could be recognized. This condition suggests that the coral life of the Mississippian time, in this area, was localized so that biostromal accumulations were formed (Krumbein and Sloss 1953).

Some of the coral forms studied were found to be ideally preserved while other specimens showed the effects of intense abrasion. The perfectly preserved forms are believed to be indigenous to the area in which they were collected, while those forms which show poor external detail are believed to be foreign to the location of collection. The abraded forms were probably transported from the site of their growth and deposited in the area where they were subsequently collected.

The conclusion relative to extensive abrasion and transport is further supported by the presence of forms which show the greatest abrasion to be in the plane of curvature of the solitary forms to that

an already elliptical outline is accentuated. This highly elliptical outline of compression was not observed in forms devoid of abrasion.

A majority of the solitary, trochoid specimens studied show a slight to pronounced compression systematically oriented parallel to the cardinal fossula and in the plane of curvature of the corallite. A few specimens of the same species showed a similar compression which was perpendicular to the fossula and at right angles to the curvature. Easton (1951) suggests this compression is a response to the action of persistant current direction upon the corallite which was oriented in its larval stage. The compression of the corallite at right angles to the cardinal fossula would possibly result if the direction of prevailing currents changed at some time subsequent to the initial orientation and contouring of the corallite.

Triplophyllites sp. A and B of this paper possess a unique profile. Although nearly circular and expanded in the calyx region, they taper apically to an extremely fine point. They show but slight curvature and the greatly expanded fossula is located about forty degrees from the plane of curvature. This form possibly inhabited an area where there was little current action, necessitating an expanded calyx area to facilitate the procurement of food. It seems that an extremely pointed apical end could accommodate successful attachment only in nearly current free waters. The slight curvature of the form and lack of compression are probably due to a slight change of conditions which produced a very mild current flow.

Corals are extremely numerous in the lower Chesteran Great Blue limestone in the northern Stansbury Mountains west of Grantsville, Utah. In the same section in Rock Canyon east of Provo, no corals were found. This condition is thought to be due to the presence of a nearly pure limestone in the Stansbury Mountain area while in the Rock Canyon, American Fork Canyon region a high percentage of silt is present (Gaines 1950, Perking 1955). Easton (1951) relates the reduction of coral populations in limestone to an increase in silty conditions, while abundant coral populations are found in silt-free, highly calcareous rocks.

Numerous species of Triplophyllites are found to predominate in the Kinderhookian and lower Osagean rocks, while species of Faberophyllum and Ekvasophyllum are numerous in the upper Meramacian and lower Chesteran rocks. The forms found in the dense, debris-ridden dolomitic Kinderhookian and Osagean rocks are very small while the forms found in the upper Meramacian and Chesteran crinoidal limestones are medium to large. The small size of the Kinderhookian and Osagean forms may indicate a scarcity of food or great difficulty in securing it. The compression of these forms indicates the presence of reasonably strong currents, so perhaps the difficulty in securing food was not from a scarcity of it necessarily, but from the turbidity of the water in which Kinderhookian and Osagean sedimentation took place. The larger sized, upper Meramacian and lower Chesteran corals lived in cleaner waters and

