1960

Ostracoda and Stratigraphy of Austin and Taylor Equivalents of Northeast Texas.

Oscar Lawrence Paulson Jr

Louisiana State University and Agricultural & Mechanical College

Follow this and additional works at: https://digitalcommons.lsu.edu/gradschool_disstheses

Recommended Citation
https://digitalcommons.lsu.edu/gradschool_disstheses/586

This Dissertation is brought to you for free and open access by the Graduate School at LSU Digital Commons. It has been accepted for inclusion in LSU Historical Dissertations and Theses by an authorized administrator of LSU Digital Commons. For more information, please contact gradetd@lsu.edu.
OSTRACODA AND STRATIGRAPHY OF AUSTIN AND TAYLOR
EQUIVALENTS OF NORTHEAST TEXAS

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

in

The Department of Geology

by

Oscar Lawrence Paulson, Jr.
B.S., Mississippi State College, 1954
M.S., Mississippi State College, 1955
January, 1960
ACKNOWLEDGEMENT

This author wishes to express his appreciation to Dr. H. V. Howe for supervising the ostracod study and for making available his type specimens and approximately 200 ostracod slides prepared from samples collected by Louis A. Gimbrede from the Austin and Taylor groups of central Texas. The author is grateful to Dr. C. O. Durham, Jr. who directed the stratigraphic study and pointed out many of the problems in the field. Mr. Roy T. Hazzard kindly provided office space and access to his electric log file in the Shreveport, Louisiana office of Gulf Oil Corporation. Dr. John T. Lonsdale and his staff at the Bureau of Economic Geology in Austin allowed this author to examine C. I. Alexander's type specimens and cuttings from a number of wells in northeast Texas. Dr. Keith Young, of the University of Texas, was most helpful in providing determinations on many of the ammonites collected during this study. The author is also grateful to Miss Janice Ann Thomas for assistance in typing the first draft of the manuscript and to Drs. H. V. Andersen, A. H. Cheetham, C. O. Durham, Jr., and H. V. Howe for constructive criticism of the manuscript.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>I  ABSTRACT</td>
<td>1</td>
</tr>
<tr>
<td>II  INTRODUCTION</td>
<td>2</td>
</tr>
<tr>
<td>III  STRATIGRAPHY</td>
<td>4</td>
</tr>
<tr>
<td>Lake Crockett member</td>
<td>4</td>
</tr>
<tr>
<td>Ector chalk</td>
<td>5</td>
</tr>
<tr>
<td>Bonham clay</td>
<td>6</td>
</tr>
<tr>
<td>Blossom sand</td>
<td>6</td>
</tr>
<tr>
<td>Brownstown marl</td>
<td>8</td>
</tr>
<tr>
<td>Gober chalk</td>
<td>8</td>
</tr>
<tr>
<td>Lower Taylor clay</td>
<td>9</td>
</tr>
<tr>
<td>Wolfe City sand</td>
<td>9</td>
</tr>
<tr>
<td>IV  FAUNAL DISTRIBUTION</td>
<td>11</td>
</tr>
<tr>
<td>V  CORRELATION PROBLEMS</td>
<td>17</td>
</tr>
<tr>
<td>VI  STRUCTURAL EFFECTS ON SEDIMENTATION</td>
<td>28</td>
</tr>
<tr>
<td>VII  SUMMARY</td>
<td>29</td>
</tr>
<tr>
<td>VIII  SYSTEMATIC PALEONTOLOGY</td>
<td>30</td>
</tr>
<tr>
<td>Phylum ARTHROPODA</td>
<td>30</td>
</tr>
<tr>
<td>Class CRUSTACEA</td>
<td>30</td>
</tr>
<tr>
<td>Order OSTRACODA</td>
<td>30</td>
</tr>
<tr>
<td>Suborder PLATycopA Sars, 1866</td>
<td>30</td>
</tr>
<tr>
<td>Family CYthereLLIDAE Sars, 1866</td>
<td>30</td>
</tr>
<tr>
<td>Genus CYthereLLA Jones, 1849</td>
<td>30</td>
</tr>
<tr>
<td>CythereLLA tuberculifera Alexander</td>
<td>30</td>
</tr>
<tr>
<td>CythereLLa sp</td>
<td>30</td>
</tr>
</tbody>
</table>
Genus CYTHERELLOIDEA Alexander, 1929 ..........31
Cytherelloidea austinensis Sexton ...............31
Cytherelloidea crafti Sexton ...................32
Cytherelloidea ozanana Sexton ..................32
Cytherelloidea spiralia Jennings .................33
Genus MORROWINA Loetterle, 1937 ...............33
Morrowina sp ..................................33
Suborder PODOCOPA Sars, 1866 .................34
Family BAIRDIIDAE Sars, 1923 ..................34
Subfamily BAIRDIIDINAE Sars, 1923 ..........34
Genus BAIRDOPPILATA Coryell, Sample, and Jennings, 1935 ..........34
Bairedopplilata pondera Jennings .............34
Family CYPRIIDAE Baird, 1849 .................34
Subfamily PONTOCYPRIDINAE Muller, 1894 ..34
Genus ARGILLOECIA Sars, 1866 .................34
Argilloecia sp ................................34
Family CYTHERIDAE Baird, 1850 ...............35
Subfamily CYTHERIDEINAE Sars, 1925 ..........35
Genus HAPLOCYTHEIDEA Stephenson, 1936 ......35
Haplocytheridea ? everetti (Berry) ............35
Haplocytheridea ? grangerensis Howe and Laurencich .................36
Haplocytheridea ? insolita Alexander and Alexander ................36
Haplocytheridea ? plummeri (Alexander) ........37
Genus ASCIOCYTHERE Swain, 1952 ...............38
Genus *AMPHICYTERURA* Butler and Jones, 1957...

*Amphicytherura dubia* (Israelsky)............82

IX SELECTED BIBLIOGRAPHY........................................94

X APPENDIX I. SAMPLE LOCALITIES.................................100

XI APPENDIX II. LOCALITIES ON INDEX MAP.........................110

XII VITA..................................................................114
<table>
<thead>
<tr>
<th>Page</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>38</td>
<td>Ascioythere n. sp. 1</td>
</tr>
<tr>
<td>39</td>
<td>Genus KRITHE Brady, Crosskey, and Robertson, 1874.</td>
</tr>
<tr>
<td>39</td>
<td>Krithe cushmani Alexander</td>
</tr>
<tr>
<td>39</td>
<td>Subfamily CYTHERINAE Dana, 1853</td>
</tr>
<tr>
<td>39</td>
<td>Genus CYTHERE Muller, 1785</td>
</tr>
<tr>
<td>39</td>
<td>&quot;Cythere&quot; n. sp. 1</td>
</tr>
<tr>
<td>40</td>
<td>Subfamily CYTHERURINAE Muller, 1894</td>
</tr>
<tr>
<td>40</td>
<td>Genus CYTHEROPTERON Sars, 1866</td>
</tr>
<tr>
<td>40</td>
<td>Cytheropteron furcalatum Alexander</td>
</tr>
<tr>
<td>40</td>
<td>Cytheropteron n. sp. 1</td>
</tr>
<tr>
<td>40</td>
<td>Cytheropteron n. sp. 2</td>
</tr>
<tr>
<td>42</td>
<td>Genus EUCYTHERURA Muller, 1894</td>
</tr>
<tr>
<td>42</td>
<td>Eucytherura quadrituberculata Skinner</td>
</tr>
<tr>
<td>42</td>
<td>Eucytherura n. sp. 1</td>
</tr>
<tr>
<td>42</td>
<td>Eucytherura n. sp. 2</td>
</tr>
<tr>
<td>44</td>
<td>Genus ORTHONOTACYTHERE Alexander, 1933</td>
</tr>
<tr>
<td>44</td>
<td>Orthonotacythere hannai (Israelsky)</td>
</tr>
<tr>
<td>45</td>
<td>Orthonotacythere scrobiculata Alexander</td>
</tr>
<tr>
<td>45</td>
<td>New genus</td>
</tr>
<tr>
<td>46</td>
<td>Genotype</td>
</tr>
<tr>
<td>47</td>
<td>Subfamily BYTHOCYTHERINAE Sars, 1926</td>
</tr>
<tr>
<td>47</td>
<td>Genus MONOCERATINA Roth, 1928</td>
</tr>
<tr>
<td>47</td>
<td>Monoceratina pedata (Marsson)</td>
</tr>
<tr>
<td>48</td>
<td>Monoceratina prothroensis Butler and Jones</td>
</tr>
<tr>
<td>48</td>
<td>Monoceratina sp</td>
</tr>
</tbody>
</table>
Subfamily BRACHYCYTH3RINAE Puri, 1955........49
Genus BRACHCYTHERE Alexander, 1933........49
  Brachycythere sphenoides (Reuss).........49
  Brachycythere taylorensis (Alexander)....50
  Brachycythere n. sp. 1..................51
  Brachycythere n. sp. 2..................52
  Brachycythere n. sp. 3..................53
  Brachycythere n. sp. 4..................54
  Brachycythere n. sp. 5..................55
  Brachycythere n. sp. 6..................57
  Brachycythere n. sp. 7..................58
Genus ALATACYTHERE Murray and Hussey, 1942...59
  Alatacythere ponderosana (Israelsky).....59
  Alatacythere tokiana (Israelsky)..........59
  Alatacythere ? n. sp. 1..................60
  Alatacythere n. sp. 2..................61
Subfamily LOXOCONCHINAE Sars, 1925........62
Genus LOXOCONCHA (Sars), 1866..............62
  Loxoconcha brownstownensis Alexander....62
  Loxoconcha cretacea Alexander...........63
Subfamily TRACHLEBERINAE Sylvester-Bradley,
  1948..................................63
Genus CYthereis Jones, 1849..................63
  Cythereis austinensis Alexander..........63
  Cythereis bicornis Israelsky............63
  Cythereis communis Israelsky............64
Cythereis dallasensis Alexander........65
Cythereis faujasi Veen.....................65
Cythereis hannai Israelsky................66
Cythereis pidgeoni (Berry)................66
Cythereis plummeri Israelsky..............67
Cythereis spoori Israelsky.................67
Cythereis n. sp. 1..........................68
Cythereis n. sp. 2..........................69
Cythereis n. sp. 3..........................71
Cythereis ? n. sp. 4.......................72
Cythereis n. sp. 5..........................73
Cythereis n. sp. 6..........................75
Genus VEEINIA Butler and Jones, 1957........76
Veenia gapensis (Alexander)................76
Veenia ozanana (Israelsky)................76
Veenia n. sp. 1............................77
Veenia n. sp. 2............................78
Veenia n. sp. 3............................79
Genus PHACORHABDOTUS Howe and Laurencich,
1958........................................80
Phacorhabdotus texanus Howe and Laurencich..80
Phacorhabdotus n. sp. 1....................80
Subfamily XESTOLEBERINAE Sars, 1928........81
Genus XESTOLEBERIS Sars, 1866................81
Xestoleberis sp............................81
Incertae Sedis.............................82
LIST OF TABLES

Page

I Formations recognized by Stephenson in northeast Texas........2
II Distribution of ostracod species in northeast Texas........13
III Distribution of ostracod species in central Texas..........14
IV Faunal relations between central and northeast Texas........27
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Location map and index to important localities</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Electric log cross section over the Preston anticline</td>
<td>7</td>
</tr>
<tr>
<td>3</td>
<td>Type locality of the Janis member</td>
<td>16</td>
</tr>
<tr>
<td>4</td>
<td>Electric log cross section showing prominent facies changes</td>
<td>18</td>
</tr>
<tr>
<td>5</td>
<td>Stephenson's concept of the relations between the Austin group and its equivalents in northeast Texas</td>
<td>21</td>
</tr>
<tr>
<td>6</td>
<td>Electric log cross section from Arkansas to the Sabine uplift</td>
<td>23</td>
</tr>
<tr>
<td>7</td>
<td>Electric log cross section showing truncation below Annona chalk and Janis member</td>
<td>24</td>
</tr>
<tr>
<td>8</td>
<td>Stratigraphic relations between Austin and Taylor equivalents of northeast Texas</td>
<td>26</td>
</tr>
</tbody>
</table>
LIST OF PLATES

Page

I Ostracod species .........................................85
II Ostracod species .........................................87
III Ostracod species ........................................89
IV Ostracod species .........................................91
V Ostracod species .........................................93
ABSTRACT

This study was undertaken to correlate the Austin group of central Texas and its equivalents in northeast Texas and, also, to determine the relationships between the Austin and Taylor equivalents of northeast Texas.

Poorly exposed outcrops in northeast Texas were studied in detail, and, in supplement, well cuttings in the Bureau of Economic Geology Well Sample Library at Austin were examined. The correlation value of a number of megafossils has been evaluated, and the ranges of some have been extended in local areas as a result of this study.

In a special study, Austin and Taylor Ostracoda of northeast Texas were compared with ostracod slides prepared by Professor H. V. Howe from samples collected by Louis A. Gimbrede in central Texas.

The carbonate sequence of the Austin group of central Texas is separated from its clastic equivalents in northeast Texas by the Preston anticline which trends northwest-southeast in Grayson and Hunt counties. Previous correlations have been made between the carbonate and clastic sequences, but this study has necessitated a number of revisions. Some of the species ranges have been strongly controlled by environment while others have not, and the boundary between the Austin and Taylor groups of central Texas and between their equivalents in northeast Texas is transitional in some areas and unconformable in others.
INTRODUCTION

In 1936 L. W. Stephenson made a reconnaissance study of north­
east Texas in an effort to correlate formations of this area with
those of the Upper Cretaceous Austin and Taylor groups of central
Texas. Since that time, however, there has been considerable con­
troversy over the Austin-Taylor boundary in northeast Texas and
over correlations between this area, central Texas, and southwest
Arkansas. The author of this paper has made a surface and sub­
surface study of the formations assigned by Stephenson to the
Austin and Taylor groups in northeast Texas (Table I) in an attempt
to solve some of these problems. Faunal comparisons, including de­
tailed correlations based on Ostracoda, were made between northeast
and central Texas.

The area discussed in this paper is shown in Fig. 1. It is
bounded on the north by the Ouachita Mountains, on the east by the
Sabine uplift, on the south by the Mexia-Talco fault system, and on
the west it extends slightly south of the Preston anticline.

The units studied crop out in a belt approximately twenty miles
wide and strike N 85° E from southwest Arkansas to the Preston anti­
cline. South of the Preston anticline the strike is N 10° E. The
dip is to the southeast at 85 feet per mile in Arkansas and 55 feet
per mile in Texas.
<table>
<thead>
<tr>
<th></th>
<th>NORTHEAST TEXAS</th>
<th>RED RIVER COUNTY</th>
<th>ARKANSAS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TAYLOR</strong></td>
<td>Upper Taylor clay</td>
<td>Upper Taylor clay</td>
<td>Marlbrook marl</td>
</tr>
<tr>
<td></td>
<td>Pecan Gap chalk</td>
<td></td>
<td>Annona chalk</td>
</tr>
<tr>
<td></td>
<td>Wolfe City sand</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lower Taylor clay</td>
<td>Annona chalk</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gober chalk</td>
<td>Brownstown marl</td>
<td>Brownstown marl</td>
</tr>
<tr>
<td></td>
<td>Brownstown marl</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Blossom sand</td>
<td>Blossom sand</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bonham clay</td>
<td>Bonham clay</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ector chalk</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table I—Formations recognized by Stephenson in northeast Texas and Arkansas.
Fig. 1—Location map and index to import...
Map and index to important localities.
STRATIGRAPHY

The Preston anticline separates the typical central Texas carbonate sequence of the Austin group from the predominantly clastic sequence in northeast Texas and Arkansas. These clastic sediments are herein referred to as Austin equivalents in order to avoid confusion which may arise from the use of Austin group, having a lithic connotation, or Austin stage, having a time connotation. The same system of nomenclature is applied to the Taylor, although the differences in lithology are not as pronounced.

Since much of the area east of the Preston anticline is masked by alluvium, a subsurface study was included to aid in the solution of many of the problems.

According to Stephenson, the Austin equivalents of northeast Texas include the Lake Crockett member, Ector chalk, Bonham clay, Blossom sand, Brownstown marl and Gober chalk in ascending order. His Taylor equivalents are the Lower Taylor clay, Wolfe City sand, Pecan Gap chalk, and Upper Taylor clay in ascending order. The following includes a brief discussion of these units and does not consider the problems in correlation, which are discussed separately.

Lake Crockett member.—The base of the Austin equivalents was considered to be the base of the Fish-bed conglomerate by Taff (1893) and Stephenson (1937). The Fish-bed conglomerate consists of a 0.5 foot bed of phosphate pebbles, sharks' teeth, and wood fragments, and at Lake Crockett dam in Fannin County (loc. 12) it is separated from the overlying Ector chalk by 17 feet of gray,
micaceous clay. McNulty (1954) places the Fish-bed conglomerate and overlying clay in the Lake Crockett member which he says is the uppermost unit of the Eagle Ford group. According to this interpretation, the base of the Ector chalk would be the base of the Austin equivalents in northeast Texas. The author of this paper, however, finds that, in Grayson County to the west, the clay of the Lake Crockett member is transitional into the overlying Ector at locs. 18 and 20, and at loc. 21 all the clay has been replaced laterally by the Ector chalk which rests directly on the Fish-bed conglomerate. For this reason, the Fish-bed conglomerate is here considered to mark the base of the Austin equivalents which rest unconformably on Eagle Ford sands and clays.

Most workers doing subsurface correlation in this area choose the base of the Ector as the base of Austin equivalents and this practice may be more desirable since there are some areas in which the Fish-bed conglomerate may be confused with sands in the underlying Eagle Ford group. The clay portion of the Lake Crockett member merges with sand east of the type locality, and in Bowie County it is easily distinguished from the underlying clays of the Eagle Ford group.

