

Ostracoda From Wells in North Carolina:

Part 2. Mesozoic Ostracoda

GEOLOGICAL SURVEY PROFESSIONAL PAPER 234-B



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By FREDERICK M. SWAIN

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*Descriptions, illustrations,
geographic distributions, and
stratigraphic ranges of
microfossils*



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CONTENTS

	Page		Page
Abstract.....	59	Systematic descriptions—Continued	
Introduction.....	59	Cytheridae.....	72
Stratigraphic Summary.....	59	Apatocythere.....	72
Mesozoic and older rocks in Esso Standard Oil Co.		Schuleridea.....	74
Hatteras Light well No. 1.....	62	Asciocythere.....	75
Mesozoic rocks in Esso Standard Oil Co. North		Haplocytheridea.....	78
Carolina Esso well No. 2.....	67	Brachycythere.....	80
Stratigraphic distribution of the Ostracoda.....	68	Cythereis.....	81
Systematic descriptions.....	68	Protocythere.....	85
Cytherellidae.....	68	Pterygocythereis.....	85
Cytherella.....	68	Cytheropteron.....	86
Cytherelloidea.....	68	Krithe.....	87
Cypridae.....	70	Gomphocythere.....	87
Cypris.....	70	Monoceratina.....	88
Paracypris.....	70	Hutsonia.....	88
Ilyocypris.....	70	Macrodentina.....	89
Bairdiidae.....	71	References.....	89
Bairdia.....	71	Index.....	91
Bairdoppilata.....	71		
Bairdiocypris.....	72		

ILLUSTRATIONS

	Page
PLATE 8. Cytherellidae, Cypridae, Bairdiidae, and Cytheridae.....	Following index
9. Cytheridae.....	Following index
FIGURE 4. Index map showing locations of wells.....	60
5. Stratigraphic sections of the Upper Cretaceous rocks in Hatteras Light well No. 1 and North Carolina Esso well No. 2.....	61
6. Stratigraphic sections of the Lower Cretaceous in Hatteras Light well No. 1 and North Carolina Esso well No. 2.....	61
7. Stratigraphic section of Upper Jurassic(?) and pre-Cambrian rocks in Hatteras Light well No. 1.....	62

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By F. M. SWAIN

ABSTRACT

This paper describes and illustrates 47 species of Mesozoic Ostracoda from two deep wells in eastern North Carolina. Twenty-two of the species are new. The following genera, one of which is new, are represented in the collection: *Cytherella* Jones, *Cytherelloidea* Alexander, *Cypris* Müller, *Paracypris* Sars, *Ilyocypris*? Brady and Norman, *Bairdia*? McCoy, *Bairdopilata* Coryell, Sample and Jennings, *Bairdiocypris*? Kegel, *Apatocythere*? Triebel, *Schuleridea* Swartz and Swain, *Asciocythere* Swain, n. gen., *Haplocytheridea* Stephenson, *Brachycythere* Alexander, *Cythereis* Jones, *Protocythere* Triebel, *Pterygocythereis* Blake, *Cytheropteron* (*Eocytheropteron*) Alexander, *Krithe* Brady, Crosskey and Robertson, *Gomphocythere* Sars, *Monoceratina* Roth, *Hutsonia* Swain, and *Macrodentina* Martin.

Equivalents or partial equivalents of the following stratigraphic units arranged in descending order are represented in the subsurface of eastern North Carolina:

Upper Cretaceous

- Peedee(?) formation
- Black Creek(?) formation
- Beds of Eutaw(?) age
- Beds of Eagle Ford(?) age
- Tuscaloosa(?) formation

Upper and Lower Cretaceous

- Beds of Washita(?) age

Lower Cretaceous

- Beds of Fredericksburg(?) age
- Beds of Trinity(?) and pre-Trinity(?) age undifferentiated

Upper Jurassic(?)

- Beds of Schuler(?) age

Pre-Cambrian

Descriptions of the lithologic sequence in each of the two wells are given. The stratigraphic subdivisions differ in several respects from those suggested in a previous paper (Swain, 1947).

INTRODUCTION

The Ostracoda described herein were obtained from two deep wells in eastern North Carolina: (1) Esso Standard Oil Co., Hatteras Light well No. 1, long. 75°31'4" W., lat. 35°15'0.5" N., Cape Hatteras, Dare County, N. C.; (2) Esso Standard Oil Co., North Carolina Esso well No. 2, long. 75°33'54" W., lat. 35°42'12" N., Pamlico Sound, Dare County, N. C. The locations of the wells are shown in figure 4.

