A FAUNULE FROM A SHALE UNIT IN THE LOWER ELY FORMATION, WEST-CENTRAL UTAH

by

Samiha Mahmoud Zazou

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by

Samiha Mahmoud Zazou

has been approved

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Chairman, Supervisory Committee

Reader, Supervisory Committee

Reader, Supervisory Committee

Head, Major Department

Dean, Graduate School

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ABSTRACT

The Confusion Range lies in the western part of Millard and Juab Counties, west-central Utah. It is bounded on the east and west by the White and the Snake Valleys, respectively. The range is 50 miles long from north to south and 7 to 10 miles wide.

The stratigraphic section in the Confusion Range has been divided according to two schemes of stratigraphic nomenclature; one was suggested by Campbell (1951) and the other was proposed by Hose and Repenning (1959). According to the stratigraphic scheme proposed by Hose and Repenning, Upper Mississippian to Lower Triassic rocks are divided into six formations of which the Ely Limestone of Late Mississippian, Early and Middle Pennsylvanian, and Permian age is the only formation related to the present study.

A shale bed 18-feet-thick, occurs 521 feet above the base of the Ely Formation. This shale bed contains the microfossils which are the subject matter of this report. The shale bed is overlain by a prominent limestone bed that contains the corals Crataniophyllum (Barbouria sp. of Hose and Repenning, 1959) which according to Hose and Repenning is 540 feet above the base of the Ely Formation.

Forty species of Ostracoda, of which one is possibly new, belonging to 14 families and 23 genera, and 8 species of Foraminifera belonging to 4 families and 8 genera, and one species of Annelida were identified from the shale bed.

The shale bed is characterized by the following ostracode genera: Bairdia, Hollinella, Healdia, Seminolites, Kirkbya, Ellipsella, Ectodemites and Glyptopleura. The genus Bairdia is represented by 5 species, Holinella by 4 species, the genera Healdia, Seminolites, and Kirkbya each is represented by 3 species, Ellipsella, Ectodemites, and Glyptopleura each is represented by one species. The ostracode species Hollinella dentata, Hollinella oklahomaensis, Seminolites elongatus, Kirkbya canyonensis, and Monoceratina ventrale are among the most characteristic guide fossils of the Pennsylvanian.

The stratigraphic distribution of species is from Upper Mississippian to Permian. The overlap of ranges of species suggests a general Pennsylvanian age and possibly Middle Pennsylvanian.

The microfaunal assemblage from the shale bed suggests a littoral to shallow marine environment and was benthonic.

INTRODUCTION

This report represents a study of the Ostracoda and Foraminifera of an outcrop of a shale unit in the Ely Formation in the Confusion Range which is located 74 miles west of Delta in west-central Utah.

Purpose

The purpose of this report is to identify, describe, and illustrate the Ostracoda and Foraminifera of a particular shale unit that is directly below a prominent coral-bearing limestone of the Ely Formation, and, if possible, to determine more precisely its age.

The Ely Formation was studied earlier by other workers. This study is primarily concerned with the microfauna of the shale unit; however macrofossils were also collected from the unit.

Previous Work

Early published information on the Confusion Range is limited to three references by Gilbert (1875, 1890, and 1928). These reports describe briefly the location, structure, and stratigraphy of the range.

More recently C. S. Bacon (1948) described the stratigraphic sequence and the general structure of the Confusion Range. Norman D. Newell (1948) discussed the Permian section, and correlated the Pennsylvanian-Lower Permian rocks of the range with the Bird Spring Formation of southern Nevada and the Oquirrh Formation of Utah.

Lawrence Ogden (1951) studied the Mississippian and the

Pennsylvanian stratigraphy of the Confusion Range. He assigned the Pennsylvanian rocks to four unnamed rock units, each unnamed rock unit is characterized by slightly different cyclic alternations. Unit 1 consists of brown silty limestones alternating with dark-gray shale. Unit 2 consists of dark-gray and brown limestones alternating with dark-gray shale. Unit 3 consists of dark-gray limestones alternating with medium-gray calcareous siltstones. Unit 4 consists of medium-gray limestones alternating with light-gray silty limestones containing chert nodules. Lawrence Ogden described the boundaries between these units as gradational. R. B. Kraetsch and R. L. Jones (1951) studied the Pennsylvanian rocks in the Confusion Range and showed that the generic ranges of fusulinids from the Bird Springs Formation transcend the Pennsylvanian-Permian boundary in the Confusion Range. G. S. Campbell (1951) showed that rocks primarily of Ordovician to Triassic age are exposed in the Confusion Range, and for the first time he separated all of the Paleozoic rocks into formations.

The latest published work in the Confusion Range is that by R. K. Hose and C. H. Repenning (1959) who studied the Upper Mississippian to Lower Triassic stratigraphy of the range. Hose and Repenning introduced considerable changes of stratigraphic nomenclature in the Confusion Range, and recognized six formations. One of these is the Ely Formation with which this study is concerned.

Present Work

Field work and preliminary laboratory work were conducted during the autumn of 1963 and winter of 1964. The stratigraphic section was

measured with a tape and Brunton compass, and samples were collected at 3-foot intervals. Final laboratory work and writing were undertaken during the spring and summer of 1965.

Location, Topography, and Accessibility

The Confusion Range lies in the western part of Millard and Juab Counties, west-central Utah (fig. 1). The range is 50 miles long from north to south and 7 to 10 miles wide.

The range lies in the eastern part of the Basin and Range physiographic province. It is bounded on the east and west by the White and Snake Valleys respectively.

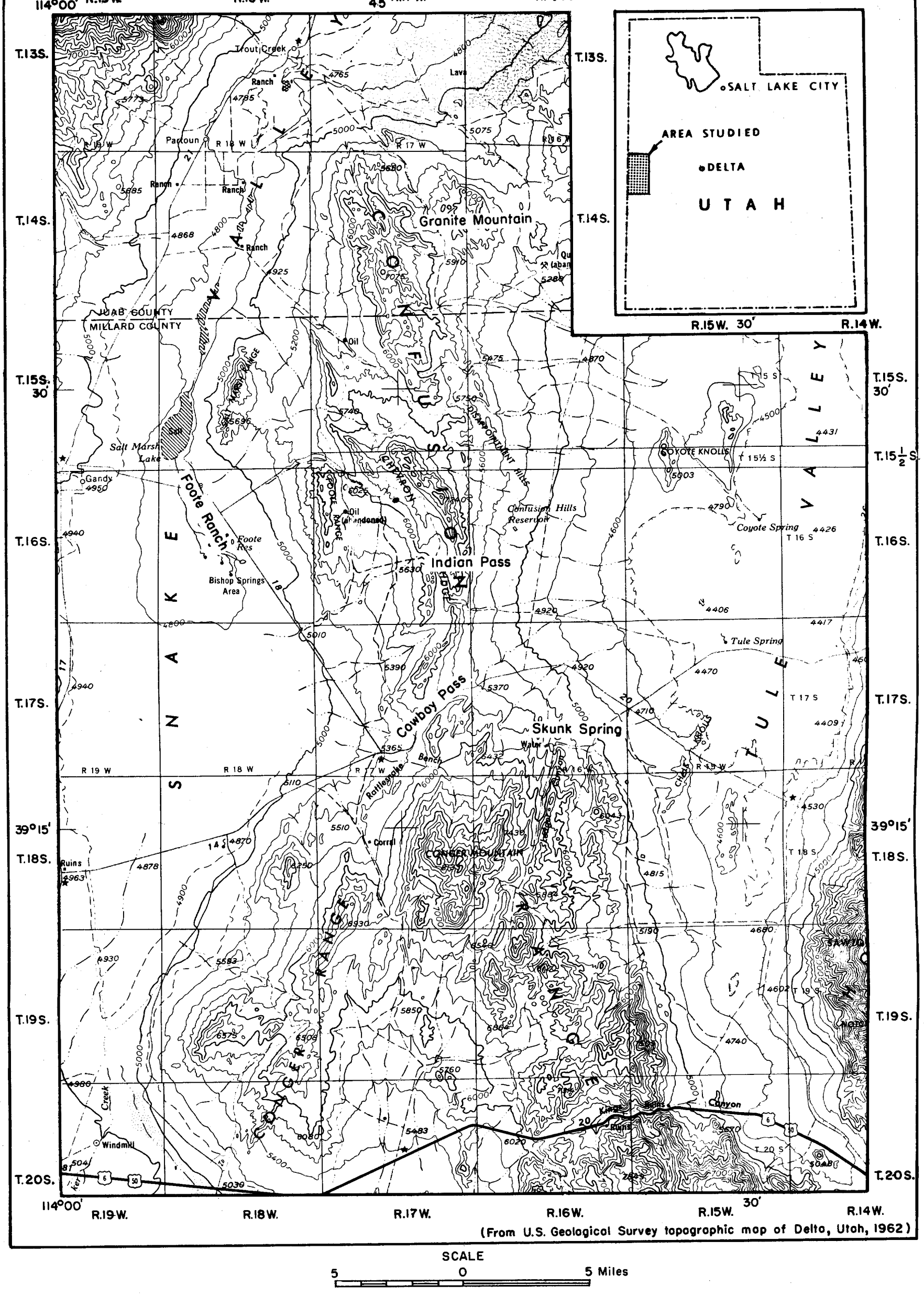
The Confusion Range is predominantly composed of folded rocks of Paleozoic age. (See fig. 2.) According to Bacon (1948, p. 1027) the range is geomorphologically divided into hogbacks, strike valleys, and a few larger anticlinal valleys and synclinal ridges. At lower elevations are pediments, fans, and shore lines of Lake Bonneville.

The Confusion Range is accessible by U. S. Highway 6-50. The range is almost midway between the towns of Ely, Nevada and Delta, Utah. The area of this study in the northern part of the range is accessible by dirt roads.

STRATIGRAPHY

General Considerations

The stratigraphic section in the Confusion Range has been divided according to two schemes of stratigraphic nomenclature; one was suggested by Campbell (1951) and the other was proposed by Hose and



(From U.S. Geological Survey topographic map of Delta, Utah, 1962)

SCALE

5 0 5 Miles

Figure 1.--Index map of northern part of Confusion Range, Utah.