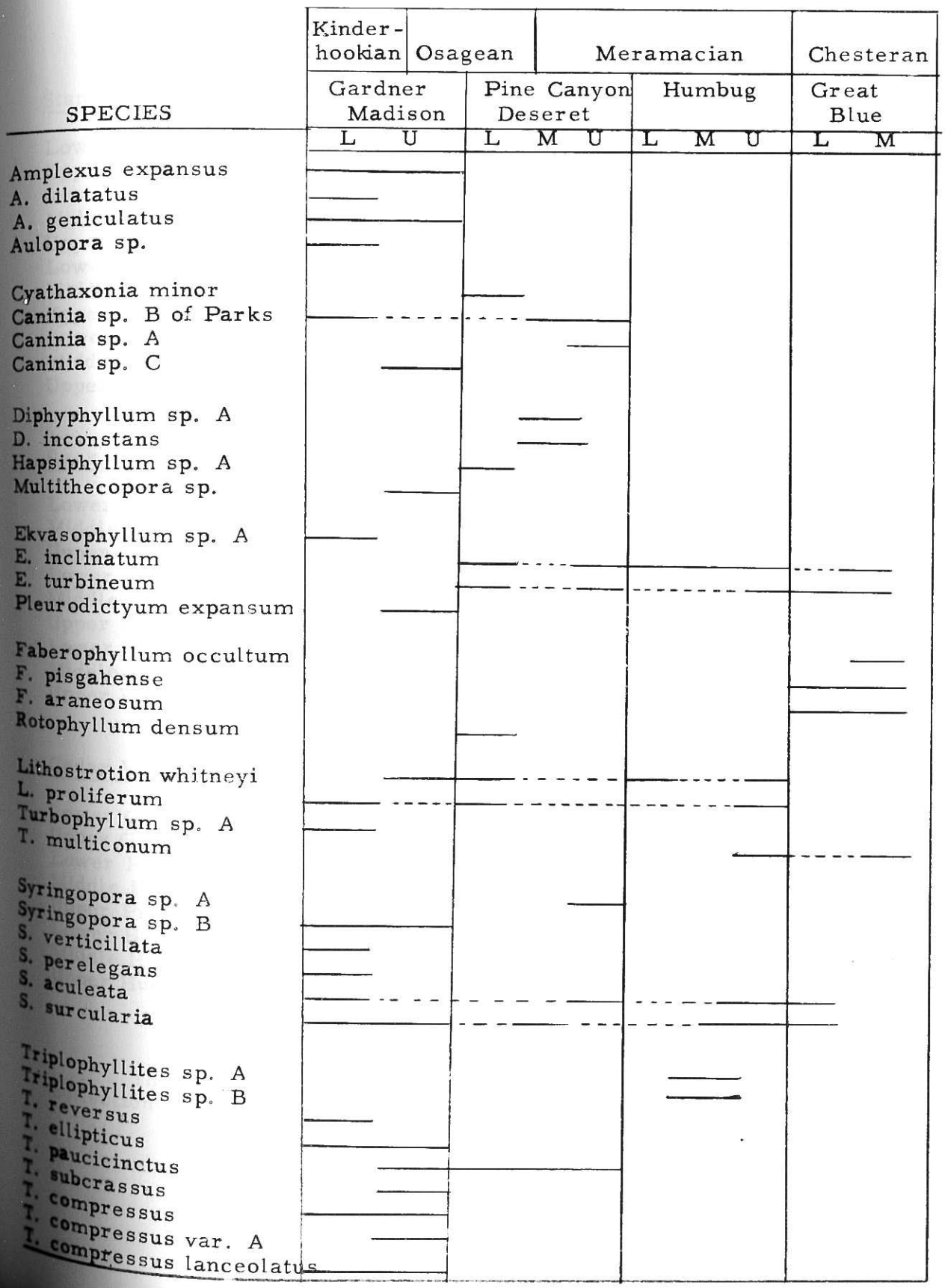
probably had little difficulty in securing abundant food. It is also possible that the size difference which exists between the Kinderhookian and Chesteran corals is the manifestation of evolutionary changes over a long period of time with evolutionary selection for increase in size.

The American Fork Canyon area proved to be sparsely populated with corals. When found they were exposed in wall outcrops from which they could be secured only with extreme difficulty. Because of the infrequency of occurrence and the extreme difficulty in securing specimens this area was abandoned as a collecting area. Perkins (1955) and Rhodes (1955) reported Triplophyllites, sp. and Syringopora sp. from the upper Gardner dolomite, however. The Deseret limestone here contains much more dolomite than is generally present in the formation, this may account in part for dearth of fossils. Livingston (1955) attributes the lack of corals in the Humbug formation here to be due to unique sedimentary conditions, where currents of varying velocities prevailed which greatly complicated living conditions of the corals with greater or lesser amounts of silt and sand. Much silt and sand in the Great Blue limestone at American Fork Canyon and Rock Canyon may account for the absence of corals in these areas (Perkins 1955, Gaines 1950).

Growth patterns could be observed in many specimens, in the form of swellings and constrictions which suggest a seasonal growth in a sub-tropical climate. The compressions and expansions giving a retarded and accelerated pattern as would be realized in winter and summer periods of growth in a sub-tropic climate. Other forms display a uniform thecal structure which would result from uniform year around growth in a completely tropical climate. The presence of a fluxuating climate in at least part of the Mississippian times could be controlled by the surface temperatures of the seas (Ma 1954).

The coral faunas reported in this study are composed largely of previously described forms. The writer feels that several new species are present and that additional collections will produce enough specimens to justify the erection of new genera and species.