**Ector chalk.**—The Ector chalk was named for the town of Ector (Stephenson, 1919) in Fannin County but is better exposed in Grayson and Collin counties (locs. 18 and 22) where it consists of massive beds of gray and brown chalk separated by thin clay partings and contains numerous *Inoceramus* sp. and *Gryphaea* sp. In Collin County and parts of Grayson County it overlies the Fish-bed conglom-
erate, but, in part of Grayson County and in Fannin County it is transitional into the underlying clay of the Lake Crockett member. The Ector is also transitional into the overlying Bonham clay.

Because of masking alluvial deposits, Stephenson was unable to trace the Ector farther east than Ravenna, Fannin County, but on electric logs the Ector can be traced into Red River County where it becomes marly. In Red River County the Ector overlies the sand which grades westward into the clay of the Lake Crockett member.

**Bonham clay.**—The Bonham clay derives its name from Bonham, Fannin County (Stephenson, 1927, p. 8), where exposures are rare and very poor. The best exposures were found in gullies five to ten miles north of Paris, Lamar County, on State Highway 79. The Bonham clay loses its identity westward over the Preston anticline where all the units from the top of the Gober chalk to the top of the Ector become calcareous and cannot be distinguished from one another (Fig. 2). To the east, a tongue of sand in the middle of the Bonham clay can be correlated with the middle sand of the Tokio sand of Arkansas and is sometimes overlain by a glauconitic chalk.

**Blossom sand.**—The type locality of the Blossom sand is a water well drilled at Blossom, Lamar County (Gordon, 1911, p. 276). However, the Blossom is well-exposed at locs. 13 and 14 in Fannin County. *Exogyra ponderosa* Say first appears in the top of the Blossom and *Ostrea travisana* Stephenson was found at locs. 11 and 14. Numerous *Placenticeras* sp. were also found at loc. 14.

Stephenson described locs. 5 and 7 as Blossom sand but this author finds that, on the basis of subsurface correlation, these
Fig. 2—Electric log cross section over the Preston anticline.
sands are stratigraphically 100 feet higher than the Blossom which is exposed at loc. 4. A species of Placenticeras from loc. 5 indicates that this sand is younger than the Blossom according to Keith Young (personal communication).

The Blossom, like the other Austin equivalents, becomes calcareous and unidentifiable over the Preston anticline and its most westward exposure is at loc. 17.

Brownstown marl.—The Brownstown marl was named by Hill (1888, p. 86) for Brownstown, Sevier County, Arkansas. Dane (1929, p. 46) later restricted the Brownstown to the lower part of Hill's Brownstown and named the upper part the Ozan.

The Brownstown marl of Texas overlies the Blossom sand throughout the area. It is transitional into the overlying Gober chalk as far east as the latitude of Blossom, Lamar County. Farther east, according to Stephenson's interpretation, an unconformity at the base of the Lower Taylor clay truncates the Gober so that Lower Taylor clay rests unconformably on Brownstown marl (loc. 6). Still farther east, at the latitude of Clarksville, Red River County, the Lower Taylor clay grades laterally into Annona chalk which overlies the Brownstown marl at loc. 3. The Brownstown marl of Texas is best exposed along Cane Creek two miles north of Roxton, Lamar County.

Gober chalk.—The Gober chalk was named by Stephenson (1927, p. 8) for the town of Gober, Fannin County. The upper five to ten feet consist of resistant calcarenite between locs. 10 and 16 and at some localities contains phosphatized Baculites sp. at the top.
The contact between the Gober and overlying Lower Taylor clay is quite distinct between the above-mentioned localities but east and west of these localities the Gober is transitional into the overlying Lower Taylor clay. The transition is not evident on the surface due to weathering in the upper part of the exposures but in the subsurface it is evident from samples that there is a gradual transition from chalk to marl.

The Gober pinches out eastward in the latitude of Blossom, Lamar County, at loc. 8, and to the west over the Preston anticline it cannot be distinguished from the underlying chalks.

The diagnostic megafossils in the Gober include a species of Terebratulina collected from loc. 9 and Delawarella delawarensis (Morton) and D. "delawarensis" (of Dane) which were identified by Keith Young.

Lower Taylor clay.—The Taylor group was named for Taylor, Williamson County, by Hill (1891, p. 73) and Lower Taylor clay has been applied in northeast Texas to the argillaceous sequence overlying the Gober chalk (Stephenson, 1927). The basal portion of the Lower Taylor clay consists of a brown marl which is transitional into the underlying Gober chalk; the upper part consists of black carbonaceous clay containing numerous E. ponderosa.

East of the Gober pinch-out, the Brownstown marl is overlain by Lower Taylor clay which grades eastward into Annona chalk.

Wolfe City sand.—The Lower Taylor clay is transitional into the overlying Wolfe City sand which was named for Wolfe City, Hunt County (Stephenson, 1918, p. 155). The Wolfe City consists
of sandstone ledges separated by brown, sandy clay and, like the Lower Taylor clay, it contains numerous *E. ponderosa* and grades westward into Annona chalk. It is overlain by the Pecan Gap chalk which is equivalent to the upper part of the Annona chalk.
FAUNAL DISTRIBUTION

A study of the fauna in the foregoing units has been concentrated on ostracods but a number of megafossil biostromes recognized in central Texas (Stephenson, 1936; Young and Marks, 1952; Smith, 1955; Durham, 1958) can be traced into northeast Texas.

The Austin group at Austin is divided into the Lower Austin chalk, the Dessau chalk (Durham, 1955), and the Burditt marl (Adkins, 1932), in ascending order. At Dallas, it is divided into a lower chalk member, middle marl member, and upper chalk member (Dallas Petroleum Geologists, 1941).

Of the characteristic megafossils recognized in central Texas, *Inoceramus undulatoplicatus* Roemer, *Ostrea travisana* Stephenson, *Exogyra ponderosa* Say, *Delawarella delawarensis* (Morton), and *Delawarella "delawarensis"* (of Dane) have been recognized in northeast Texas. *I. undulatoplicatus* occurs in the upper part of the Lower Austin in central Texas and in the middle marl member of Dallas and Collin counties but was not found farther eastward. *O. travisana* occurs at three horizons in central Texas (Durham, 1958); between the *I. undulatoplicatus* bed and the base of the Dessau, in the base of the Dessau, and in the top of the Burditt marl. In northeast Texas this species occurs only in the top of the Blossom. *E. ponderosa* first appears in the base of the Dessau in central Texas (Durham, 1958), in the lower part of the upper chalk member in Dallas County (Smith, 1955), and in the top of the Blossom in northeast Texas. *D. delawarensis* (Morton) and *D. "delawarensis"* (of Dane) are found in the Burditt of central Texas (Keith Young, personal
communication), and in the top of the Gober and 150 feet above the Gober, at loc. 15, in northeast Texas.

A detailed study of the ostracods from the areas under consideration has revealed 67 species which include 26 new species and one new genus. These species are figured and described in the following pages and their ranges in central Texas and northeast Texas are shown in Tables II and III.

The study of ostracods from the Austin and Taylor groups near Austin, Austin group of Dallas, and Austin and Taylor equivalents of northeast Texas and Arkansas reveals that a number of species are index fossils. These include Veenia n. sp. 3, Alatacythere n. sp. 2, Cythereis n. sp. 2, Cythereis n. sp. 5, Brachocythere n. sp. 3, and Monoceratina sp. Veenia n. sp. 3 is associated with the Inoceramus undulatoplicatus bed of Stephenson (1936) in the upper part of the Lower Austin and with the same bed in Dallas and Collin counties. The I. undulatoplicatus bed could not be traced north of Collin County but Veenia n. sp. 3 was found in the Bonham clay in a gully 1.7 miles west of Bonham on U. S. Highway 82 and 0.2 miles south of U. S. Highway 82 on State Highway 121. Monoceratina sp. is restricted to sample 32 in the Dessau and sample 68 in the upper chalk member in Collin County. Alatacythere n. sp. 2 is restricted to the Burditt marl in the Austin area and occurs in the upper part of the upper chalk member 25 feet from the top in Dallas and 100 feet from the top in Collin County, and at 350 feet in the Krasner well in Fannin County (well no. 5, Fig. 2). In Collin County it is always associated with Cythereis n. sp. 4. Cythereis n. sp. 2 is
Table II—Distribution of ostracod species in northeast Texas.

<table>
<thead>
<tr>
<th>Bees</th>
<th>Bonham</th>
<th>Mexia</th>
<th>Lower Dollar</th>
<th>Walla Walla</th>
<th>Perot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Veenia n. sp. 3</td>
<td>Brachyothyra n. sp. 2</td>
<td>Veenia n. sp. 1</td>
<td>Cytherella austiniensis</td>
<td>Alatasythera n. sp. 1</td>
<td>Alatasythera tokiana</td>
</tr>
<tr>
<td>&quot;Cythera&quot; n. sp. 1</td>
<td>Alatasythera n. sp. 2</td>
<td>Cytherella n. sp. 6</td>
<td>Cytheroproron parvus</td>
<td>Haploplectides 1 grangerensis</td>
<td>Phiscythereoides n. sp. 1</td>
</tr>
<tr>
<td>Cytherella dallasensis</td>
<td>Cytherella bicornis</td>
<td>Brachyothyra n. sp. 5</td>
<td>Cytherella paullani</td>
<td>Cytherella n. sp. 1</td>
<td>Cytheroproron n. sp. 2</td>
</tr>
<tr>
<td>Veenia osmanana</td>
<td>Banythura quadribarrelata</td>
<td>Brachyothyra sphencides</td>
<td>Cytherella sp.</td>
<td>Loxoconcha bronsoni</td>
<td>Cytherella hawaii</td>
</tr>
<tr>
<td>Brachyothyra n. sp. 1</td>
<td>Cytherelloidea osmanana</td>
<td>Loxoconcha hawaiiensis</td>
<td>Cytheroproron n. sp. 1</td>
<td>Banythura n. sp. 1</td>
<td>Brachyothyra n. sp. 1</td>
</tr>
<tr>
<td>Angillosea sp.</td>
<td>Kritho osmanal</td>
<td>Kastoldaria sp.</td>
<td>Banythura n. sp. 1</td>
<td>Banythura n. sp. 2</td>
<td>Cytherella spiralia</td>
</tr>
<tr>
<td>Cytherelloidea yucca</td>
<td>Cytherelloidea austiniensis</td>
<td>Haplocythere sp. 1</td>
<td>Amphiocythere n. sp. 1</td>
<td>Amphiocythere duxia</td>
<td>Haplocythere n. sp. 4</td>
</tr>
<tr>
<td>Haplocythere pedata</td>
<td>Monospathis proterocensis</td>
<td>Cytherella pignoni</td>
<td>Orthocythere sarahla</td>
<td>Brachyothyra n. sp. 6</td>
<td>Cytherella n. sp. 3</td>
</tr>
<tr>
<td>Orthocythere n. sp. 6</td>
<td>Brachyothyra n. sp. 3</td>
<td>Orthocythere hawaii</td>
<td>New Genus</td>
<td>Haplocythere sp. 1</td>
<td>Brachyothyra n. sp. 7</td>
</tr>
<tr>
<td>Haplocythere sp. 1</td>
<td>Brachyothyra n. sp. 5</td>
<td>Orthocythere hawaii</td>
<td>New Genus</td>
<td>Haplocythere sp. 1</td>
<td>Brachyothyra n. sp. 7</td>
</tr>
<tr>
<td>Brachyothyra n. sp. 2</td>
<td>Haplocythere sp. 1</td>
<td>Veenia n. sp. 2</td>
<td>Haplocythere sp. 1</td>
<td>Haplocythere sp. 1</td>
<td>Alatasythera pondarocenaceus</td>
</tr>
<tr>
<td>Lower Austin</td>
<td>Denali</td>
<td>Bastrop</td>
<td>Lower Eagle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------</td>
<td>--------</td>
<td>---------</td>
<td>-------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Vesalia n. sp. 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cytheris n. sp. 6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cytheris n. sp. 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Brachytychus n. sp. 9</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cytheris dallasensis</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cytheris elongatus</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Brachytychus n. sp. 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cytheris austiniensis</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cytheris n. sp. 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Planothecidites n. sp. 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Brachytychus n. sp. 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Angulosemis n. sp. 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Alatastegia tenuissima</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cytheris bisulcata</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Brachytychus n. sp. 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cytheris n. sp. 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Analoxythere n. sp. 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Alatastegia n. sp. 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ritha cunehali</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Vesalia osana</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cytheridinae austiniensis</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cytheridinae sp. 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Brachytychus n. sp. 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Haplophyes 7 grangerensis</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Haplophyes n. sp. 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Keatoleberis sp.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Amphicytherus dubia</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Loxoconcha vancouverensis</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cytheris n. sp. 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Brachytherus n. sp. 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ortholocythere n. sp. 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cytheris n. sp. 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cytheris plummeri</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Brachytychus n. sp. 7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Haplophyes 7 everetti</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cytheris n. sp. 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cytheridinae osana</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Haplophyes 7 plummeri</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ortholocythere n. sp. 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cytheris n. sp. 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Brachytychus n. sp. 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Alatastegia n. sp. 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Alatastegia ponderosa</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Haplophyes 7 insula</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
restricted to the Lower Taylor clay and Durango sand of central Texas and the Lower Taylor clay and Wolfe City sand of northeast Texas. Another species, Cythereis bicornis, is replaced by C. n. sp. 3 at the Austin-Taylor contact in the type area, and the former does not occur above the Brownstown in Red River County; however, C. n. sp. 3 is not present in the Annona or Brownstown.

A distinct faunal break also occurs between a chalk at the base of the Ozan at loc. 1 in McCurtain County, Oklahoma, and the underlying Brownstown marl. This chalk, the "beer-joint chalk" of earlier workers, is here named the Janis member of the Ozan formation for the community of Janis which was formerly two miles west of the Oklahoma-Arkansas state line and 0.9 miles west of the exposure (Fig. 3). Cythereis bicornis marks the top of the Brownstown and Cythereis plummeri marks the base of the Janis member in McCurtain County. Another species, Cythereis pidgeoni, occurs just below the Janis member in McCurtain County and just above the Gober in sample 49 north of Roxton, Lamar County.
Fig. 3—Type locality of the Janis member.
CORRELATION PROBLEMS

A number of previous correlations have been made between the Austin group of central Texas and its equivalents in northeast Texas and Arkansas, but this study indicates that several refinements and revisions are necessary. These correlations are discussed in the following pages.

The Lake Crockett member was originally described as consisting of the basal Fish-bed conglomerate and the clay beneath the Ector. To the west of the type locality, the clay becomes calcareous and merges with the Ector while to the east, it becomes arenaceous and merges with the basal Tokio sand as shown in Fig. 4.

The Blossom sand can be correlated with the upper sand of the Tokio formation as shown in Fig. 4 and the middle Tokio sand correlates with the sand in the middle of the Bonham clay.

Stephenson (1936) correlated the Blossom sand with the top of the Burditt on the basis of O. travisana which occurs in both units and did not think the overlying Brownstown and Gober were represented in central Texas. Durham (1958), however, found that there were two lower beds containing O. travisana in the type area and correlated the middle bed, at the base of the Dessau, with the top of the Blossom sand because the first E. ponderosa occurs at both horizons. He also found two oyster beds in the Burditt, the Exogyra laeviuscula and E. tigrina beds, could be traced northward from the type area into Lower Taylor clay, proving that the Burditt merged northward with the Lower Taylor clay. Durham believes that the Dessau also merges with Lower Taylor clay northward and that
Fig. 4—Electric log cross section showing prominent facies changes.
the contact between the upper chalk member of Dallas and the Lower Taylor clay corresponds to an unconformity at the base of the Dessau. Smith (1955) considers the upper chalk member-Lower Taylor clay contact transitional in the Dallas area but unconformable to the south. The author of this paper, however, believes this to be a transitional contact which occurs at progressively lower horizons from the Preston anticline southward (Fig. 2). The transition in Dallas and Collin counties is supported by McNulty (1955) who found that typical Gober species of foraminifera occurred in the Lower Taylor clay above the upper chalk member in these counties. The validity of this unconformity is also made questionable by the occurrence, in the upper chalk member, of Alatacythere n. sp. 2 which is restricted to the Burditt and the occurrence of Monoceratina sp. which is restricted to the Dessau chalk. From this evidence and the fact that the first E. ponderosa occurs in the upper chalk member, this author correlates the upper chalk member with the Dessau chalk and lower part of the Burditt marl of the Austin area. As stated previously, the base of the Dessau can be correlated with the top of the Blossom on the basis of O. travisana and E. ponderosa and the occurrence of Alatacythere n. sp. 2 in the Brownstown (350 feet in well no. 5, Fig. 2) indicates that a portion of the Burditt is equivalent to a portion of the Brownstown.

At the type locality near Austin, Texas, the Lower Taylor clay consists of "brown, unctuous clay" (Shreveport Geol. Soc., 1949) containing numerous E. ponderosa and is separated from the upper Austin or Burditt marl, which it overlies, by phosphate pebbles and
phosphatic molluscs. Stephenson traced this clay-chalk contact northward through Waco, Dallas, and into northeast Texas, assuming that the change in lithology and the presence of phosphate were evidence of an unconformity which corresponded to that at the type locality. Based on this concept, Stephenson explained the relations between central Texas and northeast Texas as shown in Fig. 5. He also stated that the Brownstown marl and Gober chalk were obviously younger than the Burditt, since the latter contains *O. travisana* which occurs in the Blossom sand. The thinning of the Gober chalk eastward from its type locality was attributed by Stephenson to truncation and the Lower Taylor-Gober contact was correlated with phosphatic molluscs at locs. 2 and 6 in Red River County where the Gober is absent. At loc. 6 the Lower Taylor clay has merged with Annona chalk which overlies the Brownstown marl.

The top of the Gober contains *Delawarella delawarensis* (Morton) and D. "delawarensis" (of Dane) which Keith Young says are found in the Burditt marl of central Texas. These two species are also reported by Young from Lower Taylor clay north of the type Austin, into which Durham has traced *Exogyra laeviuscula* and *E. tigrina*. This indicates that the Lower Taylor clay and Burditt marl are in part facies equivalents.