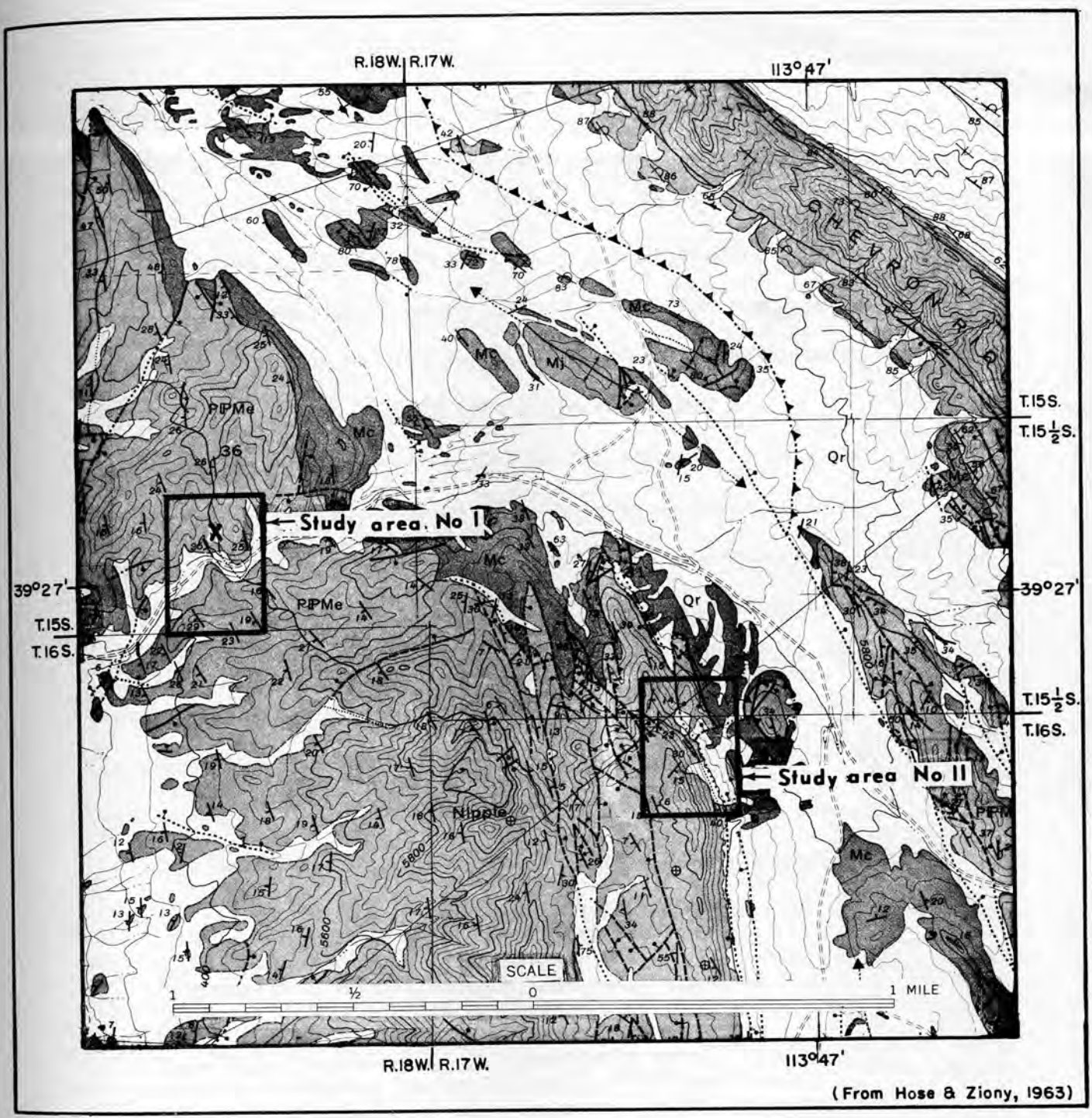


Figure 2.--Geologic map showing study areas. (X measured section)

EXPLANATION

Qr — QUATERNARY
Alluvium and colluvium

PPMe — MISSISSIPPIAN PENNSYLVANIAN AND PERMIAN
Ely Limestone

Mc — Chainman Shale

Mj — Joana Limestone

MISSISSIPPIAN

Repenning (1959).

Campbell (1951) showed that the stratigraphic section in the Confusion Range includes about 17,000 to 23,000 feet of sedimentary strata ranging in age from Ordovician to Early Triassic. Campbell divided the stratigraphic sequence in the Confusion Range into several formations of which the Bird Springs Formation of Pennsylvanian age is the only formation related to the present study.

According to the stratigraphic scheme proposed by Hose and Repenning (1959) Upper Mississippian to Lower Triassic rocks are divided into six formations and their usage is followed here. These six formations, in ascending order, are the Ely Limestone of Late Mississippian, Early and Middle Pennsylvanian, and Permian age; the Arcturus Formation of Early to Middle Permian age; the Kaibab Limestone, the Plympton Formation, and the Gerster Limestone of Permian age; and the Thaynes Formation of Early Triassic age.

Hose and Repenning (1959, p. 2168) wrote the following:

> Formational names previously applied to parts of this sequence are unsatisfactory, either because such nomenclature has been extended over distances greater than appear advisable, and in some cases has bypassed nomenclature established in areas closer to the Confusion Range, or it has failed to reflect accurately the lithologic character of the formational units. Insofar as it is feasible, the names used in this report are derived from type areas closest to the Confusion Range, although the danger inherent in extending formational names over great distances without intervening control still exists in parts of the described section. It is believed that the nomenclature proposed herein better reflects the predominant lithologic character of the formational units.

The present study pertains to the Ely Limestone, and following is a brief description of this formation.

Ely Limestone

The limestones with several interbedded thin shale units that comprise the formation of the present study were first called "Bird Spring limestone" by Newell (1948, p. 1053-1058). Subsequent workers referred to the unit as "Bird Springs formation" (Campbell, 1951, p. 24; Kraetsch and Jones, 1951, p. 60-62). According to Hose and Repenning (1959, p. 2170), "The type area for the Bird Spring formation (Hewett, 1931) is in the Goodsprings Quadrangle of southern Nevada, 200-230 miles southwest of the Confusion Range. ***In the Ely mining district of eastern Nevada, 60-75 miles west of the Confusion Range, rocks in essentially the same stratigraphic position as Newell's Bird Spring limestone were called the Ely limestone (Lawson, 1906; Spencer, 1917)." On the basis of the similarity of the type section of the Ely Formation to apparently equivalent strata in the Confusion Range, the name "Ely limestone" was introduced in the Confusion Range by Hose and Repenning (1959) for Newell's "Bird Spring limestone".

Definition and type locality.--The name "Ely limestone" was proposed by A. C. Lawson in 1906. The type area for the Ely Limestone is in the Robinson (Ely) Mining District, eastern Nevada. Lawson described the Ely Limestone as composed of regularly stratified thick-bedded more or less cherty limestone that is 1,500 feet thick. Lawson stated that the Ely Limestone underlies the Arcturus Formation and overlies the White Pine Shale of Devonian age.

Spencer (1917, p. 27) described the Ely Limestone in the type area as composed of gray or bluish dense massive limestone beds ranging

in thickness from a few feet to about 50 feet. These massive limestone beds are more or less cherty and are separated by shaly limestone. The Ely Limestone described by Spencer ranges in thickness from 2,000 to 2,500 feet, a greater thickness than that assigned to the formation by Lawson (1906).

Hose and Repenning (1959, p. 2170-2174) made a detailed study of the Ely Limestone in the Confusion Range and the following description is abstracted from their work for the convenience of the reader.

Lithologic character and thickness.--Hose and Repenning (1959, p. 2171) described the Ely Limestone as composed of a series of alternating resistant thick-bedded limestone and slope-forming slabby limestone. The resistant limestone is medium gray, coarse grained, and predominantly composed of organic detritus. This type of limestone forms massive beds ranging in thickness from 5-70 feet. The slabby limestone is medium gray and fine grained. The upper 100-350 feet of the Ely are more massive and contain fewer slabby units and less chert than the lower part.

A shale bed, 18-feet-thick, occurs 521 feet above the base of the formation. (See unit 5, fig. 3.) This shale bed contains the microfossils which are the subject matter of this report. The shale bed is overlain by a prominent limestone bed that contains the corals Cratanіophyllum (Barbouria sp. of Hose and Repenning, 1959, p. 2171) which according to Hose and Repenning (1959, p. 2171) is 540 feet above the base of the formation.

The Ely Limestone varies in thickness within the Confusion Range.

This thickness variation is partly due to the differences of depositional environments and partly due to differential erosions of the Mississippian, Pennsylvanian, and Permian components of the Ely Limestone (Hose and Repenning, 1959, p. 2171).

According to Hose and Repenning (1959, p. 2173), "The part of the Ely that is of Mississippian age ranges in thickness from about 60 feet at Skunk Spring, to about 40 feet at Indian Pass and about 15 feet about 4 miles east of the Foote Ranch. However, no beds of Mississippian age appear to be present in the Ely limestone at Granite Mountain in the northern Confusion Range." Overlying the Mississippian rocks is the Pennsylvanian part of the Ely. This part of the formation ranges in thickness from 1,450 feet southwest of Skunk Spring to 1,750 feet at Indian Pass. The Permian part of the Ely limestone ranges in thickness from 100 feet north of Indian Pass to about 350 feet southwest of Skunk Spring (Hose and Repenning, 1959, p. 2174).

In the present study the lower 537 feet of the Ely was measured by the writer. The beds range in dip from 21 to 25 degrees due west. Figure 3 shows the thickness and lithologic character of the measured part of the Ely Limestone.

Distribution.--Hose and Repenning (1959, p. 2171) stated that the Ely Limestone crops out in five areas in the Confusion Range. These are at Granite Mountain near the north end of the range, along the western side of the range east of Foote Ranch, along an arcuate ridge extending from the west flank of Desolation anticline southward

to Indian Pass, in the Conger Range, and in the center of the range near Skunk Spring.

Relation to adjacent formations.--Hose and Repenning (1959, p. 2173) stated that the Ely Limestone overlies the Chainman Shale of Mississippian age and underlies the Arcturus Formation of Permian age, and the contacts with both formations are conformable.

Fossils, age, and correlation.--Hose and Repenning (1959, p. 2173) mentioned that diagnostic fossils collected from the lower part of the Ely Limestone were identified as Productus (Diaphragmus) cestriensis Worthen and 'Buxtonia' aff. 'B.' arkansana (Girty), and this fauna is regarded by Mackenzie Gordon, Jr., as Late Mississippian in age.

Hose and Repenning (1959, p. 2173) also discussed macrofossils collected from 60 to 1,340 feet above the base of the Ely, 3.5 miles southwest of Skunk Spring. Regarding this fauna Mackenzie Gordon, Jr., stated, "The collections *** contain species typical of the lower half of the Pennsylvanian such as 'Dictyoclostus' (Antiquatonia) coloradoensis Girty, 'D.' (A.) hermosanus Girty, Spirifer opimus (Hall), S. occidentalis Girty, and Neospirifer cameratus (Morton). In some collections are holdovers from the Mississippian Chainman shale fauna, such as 'Dictyoclostus' cf. 'D.' inflatus (McChesney), Punctospirifer transversus (McChesney) and Reticulariina campestris (White). Some of these are found as high as 1,270 feet above the base of the formation. The collections of macrofossils from the section 3.5 miles south of Skunk Spring do not contain diagnostic Des Moines species."

Diagnostic microfossils collected about 1,400 feet above the base of the Ely Limestone were identified by Henbest as solenoporoid algae, Hemigordius? sp., tolypamminid species, Endothyra? sp., Globivalvulina sp., Millerella? sp., Profusulinella? sp.. Regarding this fauna, Henbest stated, "The possible stratigraphic range is Atoka to Early Permian inclusive but Atoka age appears most likely. None of the other foraminifers present opposing evidence for this conclusion. No mature or immature fusulinid shells like these have been reported in rocks that are definitely known to be older than Atoka" (Hose and Repenning, 1959, p. 2173-2174).

According to Hose and Repenning (1959, p. 2174), "Thompson and Zeller (1956) have presented additional data which support Henbest's judgment that the sequence most probably is of Atoka age. Chaetetes sp. was found by the writers about 1,000-1,300 feet above the base of the Ely limestone. Dott (1954) regards Chaetetes as a 'nearly synchronous time-stratigraphic marker' which is associated with beds whose microfauna suggests Atoka age."

Hose and Repenning (1959, p. 2174) mentioned that fusulinids were collected from the upper 200-350 feet of the Ely, and regarding the age of these rocks Henbest states that this part of the Ely represents a limited part of the Wolfcamp-Hueco time interval.

In the present study macrofossils were collected from the shale bed of the Ely Limestone (unit 5, fig. 3). These fossils were identified by Dr. W. L. Stokes of the Department of Geology, University of Utah, and they include the following forms:

Phylum BRACHIOPODA

Antiquatonia hermosana

Cleiothyridina orbicularis

Composita sp.

Hustedia sp.

Neochonetes sp.

Punctospirifer campestris

Rhipidomella elyensis

Unidentified productid

Phylum BRYOZOA

Order CRYPTOSTOMATA

Fenestella

Two unidentified bryozoan genera

Phylum COELENTERATA

Class ANTHOZOA

Crataniophyllum sp.

The assemblage indicates a general Pennsylvanian age which agrees with the age determination based on microfossils as will be shown later in this report.

MICROPALEONTOLOGY

Collecting Localities

Ten samples were collected from S ½ of projected Sec. 36, T. 15 S., R. 18 W., Salt Lake Meridian. (See geologic map, fig. 2.)

Sampling was made from the following units of the measured stratigraphic section (fig. 3): Samples 1-7 were taken from a shale bed (unit 5). This shale bed, 18-feet-thick, is 521 feet above the base of the Ely. This shale bed is overlain by a prominent limestone bed that contains the corals Crataniophyllum (Barbouria sp. of Hose and Repenning, 1959, p. 2171). Samples No. 8 and 9 were taken from a siltstone bed (unit 3) and a limestone bed (unit 1) overlying the shale bed, and sample No. 10 was taken from a siltstone bed (unit 7) underlying the shale bed. Two additional samples, No. 11 and 12, were collected from an outcrop of the shale bed--unit 5 of the stratigraphic section, figure 3--near NW corner of the NE quarter of projected Sec. 6, T. 16 S., R. 17 W.