A brief description of the stratigraphic units encountered in the two wells has been published (Swain,

1947). A survey of the regional subsurface stratigraphy and structure in eastern North Carolina, together with informative discussion of the Hatteras Light well and North Carolina Esso well No. 2, has been provided by Spangler (1950). The Cenozoic Ostracoda from the Esso Standard Oil Co. wells and from several water wells in the eastern part of the State have been described in a previous paper (Swain, 1951). Study of the extensive foraminiferal fauna obtained from the wells is still underway.

Sincere appreciation is expressed to officials of the Esso Standard Oil Co. for providing the samples of their two deep wells; and to John B. Reeside, Jr., James A. Peterson, William D. Quinlivan, Lawrence E. Monley, and Louis M. Perry of the Geological Survey for their valuable assistance in this study. The study was supported mainly by the Paleontology and Stratigraphy Branch of the United States Geological Survey but funds from the Graduate School of the University of Minnesota also provided aid in laboratory and bibliographic work.

STRATIGRAPHIC SUMMARY

The lithologic units in the two Esso Standard Oil Company wells are briefly described below, and the correlations between the wells are presented in figures 5 and 6.

The strata from 8,500 to 9,878 feet depth in the Hatteras Light well No. 1 may represent the Upper Jurassic, and perhaps are equivalent to the Schuler formation of the central Gulf region because (1) the unit contains three species of Ostracoda that occur in the Schuler, (2) an ostracode species found in the Wealden (Neocomian) of Germany occurs just above 8,500 feet, (3) the upper layers of the unit are cavernous dolomitic limestone that appears to have undergone solution and weathering, suggesting an unconformable contact with overlying strata, (4) there is general lithologic similarity of the unit to the Schuler formation of southernmost Arkansas (Swain, 1944, pp. 594-600). Figure 7 shows the Upper Jurassic(?) and



FIGURE 4.—Index map showing locations of wells.

pre-Cambrian rocks penetrated in Hatteras Light well No. 1.

The Tuscaloosa (?) formation in the Hatteras Light well No. 1 rests upon a thin marine bed believed to be of Washita age because of the occurrence of the Lower Cretaceous ostracode *Cytheropteron* (*Eocytheropteron*). The underlying 435 feet of marine strata con-

tain *Cytheropteron* (*Eocytheropteron*) *tumidum* Alexander and are believed to be Fredericksburg in age.

The strata of Washita (?) and Fredericksburg (?) age apparently are absent from the North Carolina Esso well No. 2 and the Tuscaloosa (?) formation rests unconformably upon strata that contain ostracodes of Trinity type.

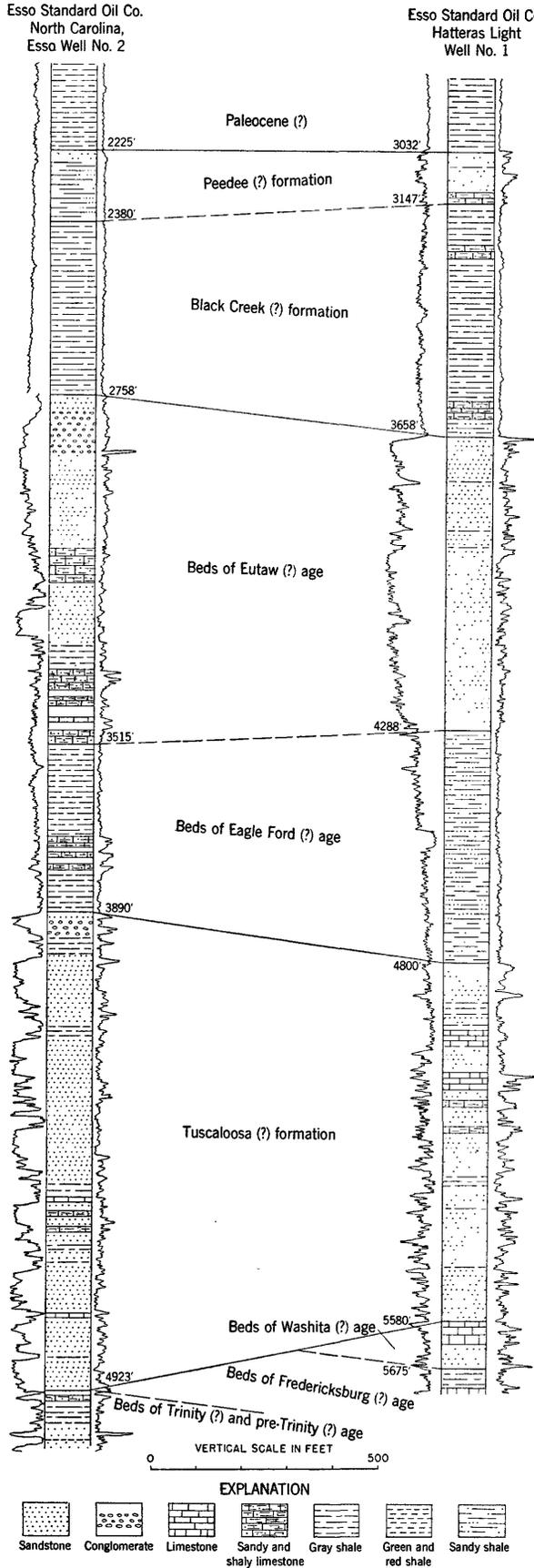


FIGURE 5.—Stratigraphic sections of the Upper Cretaceous rocks in Hatteras Light well No. 1 and North Carolina Esso well No. 2.