The presence of the above-mentioned ammonites in the Gober chalk is considered by many persons familiar with the geology of northeast Texas as a basis for correlation of the Gober with the Burditt and with the Janis member which also contains these two species. However, this author has found an oxidized bed at loc. 15
Fig. 5—Stephenson's concept of the relations between the Austin group and its equivalents in northeast Texas.
which contains phosphate pebbles, phosphatic casts of molluscs, and
the following ammonites (identified by Keith Young): Scaphites cf.
aricki, Delawarella delawarensis (Morton), D. delawarensis (Dane) non
Morton, Parapuzosia n. sp., Baculites sp., and Placenticeras (Stan-
tonoceras) guadalupae Hyatt non Roemer. This bed lies approximately
150 feet above the Gober chalk, is overlain by thin bedded chalks,
and is a distinct marker on electric logs. Fig. 4 is an east-west
electric log cross section in which the Gober chalk is shown pinch-
ing out in eastern Hopkins County in well No. 2 and the Janis member,
which has been traced downdip in Fig. 6, is a very distinct marker
at 2720 feet in the adjacent well No. 3 in Franklin County. If the
Gober is correlated with the Janis member, the section above and
below the Gober will be approximately 150 feet higher than equiva-

tents in the adjacent Franklin County well No. 3.

The presence of the same two ammonites in the oxidized bed at
loc. 15 and in the Janis member strengthens their correlation.
This horizon is correlated with the phosphatic molluscs at the base
of the Annona chalk as shown in Fig. 7 and an unconformity is placed
below it since the interval between this horizon and the top of the
Blossom thins rapidly from the basin into Red River County (Fig. 7),
Bowie County (Fig. 4), and over the Sabine uplift (Fig. 6) while the
other intervals remain more or less uniform. This unconformity can-
not be traced far into the basin, as shown in Fig. 4, but this is
to be expected. Granite fragments were found in the Janis member
in a well in Bowie County (Normandy-Frankel, E. Powell No. 1) and
were correlated with the same type of fragments in Cass County
Fig. 6—Electric log cross section from Arkansas to the Sabine uplift.

*Picks* based on grainite fragments found at this horizon and at the unconformity in the Normandy-Frankel, No. 1 Powell, Bowie Co.
Fig. 7—Electric log cross section showing truncation below Annona chalk and Janis member.
(Sohio, Sloan Taylor No. 1) where the Janis member was not represented by a distinct electric log marker.

Since the upper chalk member and, in places, the Gober are transitional into Lower Taylor clay and since some of the fauna which are considered Austin extend into Lower Taylor clay, this author believes this transition to represent continual deposition in the basin while on the shelf areas this interval is missing. The oxidized phosphate bed within the Lower Taylor clay represents the unconformity between the Austin and Taylor equivalents of northeast Texas and can be correlated with the base of the Annona and Janis member. This unconformity is correlated with the Austin-Taylor unconformity in the type area on the basis of ammonites and the distinct difference in ostracod assemblages above and below it. The stratigraphic relations between the Austin and Taylor equivalents of northeast Texas are illustrated in Fig. 8 and the faunal relations between central and northeast Texas are shown in Table IV.
Fig. 8—Stratigraphic relations between Austin and Taylor equivalents of northeast Texas.
<table>
<thead>
<tr>
<th></th>
<th>AUSTIN</th>
<th>DALLAS &amp; COLLIN COUNTIES</th>
<th>NORTHEAST TEXAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower Taylor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 7</td>
<td></td>
<td>Lower Taylor</td>
<td></td>
</tr>
<tr>
<td>Burditt 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>Gober</td>
</tr>
<tr>
<td>Dessau</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 7</td>
<td>Lower Taylor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 7</td>
<td>Dessau</td>
<td>Upper chalk member</td>
<td>Brownstown</td>
</tr>
<tr>
<td>7 8</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Lower Austin     |                   | Middle marl member       | Bonham          |
| 1 7              |                   | 5 8                      |                 |

1. Alatacythere n. sp. 2
2. Cythereis plummeri
3. Delawarella delawarens
4. Exogyra ponderosa (lowermost)
5. Inoceramus undulatoplicatus
6. Monoceratina sp.
7. Ostrea travisana
8. Veenia n. sp. 3

Table IV—Faunal relations between central and northeast Texas
The most pronounced effect on sedimentation in northeast Texas is produced by the Preston anticline which trends northwest-southeast in Grayson County. It separates the clastic sequence to the east from the carbonate sequence to the southwest. All of the clastic Austin equivalents of northeast Texas become calcareous over the Preston anticline and cannot be distinguished from one another. Southwest of the Preston anticline, the top of the chalk becomes progressively lower due to facies change and the middle part becomes argillaceous and is called the middle marl member.

The calcarenite at the top of the Gober chalk does not extend westward farther than Bailey, Fannin County which is on the east flank of the Preston anticline, indicating that the Preston anticline acted as a barrier in preventing westward deposition of the calcarenite.

The Blossom sand, which is normally about twenty-five feet thick, attains a thickness of 150 feet in two wells (Sam Krasner et al., Norwood No. 1, Fannin County and Bouse Showalter, Cantrell No. 1, Delta County) on the east flank of the Preston anticline and gradually pinches out nearer the axis.
SUMMARY

The purpose of this study has been to correlate the clastic sequence of Austin equivalents in northeast Texas with the carbonate sequence of the Austin group in central Texas on the basis of ostracods and certain megafossils. It was also intended to determine whether an unconformity exists between the Austin and Taylor equivalents of northeast Texas and if so, at what horizon. The unconformity has formerly been placed at the contact between a clay (Lower Taylor) and a chalk (Gober or upper chalk member) but this author finds that the contact is transitional, with local exceptions. Furthermore, the transition from chalk to clay occurs at different stratigraphic levels between northeast Texas and Austin.
SYSTEMATIC PALEONTOLOGY

Phylum ARTHROPODA

Class CRUSTACEA

Order OSTRACODA

Suborder PLATycopA Sars, 1866

Family CYTHERELLIDAE Sars, 1866

Genus CYTHERELLA Jones, 1849

CYTHERELLA TUBERCULIFERA Alexander

Plate I, Fig. 8

_Cytherella tuberculifera_ ALEXANDER, 1929, p. 52, pl. 2, fig. 3. ALEXANDER, 1934, p. 212. BROWN, 1957, p. 7, pl. 1, figs. 3-5. BUTLER & JONES, 1957, p. 9, pl. 6, fig. 7. HOWE & LAURENCICH, 1958, p. 257.

Diagnosis.—A species of _Cytherella_ characterized by a protuberance at the middle of the posterior margin of the right valve.

Dimensions.—Left valve: length 0.68 mm., height 0.40 mm.; right valve: length 0.73 mm., height 0.48 mm. Plesiotype no. 5928, right valve from sample 22.

CYTHERELLA SP.

Plate I, Fig. 7

_Description._—Carapace ovate; sexually dimorphous with the males being smaller and more elongate. Anterior and posterior margins evenly rounded. In the female, the dorsal margin is arched, ventral margin is straight. In the male, the dorsal and ventral margins are more or less parallel. Highest and broadest behind the middle. Right valve overlaps left everywhere but the posterior
extremity.

Dimensions.—Female left valve: length 0.80 mm., height 0.48 mm.; female right valve: length 0.83 mm., height 0.53 mm.; male left valve: length 0.62 mm., height 0.32 mm.; male right valve: length 0.63 mm., height 0.42 mm. Figured specimen no. 5929.

Genus CYTHERELLOIDEA Alexander, 1929

CYTHERELLOIDEA AUSTINENSIS Sexton

Plate II, Figs. 3, 5

Cytherelloidea austinensis SEXTON, 1951, p. 809, pl. 117, figs. 1, 2.
Cytherelloidea tollettensis SEXTON, 1951, p. 812, pl. 117, figs. 4, 5.
Cytherelloidea pecanana SEXTON, 1951, p. 814, pl. 117, fig. 11.
Cytherelloidea austinensis HOWE & LAURENCICH, 1958, p. 260.
Cytherelloidea pecanata HOWE & LAURENCICH, 1958, p. 268.
Cytherelloidea tollettensis HOWE & LAURENCICH, 1958, p. 271.

Diagnosis.—A species of Cytherelloidea characterized by two large posterior nodes in the female and one in the male, a dorsal ridge joining the upper node, and a short arcuate ridge below the muscle pit.

Remarks.—Sexton described C. tollettensis from three weathered specimens which lack the fine pits which supposedly distinguished it from C. austinensis and described C. pecanana, which is the male of the species, as a new species.

Dimensions.—Female left valve: length 0.58 mm., height 0.33 mm.; female right valve: length 0.58 mm., height 0.37 mm.; male left valve: length 0.52 mm., height 0.30 mm.; male right valve: length 0.52 mm., height 0.33 mm. Plesiotypes no. 5930-5933 in above order,
all from sample 18.

**CYTHERELLOIDEA CRAFTI** Sexton

Plate II, Fig. 4

_Cytherelloidea crafti_ SEXTON, 1951, p. 813, pl. 117, figs. 7-10.

_Cytherelloidea greenensis_ BROWN, 1957, p. 9, pl. 1, figs. 22, 23, 26, 29.

_Cytherelloidea crafti_ HOWE & LAURENCICH, 1958, p. 262.

**Diagnosis.**—A species of _Cytherelloidea_ characterized by a ridge which encircles the muscle pit, with that portion of the ridge above the pit extending posteriorly to a node; and in having a short longitudinal ridge above the ventral rim.

**Dimensions.**—Female left valve: length 0.60 mm., height 0.33 mm.; female right valve: length 0.63 mm., height 0.37 mm.; male left valve: length 0.58 mm., height 0.32 mm.; male right valve: length 0.58 mm., height 0.35 mm. Plesiotypes no. 5934-5937 in above order, all from sample 18.

**CYTHERELLOIDEA OZANANA** Sexton

Plate II, Figs. 8, 11

_Cytherelloidea ozanana_ SEXTON, 1951, p. 812, pl. 117, figs. 3, 6.

_Cytherelloidea swaini_ BROWN, 1957, p. 8, pl. 1, figs. 16-19.

_Cytherelloidea ozanana_ HOWE, 1958, p. 267.

**Diagnosis.**—A species of _Cytherelloidea_ characterized by a median ridge which turns up, then posteriorly to join a node just behind the muscle pit.

**Dimensions.**—Female left valve: length 0.57 mm., height 0.28 mm.;
female right valve: length 0.57 mm., height 0.32 mm.; male left
d valve: length 0.48 mm., height 0.25 mm.; male right valve: length
0.48 mm., height 0.27 mm. Plesiotypes no. 5938-5941 in above order,
all from sample 6.

**CYTHERELLOIDEA SPIRALIA** Jennings

Plate II, Fig. 13

*Cytherelloidea spiralia* JENNINGS, 1936, p. 42, pl. 6, fig. 2.

SCHMIDT, 1946, p. 406, pl. 61, fig. 1. SEXTON, 1951, p. 808,
811, pl. 116, fig. 9. HOWE & LAURENCICH, 1958, p. 270.

**Diagnosis.**—A species of *Cytherelloidea* characterized by a
marginal rim which, at the posterodorsal corner, turns anteriorly
below the dorsal rim, passing just above the muscle pit.

**Dimensions.**—Left valve: length 0.53 mm., height 0.28 mm.;
right valve: length 0.55 mm., height 0.32 mm. Plesiotypes no.
5942, 5943 in the above order, both being from sample 18.

**Genus MORROWINA** Loetterle, 1937

*MORROWINA* SP.

Plate I, Fig. 1

**Diagnosis.**—A species of *Morrowina* characterized by very faint,
longitudinally aligned reticulations.

**Description.**—Carapace subovate; anterior and posterior bluntly
rounded. The anterior is faintly rimmed. Highest at the anterior
end and thickest at the posterior end. Lateral surface marked by
a subcentral pit and faint reticulations which are more or less lon­
gitudinally aligned.
Dimensions.—Length 0.63 mm., height 0.32 mm. Figured specimen no. 5944 from sample 1.

Suborder PODOCOPA Sars, 1866
Family BAIRDIIDAE Sars, 1923
Subfamily BAIRDIIDAE Sars, 1923
Genus BAIRDOPPILATA Coryell, Sample, and Jennings, 1935
BAIRDOPPILATA PONDERA Jennings
Plate I, Fig. 9

Bairdoppilata pondera JENNINGS, 1936, p. 45, pl. 6, fig. 9. SCHMIDT, 1948, p. 408, pl. 61, figs. 21, 22. SWAIN, 1952, p. 71, pl. 8, figs. 8-12. SKINNER, 1956, p. 183, pl. 1, fig. 4. BROWN, 1957, p. 10, pl. 3, figs. 4, 7, 8. BUTLER & JONES, 1957, p. 14, pl. 6, figs. 6a, b. HOWE & LAURENCICH, 1958, p. 81.

Diagnosis.—A species of Bairdoppilata characterized by a strongly arched dorsum in the left valve and by its size.

Dimensions.—Length 1.12 mm., height 0.72 mm. Plesiotype no. 5945, right valve from sample 18.

Family CYPRIDAE Baird, 1849
Subfamily PONTOCYPRIDINAE Muller, 1894
Genus ARGILLOECIA Sars, 1866
ARGILLOECIA SP.
Plate I, Fig. 2

Diagnosis.—A species of Argilloecia characterized by an arched dorsal margin and acuminate posterior.

Description.—Carapace spindle-shaped; anterior narrowly rounded;
posterior acuminate. Dorsal margin broadly arched; ventral margin straight in the right valve, slightly concave in the left. Highest behind the middle. Right valve overlaps left along all margins.

Vestibule well-developed at the anterior end. Muscle scars consist of three in a vertical row with two in front. Hinge consists of a furrow in the right valve for the reception of the dorsal margin of the left valve.

Dimensions.—Length 0.40 mm., height 0.15 mm. Figured specimen no. 5946, left valve from sample 18.

Family CYTHERIDAE Baird, 1850
Subfamily CYTHERIDEINAE Sars, 1925
Genus HAPLOCYtheridea Stephenson, 1936
HAPLOCYtheridea Everetti (Berry)

Plate I, Figs. 13, 14
Cytheridea everetti Berry, 1925, p. 486, fig. 9. Alexander, 1929, p. 74, pl. 5, figs. 9, 10.
Cytheridea globosa Alexander, 1929, p. 75, pl. 5, figs. 17-19.
Cytheridea everetti Alexander, 1934, p. 223.

Diagnosis.—A species of Haplocytheridea ? characterized by two or three rows of coarse pits which are aligned vertically and finer pits which are irregularly arranged.

Remarks.—The specimens described by Alexander as Cytheridea globosa are females of the species.

Dimensions.—Female left valve: length 0.72 mm., height 0.47 mm;
female right valve: length 0.68 mm., height 0.43 mm.; male left valve: length 0.77 mm., height 0.48 mm.; male right valve: length 0.77 mm., height 0.45 mm. Plesiotypes no. 5947-5950 in above order, all from sample 55.

HAPLOCYTHERIDEA ? GRANGERENSIS Howe and Laurencich
Plate I, Fig. 11

Cytheridea perforata ALEXANDER (not ROEMER), 1929, p. 72, pl. 5, fig. 1, 2. LOETTERLE, 1937, p. 64, pl. 9, figs. 5a, b.
Cytheridea sp. aff. C. perforata SWAIN, 1948, p. 209, pl. 14, fig. 16.

Diagnosis.—A species of Haplocytheridea ? characterized by closely spaced pits which become finer toward the margins.

Dimensions.—Female left valve: length 0.55 mm., height 0.37 mm.; female right valve: length 0.53 mm., height 0.33 mm.; male left valve: length 0.65 mm., height 0.38 mm.; male right valve: length 0.62 mm., height 0.33 mm. Plesiotypes no. 5951-5954 in the above order, all from sample 53.

HAPLOCYTHERIDEA ? INSOLITA Alexander and Alexander
Plate I, Figs. 10, 12

Cytheridea insolita ALEXANDER & ALEXANDER, 1933, p. 282, figs. 2a, b, 3a, b. ALEXANDER, 1939, p. 66.

Diagnosis.—A species of Haplocytheridea ? characterized by the right valve being larger than the left and containing the sockets and groove.
Dimensions.—Left valve: length 0.63 mm., height 0.40 mm.; right valve: length 0.72 mm., height 0.48 mm. Plesiotypes no. 5955, 5956 in the above order, both being from sample 85.

HAPLOCYTHERIDEA ? PLUMMERI (Alexander)

Plate I, Fig. 5

Cytheridea plummeri ALEXANDER, 1929, p. 73, pl. 5, figs. 5-8. ALEXANDER & ALEXANDER, 1933, p. 280, figs. 1a, b, 4a, b. ALEXANDER, 1939, p. 66.

Haplocytheridea ? plummeri SCHMIDT, 1948, p. 425, pl. 62, figs. 27-29; text-figure 2f.

not Haplocytheridea ? sp. aff. H. plummeri SWAIN, 1952, p. 79, pl. 8, fig. 15.

not Cytheridea plummeri SKINNER, 1956, p. 198, pl. 4, figs. 2a-d.

Cytheridea (Haplocytheridea) plummeri BROWN, 1957, p. 18, pl. 2, figs. 9-11.

Haplocytheridea ? plummeri BUTLER & JONES, 1957, p. 16, pl. 4, fig. 9.

HOWE & LAURENCICH, 1958, p. 256.

Diagnosis.—A species of Haplocytheridea ? characterized by vertical rows of pits which become coarser at the center.