Field Procedure

At the beginning of the field season, a program of random sampling was carried out in order to locate the most suitable areas for obtaining unaltered material. After locating the area to be covered, the section was measured with Brunton compass and a hundred-foot steel tape and also described. This information was used to construct a stratigraphic column (fig. 3). The purpose of this procedure was to locate the samples with respect to the base of the Ely Formation.

Approximately two pounds of shale and siltstone were collected in each sample, and one-half of that processed for study. The remainder was saved for future reference.

SYSTEM	FORMATION	UNIT	DESCRIPTION	THICKNESS
PENNSYLVANIAN	ELY FORMATION	1	Limestone, gray, weathers same.	9' No. 9
		2	Limestone, gray, weathers same, ledge former.	6'
		3	Limestone interbedded with fossiliferous siltstone.	20' No. 8
		4	Limestone, gray, weathers same; massive, ledge former.	4'
		5	Shale, dark gray to black, highly fossiliferous.	18' No. 7 ↑ No. 1
		6	Limestone, gray; massive, ledge former.	3'
		7	Siltstone, calcareous, unfossiliferous.	9' No. 10
		8	Limestone, gray, weathers same, thick-bedded.	43'
		9	Limestone, gray, concretionary, highly fossiliferous; ledge former, calcite veinlets filling fractures.	5'
		10	Limestone, gray, highly concretionary.	12'
		11	Limestone, gray, concretionary, fossiliferous, cliff former	19'
		12	Concealed.	122'
		13	Limestone, gray, concretionary, gypsiferous, ledge former.	6'
		14	Limestone, gray, thin-bedded.	20'
		15	Limestone, gray, weathers same, highly fossiliferous, gypsiferous, ledge former.	8'
		16	Concealed	12'
		17	Limestone, gray, concretionary, contains streaks of white calcite.	3'
		18	Concealed	75'
		19	Limestone, gray, alternating with covered intervals.	33'
		20	Limestone, dark gray, weathers buff to gray; crystalline, thin-bedded, ledge former.	16'
		21	Concealed	3'
		22	Limestone, black, concretionary, highly fractured.	7'
		23	Limestone, alternating with covered intervals.	8'
		24	Limestone, black, weathers buff to brown, ledge former.	3'
		25	Limy siltstone, black, shaly structure, carbonaceous.	½'
		26	Limestone, black, alternating with covered intervals (probably siltstone).	72'
MISSISSIPPIAN	CHAINMAN SHALE		Black shale	

EXPLANATION

Limestone

Shale

Siltstone

Limy siltstone

Concretionary limestone

Concealed

Scale 30 0 30 FEET

(Section measured by Dr. Mounir T. Moussa)

Figure 3. -- Stratigraphic section of lower part of Ely Formation including shale bed with approximate positions of samples.

Preparation of Samples and Thin Sections

Preparation of samples.--The fraction processed for study is thoroughly dried, heated, then suddenly plunged into kerosene and allowed to soak for one hour then transferred from kerosene to water and allowed to soak for three days.

When the breakdown was complete, the wet-screening technique was used to concentrate the microfossils. Sieve sizes used were 10⁻, 35⁻ 60⁻, and 100 mesh. Most specimens were found in the 60 mesh fraction, but some of the smaller Ostracoda and Foraminifera were picked from the 100 mesh fraction.

Standard procedures were used for picking and mounting specimens. Types have been deposited in the University of Utah Micropaleontological collection, numbers 1695 to 1743.

Thin-sectioning.--The relatively small size (0.2-0.7 mm.) of the endothyroid Foraminifera rendered thin sectioning difficult. The writer used the following procedure: Morphologically similar individuals are collected in one single hole slide, one of them was placed flat on the surface of a glass slide and heated to 200° F. A drop or two of fluid balsam was put over the glass. After heating for a few minutes the glass was cooled until it became hard enough to endure grinding. The specimen impregnated was carefully ground down on the glass plate using fine-grained abrasives; first with # 600 and then with # 800. After washing and drying, the glass slide was again heated to between 300-360° F. As soon as the balsam melted the half--ground specimen was turned over with a fine needle. After the

specimen was turned over the glass slide was cooled, then the specimen ground down to a thickness that would permit maximum transmitted light and easy observation of internal structure.

Microfaunal Analysis

Forty species of Ostracoda belonging to 14 families and 23 genera, and 8 species of Foraminifera belonging to 4 families and 8 genera were identified from the shale bed of the Ely Formation. The family Bairdiidae is represented by 8 species, Healdiidae by 7 species, the families Hollinidae and Paraparchitidae each by 4 species; Kloedenellidae, Amphissitidae, and Kirkbyidae each by 3 species; Cavellinidae by 2 species; Youngiellidae, Glyptopleuridae, Bythocytheridae, Geisinidae, Beyrichiopsidae, and Bairdiocyprididae each by one species.

Although the ostracodes outnumber the Foraminifera in species, the Foraminifera outnumber the ostracodes in the total number of specimens present in the samples.

Age and Correlation

The microfaunal assemblage suggests a Pennsylvanian age in general and possibly Middle Pennsylvanian (See table 1); a conclusion that is in agreement with the age determination based on macrofossils as stated in earlier section of this report.

Some of the species here described are long ranging in age, for example Amphissites rugosus ranges in age from Late Mississippian to Late Pennsylvanian. Others, however, have a restricted age; for

Species	Upper Mississippian	Lower Pennsylvanian	Middle Pennsylvanian	Upper Pennsylvanian	Permian
Ostracoda:					
Amphissites rugosus					
Ectodemites plummeri					
Geisina jolliffina					
Glyptopleura irregularis					
Hollinella dentata					
Hollinella grandis					
Hollinella oklahomaensis					
Kirkbya bifrons					
Kirkbya canyonensis					
Kirkbya pergrandis					
Ellipsella calcar					
Jonesina dubia					
Jonesina elongata					
Beyrichiella n. sp.					
Microparaparchites cornutus					
Paraparchites inornatus					
Paraparchites fabula					
Proparaparchites parallelus					
Mooreites punctus					
Orthobairdia cestriensis					
Bairdia citriformis					?
Rectobairdia distressa					
Bairdia permagna					
Bairdia pennata					
Bairdia pompilioides					
Bairdiacypris nebraskensis					
Coryellites centralis					
Monoceratina ventrale					
Cavellina cavellinoides					
Cavellina footei					
Healdia colonyi					
Healdia ehlersi					
Seminolites elongatus					
Waylandella bythocyproidea					
Foraminifera:					
Endothyranella powersi					
Globivalvulina biserialis					
Millerella marblensis					
Polytaxis laheei					
Tetrataxis conica					
Annelida:					
Spirorbis anthracosia					

Table 1. -- Stratigraphic distribution of species as recorded in literature up to present time.

- - - - - - - - - - - - The range is evidently longer than the range given in literature

Source of material:

Cooper, 1941, 1946
Coryell, 1928
Galloway and Ryniker, 1930
Kellett, 1933
Moore, ed., 1961, 1964
Shimer and Shrock, 1944
Sohn, 1960, 1961

example Ectodemites plummeri which is of Early Pennsylvanian age.

The shale bed of the Ely Formation correlates faunally with the Shoal Creek Limestone (Pennsylvanian) in Illinois (Cooper, 1946). This correlation is based on the presence in both units of the following ostracode species: Ectodemites plummeri, Geisina jolliffina, Glyptopleura irregularis, Hollinella grandis, Hollinella oklahomaensis, Hollinella dentata, Kirkbya pergrandis, Ellipsella calcar, Jonesina dubia, Jonesina elongata, Microparaparchites cornutus, Paraparchites fabula, Proparaparchites parallelus, Mooreites punctus, Bairdia citriformis, Bairdia pennata, Bairdia pompilioides, Bairdiacypris nebraskensis, Coryellites centralis, Cavellina cavellinoides, Cavellina footei, Healdia ehlersi, Healdia colonyi, Seminolites elongatus, Waylandella bythocyproidea.

Two species, namely Paraparchites inornatus and Kirkbya bifrons, were reported among the Chester ostracodes of Illinois (Cooper, 1941).

Six of the species identified in this report were reported by Bradfield (1935) from the Ardmore Basin (Pennsylvanian), Oklahoma.

Of the nine species reported from the Atoka Formation (Lower Pennsylvanian) of Oklahoma (Galloway and Ryniker, 1930) the Ely fauna contains the foraminifers Globivalvulina biserialis and Endothyranella powersi.

Harlton (1927) reported two of the foraminiferal species from the Glenn Formation (Pennsylvanian) of southern Oklahoma.

Paleoecology

The paleoecology of the fossil ostracodes from the shale bed

in the Ely Formation may be inferred from the known or assumed habits of fossils and living species of the same genera. Fossil species of ostracode genera such as Amphissites, Ectodemites, Orthobairdia, Rectobairdia, Bairdiacypris, and Healdia were restricted to marine environment (Sohn, 1960 and 1961; Morkhoven, 1962). Recent species of Bairdia and Monoceratina are considered as good indicators of marine environment (Morkhoven, 1962 and 1963). Moreover, ostracodes from the shale bed are associated with other groups of marine animals such as foraminifers, bryozoans, brachiopodes, and crinoidal stems. Therefore it seems likely that the ostracodes from the shale bed lived in a marine environment.

Although recent ostracodes are known from every type of marine environment, the majority of marine species is found in the littoral and shallow marine zones (Morkhoven, 1962, p. 148). A structural feature of the littoral to shallow marine ostracodes is in heavy ornamentation (Morkhoven, 1962, p. 40). Consequently, deeper marine ostracode assemblages comprise mainly thin-shelled, translucent, mostly unornamented species (Morkhoven, 1962, p. 149). The common occurrence of heavy structural ostracodes like Amphissites, Kirkbya, Hollinella, Beyrichiella, and Glyptopleura in the shale bed suggests a shallow marine environment rather than a deep marine environment.

A number of marine ostracodes are pelagic and these forms belong exclusively to Myodocopa which have very few fossil representatives (Morkhoven, 1962, p. 150). The number of free-swimming marine podocopids is very small, and these practically all belong to the

Cyprididae (Morkhoven, 1962, p. 151). However, ostracodes from the shale bed are characterized by the presence of Monoceratina and Waylandella which are both typical benthonic ostracodes and by ornamented forms which were considered as bottom dwellers (Sohn, 1957, p. 937). Therefore it seems likely that the ostracodes from the shale bed were benthonic rather than pelagic.

In conclusion, the microfauna from the shale bed of the Ely Formation lived in a shallow marine environment and was benthonic.

SYSTEMATIC DESCRIPTIONS

Phylum ARTHROPODA

Class CRUSTACEA

Subclass OSTRACODA

Order PALAEOCOPIDA

Family AMPHISSITIDAE

Genus AMPHISSITES Girty, 1910

Amphissites aff. *A. centronotus* (Ulrich and Bassler), 1906.

Plate I, figure 1

Diagnosis.--Carapace elongate, tumid; dorsal margin straight, ventral margin nearly parallel to dorsal margin; ends subequally rounded. This species possesses three carinae; two outer carinae complete, parallel to free margins, inner carina vertical and incomplete; node central, elongate, of large size; surface covered by irregular reticulations.

Measurements of figured specimen.--Length - 0.32 mm., width - 0.18 mm., height - 0.17 mm..

Discussion.--*Amphissites* aff. *A. centronotus* represented here is similar to *Amphissites centronotus* described by Cooper (1946) and Sohn (1961) in all respects except that the median node is elongate in the former and circular in the latter.

Amphissites centronotus is distinguished from *A. rugosus* by having a discontinuous vertical carina around the elongate median node.

Occurrence.--Common in sample 1.

Univ. Utah Micropaleo. Coll. No. 1695

Amphissites rugosus Girty

Plate I, figures 2a, b

Amphissites rugosus Girty, 1910, p. 236 [fide, Sohn, 1961, p. 121]; Sohn, 1961, p. 121, pl. 7, figs. 35-38, 41-43 (for synonymy to date).