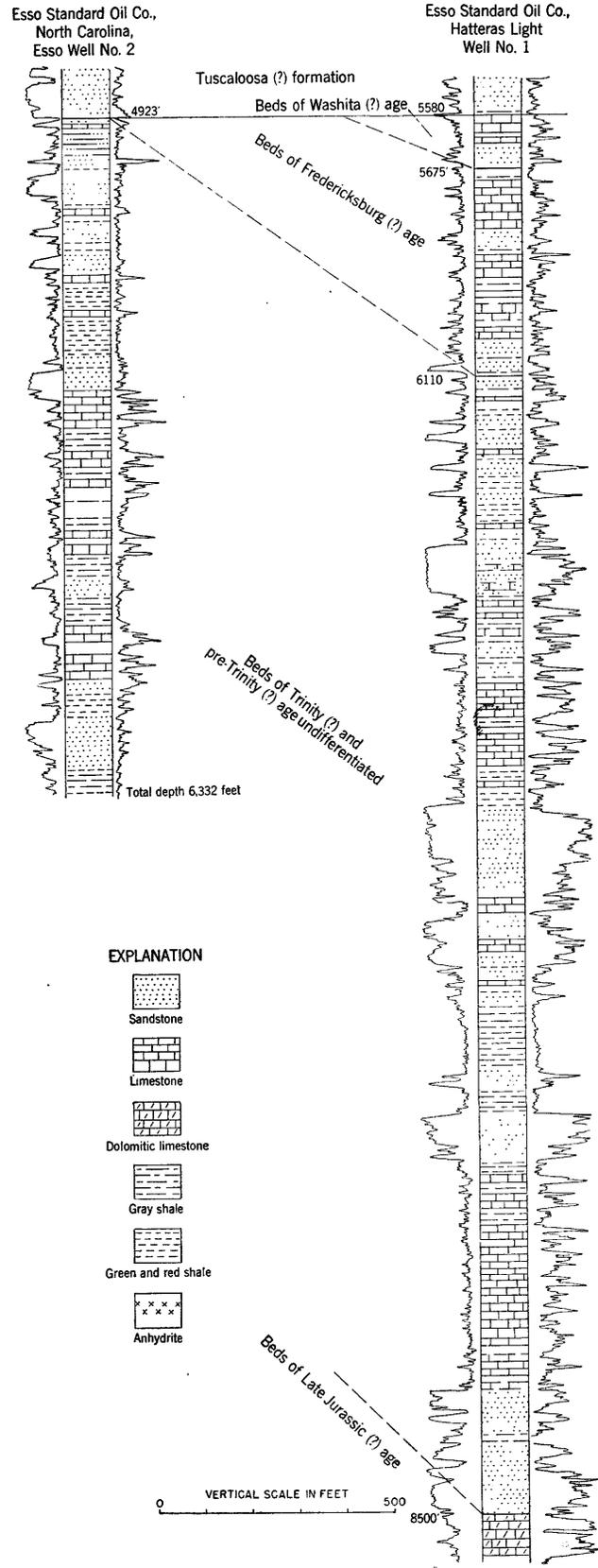


FIGURE 6.—Stratigraphic sections of the Lower Cretaceous rocks in Hatteras Light well No. 1 and North Carolina Esso well No. 2.