Dimensions.—Female left valve: length 0.43 mm., height 0.27 mm.; female right valve: length 0.41 mm., height 0.23 mm.; male left valve: length 0.47 mm., height 0.27 mm.; male right valve: length 0.45 mm., height 0.24 mm. Plesiotypes no. 5957-5960 in the above order, all from sample 55.
Genus ASCIOCYTHEHE Swain, 1952

ASCIOCYTHEHE N. SP. 1

Plate I, Figs. 4, 6

Diagnosis.—A species of Asciocythere characterized by uniformly spaced pits.

Description.—Carapace ovate in side view and lenticular in dorsal and ventral views. Anterior broadly rounded; posterior subacutely rounded with the left valve more narrowly rounded. Dorsal and ventral margins convex in the left valve and almost parallel in the right. Highest at the middle in the left valve and at the anterior end of the hinge line in the right. Left valve overlaps more along dorsal and ventral margins than at the ends. Males are more elongate than the females. Surface marked by faint, uniformly spaced pits.

Marginal area broad with the inner margin being thick and forming a shelf. Radial pore canals long and extremely numerous; normal pore canals prominent. Muscle scars consist of four in a vertical row with a U-shaped scar in front. Hinge of the left valve has long, crenulate, terminal sockets separated by a faintly crenulate groove above which there is an accommodation groove.

Dimensions.—Female left valve: length 0.50 mm., height 0.33 mm.; female right valve: length 0.45 mm., height 0.27 mm.; male left valve: length 0.58 mm., height 0.37 mm.; male right valve: length 0.57 mm., height 0.30 mm. Holotype no. 5961, female left valve; paratypes no. 5962-5964 in above order beginning with female right valve; all from sample 19.
Genus KRITHE Brady, Crosskey, and Robertson, 1874

KRITHE CUSHMANI Alexander

Plate I, Fig. 3

Krithe cushmani ALEXANDER, 1929, p. 67, pl. 4, figs. 9, 11.
ALEXANDER, 1939, p. 66. BONNEMA, 1940, p. 118, pl. 2, figs. 48-54. ALBRITTON, 1941, p. 49, 59. BOLD, 1946, p. 77, pl. 4, fig. 18.

Krithe postprojecta SCHMIDT, 1948, p. 409, pl. 61, fig. 8, text-fig. 2d. ? SWAIN, 1952, p. 87, pl. 9, fig. 11. HOWE & LAURENCICH, 1958, p. 377.


Diagnosis.—A species of Krithe characterized by an indented posterior.

Remarks.—K. cushmani Alexander is the female of the species described by Schmidt as K. postprojecta which is the male.

Dimensions.—Female: length 0.55 mm., height 0.27 mm.; male: length 0.60 mm., height 0.27 mm. Plesiotype no. 5965, male left valve; plesiotype no. 5966, female right valve; both from sample 20.

Subfamily CYTHERINAE Dana, 1853

Genus CYTHERE Muller, 1785

"CYTHERE" N. SP. 1

Plate III, Fig. 15

Diagnosis.—A species of "Cythere" characterized by semiconcentric rows of short, blunt spines which parallel all but the dorsal margin.

Description.—Carapace ovate; anterior and posterior margins
obliquely rounded but higher anteriorly. Dorsal and ventral margins straight. Highest at the middle where the ventrally distended car-apace overhangs the ventral margin. Surface marked by semiconcentric- cal rows of short, blunt spines which parallel all but the dorsal margin and become coarser toward the margins.

Vestibule better developed anteriorly. Radial pore canals straight and widely spaced. Muscle scars consist of a vertical row of four with one obliquely aligned scar in front. Hinge of the right valve has crenulate terminal teeth separated by a crenulate groove.

Remarks.—This species differs from "C." semiconcentrica in having spines rather than ridges covering the surface.

Dimensions.—Length 0.45 mm., height 0.30 mm. Holotype no. 5967, left valve from sample 18.

Subfamily CYTHERURINAE Muller, 1894

Genus CYTHEROPTERON Sars, 1866

CYTHEROPTERON FURCALATUM Alexander

Plate III, Fig. 12

Cytheropteron (Cytheropteron) furcalatum ALEXANDER, 1933, p. 194, pl. 27, figs. 7a, b.

Cytheropteron furcalatum ALEXANDER, 1939, p. 66. HOWE & LAURENCICH, 1958, p. 300.

Diagnosis.—A species of Cytheropteron characterized by a retic- ulate surface, two ventral spines, and a long caudal process.

Dimensions.—Length 0.48 mm., height 0.23 mm. Plesiotype no. 5968, right valve from sample 15.
CYTHEROPTERON N. SP. 1

Plate IV, Fig. 2

Diagnosis.—A species of Cytheropteron characterized by a blunt ventral ala from which two pitted furrows extend dorsally.

Description.—Carapace ovate; anterior and posterior acutely rounded; dorsal and ventral margins convex. Highest at the middle. A blunt ala projects laterally from the center of the ventral margin, which it slightly overhangs, and is truncate behind. Two deeply pitted furrows extend dorsally from the ala with the less pronounced rows of pits on either side. Faint ridges extend from the posterior of the ala toward the posterior margin.

Marginal area regular and having a vestibule. Radial pore canals few and widely spaced. Hinge antimerodont.

Remarks.—This species differs from C. fossatum Skinner in having a blunt rather than a rounded ala and fewer furrows which extend further ventrally.

Dimensions.—Length 0.30 mm., height 0.20 mm. Holotype no. 5969, left valve from sample 18.

CYTHEROPTERON N. SP. 2

Plate IV, Fig. 11

Diagnosis.—A species of Cytheropteron characterized by vertical rows of fine pits and a long posterovertrally directed ala.

Description.—Carapace subovate; anterior obliquely rounded; posterior compressed with a short caudal process. Highest at the middle. A long posterovertrally directed ala with median furrow rises below the middle. Vertical rows of fine pits cover the surface.
Marginal area regular and lacking a vestibule. Hinge of the right valve has crenulate terminal teeth and intervening crenulate groove.

Remarks.—This species differs from *C. harrisi* Skinner in lacking the spine below the ala and in having the rows of fine pits.

Dimensions.—Length 0.30 mm., height 0.17 mm. Holotype no. 5970, right valve from sample 81.

Genus *EUCYTHHERURA* Muller, 1894

**EUCYTHHERURA QUADRITUBERCULATA** Skinner

Plate III, Fig. 2

_Eucytherura quadrituberculata_ SKINNER, 1956, p. 202, pl. 4, fig. 11.


Diagnosis.—A species of *Eucytherura* characterized by prominent eye-spot, muscle swelling, posterocardinal node, and subalate ventral protuberance.

Dimensions.—Length 0.22 mm., height 0.12 mm. Plesiotype no. 5971, left valve from sample 81.

**EUCYTHHERURA N. SP. 1**

Plate IV, Fig. 5

Diagnosis.—A species of *Eucytherura* characterized by finely reticulate surface, a subalate ventral protuberance below and behind the middle, and a narrow ridge extending beneath it from the anterior margin.

Description.—Carapace rectangular; anterior bluntly rounded and having short, pointed denticulations; posterior compressed with a short caudal process above the middle. Highest at a distinct glassy
eye-spot. Surface marked by fine reticulations, a dorsal protuberance below and behind the middle of the dorsal margin. Near the ventral margin a similar but subalate protuberance is present and beneath it a narrow, curved ridge extends to the anterior margin. There is a broad sulcus behind the small muscle swelling. A row of three or four small, sharp spines line the dorsal margin and there is a small node in front of the ventral protuberance. In dorsal or ventral view, the sides are medially constricted and the ends compressed. Both surfaces are reticulate and the ventral is longitudinally ribbed.

Marginal area broad and having an anterior vestibule. Hinge of right valve has smooth terminal teeth and a crenulate groove between.

Remarks.—This species differs from *E. quadrituberculata* Skinner in having smaller protuberances, eye-spot, and muscle swelling and in having the curved ridge extending from the anterior margin to a point below the ventral protuberance and differs from the Midway *E. latebrosa* Weingeist in having a less pointed posterior and having a different alar protuberance.

Dimensions.—Length 0.27 mm., height 0.17 mm. Holotype no. 5972, left valve from sample 18.

**EUCYTHERURA N. SP. 2**

Plate IV, Fig. 8

**Diagnosis.**—A species of *Eucytherura* characterized by a ventral keel and median ridge which converge anteriorly.

**Description.**—Carapace rectangular; anterior obliquely rounded; posterior compressed and angulate above the middle. Highest above a small glassy eye-spot. A median ridge joins a subalate ventral keel
just below the middle near the anterior margin. The posterior end of the keel is truncate to produce a sharp corner, beneath which there is a short blade-like process. Surface marked by minute pits and a broad median sulcus.

Marginal area regular and lacking a vestibule. Muscle scars and pore canals obscure. Hinge of the right valve has smooth terminal teeth separated by a faintly crenulate groove.

Remarks.—This species differs from *E. simplex* Veen in lacking ridges between the posterior cardinal angle and the point of the keel and between the eye-spot and a distinct muscle swelling.

Dimensions.—Length 0.32 mm., height 0.18 mm. Holotype no. 5973, right valve from sample 18.

Genus *ORTHONOTACYTHERE* Alexander, 1933

*ORTHONOTACYTHERE HANNAI* (Israelsky)

Plate III, Fig. 14

*Cytheridea ? hannai* ISRAELSKY, 1929, p. 12, pl. 2A, figs. 10a, b.

*Cytheropteron hannai* ALEXANDER, 1929, p. 105, pl. 9, fig. 16.

*Orthonotacythere hannai* ALEXANDER, 1933, p. 200, pl. 25, figs. 1a-c; pl. 26, figs. 6a, b; pl. 27, figs. 14a, b. ALEXANDER, 1934, p. 65.

*Cytheridea ? hannai* ISRAELSKY, 1935, p. 482, pl. 2A, figs. 10a, b.

*Orthonotacythere hannai* var. ALEXANDER, 1939, p. 660. SKINNER, 1956, p. 202, pl. 4, figs. 9a, b. BUTLER & JONES, 1957, p. 21, pl. 4, fig. 2. HOWE & LAURENCICH, 1958, p. 437.

Diagnosis.—A species of *Orthonotacythere* characterized by a large glassy eye-spot and about seven nodes.
Dimensions.—Length 0.55 mm., height 0.33 mm. Plesiotype no. 5974, right valve from sample 73.

ORTHONOTACYTHERE SCROBICULATA Alexander

Plate III, Fig. 1

Orthonotacythere scrobiculata ALEXANDER, 1934, p. 66, pl. 8, fig. 2, 8. HOWE, 1958, p. 440.

Diagnosis.—A species of Orthonotacythere characterized by a reticulate surface, median sulcus, four nodes along the ventral margin, and one on either side of the sulcus above the middle.

Dimensions.—Length 0.38 mm., height 0.25 mm. Plesiotype no. 5975, left valve from sample 11.

NEW GENUS

Diagnosis.—A genus of the subfamily Cytherurinae characterized by scattered reticulations, a prominent muscle node surrounded by a depression, and several transverse and longitudinal ridges, the most prominent of which parallels most of the margin.

Description.—Carapace subquadrate with an angulate posterior. Sexually dimorphic with the males being longer. Surface marked by a ridge which parallels most of the margin and from the inner side of which several shorter ridges branch, several transverse ridges near the posterior end which may be connected by cross-ribs, a prominent muscle node surrounded by a depression, and scattered reticulations.

Marginal area regular and having a vestibule. Radial pore canals few, straight, and widely spaced. Normal pore canals few but prominent along the ridges. Muscle scars consist of a vertical row
of five, with the lower scar separated from the others by a gap, and an upper crescent-shaped and lower ovate scar in front of the row. Hinge antimerodont.

Remarks. — This genus differs from Otocythere Triebel in being smaller, having a submarginal ridge paralleling most of the margin instead of a swelling below and in front of the muscle node, and in having a small rounded tooth at the ends of the hinge rather than an elongate tooth. It differs from Apheloocythere Triebel in having the submarginal ridge, large muscle node, and small rounded terminal teeth in the hinge.

GENOTYPE

Plate II, Figs. 9, 10, 15

Diagnosis. — A sexually dimorphous species of the new genus characterized by a ridge paralleling all margins but the anterior one-half of the dorsal; a second ridge parallels this one on the anterior and ventral margins; a distinct muscle node lies above and in front of the center, behind which is a median sulcus and generally three short vertical ribs.

Description. — Carapace subquadrate in side view; dorsally and ventrally ovate with extremely compressed ends and a slight anterior rim. Sexually dimorphous with the males being longer. Left valve slightly overlaps the right at both ends of the hinge line. A ridge parallels the margins from the dorsal end of a sulcus, which is slightly in front of the middle, to the anterior cardinal angle. It overhangs the ventral and projects above the dorsal margin and masks a very tiny eye-spot. Another ridge branches from the inside of the
first as it turns the anteroventral corner and parallels it along the ventral margin. A third ridge branches above the second and joins a high muscle node which is just in front of the sulcus. The sulcus is continuous with a depression above and in front of the muscle node. There are usually three transverse ridges behind the sulcus and may or may not be connected by reticulations. Scattered reticulations sometimes border the other ridges.

Marginal area regular and having a vestibule. Radial pore canals straight and widely spaced. Normal pore canals few but prominent along the ridges. Muscle scars consist of a vertical row of five, with the lower scar separated from the others by a gap, and an upper crescent-shaped and lower ovate scar in front of the row.

Hinge antimerodont.

**Dimensions.**—Female: length 0.30 mm., height 0.17 mm.; male: length 0.35 mm., height 0.17 mm. Holotype no. 5976, male right valve from sample 11; paratypes no. 5977, female left valve, and no. 5978, complete male carapace from sample 51.

Subfamily BYTHOCYTHERINAE Sars, 1926

Genus MONOCERATINA Roth, 1928

MONOCERATINA PEDATA (Marsson)

Plate III, Fig. 18

Cythere pedata MARSSON, 1880, p. 46, pl. 3, figs. a-c.

Cytheropteron pedatum JONES & HINDE, 1890, p. 38, pl. 4, figs. 33-35.

Cytherura spooneri ISRAELSKY, 1929, p. 6, pl. 4A, fig. 7.

Monoceratina pedata ALEXANDER, 1933, p. 203, pl. 27, figs. 15a, b.

ALEXANDER, 1934, p. 60. BONNEMA, 1941, p. 29, pl. 6, figs. 27-
Diagnosis.—A species of Monoceratina characterized by a punctate surface, long conical spine, and tapering caudal process.

Dimensions.—Length 0.67 mm., height 0.32 mm. Plesiotype no. 5979, right valve from sample 18.

MONOCERATINA PROTHROENSIS Butler and Jones

Plate III, Fig. 11

Monoceratina prothroensis BUTLER & JONES, 1957, p. 22, pl. 4, figs. 1a-d. HOWE & LAURENCICH, 1958, p. 417.

Diagnosis.—A species of Monoceratina characterized by rows of small spines along the dorsal margin and below a long conical spine.

Dimensions.—Length 0.65 mm., height 0.30 mm. Plesiotype no. 5980, right valve from sample 18.

MONOCERATINA SP.

Plate III, Fig. 10

Diagnosis.—A species of Monoceratina characterized by dorsal and ventral ridges which connect with a vertical welt just anterior to a median sulcus and a long conical spine to which the ventral ridge is connected.

Description.—Carapace elongate subquadrate. Anterior rimmed and truncate; posterior compressed and having a caudal process at the dorsal margin. Surface marked by centrodorsal and centroventral ridges, the dorsal being slightly longer and the ventral connected
to a long conical spine below a median sulcus. Both dorsal and ven­
tral ridges blend with a broad vertical welt which lies just in front of the sulcus.

Hinge of the left valve consists of a long bar which fits in a groove of the right valve.

Dimensions.—Length 0.53 mm., height 0.25 mm. Figured specimen no. 5981.

Subfamily BRACHYCYTHERINAE Puri, 1953
Genus BRACHYCYTHERE Alexander, 1933

BRACHYCYTHERE SPHENOIDES (Reuss)

Plate IV, Fig. 7

Cythere sphenoides REUSS, 1854, p. 141, pl. 27, figs. 2a-c.

Cytheropteron sphenoides JONES & HINDE, 1890, p. 33, pl. 1, figs. 18-20.

Cytheropteron sp. B, ISRAELSKY, 1929, p. 8, pl. 1A, figs. 2a-c.

Cythere sphenoides ALEXANDER, 1933, p. 205, pl. 25, figs. 3a-c; pl. 26, figs. 7a, b; pl. 27, fig. 19. LOETTERLE, 1937, p. 53, pl. 9, figs. 1a, b. CALAHAN, 1939, p. 41, pl. 3, figs. 5a-c. SWAIN, 1952, p. 80, pl. 8, figs. 42, 43. BROWN, 1957, p. 11, pl. 4, fig. 16. BUTLER & JONES, 1957, p. 27, pl. 3, fig. 1. HOWE & LAURENCICH, 1958, p. 91.

Diagnosis.—A species of Brachycythere characterized by a round­ed, subalate keel which generally overhangs the ventral margin.

Dimensions.—Left valve: length 0.75 mm., height 0.50 mm.; right valve: length 0.75 mm., height 0.45 mm. Plesiotypes no. 5982, 5983 in above order, both from sample 15.
BRACHYCYHERE TAYLORENSIS (Alexander)

Plate IV, Fig. 14

Cythere taylorensis ALEXANDER, 1929, p. 82, pl. 7, figs. 3, 4.
Brachocythere taylorensis ALEXANDER, 1939, p. 66. HOWE & LAURENCICH 1958, p. 92.

Diagnosis.—A species of Brachocythere characterized by a row of pits along a rounded keel which separates the flattened ventral surface from the lateral surface and a row of pits on either side of the keel.

Description.—Carapace laterally subovate; dorsally and ventrally ovate with compressed ends and spade-shaped in end view. Anterior obliquely rounded; posterior denticulate, rounded below the middle and obliquely truncate above. Ventral margin inturned near the middle. Highest behind a small glassy eye-spot. Left valve overlaps right along all but the posterior margin. An elongate depression extends from below the eye-spot toward the dorsal margin. Central area swollen and pitted in the center by the enlarged openings of normal pore canals. A rounded keel separates the flattened ventral surface from the lateral surface. The keel bears a row of pits, has a row of pits below it, and another above in an irregular furrow. The ventral surface bears a longitudinal ridge in each valve. A row of obscure nodes extends from the posterior end of the keel to the posterior margin.