Diagnosis.--Carapace subquadrate, dorsal margin straight, ventral margin nearly parallel to dorsal margin, ends subequally rounded. This species possesses three carinae, complete and parallel to free margins; node circular, of large size, and slightly anterior to center; surface covered by irregular reticulations.

Measurements of figured specimen.--Length - 0.48 mm., width - 0.23 mm., height - 0.29 mm..

Discussion.--The difference between this species and A. centronotus is mentioned under discussion of A. centronotus.

Occurrence.--Common in sample 1.

Univ. Utah Micropaleo. Coll. No. 1696

Genus ECTODEMITES Cooper, 1941

Ectodemites plummeri Cooper

Plate I, figures 3a, b

Ectodemites plummeri Cooper, 1945, p. 368, pl. 57, figs. 1-6, 21, 30 (not figs. 7-20, 22-29, 31-36=Kegelites? sp. C); Sohn, 1961, p. 127 (for synonymy to date).

Diagnosis.--Carapace relatively short, tumid; dorsal margin straight, ventral margin broadly convex; ends equally rounded; cardinal angles more than 90°; posterior shoulder subdued; two marginal ridges low and subparallel to free margins; median node very low; surface covered with coarse reticulations.

Measurements of figured specimen.--Length - 0.32 mm., width - 0.10 mm., height - 0.19 mm..

Discussion.--Genus Ectodemites is distinguished from genus Kegelites by having subdued posterior shoulder and very low median node while the latter has prominent posterior shoulder and well--developed central node.

According to Sohn (1961, p. 126) the holotype - "Ectodemites" primus - has a very poorly preserved but distinct dorsal shield. Although this character is considered by Sohn as diagnostic of Amphissites s. s., the genus "Ectodemites" is provisionally retained for the few species that exhibit the generic features described by Cooper.

Occurrence.--Abundant in samples 1, 5, and 11, common in samples 2 and 12, and rare in samples 3, 4, and 8.

Family GEISINIDAE

Genus GEISINA Johnson, 1936

Geisina jolliffina Cooper

Plate I, figure 4

Geisina jolliffina Cooper, 1946, p. 110, pl. 18, figs 3, 4.

Diagnosis.--Carapace relatively short, subovate in lateral view; hinge line straight, ventral margin broadly convex; anterior end rounded, posterior end straight; sulcus deep, anterior to center, extending down from the hinge line; ventral and anterior margins bordered by narrow flange; surface marked by medium pits.

Measurements of figured specimen.--Length - 0.33 mm., width - 0.11 mm., height - 0.18 mm..

Occurrence.--Common in samples 1, 3, and 11, and rare in sample 4.

Univ. Utah Micropaleo. Coll. No. 1698

Family GLYPTOPLEURIDAE

Genus GLYPTOPLEURA Girty, 1910

Glyptopleura irregularis Delo

Plate I, figure 5

Glyptopleura irregularis Delo, 1931, p. 44, pl. 4, fig. 5; Cooper, 1946, p. 79, pl. 10, figs. 41-42.

Diagnosis.--Carapace subovate, tumid; hinge line straight, ventral

margin broadly convex; ends rounded, posterior end narrower than anterior end; cardinal angles rounded; valve surface marked by few ribs crossing obliquely from anteroventral to posterodorsal regions, ending posteriorly with ends raised above shell surface to form ear-like processes; pit below second rib; dimorphic.

Measurements of figured specimen.--Length - 0.30 mm., width - 0.16 mm., height - 0.19 mm..

Discussion.--This species is distinguished from other species of Glyptopleura by having fewer ribs crossing obliquely from anteroventral to posterodorsal regions, ending posteriorly with ear-like processes; the difference between the male and female is very clear (dimorphism), especially in the dorsal view where the posterior end of the female is bulbous giving a triangular shape to the dorsal view.

Occurrence.--Rare to common in samples 1, 7, and 12, and abundant in sample 5.

Univ. Utah Micropaleo. Coll. No. 1699

Family HOLLINIDAE

Genus HOLLINELLA Coryell, 1928

Hollinella grandis Cooper

Plate I, figures 7a, b

Hollinella grandis Cooper, 1946, p. 92, pl. 13, figs 41-46.

Diagnosis.--Carapace large, tumid; hinge line long, straight;

frill wide, thin; anterior node very large, rises from shell surface and extending above dorsal margin; posterior node small; sulcus deep; surface finely granulose.

Measurements of figured specimen.--Length - 0.52 mm., width - 0.24 mm., height - 0.26 mm..

Discussion.--Hollinella grandis is distinguished by having large carapace and a very prominent anterior node.

Occurrence.--Rare in sample 12.

Univ. Utah Micropaleo. Coll. No. 1700

Hollinella oklahomaensis (Harlton)

Plate I, figure 8

Jonesina oklahomaensis Harlton, 1928, p. 133, pl. 21, figs 3a, b.

Hollinella oklahomaensis (Harlton), 1929, p. 146, pl. 1, figs 8a, b; Cooper, 1946, p. 94, pl. 14, figs 37-45 (for synonymy to date).

Diagnosis.--Carapace small, flattened; equivalved and straight hinge-lined ostracodes; anterior node small, posterior node faint; sulcus inconspicuous; free margins unfrilled; shell surface coarsely papillose.

Measurements of figured specimen.--Length - 0.19 mm., width - 0.04 mm., height - 0.11 mm..

Discussion.--Hollinella oklahomaensis represented here is identical

with the small instars of H. oklahomaensis described by Cooper (1946). The adult forms of Illinois species have more prominent nodes and wide frill, carrying a spine which is not developed in the small instars represented here.

Occurrence.--Rare in sample 1.

Univ. Utah Micropaleo. Coll. No. 1701

Hollinella cf. H. harltoni Kellett

Plate I, figure 9

Hollinella harltoni Kellett, 1929, p. 211, pl. 26, figs 10a, b.

Diagnosis.--Carapace small, subquadrangular, equivalved; hinge line straight, long, shorter than shell length; anterior node prominent, its upper edge little below the hinge line, posterior node small, poorly developed, forming a U-shaped sinus with the anterior node; free margin bordered with a low ridge; surface finely granulose.

Measurements of figured specimen.--Length - 0.26 mm., width - 0.06 mm., height - 0.18 mm..

Discussion.--The species represented here is similar to H. harltoni described by Kellett but it does not show the row of spines running parallel to the ventral margin of H. harltoni.

Occurrence.--Rare in samples 2 and 4.

Univ. Utah Micropaleo. Coll. No. 1702

Hollinella dentata Coryell

Plate I, figure 6

Hollinella dentata Coryell, 1928, p. 378, pl. 51, fig. 1; Cooper 1946, p. 90, pl. 13, figs. 32-38 (for synonymy to date).

Diagnosis.--Carapace small; hinge line long, straight; anterior node large, rising from shell surface, its upper edge little below hinge line, posterior node small but prominent; sulcus wide, shallow; frill moderate, thin, showing the characteristic radiations; shell surface finely granulose.

Measurements of figured specimen.--Length - 0.19 mm., width - 0.08 mm., height - 0.10 mm..

Discussion.--The specimens represented here are small instars of H. dentata described by Cooper. This small instar is distinguished from the adult forms of H. dentata by lacking the very broad fragile frill carrying long anterior spine which characterizes the adult form.

Occurrence.--Rare in sample 2.

Univ. Utah Micropaleo. Coll. No. 1703

Family KIRKBYIDAE

Genus KIRKBYA Jones, 1859

Kirkbya bifrons Croneis and Thurman

Plate I, figure 10

Kirkbya bifrons Croneis and Thurman, 1938 [fide, Cooper, 1941, p. 87]; Cooper, 1941, pl. 10, figs. 5-7.

Diagnosis.--Carapace elongate, greatest length near dorsal margin, hinge line straight, slightly channelled; lateral surface convex; inner and outer keels faint; posterior shoulder small, extending slightly above hinge line; surface marked by ovate pits.

Measurements of figured specimen.--Length - 0.30 mm., width - 0.12 mm., height - 0.16 mm..

Discussion.--K. bifrons is distinguished from K. canyonensis by having a very faint posterodorsal shoulder and low keels, while the latter has a very prominent posterior shoulder and conspicuous keels.

Occurrence.--Common in sample 4.

Univ. Utah Micropaleo. Coll. No. 1704

Kirkbya canyonensis Harlton

Plate I, figures 11a, b

Kirkbya canyonensis Harlton, 1929, p. 153, pl. 2, figs. 5a, b; Kellett, 1933, p. 89, pl. 15, figs. 1-7.

Diagnosis.--Carapace subrectangular, greatest length near dorsal margin; hinge line straight, slightly grooved; ventral margin broadly convex; ends subequally rounded; a thick ridge-like elongate node located in the center of the valve, a second node posterior to it rising above hinge line to form a posterior shoulder; inner and outer keels conspicuous; surface marked by small pits.

Measurements of figured specimen.--Length - 0.44 mm., width - 0.27 mm., height - 0.18 mm..

Discussion.--According to Sohn (1961, p. 140), "Cooper (1946, p. 105) referred K. canyonensis and K. knighti to K. kellettae because he assumed all three to be growth stages of the same species" since they were described by Harlton (1929) from one horizon and locality. Sohn (1961) mentioned that Cooper's assumption is not valid because Sohn's "study of growth series of Aurikirkbya wordensis and A. barbarae (Sohn, 1950) showed that the lobation is constant within the growth series that range in length from 0.8 to 1.76 mm. and from 0.9 to 2.07 mm.. The three species differ in lobation."

Occurrence.--Common in sample 1, and abundant in sample 5.

Univ. Utah Micropaleo. Coll. No. 1705

Kirkbya pergrandis Kellett

Plate I, figure 12

Kirkbya pergrandis Kellett, 1933, p. 85, pl. 14, fig. 31; Cooper, 1946, p. 106, pl. 17, fig. 10.

Diagnosis.--Carapace elongate; dorsal margin slightly curved, ventral margin broadly convex; hinge line undefined; flange inconspicuous, shoulder prominent; surface smooth.

Measurements of figured specimen.--Length - 0.40 mm., width - 0.11 mm., height - 0.13 mm..

Discussion.--K. pergrandis is distinguished by having large carapace, smooth surface, and broadly convex ventral margin.

Occurrence.--Rare in sample 1.

Univ. Utah Micropaleo. Coll. No. 1706

Family KLOEDENELLIDAE

Genus ELLIPSELLA Coryell and Rogatz, 1932

Ellipsella calcar (Harlton)

Plate I, figures 13a, b, c

Cytherella calcar Harlton, 1928, p. 141, pl. 21, figs. 16a, b.

Ellipsella calcar (Harlton); Kellett, 1936, p. 772; Cooper, 1946, p. 109, pl. 17, figs 24-28 (for synonymy to date).

Diagnosis.--Carapace medium, tumid; lateral outline subrhomboidal; dorsal and ventral margins straight, subparallel; overlap undefined around ends, moderate along ventral margin; hinge line straight with a pronounced anterior overlap of right valve over left valve; sulcus faint, shallow, surface minutely punctate; dimorphic.

Measurements of figured specimens.--Male, length - 0.41 mm., width - 0.17 mm., height - 0.26 mm.; female, length - 0.45 mm., width - 0.24 mm., height - 0.27 mm..

Discussion.--E. calcar is distinguished by having subrhomboidal carapace and straight subparallel dorsal and ventral margins, and straight hinge line with a pronounced anterior overlap of right valve

over left valve. The difference between male and female is very clear especially in the dorsal view where the posterior end of the female is enlarged giving a triangular shape to the dorsal view.

Occurrence.--Common in sample 1 and abundant in samples 2-7, 11, and 12.

Univ. Utah Micropaleo. Coll. No. 1707

Genus JONESINA Ulrich and Bassler, 1908

Jonesina dubia Bradfield

Plate I, figure 14

Jonesina dubia Bradfield, 1935, p. 43, pl. 3, figs. 1a, b; Cooper, 1946, p. 112, pl. 18, figs 10, 11.

Diagnosis.--Carapace small, relatively tumid; lateral outline subquadrate; dorsal margin straight, ventral margin broadly convex; ends subequally rounded; sulcus narrow, slightly anterior to midportion; overlap narrow, clear, uniform around free margins; surface finely granulose.