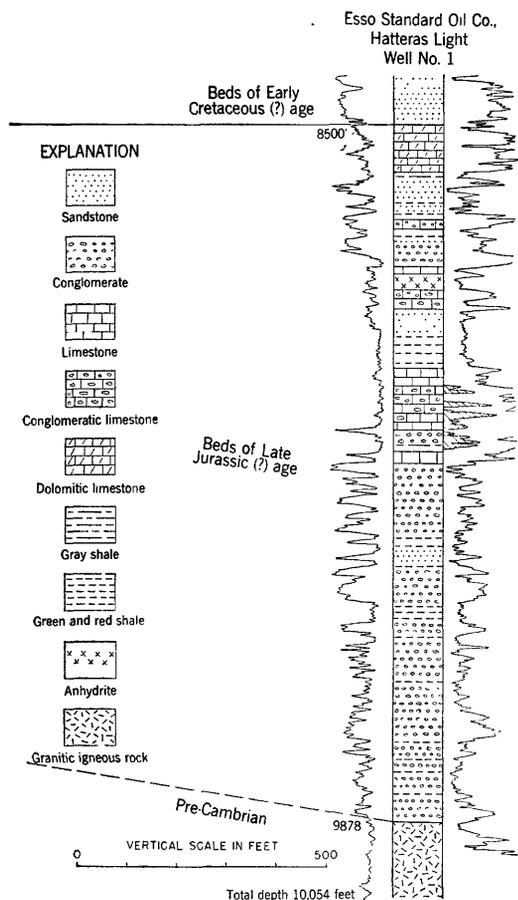


FIGURE 7.—Stratigraphic section of the Upper Jurassic(?) and pre-Cambrian rocks in Hatteras Light well No. 1.

MESOZOIC AND OLDER ROCKS IN ESSO STANDARD OIL COMPANY HATTERAS LIGHT WELL NO. 1

	Depth (feet)	Thickness (feet)
Upper Cretaceous¹		
Peedee(?) formation		
Sandstone, white, fine-grained, slightly porous, in part with siliceous cement, more coarsely glauconitic than overlying Paleocene?; some beds of sandy, partly calcareous siliceous shale and chert. Core 3,063–3,070 feet, recovered 30 inches of white, slightly calcareous, finely glauconitic, highly siliceous shale, sp gr 2.82 ²	3,033–3,080	47
Chalk, light-gray and white, sandy, siliceous, glauconitic; with interbedded siliceous marl.....	3,104	24
Marl, light-gray and white, highly siliceous, finely glauconitic; <i>Cytherella</i> cf. <i>C. obesa</i> Alexander, <i>Cytherella</i> spp. ³	3,147	43

¹The Cenozoic rocks in this well have been described (Swain, 1947; Spangler, 1950). Spangler (1950, fig. 9) places the Cretaceous and Tertiary contact at 2,415 feet below sea level at a depth of 2,439 feet, but there are ostracodes indicative of an Eocene age in core samples from depths of 2,531–2,541 feet and 2,593–2,603 feet and in drill-cutting samples as deep as 2,840–2,850 feet (Swain, 1951, pp. 10–11 and 12).

²Specific gravity determinations were supplied by Esso Standard Oil Co.

³Not described because too poorly preserved.

Upper Cretaceous—Continued
Black Creek (?) formation

Shale and marl, medium- and light-gray; with units containing white chalk layers from 3,147–3,197 feet, 3,205–3,235 feet, 3,270–3,290 feet and between 3,480–3,660 feet; sandy unit 3,520–3,540 feet; abundant glauconite and nodular siderite 3,205–3,235 feet. Core 3,160–3,170 feet, recovered 10 feet, white, chalky, finely sandy, slightly glauconitic, slightly fossiliferous limestone and marl, sp gr ranges from 1.89 to 2.02. Core 3,269–3,279 feet, recovered 10 feet, medium-gray, laminated calcareous shale containing abundant Foraminifera and oyster fragments. Core 3,380–3,390 feet, recovered 30 inches, medium-gray calcareous shale containing abundant small Foraminifera, *Inoceramus* prisms, and *Haplocytheridea? berryi* Swain, n. sp.; sp gr 2.32. Core 3,500–3,510 feet, recovered 8 inches, medium- and dark-gray, silty, calcareous, slightly micaceous shale containing Foraminifera and *Brachycythere sphenoides* (Reuss); sp gr 2.19. Core 3,657–3,666 feet, recovered 16 inches, grass-green and gray-brown, mottled, sandy, glauconitic shale, and shaly sandstone containing large angular and subrounded quartz grains; sp gr 2.13; part of this core belongs to subjacent unit. Other Ostracoda obtained from drill cutting samples in the Black Creek (?) formation are: *Cytherella navarroensis* Alexander (3,130–3,140 feet), *Bairdoppilata pondera* Jennings (3,410–3,420 feet), *Haplocytheridea? sp. aff. H? plummeri* (Alexander) (3,550–3,560 feet), *Brachycythere darenensis* Swain, n. sp. (3,200–3,210 feet), *Brachycythere nausiformis* Swain, n. sp. (3,640–3,650 feet), *Protocythere paratriplicata* Swain, n. sp. (3,240–3,250 feet), *Cythereis bicornis* Israelsky (3,625 feet). Spangler (1950, p. 113) reported the following Foraminifera from the Black Creek formation: *Globotruncana arca* (Cushman), *Planulina taylorensis* (Carsey), *Kyphopyxa christneri* (Carsey), *Vaginulina regina* (Plummer) (= *V. texana* Cushman).....