Marginal area wide anteriorly and lacking a vestibule. Radial pore canals long, numerous, bulbous, and interspersed with pseudo-radial canals. Normal pore canals prominent. Hinge hemiamphidont
with a faint accommodation groove above the hinge bar of the left valve.

**Dimensions.**—Right valve: length 0.70 mm., height 0.42 mm.;
left valve: length 0.75 mm., height 0.48 mm. Plesiotypes no. 5984, 5985 in the above order, both from sample 55.

**BRACHCYTHERE N. SP. 1**

Plate IV, Fig. 10

**Diagnosis.**—A species of **Brachocythere** characterized by a broad furrow above the ventral keel and a narrow groove extending from the eye-spot to the ventral margin and paralleling the anterior margin.

**Description.**—Carapace subpyriform; anterior obliquely rounded; posterior angulate near the middle, being faintly concave above and rounded below the middle. Sexually dimorphous with the males being more elongate. Dorsal margin straight; ventral margin broadly convex. Left valve slightly overlaps the right along dorsal and ventral margins. Highest near a small glassy eye-spot. Inflated ventrally to form a slight ventral keel above which is a broad shallow groove. A narrow groove, paralleling the anterior margin, extends from beneath the eye-spot to the ventral margin. Central area marked by widely spaced pits.

Marginal area regular and lacking a vestibule. Radial pore canals straight, non-bulbous, and more numerous near the ventral margin. Muscle scars consist of a vertical row of four scars in which the upper is L-shaped, the next two are adjacent oval scars, and the lower scar is an elongate oval. In front of this row is an L-shaped scar and a lower ovate scar. Hinge hemiamphidont.
Remarks.—This species differs from B. ? n. sp. 3 in being less inflated ventrally, lacking the coarse pits in the central area, and in having the broad furrow above the slight keel.

Dimensions.—Female: length 0.70 mm., height 0.47 mm.; male: length 0.77 mm., height 0.47 mm. Holotype no. 5986, male left valve; paratype no. 5987, male right valve; paratype no. 5988, female left valve; paratype no. 5989, female right valve; all from sample 15.

BRACHYCYTHERE N. SP. 2

Plate IV, Fig. 13

Diagnosis.—A subpyriform species of Brachycythere characterized by a deep longitudinal furrow just below the middle of the coarsely pitted central area and by a narrow groove which parallels the anterior margin and separates the compressed anterior from the tumid central area.

Description.—Carapace subpyriform; anterior compressed and evenly rounded; posterior compressed and angulate at the middle. Dorsal outline arched just behind a small glassy eye-spot; ventral margin slightly inturned from the middle to the anterior end. Left valve overlaps the right along all margins. A deep, pitted, longitudinal furrow lies just below the center and just above a slight keel which bears a row of pits and is furrowed in the posterior half. A narrow groove, paralleling the anterior margin, extends from a depression just behind the eye-spot to the anterior end of the furrow and separates the flattened anterior from the inflated central area. Both the inflated lateral surface and the flattened ventral surface are covered with pits which represent the openings
of normal pore canals. Those on the ventral surface are arranged in three or four longitudinal rows.

Marginal area widest anteriorly with numerous radial canals which are bulbous near the outer margin, straight and widely spaced. Normal pore canals represented by coarse pits. Hinge hemiamphidont with a strong accommodation groove above the hinge bar in the anterior half of the left valve.

Remarks.—This species differs from *B. rhomboidalis* in having a groove separating the flattened anterior from the inflated central area, being more coarsely pitted, and lacking the well-developed keel.

Dimensions.—Length 1.00 mm., height 0.63 mm. Holotype no. 3990, left valve from sample 10.

BRACHYCYTHERE ? N. SP. 3

Plate IV, Fig. 12

Diagnosis.—A species of *Brachycythere* characterized by being extremely tumid, having coarse pits in the central area, and a shallow groove separating the tumid central area from the flattened anterior.

Description.—Carapace ovate in side view; subovate with compressed ends in dorsal view; and spade-shaped in posterior view. Highest above the eye-spot. A narrow groove, which begins at a depression behind the small glassy eye-spot, parallels the anterior margin and separates the flattened anterior from the tumid central area. Closely spaced, coarse pits cover the central area.

Marginal area lacking a vestibule and characterized in the
the right valve, by the development of a very distinct selvage which is continuous along anterior, ventral, and posterior margins and which is most strongly developed in the posterior half of the ventral margin. Selvage is bordered on the outside by a wide flange groove and is separated from the rather inconspicuous list by a narrow selvage groove. Corresponding features are scarcely recognizable in the marginal area of the left valve. Radial pore canals straight, non-bulbous, and more numerous below the middle. Pseudoradial pore canals produced near the anteroventral margin. Normal pore canals prominent in the tumid central area. Hinge of right valve has a dorsally triangular anterior tooth with a round knob at the apex and postjacent socket separated from a faintly orenulate, triangular, posterior tooth by a groove. Left valve has an accommodation groove above the median bar.

Remarks.—This species differs from B. n. sp. 1 in being much more inflated, having coarse pits in the central area, and lacking the broad furrow below the middle.

Dimensions.—Length 0.73 mm., height 0.48 mm. Holotype no. 5991, left valve from sample 85.

BRACHYCYTHERE N. SP. 4

Plate IV, Fig. 3

Diagnosis.—A species of Brachycythere characterized by a triangular ala.

Description.—Carapace laterally subtriangular; dorsally and ventrally diamond-shaped with compressed ends, and spade-shaped in end view. Anterior margin faintly denticulate; ventral margin
slightly inturned in front of the middle. Left valve overlaps right along all margins. Highest above an arcuate depression which lies just behind a small glassy eye-spot. A triangular ala, with thickened apex from which a shallow groove extends anteriorly, separates the flattened ventral surface from the lateral surface. Ventral surface longitudinally ribbed. A small node lies midway between posterior extremity and posterodorsal corner.

Marginal area regular and lacking a vestibule. Radial pore canals long, thread-like, and evenly spaced. Muscle scars indistinct. Adductor scars in a vertical row in which some are divided and in front of which is a large V-shaped scar. Hinge hemiamphidont. An accommodation groove above the hinge bar of the left valve is enlarged anteriorly.

Remarks.—This species differs from *B. sphenoides* in having a triangular ala rather than a rounded keel.

Dimensions.—Left valve: length 0.70 mm., height 0.42 mm.; right valve: length 0.70 mm., height 0.38 mm. Holotype no. 5991, right valve from sample 68.

**BRACHYCYTHERE N. SP. 5**

Plate IV, Figs. 4, 6

Diagnosis.—A species of *Brachycythere* characterized by its subtriangular shape in lateral view and the nearly smooth lateral and ventral surfaces which are separated by a faint ridge.

Description.—Carapace laterally subtriangular; dorsally and ventrally ovate with compressed ends; and, in end view, forming an almost equilateral triangle. Posterior slightly turned down and
angulate at the ventral margin. Dorsal outline arched just behind a small glassy eye-spot; ventral margin intumed in front of the middle. Left valve overlaps right along all but the acuminate posterior margin. There are variations in the surface ornamentation from smooth to a surface with a faint central ridge which extends almost vertically from a point near the dorsal margin to the center where it turns obliquely adanterior to a slight keel at the angulation between the ventral and lateral surfaces. Behind this ridge is a shorter ridge paralleling the oblique portion and a row of three shallow pits extending from the center of the shorter ridge to the posterior end of the keel.

Marginal area narrow and lacking a vestibule. Radial pore canals slightly sigmoid, non-bulbous, widely spaced, and more numerous below the middle. Pseudoradial pore canals few and bending dorsally above the middle. Normal pore canals prominent in the most inflated portion. Muscle scars consist of a vertical row of four; an upper crescent-shaped scar, two small adjacent scars, and a lower elongate scar. In front of the row is a crescent-shaped scar with a small round scar beneath. Hinge hemiamphidont with an accommodation groove above the hinge bar of the left valve.

Remarks.—This species differs from *B. ledniforma* (Israelsky) in having a smooth ventral surface rather than rows of pits.

Dimensions.—Length 0.65 mm., height 0.37 mm. Holotype no. 5993, left valve from sample 68; paratype no. 5994, right valve from sample 13.
Diagnosis.—A species of Brachycythere characterized by a subalate keel and almost parallel dorsal and ventral margins.

Description.—Carapace laterally subovate; dorsally and ventrally ovate with compressed ends, and spade-shaped in end view. Anterior obliquely rounded; posterior denticulate, convex below a subangulation and concave above it. Ventral margin inturned in front of the middle. Highest behind a small glassy eye-spot. Left valve overlaps the right along the dorsal margin. A subalate keel, separating the lateral surface from the ventral surface, is truncate posteriorly and bears a row of pits. The upper part of the keel forms a shelf-like projection above which there is an elongate depression with a row of pits. The central area has widely spaced pits and several obscure nodes are aligned between the posterior end of the keel and the posterior margin. There is a crescent-shaped depression below and behind the eye-spot. Each valve has two longitudinal ridges on the flattened ventral surface.

Marginal area regular and lacking a vestibule. Radial pore canals straight, numerous, and bulbous near the outer margin. Hinge hemiamphidont.

Remarks.—This species fits the description of B. jerseyensis Jennings which Swain placed in synonymy with B. rhomboidalis (Berry). It differs from B. rhomboidalis in having a more elongate carapace and a more pronounced keel which is truncate posteriorly.

Dimensions.—Length 0.70 mm., height 0.37 mm. Holotype no. 5994, right valve from sample 55.
BRACHYCYHERE N. SP. 7

Plate IV, Fig. 9

Diagnosis.—A species of *Brachycythere* characterized by coarse pits arranged in longitudinal rows on the ventral surface and which diverge from a point below and in front of the center on the lateral surface.

Description.—Carapace laterally subtrapezoidal; dorsally and ventrally ovate with compressed ends, and spade-shaped in end view. Posterior turned down and angulate at the ventral margin. Ventral margin inturned in front of the middle. Left valve overlapes the right along all margins. Behind the small, glassy eye-spot is a depression which is connected to a curved furrow which separates the compressed anterior from the swollen central area. The broad ventral surface has three to five longitudinal rows of pits separated by ridges. Lateral surface also bears rows of pits which tend to curve around the muscle area and fan out behind.

Marginal area broad anteriorly and lacking a vestibule. There is a short flange furrow and selvage behind the inturned ventral margin of the left valve. Radial pore canals long, numerous, and bulbous near the outer margin. Pseudoradial canals are less numerous and both are dorsally directed above the middle. Normal pore canals very numerous. Hinge hemiamphidont with an accommodation groove above the hinge bar of the left valve.

Remarks.—This species differs from *B. ledaforma* (Israelsky) in having coarse pits arranged in rows forming a fan-like pattern and differs from *B. foraminosa* Alexander, of the Midway, in lacking
the sharp, subalate edge formed by the junction of the lateral and ventral surfaces and lacking the denticulations along the anterior margin.

Dimensions.—Length 0.65 mm., height 0.38 mm. Holotype no. 5995, right valve from sample 51.

Genus ALATACYTHERE Murray and Hussey, 1942

ALATACYTHERE PONDEROSANA (Israelsky)

Plate II, Fig. 2

Cytheropteron ponderosana ISRAELSKY, 1929, p. 9, pl. 2A, figs. 1a-c.

Cythereis thomasi ISRAELSKY, nom. nov., in ALEXANDER, 1933, p. 211, pl. 25, figs. 16a, b. CALAHAN, 1939, p. 41, pl. 3, fig. 3.

ALEXANDER, 1939, p. 66.

Pterygocythereis thomasi HILL, 1954, p. 816, pl. 98, figs. 5a-c; pl. 99, figs. 2a-c.

Alatacythere ponderosana BUTLER & JONES, 1957, p. 29, pl. 2, figs. 4a-c. HOWE & LAURENCICH, 1958, p. 42.

Diagnosis.—A species of Alatacythere characterized by an arched ridge in the center of the dorsal margin.

Dimensions.—Length 0.73 mm., height 0.42 mm. Plesiotype no. 5996, left valve from sample 86.

ALATACYTHERE TOKIANA (Israelsky)

Plate II, Fig. 1

Cytheropteron tokiana ISRAELSKY, 1929, p. 9, pl. 1A, figs. 8, 9a, b.

ISRAELSKY, 1935, p. 479, pl. 1A, figs. 8, 9a, b.

Cythereis tokiana LOETTERLE, 1937, p. 55, pl. 9, figs. 4a, b.

not Cythereis (Pterygocythereis) tokiana BOLD, 1946, p. 100, pl. 6,
fig. 9.


Alatacythere tokiana HOWE & LAURENCHICH, 1958, p. 45.

Diagnosis.—A species of Alatacythere characterized by its sub-rectangular shape and a blade-like ridge along the central part of the dorsal margin.

Dimensions.—Length 0.83 mm., height 0.43 mm. Plesiotype no. 5997, left valve from sample 8.

ALATA CYTHERE ? N. SP. 1

Plate III, Fig. 13

Diagnosis.—A species of Alatacythere ? characterized by laterally compressed valves and a ventral row of spines rather than an ala.

Description.—Carapace subtriangular in lateral view; dorsally and ventrally triangular with compressed ends. Anterior rimmed, denticulate below the middle, and frilled above. Posterior angulate at the middle, rimmed and denticulate. Highest at a large, glassy eyespot over which the frill extends. One or two spines near the center of the hinge line and another at the posterior end of it, extend above the dorsal margin. Arrow of spines above the ventral margin become longer posteriorly and a sharp ridge below this row terminates in a rectangular blade beneath the largest spine. There are generally two short spines above the largest spine in the ventral row.

Marginal area regular and lacking a vestibule. Radial and pseudoradial pore canals straight and widely spaced. Muscle scars con-
sist of a vertical row of four in front of which is an upper V-shaped scar and a lower round scar. Hinge paramphidont.

Remarks.—Since Alatacythere has a hemiamphidont hinge, this species is questionably assigned to that genus.

Dimensions.—Length 0.58 mm., height 0.32 mm. Holotype no. 5998, right valve from sample 20.

ALATACYTHERE N. SP. 2
Plate II, Figs. 14, 16

Diagnosis.—A species of Alatacythere characterized by a more or less flat lateral surface separated from the flat ventral surface by a narrow keel and by a centrodorsal ridge which projects above the dorsal margin where it ends in either a short spine or sharp angulation.

Description.—Carapace laterally subrectangular; dorsally and ventrally fusiform with compressed ends; and shaped like a milk bottle in end view. Anterior margin broadly rounded, denticulate, and having a slight rim; posterior slightly rimmed, rounded below the middle where it is denticulate, and obliquely truncate above the middle. Ventral margin only slightly inturned in front of the middle. Highest at hinge ear in the left valve and at eye-spot in the right valve. A narrow keel separates the flat ventral surface from the gently inflated lateral surface. A longitudinal ridge divides the flat ventral surface and projects below the posterior end of the keel as a blade which is connected to the keel by a short ridge. A short, blunt node lies above the blade with three or four smaller ones scattered above it. There is a small depression behind the
distinct eye-spot and a centrodorsal ridge which protrudes above the dorsal margin where it ends either in a short spine or a sharp angulation. Left valve overlaps right at the hinge ear and at the posterodorsal corner.

Marginal area regular and lacking a vestibule. Radial and pseudoradial pore canals thread-like. Muscle scars generally consist of a vertical row of four in which the upper and lower are crescentic and the two in the middle are ovate and separated from the upper scar by a gap. In front of the row there is an upper ovate and lower crescentic scar. Hinge hemiamphidont.

**Dimensions.**—Length 0.72 mm., height 0.45 mm. Holotype no. 5999, right valve from sample 26; paratype no. 6000, left valve from sample 76.

Subfamily **LOXOCONCHINAE** Sars, 1925

Genus **LOXOCONCHA** (Sars), 1866

**LOXOCONCHA BROWNSTOWNENSIS** Alexander

Plate III, Fig. 3

Loxoconcha brownstownensis ALEXANDER, 1936, p. 694, pl. 93, fig. 9.

HOWE & LAURENCHIC, 1953, p. 383.

**Diagnosis.**—A species of Loxoconcha characterized by irregularly arranged reticulations.

**Remarks.**—This species is sometimes deformed with a depressed central area which results in some of the ridges being more prominent than others. It differs from *L. fletcheri* in lacking alignment of reticulations parallel to the margins.

**Dimensions.**—Length 0.35 mm., height 0.18 mm. Plesiotype no.
LOXOCONCHA CRETACEA Alexander
Plate III, Fig. 5

*Loxoconcha cretacea* ALEXANDER, 1936, p. 693, pl. 93, figs. 5, 7.

Diagnosis.—A species of *Loxoconcha* characterized by longitudinal ridges with deep pits between.

Dimensions.—Length 0.40 mm., height 0.20 mm. Plesiotype no. 6002, complete carapace from sample 86.

Subfamily TRACHYLEBERINAE Sylvester-Bradley, 1948

Genus *CYTHEREIS* Jones, 1849

*CYTHEREIS AUSTINENSIS* Alexander
Plate V, Fig. 9

*Cythereis austinensis* ALEXANDER, 1929, p. 99, pl. 7, fig. 11. Howe & Laurencich, 1958, p. 182.

Diagnosis.—A species of *Cythereis* characterized by a reticulate surface and dorsal and median ridges which are connected by a short cross-rib.

Dimensions.—Female: length 0.52 mm., height 0.28 mm.; male: length 0.57 mm., height 0.28 mm. Plesiotype no. 6003, female left valve; plesiotype no. 6004, male right valve; both from sample 12.