Measurements of figured specimen.--Length - 0.22 mm., width - 0.11 mm., height - 0.14 mm..

Occurrence.--Rare in samples 3, 4, 5, and 12.

Univ. Utah Micropaleo. Coll. No. 1708

Jonesina elongata Cooper

Plate I, figure 15

Jonesina elongata Cooper, 1946, p. 113, pl. 18, figs. 18, 19.

Diagnosis.--Carapace elongate, lateral outline subrectangular; hinge line undefined; dorsal and ventral margins straight, subparallel; ends subequally rounded; sulcus narrow, deep, slightly shifted from center; overlap unknown; surface granulations inconspicuous.

Measurements of figured specimen.--Length - 0.25 mm., width - 0.06 mm., height - 0.13 mm..

Discussion.--J. elongata is distinguished from J. dubia by having elongate, subrectangular carapace and subparallel dorsal and ventral margins, and a triangular dorsal view.

Occurrence.--Rare in samples 1, 2, and 5.

Univ. Utah Micropaleo. Coll. No. 1709

Family BEYRICHIOPSIDAE

Genus BEYRICHIELLA Jones and Kirkby, 1886

Beyrichiella n. sp.

Plate I, figures 16a, b

Diagnosis.--Carapace medium, lateral outline subrectangular, with distinct backward swing; hinge line straight, slightly channelled;

free margins bordered by narrow frill; two lobes located on each valve connected with a ridge which ends posteriorly with a crest; dimorphic.

Measurements of figured specimen.--Length - 0.39 mm., width - 0.18 mm., height - 0.19 mm..

Occurrence.--Common in samples 2 and 4, and rare in samples 3, 5, 7, 11, and 12.

Univ. Utah Micropaleo. Coll. No. 1710

Family PARAPARCHITIDAE

Genus MICROPARAPARCHITES Croneis and Gale, 1938

Microparaparchites cornutus Cooper

Plate I, figures 17a, b, c

Microparaparchites cornutus Cooper, 1946, p. 118, pl. 20, figs. 13-15.

Diagnosis.--Carapace small, subovate in lateral outline; dorsal margin slightly concave, ventral margin convex; ends subequally rounded, greatest height anterior; hinge line slightly grooved; posterodorsal area strongly swollen, bearing long spine on posterodorsal corner of each valve; overlap narrow, uniform around free margins; surface granulations undefined.

Measurements of figured specimen.--Length - 0.25 mm., width - 0.11 mm., height - 0.16 mm..

Discussion.--M. cornutus is distinguished from Paraparchites

inornatus by having strongly swollen posterodorsal area, bearing long spine on posterodorsal corner of each valve.

Occurrence.--Rare in samples 4, 7, and 12.

Univ. Utah Micropaleo. Coll. No. 1711

Genus PARAPARCHITES Ulrich and Bassler, 1906

Paraparchites inornatus (McCoy)

Plate I, figure 18

Cythere inornata McCoy, 1844, p. 167, pl. 23, fig. 18 [fide, Cooper, 1941, p. 62].

Paraparchites inornatus (McCoy); Cooper, 1941, p. 62, pl. 13, figs. 13, 14 (for synonymy to date).

Diagnosis.--Carapace medium, subovate in lateral outline; hinge line straight; longest diameter crossing diagonally from anteroventral to posterodorsal regions; ends subequally rounded, greatest height anteriorly; right valve carrying a distinct short spine on posterodorsal portion; overlap narrow around free margins except posteroventral portion where overlap is prominent.

Measurements of figured specimen.--Length - 0.42 mm., width - 0.10 mm., height - 0.34 mm..

Discussion.--P. inornatus is distinguished by having a distinct short spine on the posterodorsal region of the right valve.

Occurrence.--Rare in sample 6 and common in sample 8.

Univ. Utah Micropaleo. Coll. No. 1712

Paraparchites fabula Cooper

Plate I, figure 19

Paraparchites fabula Cooper, 1946, p. 120, pl. 21, figs. 28-30.

Diagnosis.--Carapace small, somewhat tumid, semiovate in lateral outline; dorsal margin straight, short, ventral margin strongly convex; ends subequally rounded, greatest forward; overlap narrow; surface granulations undefined.

Measurements of figured specimen.--Length - 0.14 mm., width - 0.08 mm., height - 0.10 mm..

Discussion.--P. fabula is distinguished from P. inornatus by lacking the spine on the posterodorsal region of the right valve which characterizes the latter.

Occurrence.--Rare in samples 1 and 3.

Univ. Utah Micropaleo. Coll. No. 1713

Genus PROPARAPARCHITES Cooper, 1941

Proparaparchites parallelus

Plate I, figure 20

Proparaparchites parallelus Cooper, 1946, p. 121, pl. 21, figs. 37, 38.

Diagnosis.--Carapace medium, flat, subrectangular in lateral outline, without pronounced swing; dorsal margin straight, ventral margin broadly convex to nearly straight; ends equally rounded; surface smooth.

Measurements of figured specimen.--Length - 0.24 mm., width - 0.08 mm., height - 0.13 mm..

Discussion.--Proparaparchites parallelus is distinguished by having subrectangular carapace, parallel dorsal and ventral margins, equally rounded ends, and without pronounced swing.

Occurrence.--Rare in samples 3 and 4.

Univ. Utah Micropaleo. Coll. No. 1714

Family YOUNGIELLIDAE

Genus MOOREITES Coryell and Billings, 1932

Mooreites punctus (Wilson)

Plate I, figures 21, 22

Youngiella puncta Wilson, 1933, p. 416, pl. 50, figs. 4a-d.

Mooreites punctus (Wilson), Cooper, 1946, p. 123, pl. 21, figs. 3, 4.

Diagnosis.--Carapace small, subrhomboidal in lateral outline; dorsal margin straight, ventral margin subparallel to dorsal margin; ends subequally rounded, bordered by narrow ridge; surface marked by small pits.

Measurements of figured specimen.--No. 21, length - 0.17 mm., width - 0.05 mm., height - 0.08 mm.; No. 22, length - 0.18 mm., width - 0.07 mm., height - 0.09 mm..

Discussion.--M. punctus is distinguished by having subrhomboidal carapace and narrow ridges bordering the anterior and posterior extremities.

Occurrence.--Rare in sample 1 and abundant in samples 2 and 4.

Univ. Utah Micropaleo. Coll. No. 1715

Order PODOCOPIDA

Family BAIRDIIDAE

Genus BAIRDIA McCoy, 1844

Bairdia aff. B. bicornis Bradfield, 1935

Plate I, figure 23

Diagnosis.--Carapace large, biconvex; dorsal margin high, short, nearly straight, ventral margin slightly incurved; ends steep, strongly concave, posterior beak upturned; overlap strong along dorsal margin, narrow, uniform along anterior, posterior, and central region of ventral margin; surface smooth.

Measurements of figured specimen.--Length - 0.63 mm., width - 0.19 mm., height - 0.37 mm..

Discussion.--Bairdia aff. B. bicornis represented here is similar

to B. bicornis described by Bradfield (1935) in all respects except that it lacks the tubercles located at the junction of anterodorsal slope and anterior margin of B. bicornis described by Bradfield.

Occurrence.--Common in samples 3 and 4.

Univ. Utah Micropaleo. Coll. No. 1716

Genus ORTHOBAIRDIA Sohn, 1960

Orthobairdia cestriensis (Ulrich)

Plate I, figures 24, 30

Bairdia cestriensis Ulrich, 1891 (part), p. 210, pl. 17, figs. 6a-c (not figs. 7a, b; steinkern of indet. sp.).

Orthobairdia cestriensis (Ulrich); Sohn, 1960, p. 65, pl. 3, figs 24-27 (for synonymy to date).

Diagnosis.--Carapace large, elongate, tumid; dorsal margin low, broadly convex, ventral margin slightly incurved; anterior end rounded, posterior end steep with a short posterior beak; overlap moderate along dorsal margin and central part of ventral margin, narrow around anterior end; surface finely granulose.

Measurements of figured specimen.--No. 24, length - 0.60 mm., width - 0.28 mm., height - 0.34 mm.; No. 30, length - 0.58 mm., width - 0.27 mm., height - 0.35 mm..

Discussion.--Genus Orthobairdia is characterized by parallel sides in dorsal outline.

Occurrence.--Common in samples 1, 2, 7, and 8, abundant in samples 3, 4, 5, 6, 11, and 12.

Univ. Utah Micropaleo. Coll. No. 1717

Bairdia citriformis Knight

Plate I, figure 25

Bairdia citriformis Knight, 1928, p. 321, pl. 43, figs. 4a-d; Cooper, 1946, p. 43, pl. 1, figs. 23-26 (for synonymy to date).

Diagnosis.--Carapace large; dorsal margin highly arched, ventral margin slightly incurved to nearly straight; anterior end broad, rounded, posterior beak slightly upturned; overlap strong along antero-dorsal and central part of ventral margin, narrow, uniform around ends; surface finely granulose.

Measurements of figured specimen.--Length - 0.65 mm., width - 0.10 mm., height - 0.37 mm..

Discussion.--B. citriformis is distinguished by having highly arched dorsal margin, and narrow, pointed, upturned posterior beak, and attenuated terminations as seen in dorsal view.

Occurrence.--Common in sample 2.

Univ. Utah Micropaleo. Coll. No. 1718

Genus RECTOBAIRDIA Sohn, 1960

Rectobairdia distressa (Geis)

Plate I, figure 26

Bairdia distressa Geis, 1940, in Sohn, p. 154.

Rectobairdia distressa (Geis); Sohn, 1960, p. 54, pl. 2, figs. 3-5 (for synonymy to date).

Diagnosis.--Carapace medium, elongate, thick; dorsal margin broadly convex, with nearly straight central portion, ventral margin slightly incurved; anterodorsal and posterodorsal slopes gentle, posterior beak short; overlap strong along central part of ventral margin, narrow, uniform around other points; surface finely granulose.

Measurements of figured specimen.--Length - 0.45 mm., width - 0.16 mm., height - 0.23 mm..

Discussion.--Genus Rectobairdia is distinguished from genus Bairdia by having a straight to very gently curved dorsal margin and a pointed posterior.

Occurrence.--Abundant in samples 1, 2, 3, 11, and 12, common in samples 5, 6, and 7.

Univ. Utah Micropaleo. Coll. No. 1719

Bairdia permagna Geis

Plate I, figures 27, 32

Bairdia permagna Geis, 1932, p. 175, pl. 25, figs. 11a, b; Sohn, 1960, p. 30, pl. 2, figs. 20-24 (for synonymy to date).

Diagnosis.--Carapace large, elongate; dorsal margin broadly

arched, ventral margin slightly incurved; anterodorsal and posterodorsal slopes very gentle, anterior end rounded, posterior beak short, wide; overlap prominent along dorsal margin and central part of ventral margin, narrow around other points; surface smooth.

Measurements of figured specimen.--No. 27, length - 0.68 mm., width - 0.21 mm., height - 0.36 mm.; No. 32, length - 0.70 mm., width - 0.05 mm., height - 0.32 mm..

Discussion.--B. permagna is distinguished by having large, elongate carapace with very gentle anterodorsal and posterodorsal slopes.

Occurrence.--Rare to common in samples 1, 3, 4, and 12.

Univ. Utah Micropaleo. Coll. No. 1720

Bairdia pennata Coryell and Sample

Plate I, figure 28

Bairdia angulata Coryell and Sample, 1932, p. 262, pl. 25, fig. 16.

Bairdia pennata Coryell and Sample, 1933, p. 187; Cooper, 1946, p. 49, pl. 3, figs. 1-4; pl. 4, figs. 3-4.

Diagnosis.--Carapace medium, elongate, thick; dorsal margin broadly arched, ventral margin nearly straight; anterior end broad, rounded, posterodorsal slope gentle, posterior beak pointed; overlap narrow around free margins; surface finely granulose.

Measurements of figured specimen.--Length - 0.43 mm., width - 0.17 mm., height - 0.22 mm..

Occurrence.--Rare to common in samples 2, 3, 6, 7, and 11, and abundant in samples 1, 4, and 12.