3,660 513

Beds of Eutaw (?) age⁴

Sandstone, white and light-gray, fine- to coarse-grained and conglomeratic, partly calcareous, argillaceous and glauconitic; upper 10 to 20 feet contain limonitic material staining quartz grains and interstitial clays, suggesting weathering, but sandy portion of core 3,657–3,666 feet as described in overlying unit contains no observable li-

⁴Swain (1947) referred this unit to the Magothy? formation. Spangler (1950, p. 130) terms approximately the same stratigraphic unit the Eutaw formation. As here used, "beds of Eutaw(?) age" implies approximate but not definitely proved stratigraphic equivalence to the Eutaw formation of the central Gulf region, the Austin chalk of Texas, and the Magothy formation of the Middle Atlantic States.

Upper Cretaceous—Continued

Beds of Eutaw (?) age—Continued	Depth (feet)	Thickness (feet)
monitic coloring. Core 3,693–3,703 feet, recovered 3 feet, light-gray, fine-grained, partly argillaceous, micaceous, slightly glauconitic sandstone, with flakes of a mineral resembling chlorite; some flakes of muscovite are partly altered to a mineral resembling chlorite; sp gr 2.60; <i>Asciocythere macropunctata</i> Swain, n. sp., <i>Cythereis quadrialira</i> Swain, n. sp. (drill-cutting sample 3,750–3,760 feet)---	3, 755	95
Sandstone, light-gray and white, fine- to coarse-grained, calcareous, glauconitic. Core, 3,827–3,837 feet, recovered 6 feet light gray-brown, fine-grained, partly calcareous, micaceous, glauconitic sandstone, containing flakes of a mineral resembling chlorite; sp gr ranges from 1.96 to 2.41. Ostracoda obtained from drill-cutting samples are: <i>Asciocythere? acuminata</i> Swain, n. sp. (3,780–3,790 feet), <i>Brachyocythere nausiformis</i> Swain, n. sp. (3,780–3,790 feet), <i>Monoceratina</i> sp. aff. <i>M. semiornata</i> Alexander (3,800–3,810 feet) -----	3, 855	100
Sandstone, fine- and coarse-grained, poorly consolidated; conglomeratic and ferruginous in upper 50 feet; well sorted, averaging 2 mm, and containing milky, rose, and amethystine quartz grains from 3,900–3,930 feet; ferruginous in lower 50 feet. Core 3,930–3,940 feet, recovered 10 feet, white, fine- and coarse-grained, subrounded and angular-grained friable sandstone, sp gr 1.88. Core 4,042–4,052 feet, recovered 4 feet 6 inches, light-gray, fine-grained, argillaceous, micaceous sandstone, containing flakes of chlorite?; sp gr ranges from 1.97 to 2.04. <i>Haplocytheridea? sp. aff. H? plummeri</i> Alexander obtained from drill cuttings (3,990–4,000 feet)---	4, 110	255
Sandstone, light-gray and white, fine- and medium-grained, calcareous, partly glauconitic and micaceous. Core 4,152–4,162 feet, recovered 10 feet, light-gray, fine-grained, angular-grained, calcareous, very micaceous, glauconitic sandstone; sp gr 1.83. Core 4,275–4,285 feet recovered 4 feet, light-gray, fine- and very fine-grained, argillaceous, micaceous sandstone, containing flakes of a mineral resembling chlorite; sp gr 2.01. <i>Cythereis ornatissima</i> (Reuss) (4,260–4,270 feet) -----	4, 288	178

Beds of Eagle Ford (?) age

Shale, light-gray, partly sandy and calcareous, glauconitic, and containing thin layers of white, fine-grained, calcareous, chloritic? sandstone in upper half. Core 4,385–4,395 feet, recovered 28 inches, light-gray, very sandy, micaceous shale, containing flakes of a mineral resembling chlorite; sp gr 2.42. Core 4,485–4,495 feet, recovered 8 feet 6 inches, light gray, silty, micaceous shale; sp gr ranges from