TABLE OF SPECIES OCCURRENCE



LOCATION NUMBERS

Stansbury Mountains

Lower Gardner	Y10010
Upper Gardner	11
Lower Pine Canyon	12
Middle Pine Canyon	13
Upper Pine Canyon	14
Lower Humbug	15
Middle Humbug	16
Upper Humbug	17
Lower Great Blue	18
Middle Great Blue	19
Upper Great Blue	20

White Lake Hills

Lower Gardner	Y10021
Upper Gardner	22
Lower Pine Canyon	23
Middle Pine Canyon	24
Upper Pine Canyon	25
Lower Humbug	26
Middle Humbug	27
Upper Humbug	28
Lower Great Blue	29
Middle Great Blue	30

Rock Canyon

Lower Madison	Y10031
Middle Madison	32
Upper Madison	33
Lower Deseret	34
Middle Deseret	35
Upper Deseret	36
Lower Humbug	37
Middle Humbug	38
Upper Humbug	39

Long Ridge

Upper Deseret	Y10040
Lower Humbug	41
Middle Humbug	42
Upper Humbug	43
Lower Great Blue	44
Middle Great Blue	45

Cedar Valley Hills

Lower Gardner	Y10046
Upper Gardner	47
Lower Pine Canyon	48
Middle Pine Canyon	49
Upper Pine Canyon	50
Lower Humbug	51
Middle Humbug	52
Upper Humbug	53

Rattlesnake Spur

Lower Gardner	Y10054
Upper Gardner	55
Lower Pine Canyon	56
Middle Pine Canyon	57
Upper Pine Canyon	58
Lower Humbug	59
Middle Humbug	60
Upper Humbug	61

The locality numbers indicate composite collections and not collections from individual beds.

Figure 3

SELECTED REFERENCES

Baker, A. A. (1947), Stratigraphy of the Wasatch Mountains in the Vicinity of Provo, Utah, U.S. Geol. Survey, Oil and Gas Preliminary Investigations, Chart 30.

Bassler, R. S. (1950), Faunal Lists and Descriptions of Paleozoic Corals, Geological Society of American, Memoir 44.

Calderwood, K. W. (1951), Geology of the Cedar Valley Hills Area, Utah, Unpublished M. S. Thesis, Brigham Young University.

Darrah, W. C. (1936), The Peel Method in Paleobotany, Bot. Mus. Leaflets, Harvard University, 4:1-8.

Easton, W. H. (1945), Corals From the Otter Formation (Mississippian) of Montana, Journal of Paleo. Vol. 19.

_____ (1945), Amplexoid Corals From the Chester of Illinois and Arkansas, Journal of Paleo. Vol. 19.

_____ (1951), Mississippian Cuneate Corals, Journal of Paleo. Vol. 25.

_____ and Gutschick, R. C. (1953), Corals From the Redwall Limestone (Mississippian) of Arizona, Bull. So. Calif. Acadmey of Sciences, Pt. 3, Vol. 52.

Gaines, P. W. (1950), Stratigraphy and Structure of the Provo-Rock Canyon Areas, South Central Wasatch Mountains, Utah, Unpublished M. S. Thesis, Brigham Young University.

Gilluly, James (1932), Geology and Ore Deposits of the Stockton and Fairfield Quadrangles, Utah, U.S. Geol. Survey Mon. 32 pt. 2.

Girty, G. H. (1907), Geology of the Yellowstone National Park, Devonian and Carboniferous Fossils, U. S. Geol. Survey Mon. 32 pt. 2.

Gott, P. F. (1945), Proceedure of Simplified Stereophotography of Fossils, Journal of Paleo. Vol. 19.

Grabau, A. W. and Shimer, H. W. (1907), North American Index Fossils, The New Era Printing Company.

Heiner, Ted (1954), Geology of the Northern Stansbury Mountains Area, Utah, Unpublished Field Notes.

Hill, D. (1935), British Terminology for Rugose Corals, Geol. Magazine Vol. 72.

Hudson, R. G. S. (1944), Lower Carboniferous Corals of the Genera Rotophyllum and Permia, Journal of Paleo., Vol. 18.

Jeffords, R. M. (1945), Caninia From the Lower Carboniferous of New Mexico, Journal of Paleo. Vol. 17.

Johns, K. H. (1950), Geology of the Twelve Mile Pass Area, Utah County, Utah, Unpublished M. S. Thesis, Brigham Young University.

Kelly, W. A. (1942), Lithostrotiontidae in the Rocky Mountains, Journal of Paleo. Vol. 16.

Krumbein, W. C. and Sloss, L. L. (1953), Stratigraphy and Sedimentation, W. H. Freeman and Company, San Francisco, California

Lang, W. D.; Smith, S. and Thomas H. D. (1940), Index of Paleozoic Coral Genera, Printed by Order of the Trustees of the British Museum.