Univ. Utah Micropaleo. Coll. No. 1721

Bairdia pompilioides Harlton

Plate I, figure 29

Bairdia pompilioides Harlton, 1928, p. 140, pl. 21, fig. 13; Cooper, 1946, p. 49, pl. 3, figs. 39-43 (for synonymy to date).

Diagnosis.--Carapace large, subfusiform; greatest height and thickness central; dorsal margin broadly arched, ventral margin slightly incurved; anterodorsal and posterodorsal slopes steep, concave, posterior beak short, pointed, and upturned; overlap prominent along dorsal margin, anterodorsal portion, and central part of ventral margin, narrow, uniform along other points; surface finely granulose.

Measurements of figured specimen.--Length - 0.68 mm., width - 0.22 mm., height - 0.28 mm..

Discussion.--B. pompilioides is distinguished from B. permagna by having subfusiform carapace, highly arched dorsal margin, steep anterodorsal and posterodorsal slopes, and narrow, pointed, upturned posterior beak.

Occurrence.--Rare to common in samples 1, 2, 3, 5, 6, and 8, and abundant in sample 4.

Univ. Utah Micropaleo. Coll. No. 1722

Genus BAIRDIACYPRIS Bradfield, 1935

Bairdiacypris nebraskensis (Upson)

Plate I, figure 31

Bairdia nebraskensis (Upson), 1933, p. 18, pl. 1, figs. 6a, b [fide, Cooper, 1946, p. 54].

Bairdiacypris nebraskensis (Upson); Cooper, 1946, p. 54, pl. 4, figs. 28, 29 (for synonymy to date).

Diagnosis.--Carapace medium, elongate, suboblong in lateral view; dorsal margin broadly arched, ventral margin gently concave; anterior end broad, rounded, posterior end narrow; overlap conspicuous along dorsal margin and central portion of ventral margin, undefined around other points.

Measurements of figured specimen.--Length - 0.53 mm., width - 0.14 mm., height - 0.22 mm..

Occurrence.--Common in sample 1.

Univ. Utah Micropaleo. Coll. No. 1723

Family BAIRDIOCYPRIDIDAE

Genus CORYELLITES Kellett, 1936

Coryellites centralis (Coryell and Billings)

Plate II, figure 33

Bythocypris centralis Coryell and Billings, 1932, p. 174, pl. 17, fig. 11.

Coryellites centralis (Coryell and Billings); Cooper, 1946, p. 56, pl. 4, figs. 45, 46 (for synonymy to date).

Diagnosis.--Carapace elongate, thick; dorsal margin broadly convex to nearly straight, ventral margin slightly incurved; anterior end broad, rounded, posterior end less rounded; overlap prominent along ventral margin, narrow, uniform around other points; surface smooth.

Measurements of figured specimen.--Length - 0.38 mm., width - 0.16 mm., height - 0.20 mm..

Occurrence.--Common in sample 4.

Univ. Utah Micropaleo. Coll. No. 1724

Family BYTHOCYTHERIDAE

Genus MONOCERATINA Roth, 1928

Monoceratina ventrale Roth

Plate II, figure 34

Monoceratina ventrale Roth, 1928, p. 16, figs. 1a, b, c.

Diagnosis.--Carapace small, tumid, triangular in dorsal view; hinge line long, straight, channeled; ventral margin slightly convex; ends subequally rounded; posteroventral portion carrying a conspicuous wing-like protuberence extending posteriorly; surface finely granulose.

Measurements of figured specimen.--Length - 0.21 mm., width - 0.12 mm., height - 0.13 mm..

Discussion.--M. ventrale is distinguished from other species of Monoceratina by having triangular dorsal view and prominent wing-like protuberances.

Occurrence.--Rare in samples 1, 2, 3, 5, 6, and 12, and common in samples 4 and 11.

Univ. Utah Micropaleo. Coll. No. 1725

Family CAVELLINIDAE

Genus CAVELLINA Coryell, 1928

Cavellina cavellinoides (Bradfield)

Plate II, figures 35, 37

Cytherella cavellinoides Bradfield, 1935, p. 124, pl. 11, figs. 3a, b.

Cavellina cavellinoides (Bradfield); Cooper, 1946, p. 71, pl. 7, figs. 34, 35.

Diagnosis.--Carapace large, elongate, subovate in lateral outline; dorsal margin broadly arched, ventral margin slightly concave to nearly straight; ends subequally rounded, posterior slope steep; overlap strong along dorsal and ventral margins, moderate around ends; surface smooth.

Measurements of figured specimens.--No. 35, length - 0.43 mm., width - 0.14 mm., height - 0.24 mm.; No. 37, length - 0.35 mm., width - 0.06 mm., height - 0.21 mm..

Discussion.--C. cavellinoides is distinguished from C. footei by having elongate, subovate carapace, prominent overlap along dorsal and

ventral margins, and very steep posteroventral truncation.

Occurrence.--Rare in samples 1, 2, 11, and 12, common in samples 4 and 5.

Univ. Utah Micropaleo. Coll. No. 1726

Cavellina footei (Coryell and Booth)

Plate II, figure 36

Cytherella footei Coryell and Booth, 1933, p. 270, pl. 4, fig. 11.

Cavellina footei (Coryell and Booth); Cooper, 1946, p. 72, pl. 9, figs. 46, 47.

Diagnosis.--Carapace medium, thick, ovate in lateral view; dorsal margin strongly arched, ventral margin slightly convex; ends subequally rounded; overlap wide along central part of dorsal and ventral margins, narrow around ends; surface finely granulose.

Measurements of figured specimen.--Length - 0.26 mm., width - 0.12 mm., height - 0.17 mm..

Discussion.--C. footei is distinguished by having ovate lateral outline and faint posteroventral truncation.

Occurrence.--Common in samples 3, 4, 5, 6, 7, 8, 11, and 12.

Univ. Utah Micropaleo. Coll. No. 1727

Family HEALDIIDAE

Genus HEALDIA Roundy, 1926

Healdia ehlersi Bradfield

Plate II, figure 39

Healdia ehlersi Bradfield, 1935, p. 109, pl. 9, figs. 11a, b; Cooper, 1946, p. 82, pl. 12, figs 6-8 (for synonymy to date).

Diagnosis.--Carapace medium, tumid, subtriangular in lateral outline; dorsal margin roundly angular, ventral margin straight; anterior end broad, rounded, posterior end truncate; overlap prominent along anterodorsal and ventral margins, narrow, uniform around ends; posterior ridge well developed, carrying two short spines; surface smooth.

Measurements of figured specimen.--Length - 0.24 mm., width - 0.12 mm., height - 0.17 mm..

Discussion.--H. ehlersi is distinguished from H. colonyi by having the posterior spines joined by a thick ridge.

Occurrence.--Abundant in samples 1, 2, 3, 4, 8, 11, and 12, and rare in samples 6 and 7.

Univ. Utah Micropaleo. Coll. No. 1728

Healdia colonyi Coryell and Booth

Plate II, figures 38, 40, 41

Healdia colonyi Coryell and Booth, 1933, p. 266, pl. 4, figs. 9, 10; Cooper, 1946, p. 81, pl. 11, figs. 43-47 (for synonymy to date).

Diagnosis.--Carapace large, thick, subtriangular in lateral outline; dorsal margin strongly arched, with equal slopes, ventral margin slightly concave; ends subequally rounded, posterodorsal area flattened, slightly channelled; spines long, directed backward, with no bridge in between, posterior shoulder rounded; overlap wide along dorsal and ventral margins, narrow around anterior end.

Measurements of figured specimens.--No. 38, length - 0.26 mm., width - 0.08 mm., height - 0.12 mm.; No. 40, length - 0.28 mm., width - 0.10 mm., height - 0.18 mm.; No. 41, length - 0.27 mm., width - 0.09 mm., height - 0.11 mm..

Discussion.--Specimens No. 38 and No. 41 are small instars of H. colonyi.

Occurrence.--Abundant in samples 1, 2, 3, 4, 8, 11, and 12, and common in samples 5, 6, and 7.

Univ. Utah Micropaleo. Coll. No. 1729

Healdia aff. H. colonyi Coryell and Booth

Plate II, figures 42, 43

Discussion.--This species has the same general characteristics as Healdia colonyi, but differs in having elongate, oval shape with a much lower dorsal margin.

Measurements of figured specimens.--No. 42, length - 0.29 mm., width - 0.10 mm., height - 0.15 mm.; No. 43, length - 0.29 mm., width - 0.10 mm., height - 0.16 mm..

Occurrence.--Common in samples 1, 4, 6, 7, 8, and 11, and abundant in sample 12.

Univ. Utah Micropaleo. Coll. No. 1730

Genus SEMINOLITES Coryell, 1928

Seminolites elongatus Coryell

Plate II, figures 44a, b

Seminolites elongatus Coryell, 1928, p. 88, pl. 11, fig. 2; Cooper, 1946, p. 87, pl. 13, figs. 14-16 (for synonymy to date).

Diagnosis.--Carapace elongate; dorsal margin broadly arched, greatest height slightly anterior, ventral margin straight; anterior end broad, rounded, posterior end truncated; overlap wide along ventral margin, narrow, uniform around other points (overlap undefined around posterior end); two ridges bordering terminal ends, with slightly depressed furrows on inside edges; surface marked by round pits in the posterior half of each valve.

Measurements of figured specimen.--Length - 0.24 mm., width - 0.08 mm., height - 0.12 mm..

Discussion.--S. elongatus is distinguished from S. healdoides by having low and narrow carapace while the latter has a subtriangular carapace with anterior end much broader than posterior and the posterior

ridge bearing two small spines.

Occurrence.--Rare in samples 3 and 5, abundant in sample 4, and common in samples 11 and 12.

Univ. Utah Micropaleo. Coll. No. 1731

Seminolites aff. *S. elongatus* Coryell, 1928

Plate II, figure 45

Measurements of figured specimen.--Length - 0.25 mm., width - 0.06 mm., height - 0.17 mm.

Discussion.--*S.* aff. *S. elongatus* is a specific variation of *S. elongatus* Coryell. *S.* aff. *S. elongatus* has the same general characteristics as *S. elongatus* but differs in having a subtriangular shape and a highly arched dorsal margin.

Occurrence.--Common in sample 4 and 11.

Univ. Utah Micropaleo. Coll. No. 1732

Seminolites healdoides Bradfield

Plate II, figures 46a, b

Seminolites healdoides Bradfield, 1935, p. 117, pl. 10, fig. 8.

Diagnosis.--Carapace small, subtriangular in lateral outline; dorsal margin highly arched, ventral margin straight, greatest height forward; anterior end broad, rounded, posterior end truncate; overlap undefined;

two ridges bordering terminal ends, the posterior ridge bearing two small spines; surface marked by few rounded pits in the posterior half of each valve.

Measurements of figured specimen.--Length - 0.23 mm., width - 0.11 mm., height - 0.13 mm..

Occurrence.--Abundant in sample 4 and rare in sample 3.

Univ. Utah Micropaleo. Coll. No. 1733

Genus WAYLANDELLA Coryell and Billings, 1932

Waylandella bythocyproidea (Warthin)

Plate II, figure 47

Healdia bythocyproidea Warthin, 1930, p. 76, pl. 6, figs. 12a, b.

Waylandella bythocyproidea (Warthin); Cooper, 1946, p. 64, pl. 7, figs. 14-16 (for synonymy to date).

Diagnosis.--Carapace large, ovate in lateral outline; dorsal margin broadly convex, ventral margin slightly convex to nearly straight; ends equally rounded; overlap narrow, uniform around free margins; posteroventral portion of each valve carrying a very small spine.

Measurements of figured specimen.--Length - 0.78 mm., width - 0.18 mm., height - 0.42 mm..

Discussion.--Waylandella differs from Healdia in having more elongate lateral outline and lacking dorsal angulation and posterior portion of the valve carrying one or two spines joined with or without

a bridge.

W. bythocyproidea is distinguished by having one small spine located in posteroventral portion of each valve.

Occurrence.--Common in samples 2, 6, and 12

Univ. Utah Micropaleo. Coll. No. 1734

Phylum PROTOZOA

Class SARCODINA

Order FORAMINIFERIDA

Superfamily ENDOTHYRACEA

Family ENDOTHYRIDAE

Genus ENDOTYHRA Phillips, 1846

Endothyra symmetrica Zeller

Plate II, figure 48

Endothyra symmetrica Zeller, 1957, p. 701, pl. 75, figs. 14, 18, 19; pl. 78, figs. 8, 9; pl. 80, fig. 6.