Upper Cretaceous—Continued

Beds of Eagle Ford (?) age—Continued	Depth (feet)	Thickness (feet)
2.31 to 2.34; <i>Haplocytheridea? graysonensis</i> (Alexander). Ostracoda obtained from drill-cutting samples of beds of Eagle Ford (?) age are <i>Bairdia</i> cf. <i>B. alexandrina</i> Blake (4,470–4,480 feet), <i>Cythereis</i> cf. <i>C. bicornis</i> Israelsky (4,320–4,330 feet), <i>Cythereis ornatissima</i> (Reuss) (4,410–4,420 feet), <i>Pterygocythereis</i> cf. <i>P. tokiana</i> (Israelsky) (4,440–4,450 feet)-----	4, 542	254
Beds of Eagle Ford (?) age or Tuscaloosa (?) formation		
Shale, light-gray, micaceous, more calcareous than overlying unit; contains siderite pellets (according to Spangler, 1950, p. 113). Core 4,595–4,605 feet, recovered 3 feet, very pale gray, waxy-textured, micaceous shale containing <i>Estheria? sp.</i> ; sp gr 2.36. Core 4,700–4,710 feet, recovered 14 inches, light-gray, slightly fossiliferous shale; sp gr 2.35. Ostracoda obtained from drill-cutting samples in the unit are: <i>Bairdia? cf. B. alexandrina</i> Blake (4,750–4,760 feet), <i>Cythereis</i> sp. aff. <i>C. rugosissima</i> Alexander (4,600–4,610 feet), <i>Cythereis simulonuda</i> Swain, n. sp. (4,780–4,790 feet), <i>Cythereis ornatissima</i> (Reuss) (4,640–4,650 feet)-----	4, 800	258
Tuscaloosa (?) formation		
Sandstone, shale and limestone, interbedded. Sandstone is white and light-gray, thin to thick bedded, mostly fine calcareous, glauconitic, grains angular and subrounded, containing oyster shells and other fossils, stained with limonite 4,800–4,820 feet and 5,335–5,355 feet; shale is gray, micaceous, calcareous, partly glauconitic, chloritic?, silty and sandy; limestone is white, coquinoid, oyster-bearing, partly sandy, glauconitic, stained with limonite 4,945–4,965 feet, and 5,150–5,180 feet. Core 4,902–4,905 feet, recovered 29 inches, medium-gray, very sandy, micaceous, chloritic? shale; sp gr 2.25. Core 4,991–4,996, recovered 6 inches, white, fine, angular-grained porous, micaceous, chloritic? sandstone. Core 5,294–5,304 feet, recovered 14 inches, medium-gray, micaceous, silty, chloritic? shale; sp gr 2.18. Core 5,254–5,264 feet, recovered 5 feet, light-gray, fine-grained, calcareous, argillaceous, micaceous, chloritic?, sandstone; sp gr ranges from 2.54 to 2.56. Core 5,280–5,290 feet, recovered 10 feet, light-gray, fine-grained, calcareous, argillaceous, micaceous sandstone; sp gr ranges from 2.29 to 2.53. Core 5,399–5,404 feet, recovered 5 feet, light-gray, fine, angular-grained, friable, silty, micaceous, chloritic? sandstone; sp gr 2.03. <i>Cythereis simulonuda</i> Swain, n. sp. (5,340–5,350 feet)-----	5, 580	780