*CYTHEREIS BICORNIS* Israelsky
Plate V, Fig. 7
Cythereis bicornis ISRAELSKY, 1929, p. 19, pl. 4A, figs. 10a-c.

ALEXANDER, 1929, p. 100, pl. 8, figs. 4, 5. ISRAELSKY, 1935, p. 489, pl. 4A, figs. 10a-c. ALEXANDER, 1939, p. 66.

Cythereis cf. C. bicornis SWAIN, 1948, p. 200, pl. 13, figs. 15, 16.

Cythereis bicornis SWAIN, 1952, p. 84, pl. 9, fig. 31. HOWE & LAURENCICCH, 1958, p. 183.

Diagnosis.—A species of Cythereis characterized by a short, quadrate, dorsal ridge, a median ridge directed ventrally in front of a muscle swelling from which it is separated by a gap, and an irregular ventral ridge; all ridges have cross-ridges which merge with reticulations when present.

Dimensions.—Length 0.55 mm., height 0.30 mm. Plesiotype no. 6005, left valve from sample 12.

CYTHEREIS COMMUNIS Israelsky

Plate II, Fig. 7

Cythereis communis ISRAELSKY, 1929, p. 14, pl. 3A, figs. 9-13.

ALEXANDER, 1929, p. 101, pl. 9, fig. 18. JENNINGS, 1936, p. 52, pl. 7, fig. 3. SCHMIDT, 1948, p. 419, pl. 61, figs. 11-13.

Cythereis (Pterygoicythereis) cf. C. (P.) communis SWAIN, 1948, p. 207, pl. 14, figs. 5-7.

Cythereis communis SKINNER, 1956, p. 196, pl. 3, figs. 7a-c.

Trachyleberis communis BROWN, 1957, p. 35, pl. 3, fig. 6. HOWE & LAURENCICCH, 1958, p. 189.

Diagnosis.—A species of Cythereis characterized by a ventrally deflected posterior with long spines and three broad, sinuous, pitted ridges.
Dimensions.—Length 0.70 mm., height 0.38 mm. Plesiotype no. 6006, left valve from sample 1.

CYTHEREIS DALLASENSIS Alexander

Plate V, Fig. 16

Cythereis dallasensis ALEXANDER, 1929, p. 99, pl. 8, figs. 8, 9.

Cythereis ornatissima ALEXANDER, 1933, p. 210, pl. 25, fig. 18; pl. 26, figs. 11a, b; pl. 27, figs. 16a, b. CALAHAN, 1939, p. 41, pl. 3, figs. 9, 10.

Cythereis dallasensis HOWE & LAURENCICH, 1958, p. 192.

Diagnosis.—A species of Cythereis characterized by a reticulate surface with spines forming at the intersections and by large protuberances at the posterior dorsal and ventral margins.

Dimensions.—Length 0.82 mm., height 0.42 mm. Plesiotype no. 6007, right valve from sample 12.

CYTHEREIS FAUJASI Veen

Plate V, Fig. 2

Cythereis faujasi Veen, 1936, p. 23, pl. 6, figs. 58-63.

Cythereis caudata BUTLER & JONES, 1957, p. 34, pl. 4, fig. 8. HOWE & LAURENCICH, 1958, p. 188.

Cythereis faujasi HOWE & LAURENCICH, 1958, p. 197.

Diagnosis.—A species of Cythereis characterized by a finely pitted surface, several papillae in front of and behind a prominent muscle swelling, and by dorsal and ventral ridges which end posteriorly in tubercles.

Remarks.—C. caudata was thought to differ from C. faujasi
in having weak ridges extending from the muscle node and having a more pointed posterior. In the author's material, only a few specimens have the ridges extending from the muscle node and there are several specimens having a posterior which is rounded below the middle and slightly concave above.

**Dimensions.**—Length 0.50 mm., height 0.25 mm. Plesiotype no. 6008, right valve; plesiotype no. 6009, left valve; both from sample 68.

**CYTHEREIS HANNAI** Israelsky

*Plate V, Fig. 13*

Cythereis hannai ISRAELSKY, 1929, p. 16, pl. 4A, figs. 1a-c. ALEXANDER, 1939, p. 66.

**Diagnosis.**—A species of *Cythereis* characterized by a reticulate surface with males having a posterodorsal protuberance and females having an additional protuberance on the ventral margin.

**Dimensions.**—Female: length 0.53 mm., height 0.28 mm.; male: length 0.63 mm., height 0.30 mm. Plesiotypes no. 6010, female right valve; plesiotype no. 6011, male right valve; both from sample 18.

**CYTHEREIS PIDGEONI** (Berry)

*Plate V, Fig. 3*

Cytheridea pidgeoni BERRY, 1925, p. 485, figs. 7, 8.

Cytheridea ? pidgeoni TRIEBEL, 1941, p. 341, pl. 10, fig. 113.

Cythereis pidgeoni SCHMIDT, 1948, p. 421, pl. 62, figs. 2-6. HOWE & LAURENCICH, 1958, p. 223.

**Diagnosis.**—A species of *Cythereis* characterized by low, round-
ed cross-ridges between three longitudinal ridges.

Remarks.—This species differs from C. huntensis (Alexander) in being rectangular rather than triangular, having a short spine at the posterior end of the ventral ridge, and having a lower ridge which stops below the spine rather than turning down to join the posterior rim. Trachyleberis pidgeoni (Berry), which was reported by Brown (1957), is probably C. huntensis.

Dimensions.—Female: length 0.47 mm., height 0.27 mm.; male: length 0.58 mm., height 0.27 mm. Plesiotype no. 6012, male right valve from sample 11.

CYTHEREIS PLUMMERI Israelsky

Plate V, Fig. 15
Cythereis plummeri ISRAELSKY, 1929, p. 18, pl. 4A, figs. 2, 3.
ALEXANDER, 1939, p. 66. HOWE & LAURENCICH, 1958, p. 224.

Diagnosis.—A species of Cythereis characterized by deep reticulations with small spines along the ridges and by long, broad spines along dorsal and ventral margins.

Dimensions.—Female: length 0.85 mm., height 0.50 mm.; male: length 0.95 mm., height 0.50 mm. Plesiotype no. 6013, female left valve from sample 86.

CYTHEREIS SPOORI Israelsky

Plate V, Fig. 11
Cythereis spoori ISRAELSKY, 1929, p. 17, pl. 4A, figs. 4, 5.

ISRAELSKY, 1935, p. 487, pl. 4A, figs. 4, 5. ALEXANDER, 1939, p. 66.

**Diagnosis.**—A species of *Cythereis* characterized by three longitudinal ridges with reticulations between and by low nodes at the junction of ridges and reticulations.

**Dimensions.**—Female: length 0.50 mm., height 0.28 mm.; male: length 0.53 mm., height 0.27 mm. Plesiotype no. 6014, male right valve from sample 11.

**CYTHEREIS N. SP. 1**

**Diagnosis.**—A species of *Cythereis* characterized by an arched median row and straight ventral row of small nodes at junctions of lacy reticulations.

**Description.**—Carapace subrectangular; anterior rounded and having a noded rim and denticulate margin. Posterior compressed, bordered by a noded rim, and angulate above the middle. Highest at the anterocardinal angle. Left valve overlaps right at the anterodorsal and posterodorsal corners. Ventral margin slightly intumed in front of the middle. The surface is covered with lacy reticulations, bears traces of three longitudinal ribs, and has a curved cross-rib extending from the glassy eye-spot to the muscle swelling. Dorsal rib short, high thin, truncate on the ends and rises above the dorsal margin behind the middle. Median rib represented by a curved row of nodes which are separated from the muscle swelling by a gap. The ventral rib is also represented by a row of nodes which starts near the anterior margin and ends in a blunt spine above and behind the middle of the ventral margin. A longitudinal rib on the ventral surface is visible below this. The row of nodes separates
the ventral surface from the lateral surface. Viewed ventrally, the outline is arrowhead-shaped. The margin is bordered by a very flattened rim which is widest at the point where the margin is inverted. This rim is continuous with the anterior and posterior marginal rims. Surface reticulate. Viewed dorsally, the carapace is arrowhead-shaped with compressed posterior. The narrow dorsal surface is reticulate. The area between the anterior rim and anterior margin is strongly reticulate. Left valve bears a node at the posterior end of the hinge line.

Marginal area regular and lacking a vestibule. Radial pore canals straight and more closely spaced below the middle. Hinge holamphidont with a crenulate furrow in the left valve.

Remarks.—This species differs from C. bicornis Israelsky in having rows of nodes instead of a median and ventral ridge and in having lacy reticulations.

Dimensions.—Length 0.68 mm., height 0.33 mm. Holotype no. 6015, left valve from sample 8.

CYTHEREIS N. SP. 2

Plate V, Fig. 10

Diagnosis.—A subquadrate species of Cythereis characterized by a heavy shell and reticulations on either side of the median rib.

Description.—Carapace subquadrate; anterior obliquely rounded and having a thick noded rim and denticulate margin. Posterior compressed, broadly concave above the middle, convex below, and bearing a noded rim. Sexually dimorphous with the males being more
elongate. Dorsal and ventral margins subparallel with the ventral margin inturned in front of the middle. Highest at a glassy eye-spot above which there is a hinge ear in the left valve. Left valve overlaps the right more strongly at the hinge ear and posterodorsal corner. The lateral surface is essentially smooth, marked by a glassy eye-spot, prominent muscle swelling and three longitudinal ribs. In lateral view, the dorsal rib rises above the dorsal margin and is separated from the eye-spot by a short gap. Both sides of it are marked by deep reticulations. Median rib slightly arched, pitted on either side, and separated from an elongate muscle node by a gap. It also bears deep reticulations both dorsally and ventrally. The ventral rib is reticulate on either side, continuous with the anterior rim, truncate above the compressed posterior, and separates the lateral surface from the flattened ventral surface. Viewed dorsally or ventrally the carapace is subovate with the lateral surface extending out beyond the dorsal and ventral surfaces and being constricted in the middle. Dorsal surface is only slightly triangular and ventral surface is strongly triangular.

Marginal area regular. Radial pore canals straight and evenly spaced. Hinge holamphidont with sockets of the left valve more or less open to the interior.

Remarks.—This species differs from C. hazardi in having broader longitudinal ribs, more prominent muscle swelling and eye-spot, and lacking the branching cross-ribs between the longitudinal ribs.

Dimensions.—Female: length 0.70 mm., height 0.38 mm.; male:
length 0.80 mm., height 0.38 mm. Holotype no. 6016, male right valve; paratype no. 6017, female left valve; both from sample 85.

CYTHEREIS N. SP. 3
Plate V, Fig. 4

Diagnosis.—A species of Cythereis characterized by broad dorsal and median ridges and a ventral ridge which partially encircles a sharp spine near the posterior end.

Description.—Carapace subtrapezoidal; anterior obliquely rounded, rimmed, and having a double row of denticles below the middle. Posterior compressed, angulate at the ventral margin, and having a rim which bears denticles along its crest. Ventral margin inturned in front of the middle. Highest above a glassy eye-spot. Left valve slightly overlaps the right at both ends of the hinge line. Lateral surface marked by a weak ridge connecting the eye-spot to a distinct muscle swelling, a sharp ventral spine above the compressed posterior, and three longitudinal ribs. A raised rim extends from the eye-spot back to the middle of the dorsal margin. Below the posterior end of this rim a centrodorsal ridge rises above the margin and turns sharply down at the posterocardinal angle. A thick median ridge is separated from an elongate muscle swelling by a gap. A ventral ridge begins at the anterior rim and at a point below the median gap turns posteroventrally beneath the sharp spine. Viewed dorsally or ventrally the carapace has compressed ends and the outline of the lateral surface is ovate with constricted middle. Behind the constriction each valve possesses an acicular spine. The anterior and posterior rims are continuous
with a low ventral rim.

Marginal area narrow and lacking a vestibule. Radial pore canals straight, sparse and evenly spaced. Muscle scars consist of a vertical row of four elongate scars on the posterior side of the muscle pit and a V-shaped scar in the center of the pit. Hinge hol-amphidont with stepped anterior tooth in the right valve and crenulate median element.

Remarks.—This species differs from Cythereis bicornis Israelsky in being smaller, more acuminate posteriorly, having broader longitudinal ridges, and a ventral ridge which turns down beneath a sharp spine at its posterior end. In some specimens the longitudinal ridges are bordered by reticulations.

Dimensions.—Length 0.55 mm., height 0.30 mm. Holotype no. 6018, right valve from sample 53.

CYTHEREIS ? N. SP. 4
Plate V, Fig. 1

Diagnosis.—A extremely compressed species of Cythereis ? characterized by a reticulate surface and low dorsal and ventral ribs which terminate in reticulate tubercles.

Description.—Carapace oblong subtriangular and laterally compressed; anterior obliquely rounded, rimmed and having reticulations between the rim and a frill along the margin. Posterior compressed, faintly rimmed, and acutely angulate below the middle. Highest anteriorly with valves being of equal size. Lateral surface has reticulations which become smaller toward a low muscle spot, no median rib, and low dorsal and ventral ribs. Anterior rim continuous with
low dorsal and ventral rims which end posteriorly in reticulate tubercles. No visible eye-spot. In dorsal and ventral views the carapace has nearly parallel sides, is barely arrowhead-shaped, and has reticulations on both surfaces.

Marginal area regular and lacking a vestibule. Radial pore canals obscured by the thick marginal rim and muscle scars obscured by surface reticulations. Hinge holamphidont.

Remarks.—This species is questionably placed in Cythereis because it lacks the median rib and eye-spot. Platocythereis lacks the median rib but this species lacks the crest above the muscle swelling and the eye-spot which are characteristics of that genus. This species differs from C. hannai Israelsky in being larger, more compressed, and lacking prominent muscle swelling and eye-spot. It differs from C. carpentereae in being reticulate rather than pitted and lacking the prominent eye tubercle.

Dimensions.—Length 0.63 mm., height 0.33 mm. Holotype no. 6019, right valve; paratype no. 6020, left valve; both from sample 76.

CYTHEREIS N. SP. 5
Plate V; Fig. 14

Diagnosis.—A species of Cythereis characterized by a high frill-like anterior rim which is continuous with dorsal and ventral ridges, a sharp vertical ridge at the muscle spot, and branching cross-ribs.

Description.—Carapace subquadrate; anterior obliquely rounded with denticulate margin and high frill-like rim. Posterior com-
pressed with rounded rim and slightly angulate above the middle. 
Above the angulation the margin is concave and below it is convex 
and bears spines. Highest at a round glassy eye-spot. Lateral sur-
face marked by three sharp longitudinal ridges, a sharp transverse 
rib above the muscle spot, in front of which there are reticulations, 
and branching cross-ribs between the longitudinal ridges. The an-
terior rim is continuous with frill-like dorsal and ventral ridges. 
The dorsal ridge projects above the margin and turns sharply down 
above the compressed posterior end where the ventral ridge is trun-
cate. A blade-like median ridge is separated from a sharp vertical 
ridge above the muscle spot by a gap. Viewed dorsally or ventrally 
the carapace is subovate with compressed ends and the centrally 
constricted lateral surface is visible below. The dorsal surface 
is slightly arrowhead-shaped and faintly reticulate while the ven-
tral surface is strongly arrowhead-shaped and reticulate.

Marginal area regular and lacking a vestibule. Radial pore 
canals straight and evenly spaced. Muscle scars consist of a ver-
tical row of four elongate scars in front of which there is a V-
shaped scar. Hinge holamphidont.

Remarks.—This species differs from C. hazardi in being 
larger, having frill-like ridges, and a transverse rather than 
longitudinal rib above the muscle spot, in front of which there 
are reticulations instead of cross-ribs.

Dimensions.—Length 0.77 mm., height 0.38 mm. Holotype no. 
6021, right valve from sample 86.
Cythere semiplicata ALEXANDER, 1929, p. 80, pl. 6, figs. 9, 15.

**Diagnosis.**—Carapace subrectangular; anterior broadly rounded, rimmed, and denticulate; posterior compressed, rimmed, angulate at the middle and denticulate below. Left valve overlaps right in front of the eye-spot and at the posterior end of the hinge line. Ventral margin inturned in front of the middle. Sexually dimorphic with the males being more elongate. Surface marked by an irregular dorsal ridge and straight ventral ridge which turn sharply toward a median ridge above the compressed posterior. The median ridge is separated from a prominent elongate muscle swelling by a gap. Viewed dorsally or ventrally the carapace is subovate with a constricted middle and compressed ends. The ventral surface is triangular and a ventral rim is continuous with anterior and posterior rims in the left valve. In the right valve, the ventral rim is continuous with the posterior rim but separated from the anterior by a gap and connected to the posterior end of the ventral ridge by a cross-rib.

Marginal area broad and lacking a vestibule. Radial and pseudoradial pore canals straight and numerous. Muscle scars consist of a vertical row of four in front of which is a U-shaped scar. Hinge holamphidont.

**Remarks.**—This species differs from *C. semiplicata* (Reuss) in having more distinct ridges which turn sharply toward the median ridge at their posterior end.
Dimensions.—Female: length 0.62 mm., height 0.38 mm. male: length 0.72 mm., height 0.38 mm. Holotype no. 6022, female left valve; paratype no. 6023, male right valve; both from sample 76.

Genus VEENIA Butler and Jones, 1957

VEENIA GAPENSIS (Alexander)

Cythere gapensis ALEXANDER, 1929, p. 84, pl. 6, figs. 16, 17.
Cythere gapensis HOWE & LAURENCICH, 1958, p. 158.

Diagnosis.—A species of Veenia characterized by strong cross-ribs between longitudinal ridges and rims.

Dimensions.—Female left valve: length 0.52 mm., height 0.30 mm.; female right valve: length 0.52 mm., height 0.27 mm.; male left valve: length 0.60 mm., height 0.32 mm.; male right valve: length 0.60 mm., height 0.28 mm. Plesiotype no. 6024, male right valve; plesiotype no. 6025, female left valve; both from sample 51.