Lindgren, Waldemar, and Loughlin, G. F. (1919), Geology and Ore Deposits of the Tintic Mining District, Utah, U. S. Geol. Survey, Prof. Paper 107, Government Printing Office, Washington D. C.

Livingston, V. E. Jr. (1955), Sedimentation and Stratigraphy of the Humbug Formation in Central Utah, Unpublished M. S. Thesis, Brigham Young University.

Lovering, T. S. (1949), Rock Alteration as a Guide to Ore, East Tintic District, Utah, Monograph 1, Economic Geology.

Ma, T. Y. H. (1954), Climate and Relative Position of the Continents During the Lower Carboniferous Period, Acta Geologica Taiwanica, Science Report of the National Taiwan University No. 6.

McFarland, C. R. (1955), Geology of the West Canyon area, Northwestern Utah County, Utah, Unpublished M. S. Thesis, Brigham Young University.

McLaren, D. J. and Sutherland, P. R. (1949), Lithostrotion From Northeast British Columbia and the Bearing on the Genomorph Concept, Journal of Paleo. Vol. 23.

Meek, F. B. (1870), Lists of Fossils From Utah, With Some Notes, U. S. Geol. Survey Fortyth Parallel Report, Vol. 4.

Moore, R. C.; Lalicker, C. G. and Fischer, A. G. (1952), Invertebrate Fossils, McGraw-Hill Book Company Inc.

Parks, J. M., Jr. (1951), Corals From the Brazier Formation (Mississippian) of Northern Utah, Journal of Paleo. Vol. 25.

Peale, A. C. (1893), The Paleozoic Section of the Vicinity of Three Forks, Montana, U. S. Geol. Survey Bull. 110, Government Printing Office, Washington D. C.

Perkins, R. F. (1955), Structure and Stratigraphy of the Lower American Fork Canyon-Mahogany Mountain Area, Utah County, Utah, Unpublished M. S. Thesis, Brigham Young Universiy.

Rhodes, James, (1954), Geology of Buckley Mountain, Unpublished M. S. Thesis, Brigham Young University.

Rominger, C. (1876), Geology of Lower Penninsula, Mich Geol. Survey, Vol. 3.

Sanford, W. G. (1939), A Review of the Families of Tetracoralla, American Journal of Science, Vol. 237.

Shimer, H. W. and Shrock, R. R. (1944), Index Fossils of North America, The Technology Press, Massachusetts Institute of Technology.

Shrock, R. R. and Twenhofel, W. H. (1953), Principles of Invertebrate Paleontology, McGraw-Hill Book Company.

Sloss, L. L. (1945), Corals From the Post Osage (Mississippian) of Montana, Journal of Paleo. Vol. 19.

Spurr, J. E. (1894), Economic Geology of the Mercur Mining District, Utah, U. S. Geol. Survey Sixteenth Ann. Rept. pt. 2

Tower, G. W., Jr. and Smith, G. O. (1898), Geology and Mining Industry of the Tintic District, Utah, U. S. Geol. Survey Nineteenth Ann Rept. pt. 3.

Weller, M. J. (1948), Corrolation of the Mississippian Formations of North America, Geological Society of America Bull. Vol. 59.

Weller, Stuart. (1909), The Fauna of the Fern Glen Formation, Geological Society of America Bull. Vol. 20.

White, B. O. (1954), Geology of West Mountain and Northern Portion of Long Ridge, Utah County, Utah, Unpublished M. S. Thesis, Brigham Young University.