Upper and Lower Cretaceous		Depth	Thickness	Lower Cretaceous—Continued		Depth	Thickness
Beds of Washita (?) age		(feet)	(feet)	Beds of Trinity (?) and pre-Trinity (?) age		(feet)	(feet)
Limestone, white and brown, finely crystalline, sandy, stained with limonite, and interbedded gray sandy shale. Core 5,582-5,587 feet, recovered 5 feet, gray-brown, silty shale, with scattered quartz grains; cavernous structure due to leaching of soluble shell material, cavities lined with limonite, sp gr 2.16-----		5,630	50	grained sandstone; sp gr ranges from 1.90 to 2.23. <i>Cypris?</i> sp. (6,460-6,470 feet), <i>Ilyocypris? tumida</i> Swain, n. sp. (6,350-6,360 feet), <i>Apatocythere? leguminoides</i> Swain, n. sp. (6,350-6,360 feet), <i>Schuleridea hatterasensis</i> Swain, n. sp. (6,300-6,310 feet), <i>Asciocythere rotunda</i> (Vanderpool) (6,300-6,310 feet), <i>Asciocythere? cf. A? amygdaloides</i> (Cornuel) (6,250-6,260 feet), <i>Asciocythere? triangularis</i> Swain, n. sp. (6,430-6,440 feet), <i>Pterygocythereis cf. P. tokiana</i> (Israelsky) (6,310-6,320 feet), <i>Cytheropteron (Eocytheropteron) tumoides</i> Swain, n. sp. (6,340-6,350 feet), <i>C. (E.) trinitiensis</i> (Vanderpool) (6,170-6,180 feet), <i>Hutsonia? microrugosa</i> Swain, n. sp. (6,260-6,270 feet)---		6,475	365
Sandstone, white, fine-grained, micaceous, calcareous, fossiliferous, chloritic?, glauconitic in lower part; and interbedded dark-gray, soft, fissile, finely micaceous shale. Core 5,642-5,652 feet, recovered 2 feet 6 inches, gray, very sandy, calcareous, fossiliferous shale; sp gr 2.56. <i>Cytheropteron (Eocytheropteron) acaudatum</i> Swain, n. sp. (5,640-5,650 feet)-----		5,675	45	Sandstone, white and light-green, fine- and coarse-grained above, fine- and medium-grained below, grains angular and subrounded, partly calcareous, massive. Core 6,487-6,497 feet, recovered 10 feet, light-gray and white, medium-grained, angular-grained sandstone, with abundant snow-white silt; sp gr ranges from 2.15 to 2.63. Core 6,497-6,507 feet, recovered 9 feet, light-gray and white, fine- and medium-grained with grains angular and subrounded, slightly calcareous sandstone, containing abundant snow-white silt, oyster fragments and large muscovite flakes; sp gr ranges from 2.16 to 2.627. Core 6,507-6,512 feet recovered 5 feet, white, fine- and medium-grained very silty sandstone and siltstone; sp gr ranges from 2.137 to 2.186. Core 6,512-6,522 feet, recovered 7 feet 6 inches, light gray, fine, angular-grained, micaceous, chloritic? sandstone; sp gr ranges from 2.11 to 2.14. Core 6,522-6,532 feet, recovered 4 feet, light-gray, fine- and medium-grained, very silty, friable, micaceous sandstone; sp gr ranges from 2.13 to 2.38 feet. Core 6,532-6,542 feet, recovered 3 feet, light gray, fine, angular-grained, silty, micaceous sandstone; sp gr 2.19. Core 6,542-6,552 feet, recovered 7 feet, as preceding, but argillaceous; sp gr 2.14. Core 6,552-6,562, recovered 10 feet, as preceding, chloritic?; sp gr ranges from 2.15 to 2.64. Core 6,562-6,572 feet, recovered 10 feet, as preceding; sp gr ranges from 2.11 to 2.17. Core 6,572-6,581 feet, recovered 7 feet, as preceding, carbonaceous; sp gr ranges from 2.09 to 2.18. <i>Schuleridea hatterasensis</i> Swain, n. sp. (6,477-6,482 feet)-----		6,585	110
Lower Cretaceous				Shale, sandstone and limestone, interbedded. Shale is mostly light green and contains sandy laminae; sandstone is white, fine-grained, calcareous and contains oyster shells; limestone is white finely crystalline, sandy, and contains oyster shells. Core 6,132-6,137 feet, recovered 5 feet, light gray, fine- and medium-grained, argillaceous, calcareous, micaceous sandstone, containing oyster shells; sp gr 2.65. Core 6,307-6,311 feet, recovered 18 inches, light-gray, fine- and medium-grained, grains round and subangular, calcareous, micaceous, chloritic? sandstone; sp gr 2.45. Core 6,370-6,373 feet, recovered 3 feet, gray clay-shale with laminae of white (ashy?), siltstone and white, fine-			
Beds of Fredericksburg (?) age				Beds of Trinity (?) and pre-Trinity (?) age undifferentiated			
Limestone interbedded with lesser amounts of sandstone and shale. Limestone is white, brown and reddish brown, finely crystalline, sandy, fossiliferous, partly glauconitic, slightly sideritic. Sandstone is light gray, fine-grained, calcareous, fossiliferous, slightly glauconitic. Shale is dark gray, silty, micaceous, sandy, containing a little light-gray waxy mudstone in lower 100 feet. Core 5,733-5,738 feet, recovered 16 inches, light-gray, silty, micaceous, chloritic? shale, with mollusk prisms; sp gr 2.27. Core 5,850-5,860 feet, recovered 15 inches, light-gray, very sandy, silty, micaceous, chloritic? shale; sp gr ranges from 2.18 to 2.55. Core 6,108-6,110 feet, recovered 10 inches, light-gray, fine, angular-grained, slightly silty, porous, micaceous, chloritic? sandstone. <i>Cytheropteron (Eocytheropteron) tumidum</i> Alexander (5,790-5,800), <i>Apatocythere? leguminoides</i> Swain, n. sp. (6,040-6,050 feet)---		6,110	435				