VEENIA OZANANA (Israelsky)

Plate II, Fig. 12

Cythereis ozanana ISRAELSKY, 1929, p. 13, pl. 3A, figs. 1-3.
Cythereis ponderosana ISRAELSKY, 1929, p. 13, pl. 3A, figs. 5-8.
Cythere ponderosana ALEXANDER, 1929, p. 83, pl. 6, fig. 3.
Cythereis ozanana ALEXANDER, 1933, p. 212. LOETTERLE, 1938, p. 64, pl. 11, fig. 6, ALEXANDER, 1939, p. 66. BOLD, 1946, p. 98, pl. 6, figs. 12a-c. BOLD, 1950, p. 108.
Veenia ozanana BUTLER & JONES, 1957, p. 44, pl. 3, figs. 4a-e.

HOWE & LAURENCICH, 1958, p. 512.
**Diagnosis.**—A species of Veenia characterized by three broad ridges with large pits below the dorsal and median and above the ventral ridge.

**Dimensions.**—Female left valve: length 0.63 mm., height 0.38 mm.; female right valve: length 0.63 mm., height 0.35 mm.; male left valve: length 0.75 mm., height 0.42 mm.; male right valve: length 0.75 mm., height 0.37 mm. Plesiotype no. 6026, female left valve from sample 86.

VEENIA N. SP. 1

Plate III, Fig. 7

**Diagnosis.**—A species of Veenia characterized by deep pits bordering the narrow longitudinal ribs.

**Description.**—Carapace elongate subtriangular; anterior rounded, denticulate, and having a rim which is separated from the margin, above the middle, by reticulations. Posterior angulate at the middle and denticulate below. Highest at the hinge ear which, in the left valve, overlaps the right and below which there is a glassy eye-spot. Surface marked by three longitudinal ridges which are bordered by deep pits. In ventral and dorsal views, the carapace is arrowhead-shaped. Dorsal ridge arched, sinuous above, and protrudes above the dorsal margin. Median ridge arched and having a slight muscle swelling near the anterior end. Ventral ridge is straight and connected to the anterior rim. In dorsal and ventral views, the carapace is arrowhead-shaped. A ventral rim joins the dorsal ridge at its junction with the anterior rim in the left valve and behind this junction in the right.
Marginal area regular and lacking a vestibule. Radial pore canals straight and numerous. Muscle scars consist of a vertical row of four in front of which is a U-shaped upper and round lower scar. Hinge holamphidont.

Remarks.—This species differs from V. ozanana in being smaller, having sharper longitudinal ridges and more pronounced pits, and having a ventral rim.

Dimensions.—Female left valve: length 0.50 mm., height 0.32 mm.; female right valve: length 0.50 mm., height 0.28 mm.; male left valve: length 0.62 mm., height 0.33 mm.; male right valve: length 0.62 mm., height 0.28 mm. Holotype no. 6027, female left valve; paratype no. 6028, male right valve; both from sample 8.

VEENIA N. SP. 2

Plate V, Fig. 8

Diagnosis.—A species of Veenia characterized by a deeply punctate surface with pits aligned longitudinally and by a furrow extending from behind the eye-spot to the ventral margin.

Description.—Carapace subtriangular; anterior compressed, obliquely rounded, and denticulate; posterior angulate at the middle and denticulate below. Highest at the hinge ear which, in the left valve, overlaps the right. A furrow, paralleling the anterior margin, extends from behind the eye-spot to the ventral margin, separating the compressed anterior from the swollen central area. Above the middle and just behind the furrow is a deep depression with the remainder of the surface having deep, longitudinally aligned pits.

Marginal area regular and lacking a vestibule. Radial and
pseudoradial pore canals few and dorsally directed above the middle; more numerous and straight below. Hinge holamphidont.

Remarks.—This species differs from V. arachoides in lacking the median ridge.

Dimensions.—Left valve: length 0.67 mm., height 0.38 mm.; right valve: length 0.67 mm., height 0.35 mm. Holotype no. 6029, right valve; paratype no. 6030, left valve; both from sample 51.

VEENIA N. SP. 3
Plate V, Fig. 6

Diagnosis.—A species of Veenia characterized by having a completely reticulate carapace.

Description.—Carapace subtriangular; anterior obliquely rounded, denticulate, and having a rim which is separated from the margin, above the middle, by reticulations. Posterior rimmed, angular at the middle, and denticulate below. Left valve slightly overlaps the right at the hinge ear and the posterior end of the hinge line. Sexually dimorphous with the males being more elongate. Surface marked by three longitudinal ribs which are separated by reticulations and by a small, glassy eye-spot which is masked by the anterior rim. The dorsal rib is sinuous above and the median rib is interrupted by a low muscle swelling. Viewed dorsally or ventrally the carapace is subtriangular with compressed ends and reticulate surfaces. The dorsal rib and a ventral rim are continuous with anterior and posterior rims.

Marginal area regular and lacking a vestibule. Radial pore canals arranged in groups of two or three. Hinge hemiamphidont.
Remarks.—This species is similar to *V. gapensis* (Alexander) and *V. n. sp. 1* in size and shape but the reticulate surface distinguishes it from the other two.

Dimensions.—Female: length 0.50 mm., height 0.28 mm.; male: length 0.60 mm., height 0.30 mm. Holotype no. 6031, female left valve from sample 9.

Genus **Phacorhabdotus** Howe and Laurencich, 1958

**Phacorhabdotus texanus** Howe and Laurencich

Plate III, Fig. 9

*Phacorhabdotus texanus* HOWE & LAURENCICH, 1958, p. 457.

Diagnosis.—A species of *Phacorhabdotus* characterized by three short longitudinal ridges near the posterior end and a flaring anterior.

Dimensions.—Female: length 0.57 mm., height 0.33 mm.; male: length 0.63 mm., height 0.33 mm. Plesiotype no. 6032, male right valve from sample 1.

**Phacorhabdotus n. sp. 1**

Plate III, Fig. 8

Diagnosis.—A species of *Phacorhabdotus* characterized by faint dorsal and ventral ridges and a median longitudinal welt near the posterior end.

Description.—Carapace having a broadly rounded anterior and tapering toward the posterior which is subangulate at the middle in the right valve and bluntly rounded in the left. Highest at the anterior end of the hinge line in the left valve and slightly behind it in the right. Left valve overlaps right at the highest point on
the dorsal margin, an opposite point on the ventral margin, and at
the posterior end of the hinge line. Sexually dimorphous with the
males being more elongate. Surface marked by faint dorsal and ven-
tral ribs which become more distinct posteriorly and a short longi-
tudinal median welt near the posterior end. Viewed dorsally or
ventrally the carapace is broader posteriorly and tapers adanterior.

Marginal area broad and lacking a vestibule. Radial pore
canals generally paired and pseudoradial canals few. Muscle scars
consist of a vertical row in which there is a lower round scar, a
middle elongate scar, and two adjacent upper scars in front of which
there is an obliquely aligned S-shaped scar. Hinge holamphidont
with the anterior part of the hingement set obliquely to the other
portion.

Remarks.—This species differs from *P. texanus* in having less
sharply defined ridges, a continuous dorsal ridge, and a longer
ventral ridge.

Dimensions.—Female: length 0.48 mm., height 0.28 mm.; male:
length 0.52 mm., height 0.25 mm. Holotype no. 6033, male right
valve; paratype no. 6034, male left valve; paratype no. 6035, female
right valve; paratype no. 6036, female left valve; all from sample
81.

Subfamily XESTOLEBERINAe Sars, 1928

Genus XESTOLEBERIS Sars, 1866

XESTOLEBERIS SP.

Plate II, Fig. 6

Diagnosis.—A species of *Xestoleberis* characterized by an ex-
tremely tumid posterior.

Description.—Carapace pyriform; anterior and posterior evenly rounded but broader posteriorly. Sexually dimorphous with the males being more elongate. Dorsal margin arched and carapace highest at the middle. Left valve slightly overlaps right.

Marginal area has a well-developed vestibule. Radial pore canals short and widely spaced; normal pore canals distinct. Hinge of right valve has elongate, crenulate terminal teeth and intervening crenulate groove.

Dimensions.—Female: length 0.38 mm., height 0.27 mm.; male: length 0.38 mm., height 0.22 mm. Figured specimen no. 6037, female left valve from sample 73.

INCERTAE SEDIS

Genus AMPHICYTHERURA Butler and Jones, 1957

AMPHICYTHERURA DUBIA (Israelsky)

Plate III, Fig. 4

Cytherura ? dubia ISRAELSKY, 1929, p. 6, pl. 4A, fig. 6.

Eucytherura chelodon ALEXANDER, 1936, p. 692, pl. 93, figs. 6, 12.

ALEXANDER, 1939, p. 66.

Amphicytherura dubia BUTLER & JONES, 1957, p. 42, pl. 5, figs. la-d.

HOWE & LAURENCICH, 1958, p. 47.

Diagnosis.—A species of Amphicytherura characterized by a median ridge which turns up to join the eye-spot, has short branches on either side, and bifurcates posteriorly to join a posterior ridge and a dorsal ridge.

Remarks.—This genus is removed from Trachyleberinae due to the
fact that the dentition is schizodont and it has a slight caudal process.

**Dimensions.**—Length 0.37 mm., height 0.22 mm. Plesiotype no. 6038, right valve from sample 18.
EXPLANATION OF PLATE 1

Fig. 1—Morrowina sp. X 75.
Fig. 2—Argilloecia sp. X 60.
Fig. 3—Krithe cushioni Alexander. Male, X 75.
Fig. 4, 6—Asciocythere n. sp. 1. Fig. 4, holotype; both are females, X 75.
Fig. 5—Haplocytheridea ? plummeri (Alexander). Male, X 75.
Fig. 7—Cytherella sp. Female, X 60.
Fig. 8—Cytherella tuberculifera Alexander. X 60.
Fig. 9—Bairdoppilata pondera Jennings. X 45.
Fig. 10, 12—Haplocytheridea ? insolita Alexander and Alexander. X 75.
Fig. 11—Haplocytheridea ? grangerensis Howe and Laurencich. X 75.
Fig. 13, 14—Haplocytheridea ? everetti (Berry). X 75.
EXPLANATION OF PLATE II

Fig. 1—Alatocythere tokiana (Israelsky). X 75.

Fig. 2—Alatocythere ponderosa (Israelsky). X 75.

Fig. 3, 5—Cytherelloidea austiniensis Sexton. Fig. 3, female; Fig. 5, male; both X 75.

Fig. 4—Cytherelloidea crafti Sexton. Female, X 75.

Fig. 6—Kestoleberis sp. Female, X 75.

Fig. 7—Cythereis communis Israelsky. X 75.

Fig. 8, 11—Cytherelloidea ozanana Sexton. Fig. 8, male; Fig. 11, female; both X 75.

Fig. 9, 10, 15—Genotype of new genus. Fig. 9, female; Fig. 10, male; Fig. 15, dorsal view of male; all X 90.

Fig. 12—Veenia ozanana (Israelsky). Female, X 75.

Fig. 13—Cytherelloidea spiralia Jennings. X 75.

Fig. 14, 16—Alatocythere n. sp. 2. Fig. 16, holotype; both X 75.
EXPLANATION OF PLATE III

Fig. 1--Orthonotacythere scrobiculata Alexander. X 75.
Fig. 2--Eucytherura quadrituberculata Skinner. X 105.
Fig. 3--Loxoconcha brownstownensis Alexander. X 90.
Fig. 4--Amphicytherura dubia (Israelsky). X 90.
Fig. 5--Loxoconcha cretacea Alexander. X 90.
Fig. 6--Veenia gapensis (Alexander). Male, X 75.
Fig. 7--Veenia n. sp. 1. Holotype, female, X 75.
Fig. 8--Phacorhabdotus n. sp. 1. Holotype, male, X 75.
Fig. 9--Phacorhabdotus texanus Howe and Laurencich. Male, X 75.
Fig. 10--Monoceratina sp. X 75.
Fig. 11--Monoceratina prothreoensis Butler and Jones. X 75.
Fig. 12--Cytheropteron furcalatum Alexander. X 75.
Fig. 13--Alatacythere n. sp. 1. Holotype, X 75.
Fig. 14--Orthonotacythere hannai (Israelsky). X 75.
Fig. 15--"Cythere" n. sp. 1. Holotype, X 75.
Fig. 16--Monoceratina pedata (Marsson). X 75.
Plate III
EXPLANATION OF PLATE IV

Fig. 1--Brachycythere n. sp. 6. Holotype, X 75.
Fig. 2--Cytheropteron n. sp. 1. Holotype, X 90.
Fig. 3--Brachycythere n. sp. 4. Holotype, X 75.
Fig. 4, 6--Brachycythere n. sp. 5. Fig. 4, holotype; both X 75.
Fig. 5--Euoytherura n. sp. 1. Holotype, X 90.
Fig. 7--Brachycythere sphenoides (Reuss). X 75.
Fig. 8--Euoytherura n. sp. 2. Holotype, X 90.
Fig. 9--Brachycythere n. sp. 7. Holotype, X 75.
Fig. 10--Brachycythere n. sp. 1. Holotype, male, X 75.
Fig. 11--Cytheropteron n. sp. 2. Holotype, X 90.
Fig. 12--Brachycythere ? n. sp. 3. Holotype, X 75.
Fig. 13--Brachycythere n. sp. 2. Holotype, X 60.
Fig. 14--Brachycythere taylorensis (Alexander). X 75.
EXPLANATION OF PLATE V

Fig. 1—Cythereis n. sp. 4. Holotype, X 75.

Fig. 2—Cythereis faujasi Veen. X 75.

Fig. 3—Cythereis pidgeoni (Berry). X 75.

Fig. 4—Cythereis n. sp. 3. Holotype, X 75.

Fig. 5—Cythereis n. sp. 6. Holotype, X 75.

Fig. 6—Veenia n. sp. 3. Holotype, female, X 75.

Fig. 7—Cythereis bicornis Israelsky. X 75.

Fig. 8—Veenia n. sp. 2. Holotype, X 75.

Fig. 9—Cythereis austinemensis Alexander. X 75.

Fig. 10—Cythereis n. sp. 2. Holotype, male, X 75.

Fig. 11—Cythereis spoori Israelsky. X 75.

Fig. 12—Cythereis n. sp. 1. Holotype, X 75.

Fig. 13—Cythereis hannai Israelsky. X 75.

Fig. 14—Cythereis n. sp. 5. Holotype, X 75.

Fig. 15—Cythereis plummeri Israelsky. X 75.

Fig. 16—Cythereis dallasensis Alexander. X 75.
SELECTED BIBLIOGRAPHY


__________, 1934, Ostracoda of the genera Monoceratina and Orthonotacythere from the Cretaceous of Texas: Jour. Paleontology, v. 8, p. 57-67, pl. 8.


DALLAS GEOLOGICAL AND GEOPHYSICAL SOCIETIES, 1957, The geology and geophysics of Cooke and Grayson counties, Texas, 211 p.

DALLAS PETROLEUM GEOLOGISTS, 1941, Geology of Dallas County, Texas: Field and Laboratory, v. 10, no. 1, 181 p.


JONES, T. R., and HINDE, G. J., 1890, A supplementary monograph of the Cretaceous Entomostraca of England and Ireland: Palaeon-


STEPHENVSON, L. W., 1918, A contribution to the geology of northeastern Texas and southern Oklahoma: U. S. Geol. Survey Prof. Paper 120, p. 129-163.


TRIEBEL, ERICH, 1941, Zur morphologie und ökologie der fossilen ostracoden, mit beschreibung einiger neuer gattungen und arten: Senckenbergiana, Bd. 23, p. 294-400, 15 pls.

_____________, and KLINER, WOLFGANG, 1959, Neue ostracoden-gattungen aus dem deutschen Lias: Geol. Jb., Bd. 76.


APPENDIX I
Sample Localities

1. Annona chalk: 12 feet above the phosphate zone at the base of the chalk. Go 0.9 mi. east of the square at Clarksville, Red River County on U. S. Hwy. 82; turn north on Farm Road 1159 for 2.4 mi.; turn east on Farm Road 1700 for 2.9 mi. then north on dirt road for 0.3 mi.

2. __________: 15 feet above the phosphate zone at the base of the chalk. Same location as the above.

3. __________: 45 feet above the phosphate zone at the base of the chalk. Same location as the above.

4. __________: Road cut 0.35 mi. north of White Rock cemetery, Red River County.

5. __________: 30 feet below top of hill at Hopson cemetery. Go 5.5 mi. west of Foreman, Little River County on State Hwy. 32; turn south 1.5 mi., east 1.0 mi., south 0.5 mi. and east 0.7 mi.

6. Blossom sand: 1 foot below the top of the Blossom in creek 500 yds. north of road to Pleasant Valley Ranch. Go 3.3 mi. north of the square in Honey Grove, Fannin County on Farm Road 100; turn west 0.4 mi. and walk 500 yds north to the creek.

7. __________: 5 feet below the top of the Blossom in creek 500 yds. north of road to Pleasant Valley Ranch. Same location as the above.

8. Bonham clay: In gully at bridge 0.8 mi. west of Sumner and 1.4
mi. east of Globe, Lamar County.

9. ___________: In ditch below culvert. Go 1.7 mi. west of the square in Bonham, Fannin County, on U. S. Hwy. 82; turn south 0.4 mi. on State Hwy. 121.

10. ___________: At 725 feet in Krasner et al., Norwood No. 1, John Yeary Survey, Fannin County.

11. Brownstown marl: 6 feet below the Janis member 1.1 mi. west of the Okla.-Ark. state line on State Hwy. 21, McCurtain County.

12. ___________: In gully west of Farm Road 100, 3.7 mi. north of the square in Honey Grove, Fannin County.

13. ___________: Just below the Gober-in-gully at bridge. Go 1.9 mi. east of the square at Honey Grove, Fannin County on U. S. Hwy. 82; turn north 1.4 mi. on Farm Road 1396; turn east 0.6 mi. on dirt road then north 1.0 mi. to bridge.