EXPLANATION OF PLATE 1

All figures are x1 unless otherwise stated

Figure 1. Syringopora perelegans Y10054

2. Syringopora verticillata Y10054

3A. Syringopora aculeata side view Y10054
3B. Syringopora aculeata vertical view

4. Syringopora sp. A Y10010

5. Syringopora surcularia Y10029

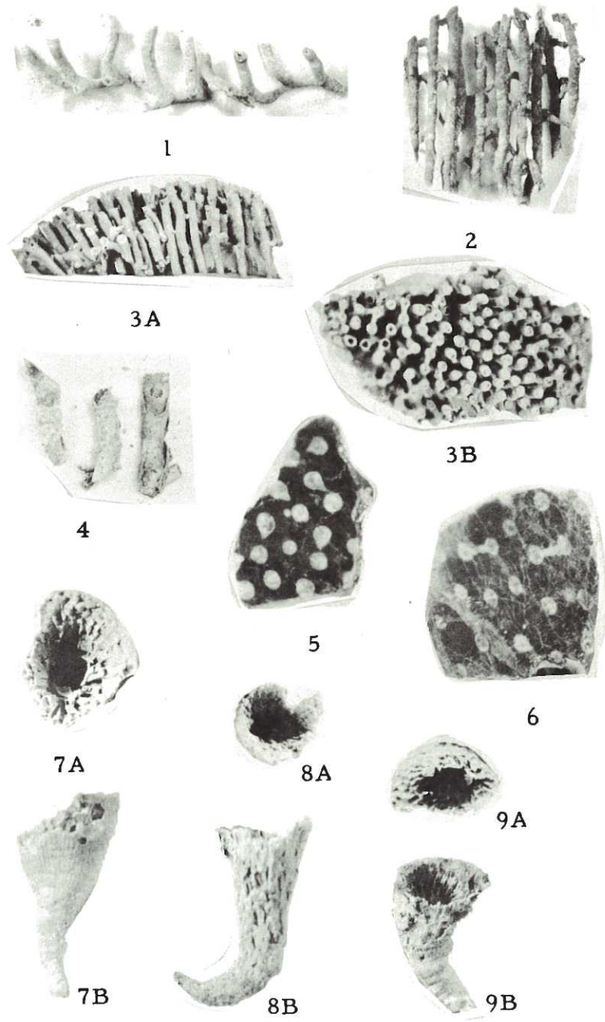
6. Syringopora sp. B Y10050

7A. Amplexus expansus calyx view Y10010
7B. Amplexus expansus side view

8A. Amplexus geniculatus calyx view Y10010
8B. Amplexus geniculatus side view

9A. Amplexus dilatatus calyx view Y10021
9B. Amplexus dilatatus side view

PLATE 1



EXPLANATION OF PLATE 2

All figures are X 1 unless otherwise stated

Figure 1A. Diphyphyllum sp. A longitudinal section Y10035
1B. Diphyphyllum sp. A transverse section

2A. Diphyphyllum inconstans transverse section Y10013
2B. Diphyphyllum inconstans longitudinal section

3A. Lithostrotion proliferum longitudinal section Y10010.
3B. Lithostrotion proliferum calyx view

4. Multithecopora sp. Y10022

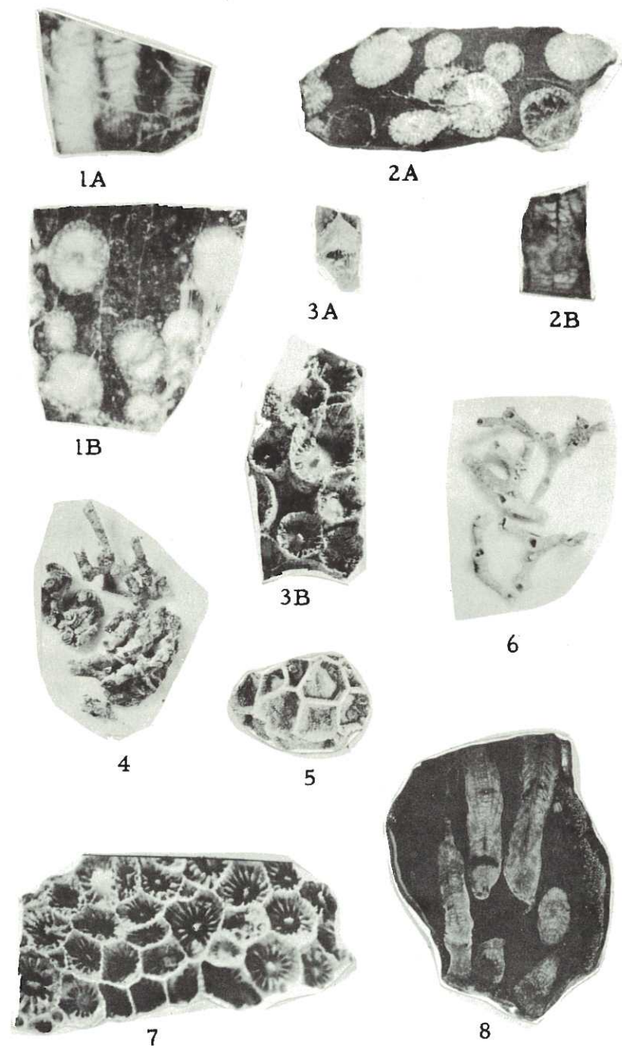
5. Pleurodictyum expansum calyx view Y10022