Diagnosis.--Test free, discoidal, umbilicate on both sides, involute; chambers numerous, slightly swollen between sutures; coiling planispiral, rate of coil expansion medium; septa moderately long with slight anterior direction; proloculus small; diameter of figured specimen, 0.23 mm..

Discussion.--E. symmetrica is distinguished by regular and medium rate of expansion of shell coiling.

Occurrence.--Common in samples 1, 2, 3, 4, and 5, rare in sample 11.

Univ. Utah Micropaleo. Coll. No. 1735

Genus ENDOTHYRANELLA Galloway and Harlton, 1927

Endothyranella powersi (Harlton)

Plate II, figure 49

Ammobaculites powersi Harlton, 1927, p. 21, pl. 3, figs. 3a-e.

Endothyranella powersi (Harlton); Galloway and Harlton, 1930, p. 25; Warthin, 1930, p. 21, pl. 1, figs. 13, 14.

Diagnosis.--Test free, early portion coiled, nearly planispiral, umbilicate, slightly involute, finally uncoiling and becoming rectilinear, aperture terminal.

Occurrence.--Common in sample 11.

Univ. Utah Micropaleo. Coll. No. 1736

Genus GRANULIFERELLA Zeller, 1957

Granuliferella granulosa Zeller

Plate II, figure 51

Granuliferella granulosa Zeller, 1957, p. 695, pl. 77, figs. 1, 7, 8, 14, 19, 20; pl. 78, fig. 2; pl. 79, figs. 3, 4, 5, 20, 21, 22; pl. 81, figs. 4, 5, 7, 8, 10; pl. 82, figs. 6, 7.

Diagnosis.--Test small, slightly asymmetrical, involute, umbilicate on one side; chambers few, relatively large, slightly swollen between sutures, proloculus indistinct; septa long, with anterior direction;

secondary deposits absent; coiling plectogyroid, volutions few; diameter of figured specimen, 0.19 mm..

Discussion.--Granuliferella differs from Plectogyra by its single layered wall, larger proportional chamber size, and small number of volutions.

Occurrence.--Abundant in samples 1-4, and 6, common in samples 7, 11, and 12, rare in sample 8.

Univ. Utah Micropaleo. Coll. No. 1737

Genus PLECTOGYRA Zeller, 1950

Plectogyra sp. Zeller

Plate II, figure 52

Plectogyra sp. Zeller, 1953, pl. 27, figs. 18, 19, 21.

Diagnosis.--Test discoidal, involute, plectogyral coiling, umbilicate on one side only; chambers few, slightly swollen between sutures, proloculus indistinct; septa long and show anterior inclinations; secondary deposits not well developed; diameter of figured specimen, 0.18 mm.

Occurrence.--Abundant in samples 1-6, common in samples 7, 11, and 12, rare in sample 8.

Univ. Utah Micropaleo. Coll. No. 1738

Family BISERIAMMINIDAE

Genus GLOBIVALVULINA Schubert, 1921

Globivalvulina biserialis Cushman and Waters

Plate II, figure 50

Globivalvulina biserialis Cushman and Waters, 1928, p. 64, pl. 8, fig. 7 [fide, Galloway and Ryniker, 1930, p. 16]; Galloway and Ryniker, 1930, p. 16, pl. 2, figs. 10, 11; pl. 3, figs. 2a-c.

Diagnosis.--Test hemispherical, dorsal side strongly convex, ventral side flatten to slightly concave; test starting with a proloculus which divided into chambers biserially arranged, twice as broad as long; aperture elongate, on the inner side of the last chamber; surface finely punctate.

Measurements of figured specimen.--Length - 0.23 mm., height - 0.10 mm..

Occurrence.--Abundant in samples 1-4, and 6, rare to common in samples 5, 7, and 12.

Univ. Utah Micropaleo. Coll. No. 1739

Family TETRATAXIDAE

Genus POLYTAXIS Cushman and Waters, 1928

Polytaxis laheei Cushman and Waters

Plate II, figure 54

Polytaxis laheei Cushman and Waters, 1928, p. 51, pl. 7, fig. 7 [fide, Warthin, 1930, p. 26]; Warthin, 1930, p. 26, pl. 1, figs. 21a, b.

Diagnosis.--Test low conical, extremely depressed in side view, consisting of proloculum and elongate crescentic chambers, arranged in several whorls, becoming larger and increasing in numbers toward last whorl; ventral side concave; aperture on umbilical side.

Measurements of figured specimen.--Diameter - 0.61 mm., height - 0.10 mm..

Discussion.--P. laheei is distinguished by having extremely depressed conical test.

Occurrence.--Rare in samples 2, 6, 7, and 11.

Univ. Utah Micropaleo. Coll. No. 1740

Genus TETRATAXIS Ehrenberg, 1843

Tetrataxis conica Ehrenberg

Plate II, figure 55

Tetrataxis conica Ehrenberg, 1843, p. 106 [fide, Harlton, 1927, p. 22]; Harlton, 1927, p. 22, pl. 4, figs. 5a-d (for synonymy to date).

Diagnosis.--Test conical, round in dorsal view; apical end slightly rounded; chambers numerous, arranged in spirals, becoming larger and decrease in number toward the last whorl; base concave, with aperture opening in the four-lobed umbilicus; surface smooth.

Measurements of figured specimen.--Diameter - 0.32 mm., height - 0.16 mm..

Occurrence.--Common in samples 1, 2, 3, 7, 11, and 12, abundant in

samples 5 and 6, few in sample 4.

Univ. Utah Micropaleo. Coll. No. 1741

Superfamily FUSULINACEA

Family OZAWAINELLIDAE

Genus MILLERELLA Thompson, 1942

Millerella marblensis

Plate II, figure 53

Millerella marblensis, 1964, Treatise on invertebrate paleontology, Part C, Protista 2[1], p. 396, fig. 398, 4a, b.

Diagnosis.--Test medium, discoidal, involute to partly evolute; periphery rounded; coiling planispiral; rate of expansion of the shell is uniform; chambers numerous, not swollen between sutures, proloculus small; septa numerous, thin, show prominent anterior inclinations; wall slightly thick; diameter of figured specimen, 0.18 mm..

Occurrence.--Common in samples 3, 5, and 11, abundant in samples 1, 2, 4, and 12.

Univ. Utah Micropaleo. Coll. No. 1742

Phylum ANNELIDA

Class CHAETOPODA

Order PHANEROCEPHALA

Genus SPIRORBIS Lamarck, 1801

Spirorbis anthracosia Whitfield

Plate II, figure 56

Spirorbis anthracosia Whitfield, 1881, p. 128 [fide, Warthin, 1930, p. 35]; Warthin, 1930, p. 35, pl. 2, figs. 14a, b.

Diagnosis.--Shell small to large, snail-like tube, fairly high spired with flat base so that all the whorls can be seen on the ventral side; surface marked with concentric striae and irregular nodes; diameter of figured specimen ranges from 0.28 to 0.66 mm. and height ranges from 0.10 to 0.44 mm..

Occurrence.--Few in samples 1-4 and 12, common in samples 6 and 7.

Univ. Utah Micropaleo. Coll. No. 1743

SUMMARY AND CONCLUSIONS

1. Forty species of ostracodes and 8 species of Foraminifera and one species of Annelida are figured and described from the shale bed.

2. The ostracode assemblage exhibits close affinity to Pennsylvanian ostracodes of Illinois. A few species previously described from the Chesterian strata of Illinois are also present.

3. The assemblage from the shale unit in the Ely Formation suggests a general Pennsylvanian age and possibly Middle Pennsylvanian.

4. The microfaunal assemblage suggests a littoral to shallow marine environment and was benthonic.

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PLATE I

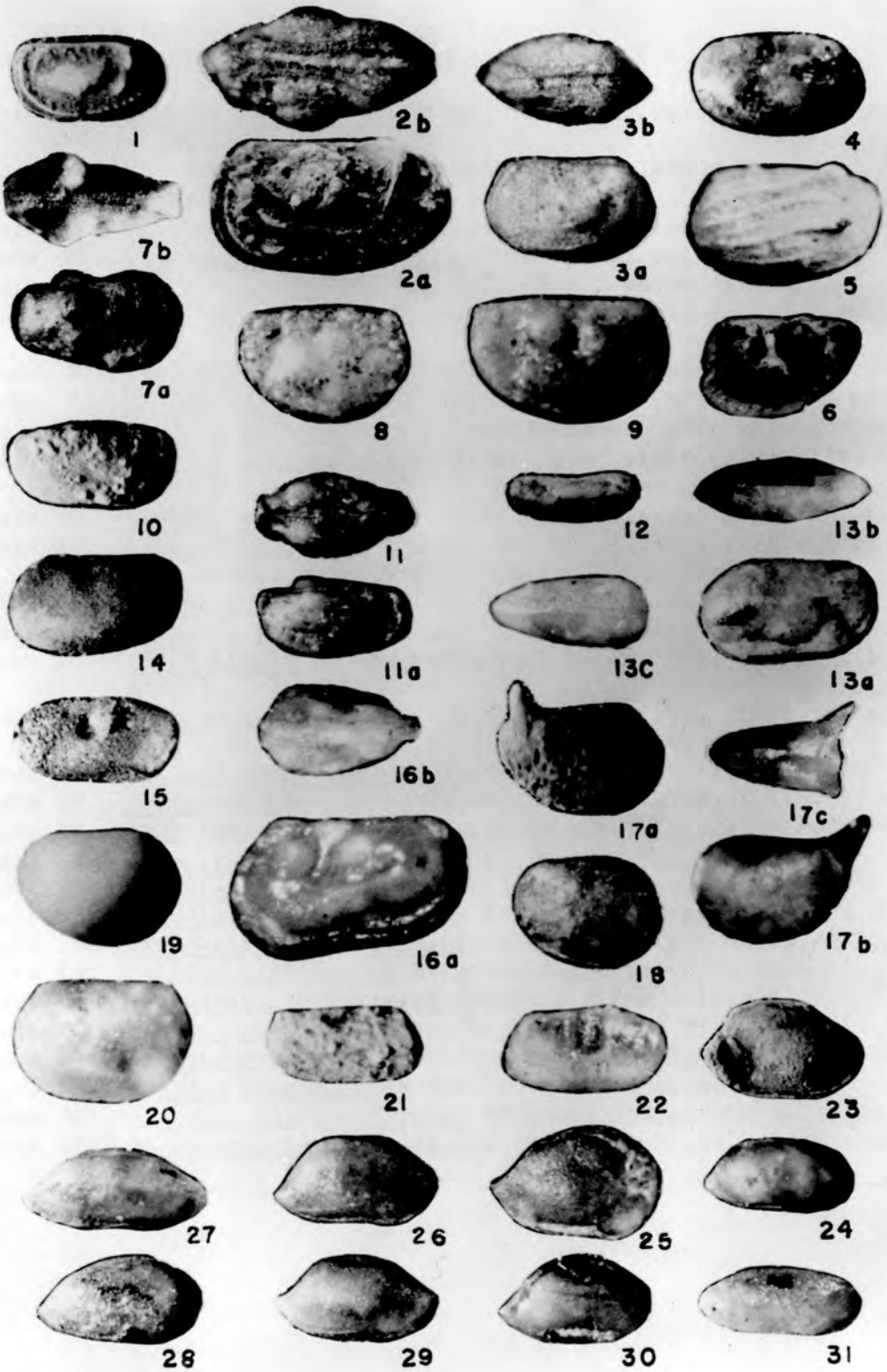
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PLATE I