14. ___________: In gully east of road. Go 0.7 mi. east of Dodd City, Fannin County on U. S. Hwy. 82; turn north 1.1 mi. on Farm Road 897.

15. ___________: In creek west of road. Go east 0.3 mi. from Petty, Lamar County, R.R. station on Farm Road 1509, then turn south 0.2 mi. to bridge.

16. ___________: Just below the base of the Gober. Go 2.0 mi. north of Roxton, Lamar County, R.R. station on Farm Road 38; turn west 0.2 mi. to Cane Creek; walk 300 yds. north to the calcarenite at the base of the Gober.
17. In creek east of road. Go south from Blossom, Lamar County 0.3 mi. on Farm Road 194; turn east 0.6 mi. on Farm Road 194 then south 2.4 mi. on second class road.

18. 1 foot below the Annona chalk 300 yds. north of Freehope Church. From the square in Clarksville, Red River County, go east 0.9 mi. on U. S. Hwy. 82; turn north 3.4 mi. on Farm Road 1159; turn east 0.2 mi. on dirt road to Freehope Church.

19. 17 feet below phosphate zone at the base of the Annona. Go 0.9 mi. east of the square at Clarksville, Red River County on U. S. Hwy. 82; turn north on Farm Road 1700 for 2.9 mi. then north on dirt road for 0.3 mi.

20. 20 feet below phosphate zone at the base of the Annona. Same location as the above.

21. 1 foot above the top of the Blossom in creek 500 yds. north of road to Pleasant Valley Ranch. Go 3.3 mi. north of the square in Honey Grove, Fannin County on Farm Road 100; turn west 0.4 mi. and walk 500 yds. north to creek.

22. At 280 feet in Krasner et al., Norwood No. 1, John Yeary Survey, Fannin County.

23. At 350 feet at same location as the above.


25. Just below top of chalk. Same as above location.
26. _______: Marl just below second chalk bed or 6.5 feet from top of the Burditt. Same as the above location.

27. _______: Marl just below third chalk bed or 10.5 feet from top of the Burditt. Same as the above location.

28. Dessau chalk: Gully on west side of road, 150 yds. north of tributary of Big Walnut Creek, 3.5 mi. south of Dessau, Travis County.

29. _______: Just below abundant *Gryphaea aucella* in ditch on west side of road, at same location as the above.

30. _______: Just above abundant *Gryphaea aucella* in ditch on east side of road, at same location as the above.

31. _______: *Terebratulina* bed in ditch on east side of road, at same location as the above.

32. _______: Upper *Exogyra ponderosa* bed in shallow ditch on east side of road, at same location as the above.

33. _______: Marl break just below *Exogyra laeviuscula* in shallow ditch on east side of road, at same location as the above.

34. _______: *Exogyra laeviuscula* bed in shallow ditch on east side of road, at same location as the above.

35. Gober chalk: 10 feet below top of Gober in quarry west of road. Go south from the square at Paris, Lamar County 1.7 mi. on State Hwy. 24; turn south on Farm Road 1497 for 8.2 mi.

36. _______: 1 foot above creek bed on State Hwy. 78, 0.5 mi. northeast of Jct. U. S. Hwy. 69 and State Hwy. 78 at Leonard, Fannin County.

37. _______: 1 foot below the top of quarry north of road. Go
4.0 mi. south from the Jct. of Farm Road 905 and U. S. Hwy. 271, on U. S. Hwy. 271, at Paris, Lamar County; turn east 1.5 mi. on dirt road to quarry.

38. Lower Austin: Four samples from prominent marl breaks in west end of bluff upstream from fault on Vinson Creek on west side of road. Go south 5.3 mi. on U. S. Hwy. 81 from its Jct. with U. S. Hwy. 183 in Austin; turn southeast 2.1 mi. to Vinson Creek.

39. __________: Marl just below hard chalk at water level, 200 yds. upstream on Williamson Creek, 4.2 mi. south of Jct. of U. S. Hwy. 81 and 183 in Austin, Travis County on U. S. Hwy. 81.

40. __________: Chalky marl just below prominent chalk bed 200 yds. upstream on Williamson Creek, at same location as the above.

41. __________: Marly chalk just below prominent chalk ledge containing numerous *Gryphaea*, 100 yds. downstream on Williamson Creek, at same location as the above.

42. __________: Marl between two *Exogyra laeviuscula* beds behind cow barns 0.5 mi. upstream on Williamson Creek, at same location as the above.

43. __________: Prominent marl break below lower massive chalk just upstream from Hwy. 81 crossing on Williamson Creek, at same location as the above.

44. __________: Glauconitic bed between two bored zones in shallow ditch on east side of road, 3.5 mi. south of Dessau, Travis
45. ___________: Marl break in gully leading to creek, at same location as the above.

46. ___________: Lower marl on slope to Big Walnut Creek, at same location as the above.

47. ___________: Marl above knobby chalk which forms bed of creek 50 yds. downstream from Dessau Road crossing, at same location as the above.

48. Lower Taylor clay: 5 feet above top of Gober in quarry west of road. Go south from square at Paris, Lamar County, 1.7 mi. on State Hwy. 24; turn south on Farm Road 1497 for 8.2 mi.

49. ___________: 1 foot above top of Gober in quarry. Go 1.3 mi. north of Roxton, Lamar County, R.R. station; turn east 0.4 mi. on dirt road to Mr. Maness' quarry.

50. ___________: Road cut on west side of road just south of bridge. From Jennings, Lamar County, go west 0.5 mi., south 1.4 mi., west 0.5 mi., and south 0.2 mi.

51. ___________: 1 foot below Exogyra ponderosa ledge at No. Sulphur River bridge on State Hwy. 24, 13.8 mi. south of the square in Paris, Lamar County.

52. ___________: 1 foot above oxidized phosphate zone at the junction of Davis Creek and No. Sulphur River. Go 0.5 mi. west of square at Ladonia, Fannin County; turn north 2.0 mi. to North Sulphur River; walk 1.2 mi. west to Jct. with Davis Creek.

53. ___________: 1 foot below oxidized phosphate zone at the Jct. of Davis Creek and No. Sulphur River. Same location
as the above.

54. ______________: 3 feet below oxidized phosphate zone at the Jct. of Davis Creek and No. Sulphur River. Same location as the above.

55. ______________: From creek bed at Davis Creek bridge, 1.8 mi. south of Silver City, Fannin County.

56. ______________: Road cut north of road. Go 3.0 mi. south from the Jct. Farm Road 272 and U. S. Hwy. 69 at Leonard, Fannin County, on the latter Hwy. and turn west 2.1 mi. on dirt road.

57. ______________: 1 foot above the chalk in Ticky Creek at bridge. Go 4.0 mi. east from the Jct. of U. S. Hwy. 75 and State Hwy. 24 at McKinney, Collin County, on the latter Hwy.; turn north 0.1 mi.; turn east 1.4 mi. to Ticky Creek bridge.

58. ______________: In gully west of road. Go south of Blossom, Lamar County, 0.3 mi. on Farm Road 194; turn east 3.0 mi. on Farm Road 194; turn south 1.3 mi. on second class road.


60. ______________: Just west of roadside park on U. S. Hwy. 290, 1.8 mi. east of Little Walnut Creek and 0.2 mi. west of Tex. Bur. Econ. Geol. loc. 226-T-50, Shreveport Geol. Soc., 1949, Travis County.

61. ______________: Upper beds at east end of road cut 0.1 mi. east of Walnut Creek and just west of R.R. overpass on Hwy.


63. ______________: 2 feet above creek bed at Davis Creek bridge, 1.8 mi. south of Silver City, Fannin County.

64. ______________: 4 feet above the Burditt at Tex. Bur. Econ. Geol. loc. 226-T-4, Shreveport Geol. Soc., 1949, Travis County.

65. ______________: Just above the Burditt at same location as the above.

66. Middle marl member: Below lowest Inoceramus undulatoplicatus ledge or 26 feet from top of the section. Go 1.0 mi. west of Jct. of State Hwy. 121 and Farm Road 720 south of McKinney, Collin County; turn north 1.3 mi.; turn west 0.8 mi. to creek at road Jct.

67. ______________: 20 feet below top of the section, just below 0.9 foot ledge containing Inoceramus undulatoplicatus. At same location as the above.

68. ______________: Just below channeled chalk bed which is just above the base of the upper chalk member near the Jct. of two creeks. Go east 0.5 mi. from the Jct. U. S. Hwy. 75 and State Hwy. 24 in McKinney, Collin County; turn north 3.5 mi. to bridge; walk west 0.3 mi. along creek.

69. ______________: 15 feet above the Inoceramus undulatoplicatus bed on east side of U. S. Hwy. 77, 0.5 mi. south of its Jct.
with Loop 12 in Dallas.

70. _______________: Just above upper massive chalk bed on east side of U. S. Hwy 77 at same location as the above.

71. _______________: Just below fragmental *Inoceramus* bed about midway up bluff on west side of U. S. Hwy. 75, 2.8 mi. south of its Jct. with Loop 12 in Dallas.

72. Ozan formation: 35 feet below chalk ledge on north side of road. Go 1.4 mi. west of Foreman, Little River County on State Hwy. 32; turn south 0.3 mi. then west 0.3 mi.

73. _______________: 2 feet below chalk ledge on west side of road. Go west 5.5 mi. from Foreman, Little River County on State Hwy. 32; turn south 1.3 mi.

74. _______________: 2 feet above the Janis member, 1.1 mi. west of the Okla.-Ark. state line on State Hwy. 21.


76. Upper chalk member: Below the upper chalk ledge at the Jct. of Prairie Creek and a tributary. Go east 1.0 mi. from Loop 12, on Lake June Road at Pleasant Grove, in southwestern Dallas; turn north 0.3 mi. then east 0.1 mi.; walk east to creek Jct.

77. _______________: Below third shell fragment bed from the top of exposures in gullies south of Farm Road 7, 0.8 mi. east of its Jct. with State Hwy. 78 in Garland, Dallas County.

78. _______________: Just above lower chalk bed which contains *Exogyra aff. E. ponderosa* (Smith, 1955). Go 2.3 mi.
southwest of Sachse, Dallas County, on State Hwy. 78; turn northwest 2.2 mi. then 0.6 mi. to bridge.

79. ______________: Marl break below upper chalk on southeast side of road at Rowlett Creek bridge. Go 2.3 mi. southwest of Sachse, Dallas County, on State Hwy. 78; turn northwest 0.9 mi. then northeast 0.9 mi. to bridge.

80. ______________: Just above *Gryphaea* bed south of bridge.
Go 2.3 mi. southwest of Sachse, Dallas County on State Hwy. 78; turn north 0.7 mi.

81. ______________: Marl 1 foot below top of quarry. Go 2.1 mi. west on Farm Road 545, from the Jct. of State Hwy. 78 and Farm Road 545 in Blue Ridge, Collin County; turn north 0.6 mi., east 0.3 mi., then north 0.5 mi. to quarry west of road.

82. ______________: Top of the chalk in Ticky Creek at bridge.
Go 4.0 mi. east on State Hwy. 24, from its Jct. with U. S. Hwy. 75 in McKinney, Collin County; turn north 0.1 mi., then east 1.4 mi. to Ticky Creek bridge.

83. ______________: Marl just below the upper chalk bed in road cut on south side of Farm Road 545, 1.6 mi. west of Valdasta, Collin County.

84. ______________: Marl just below 1.4 foot chalk bed in quarry.
Go 4.0 mi. east on State Hwy. 24, from its Jct. with U. S. Hwy. 75 in McKinney, Collin County; turn south 0.4 mi., then west 0.1 mi. to quarry.
APPENDIX II

Localities on Index Map

1. Type locality of the Janis member. 1.1 mi. west of the Okla.-Ark. state line on State Hwy. 21 in McCurtain County.

2. Stephenson's phosphate zone at base of Annona in road cut. Go 1.5 mi. east of square at Clarksville, Red River County, on U. S. Hwy. 82; turn northeast on Farm Road 114 for 5.2 mi.; turn north on Farm Road 1158 for 3.7 mi. to road cut just south of Pecan Bayou bridge.

3. Annona chalk-Brownstown marl contact. Annona exposed along road and Brownstown in gullies west of road. Go 0.9 mi. east of the square at Clarksville, Red River County on U. S. Hwy. 82; turn north on Farm Road 1159 for 2.4 mi.; turn east on Farm Road 1700 for 2.9 mi., and north 0.3 mi. on dirt road.

4. Blossom sand with large concretions. Go 0.9 mi. east of the square at Clarksville, Red River County, on U. S. Hwy. 82; turn north 2.4 mi. on Farm Road 1159; turn east 2.9 mi. on Farm Road 1700; turn north 1.8 mi. to road cut with Blossom exposed.

5. Stephenson's Blossom sand in creek east of Farm Road 1159. Go 0.9 mi. east of the square at Clarksville, Red River County, on U. S. Hwy. 82; turn north 3.2 mi. on Farm Road 1159.

6. Stephenson's Lower Taylor-Brownstown contact at phosphate zone in road cut just east of bridge 1.6 mi. southeast of Bagwell, Red River County, on old U. S. Hwy. 82.
7. Stephenson's Blossom sand, with numerous *Exogyra ponderosa*, in shallow ditch south of U. S. Hwy. 82, 2.6 mi. south of its Jct. with Farm Road 410 in Detroit, Red River County.

8. Gober pinch-out in gully 0.3 mi. southwest of house. Go south 0.3 mi. on Farm Road 194, from Blossom, Lamar County; turn east 0.6 mi. on Farm Road 194; turn south 2.7 mi. to house west of road.

9. Gober-Lower Taylor contact in branch of Big Sandy Creek, 500 yds west of house. Go west of Jennings, Lamar County for 0.9 mi., north 0.4 mi., and west 0.6 mi. to house south of road.

10. Gober chalk in quarry west of road. Go south 1.7 mi. from the square at Paris, Lamar County, on State Hwy. 24; turn southeast on Farm Road 1497 for 8.2 mi.

11. Blossom sand. Go south 1.1 mi. from the square at Paris, Lamar County, on State Hwy. 24 or to the first street south of the Colorado and Santa Fe R.R.; turn west 0.4 mi., south 0.3 mi., west 0.2 mi., and walk toward R.R. to drainage ditch.

12. Type Lake Crockett member below Lake Crockett dam. Go 11.2 mi. north of square at Honey Grove, Fannin County, on Farm Road 100 and turn west to Lake Crockett dam.

13. Blossom sand at road Jct. Go 4.4 mi. north of square at Honey Grove, Fannin County, on Farm Road 100; turn west at Allens Point School for 0.9 mi., south 0.2 mi., and west 1.1 mi. to road junction.
14. Blossom-Brownstown contact in creek 500 yds. north of road to Pleasant Valley Ranch. Go 3.3 mi. north of the square at Honey Grove, Fannin County, on Farm Road 100; turn west 0.4 mi. and walk 500 yds. north to creek.

15. Oxidized phosphate zone in the Lower Taylor clay, at the Jet. of Davis Creek and North Sulphur River. Go 0.5 mi. west of square at Ladonia, Fannin County; turn north 2.0 mi. to North Sulphur River bridge; walk 1.2 mi. west to the Jet. of Davis Creek.

16. Gober chalk at the westernmost exposure of the calcarenite. Go 0.8 mi. southeast of Bailey, Fannin County, on Farm Road 2320 to road cut on east side of road.

17. Blossom sand at its westernmost exposure. Go 2.2 mi. north of Dodd City, Fannin County to bridge just west of crossroads.

18. Lake Crockett member consisting of 6.7 feet of clay between the Ector and the Fish-bed conglomerate. Go 8.0 mi. west of the square in Sherman, Grayson County, on U. S. Hwy. 82; turn south 0.7 mi., then west 0.3 mi. to road cut on south side of road.

19. Ector chalk. Go 5.0 mi. east of the square in Sherman, Grayson County, on U. S. Hwy. 82; turn north 0.9 mi. to quarry just west of road Jet.

20. Lake Crockett member overlain by Ector chalk and underlain by Eagle Ford clay containing an Ostrea lugubris bed. Go 3.0 mi. south of Jet. of U. S. Hwy. 82 and U. S. Hwy. 75 in Sherman, Grayson County, on the latter Hwy.; turn west 2.7 mi., then southwest 0.8 mi. to bridge.
21. Ector chalk resting on Fish-bed conglomerate. Go 2.7 mi. north of Gunter, Grayson County, on State Hwy. 289; turn east 1.4 mi., south 0.1 mi., east 0.9 mi., and stop at bridge over East Fork of Trinity River.

22. Ector chalk on branch of Honey Creek. Go 4.3 mi. north of Jct. of Farm Road 455 and State Hwy. 289 in Celina, Collin County, on the latter Hwy.; turn south 0.3 mi. at school, east 1.3 mi., and south 0.7 mi. to bridge.
VITA

Oscar Lawrence Paulson, Jr. was born in El Dorado, Arkansas on October 2, 1930. He received his elementary education in Lisbon, Louisiana and Yazoo City, Mississippi and graduated from St. Clara Academy at Yazoo City in 1948. He completed a two year course in pre-engineering at Spring Hill College, Mobile, Alabama in May, 1950 and entered Mississippi State College in June 1950 to major in geology. His education was interrupted by the Korean conflict but, after two years in the U. S. Army, which were spent primarily in Korea and on Okinawa, he returned to Mississippi State College where he received his B.S. in January, 1954 and his M.S. a year later. The spring semester was spent teaching at Mississippi State College and in the Fall of 1955 work was begun on a Ph.D. which he expects to receive January 26, 1960 from Louisiana State University.
Candidate: Oscar L. Paulson, Jr.

Major Field: Geology

Title of Thesis: Ostracoda and Stratigraphy of the Austin and Taylor Equivalents of Northeast Texas

Approved:

Major Professor and Chairman

Dean of the Graduate School

EXAMINING COMMITTEE:

Date of Examination: January 8, 1960