6. Aulopora sp. Y10055

7. Lithostrotion whitneyi calyx view Y10011

8. Lithostrotion whitneyi longitudinal section Y10011
(Different specimen)

PLATE 2



EXPLANATION OF PLATE 3

All figures are Xl unless otherwise stated

Figure 1A. Ekvasophyllum inclinatum calyx view Y10027
1B. Ekvasophyllum inclinatum left alar view

2A. Ekvasophyllum turbineum calyx view Y10019
2B. Ekvasophyllum turbineum right alar view

3A. Ekvasophyllum sp. A calyx view Y10010
3B. Ekvasophyllum sp. A left alar view

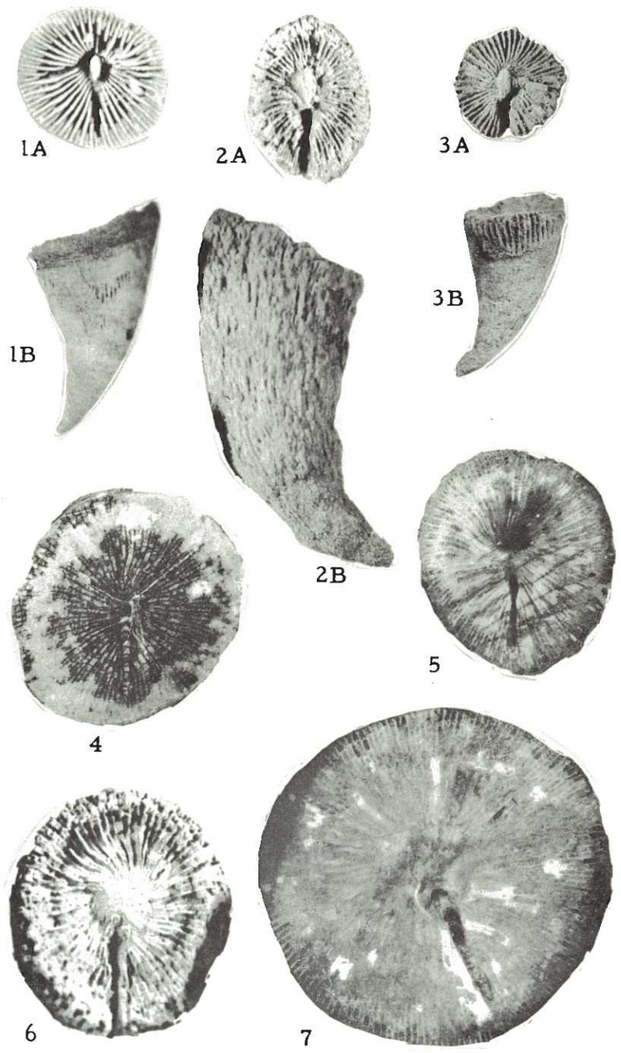
4. Faberophyllum araneosum transverse section Y10019

5. Faberophyllum pisgahense transverse section Y10019

6. Turbophyllum multiconum calyx view Y10019

7. Faberophyllum occultum transverse section Y10019

PLATE 3



EXPLANATION OF PLATE 4

All figures are X1 unless otherwise stated

Figure 1. Triplophyllites (Homalophyllites) compressus calyx view X5 Y10011

2. Triplophyllites compressus var. lanceolatus calyx view X5 Y10011

3. Cyathaxonia minor calyx view X5 Y10023

4. Rotophyllum densum transverse section X5 Y10023

5. Hapsiphyllum sp. A transverse section X5 Y10023

6. Triplophyllites (Triplophyllites) ellipticus calyx view X2 Y10010

7A. Caninia sp. A transverse section Y10050
7B. Caninia sp. A longitudinal section

8. Triplophyllites compressus sp. A calyx view X2 Y10011

9. Turbophyllum sp. A calyx view Y10010

10A. Triplophyllites sp. B calyx view Y10027
10B. Triplophyllites sp. B side view

11. Triplophyllites reversus calyx view Y10010

12A. Triplophyllites sp. A calyx view Y10027
12B. Triplophyllites sp. A side view

13A. Triplophyllites (Homalophyllites) paucicinctus calyx view Y10023
13B. Triplophyllites (Homalophyllites) paucicinctus side view

14. Triplophyllites (Homalophyllites) subcrassus calyx view Y10011

15. Caninia sp. C side view Y10033

PLATE 4