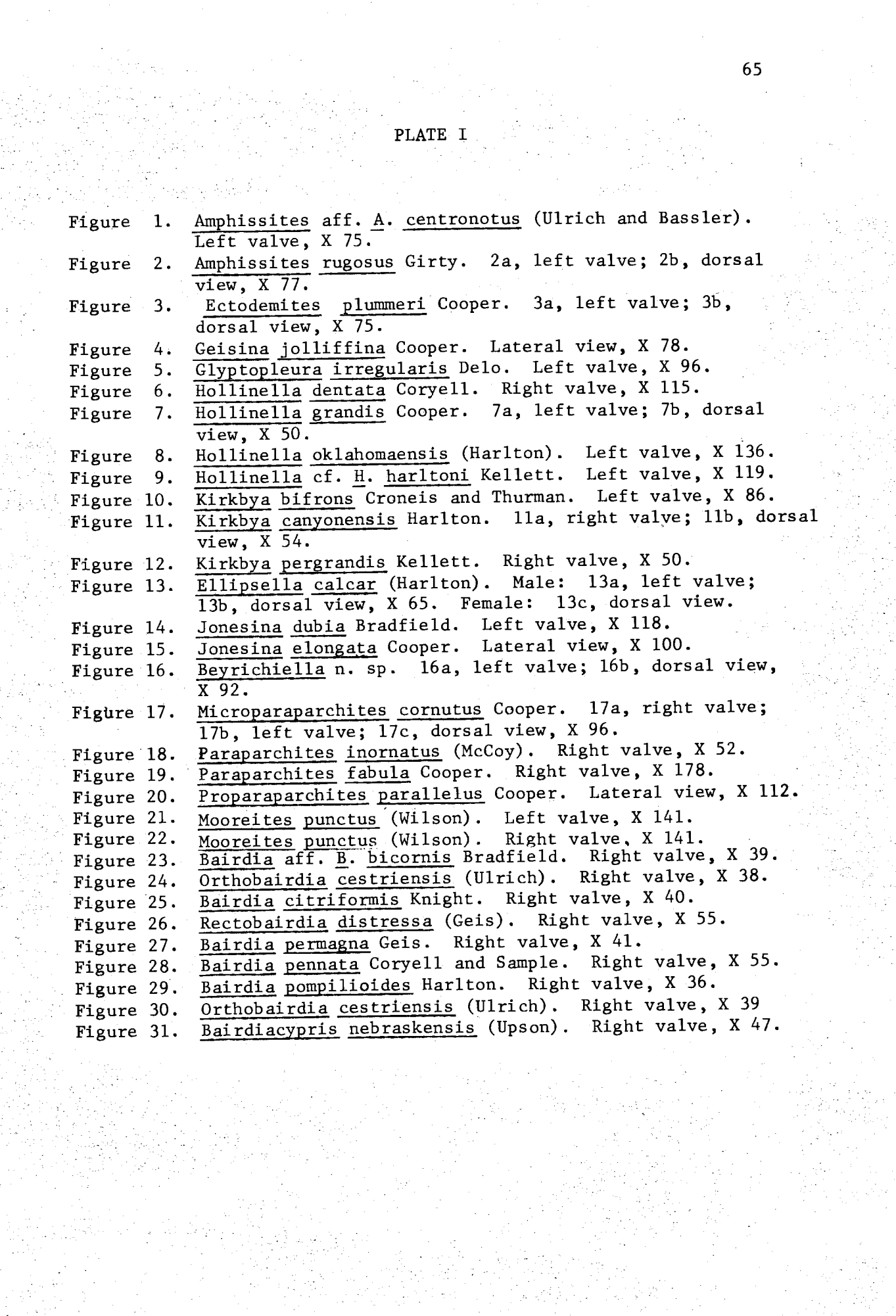

Figure 1. Amphissites aff. A. centronotus (Ulrich and Bassler). Left valve, X 75.
Figure 2. Amphissites rugosus Girty. 2a, left valve; 2b, dorsal view, X 77.
Figure 3. Ectodemites plummeri Cooper. 3a, left valve; 3b, dorsal view, X 75.
Figure 4. Geisina jolliffina Cooper. Lateral view, X 78.
Figure 5. Glyptopleura irregularis Delo. Left valve, X 96.
Figure 6. Hollinella dentata Coryell. Right valve, X 115.
Figure 7. Hollinella grandis Cooper. 7a, left valve; 7b, dorsal view, X 50.
Figure 8. Hollinella oklahomaensis (Harlton). Left valve, X 136.
Figure 9. Hollinella cf. H. harltoni Kellett. Left valve, X 119.
Figure 10. Kirkbya bifrons Croneis and Thurman. Left valve, X 86.
Figure 11. Kirkbya canyonensis Harlton. 11a, right valve; 11b, dorsal view, X 54.
Figure 12. Kirkbya pergrandis Kellett. Right valve, X 50.
Figure 13. Ellipsella calcar (Harlton). Male: 13a, left valve; 13b, dorsal view, X 65. Female: 13c, dorsal view.
Figure 14. Jonesina dubia Bradfield. Left valve, X 118.
Figure 15. Jonesina elongata Cooper. Lateral view, X 100.
Figure 16. Beyrichiella n. sp. 16a, left valve; 16b, dorsal view, X 92.
Figure 17. Microparaparchites cornutus Cooper. 17a, right valve; 17b, left valve; 17c, dorsal view, X 96.
Figure 18. Paraparchites inornatus (McCoy). Right valve, X 52.
Figure 19. Paraparchites fabula Cooper. Right valve, X 178.
Figure 20. Proparaparchites parallelus Cooper. Lateral view, X 112.
Figure 21. Mooreites punctus (Wilson). Left valve, X 141.
Figure 22. Mooreites punctus (Wilson). Right valve, X 141.
Figure 23. Bairdia aff. B. bicornis Bradfield. Right valve, X 39.
Figure 24. Orthobairdia cestriensis (Ulrich). Right valve, X 38.
Figure 25. Bairdia citriformis Knight. Right valve, X 40.
Figure 26. Rectobairdia distressa (Geis). Right valve, X 55.
Figure 27. Bairdia permagna Geis. Right valve, X 41.
Figure 28. Bairdia pennata Coryell and Sample. Right valve, X 55.
Figure 29. Bairdia pompilioides Harlton. Right valve, X 36.
Figure 30. Orthobairdia cestriensis (Ulrich). Right valve, X 39
Figure 31. Bairdiacypris nebraskensis (Upson). Right valve, X 47.

PLATE II

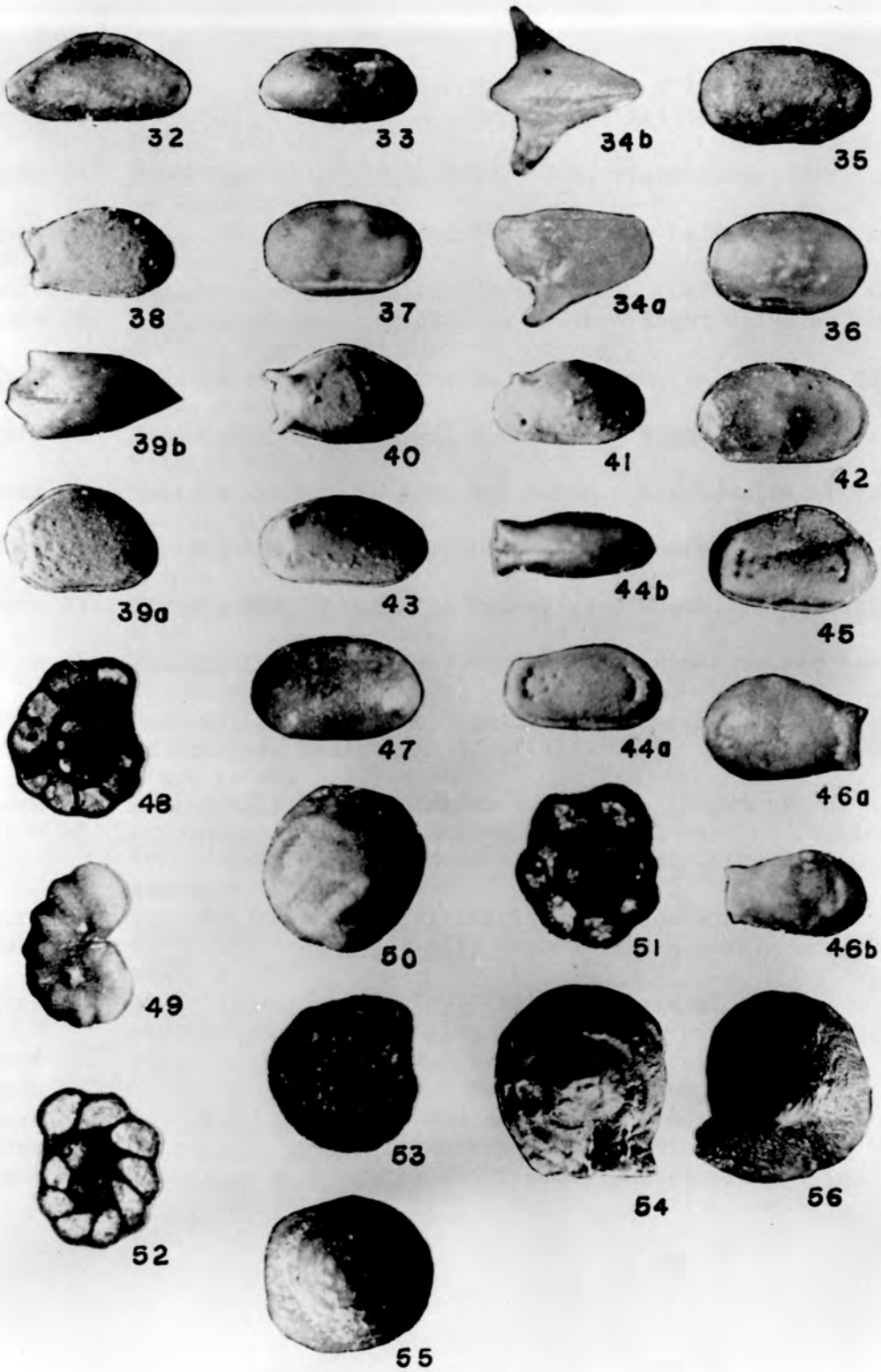
32
33
34b
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PLATE II

Figure 32. Bairdia permagna Geis. Right valve, X 40.
Figure 33. Coryellites centralis (Coryell and Billings). Right valve, X 63.
Figure 34. Monoceratina ventrale Roth. 34a, right valve; 34b, dorsal view, X 114.
Figure 35. Cavellina cavellinoides (Bradfield). Left valve, X 60.
Figure 36. Cavellina footei (Coryell and Booth). Left valve, X 92.
Figure 37. Cavellina cavellinoides (Bradfield). Left valve, X 68.
Figure 38. Healdia colonyi Coryell and Booth. Right valve of small instar, X 84.
Figure 39. Healdia ehlersi Bradfield. 39a, right valve; 39b, dorsal view, X 95.
Figure 40. Healdia colonyi Coryell and Booth. Right valve of adult form, X 82.
Figure 41. Healdia colonyi Coryell and Booth. Right valve of small instar, X 95.
Figure 42. Healdia aff. H. colonyi Coryell and Booth. Right valve, X 108.
Figure 43. Healdia aff. H. colonyi Coryell and Booth. Right valve, X 89.
Figure 44. Seminolites elongatus Coryell. 44a, right valve; 44b, dorsal view, X 100.
Figure 45. Seminolites aff. S. elongatus Coryell. Right valve, X 100.
Figure 46. Seminolites healdoides Bradfield. 46a, left valve; 46b, right valve, X 100.
Figure 47. Waylandella bythocyproidea (Warthin). Right valve, X 33.
Figure 48. Endothyra symmetrica Zeller. Sagittal section showing the proloculus and moderately anteriorly directed septa, X 86.
Figure 49. Endothyranella powersi (Harlton). Side view.
Figure 50. Globivalvulina biserialis Cushman and Waters. Dorsal view, X 108.
Figure 51. Granuliferella granulosa Zeller. Sagittal section showing manner of coiling and attitude of septa, X 115.
Figure 52. Plectogyra sp. Zeller. Sagittal section, X 100.
Figure 53. Millerella marblensis. Sagittal section, X 122.
Figure 54. Polytaxis laheei Cushman and Waters. Dorsal view, X 42.
Figure 55. Tetrataxis conica Ehrenberg. Dorsal view, X 80.
Figure 56. Spirorbis anthracosia Whitfield. Dorsal view, X 59.