Lower Cretaceous—Continued		Depth (feet)	Thickness (feet)	Lower Cretaceous—Continued		Depth (feet)	Thickness (feet)				
Beds of Trinity (?) and pre-Trinity (?) age undifferentiated—Continued				Beds of Trinity (?) and pre-Trinity (?) age undifferentiated—Continued							
limestone is white, finely crystalline, sandy; near top of unit limestones are spotted with siderite and limonite. Core 6,630–6,640 feet, recovered 5 feet, light gray, argillaceous, sandy, glauconitic limestone containing oyster shells; sp gr 2.45–2.60. <i>Paracypris</i> sp. 6,700–6,710 feet. Limestone, white and brownish-gray, finely crystalline, partly oölitic (around 6,800–6,860 and 6,920 feet) and phosphatic (at about 6,760 and 6,850 feet); interbedded gray and brownish-gray shale with “papery” texture. Core 6,734–6,774 feet, recovered 10 feet, firm, gray, silty, sandy, very micaceous, slightly fossiliferous shale; sp gr ranges from 2.34–2.58. Core 6,909–6,918 feet, recovered 5 feet, light gray, finely sandy, argillaceous, compact, fossiliferous limestone; sp gr ranges from 2.61 to 2.63. Core 6,918–6,924 feet, recovered 6 feet, light gray, dense, oyster-bearing limestone containing fine sand; sp gr 2.63. <i>Apatocythere? lanceolata</i> Swain, n. sp. 6,930–6,490 feet-----				6,935	201	recovered 7 feet, light gray, fine-grained, angular-grained, porous, slightly argillaceous, micaceous, chloritic?, sandstone; sp gr 2.14. Core 7,113–7,123 feet, recovered 9 feet, sandstone as above; sp gr 2.11. Core 7,123–7,133 feet, recovered 10 feet, sandstone as above, calcareous; sp gr ranges from 2.12 to 2.42. Core 7,191–7,201 feet, recovered 10 feet, light gray, fine-grained, angular-grained, very argillaceous sandstone; sp gr ranges from 2.09 to 2.16. Core 7,234–7,238 feet, recovered 2 feet, medium gray, micaceous shale containing microfossils; sp gr ranges from 2.60–2.67. Core 7,316–7,326 feet, recovered 10 feet, light gray, fine-grained, very argillaceous, friable, micaceous, chloritic? sandstone; sp gr ranges from 2.105 to 2.32. Core 7,326–7,336 feet, recovered 8 feet, light gray, fine-grained, angular-grained, silty, fairly porous, micaceous, chloritic? sandstone; sp gr 2.32. Core 7,400–7,410 feet, recovered 5 feet, light gray, drab, very finely sandy shale with laminae of siltstone; sp gr 2.23. <i>Cythereis</i> sp. aff. <i>C. fredericksburgensis</i> Alexander 7,310–7,320 feet-----				7,430	412
Shale, gray-green and brownish-gray in upper part, with red and purple beds in lower part; contains thin layers of white, finely crystalline limestone and of white, fine-grained angular sandstone with pink silty grains-----				7,018	83	Shale, light- and dark-gray, fissile; greenish gray in lower 50 feet; light gray, fine- to medium-grained calcareous sandstone 7,585–7,610 feet. Core 7,503–7,510 feet, recovered 3 feet 6 inches, dark-gray, compact, sandy, micaceous shale, sp gr 2.49. Core 7,594–7,602 feet, recovered 3 feet, 6 inches, light-gray, compact, sandy shale with lenticular pockets of fine-grained, argillaceous sandstone; sp gr ranges from 2.35 to 2.49. Core 7,658–7,664 feet, recovered 4 feet, light gray, very finely sandy shale; sp gr ranges from 2.405 to 2.49. <i>Cytherelloidea darensis</i> Swain, n. sp. 7,500–7,510 feet, <i>Apatocythere? tumidosa</i> Swain, n. sp. 7,640–7,650 feet-----				7,665	235
Sandstone, white with grains fine to coarse and angular to rounded, partly calcareous, in thick beds, containing layers of green shale in lower 75 feet; interbedded white, finely crystalline, fairly porous, slightly oölitic limestone at several levels, notably from 7,220–7,240 feet and 7,295–7,305 feet. Core 7,021–7,026 feet, recovered 25 inches, light-gray, dense, finely crystalline, sandy, oyster-bearing limestone with argillaceous pockets; sp gr ranges from 2.09 to 2.304. Core 7,034–7,039 feet, recovered 32 inches, light gray, fine-grained, porous, angular-grained, slightly silty sandstone; sp gr ranges from 2.17 to 2.23. Core 7,076–7,081 feet, recovered 4 feet, light gray, fine-grained, porous, angular-grained, slightly calcareous sandstone with waxy clay; sp gr ranges from 2.23 to 2.65. Core 7,081–7,091 feet, recovered 4 feet, light-gray to white, porous, recrystallized, micaceous, sandy, oyster-bearing limestone; sp gr ranges from 2.28 to 2.42. Core 7,091–7,096 feet, recovered 2 feet 6 inches, white, fine-grained, angular-grained, silty, friable sandstone; sp gr 2.205. Core 7,096–7,106 feet, light gray, fine-grained, angular-grained, porous, slightly silty, argillaceous, chloritic?, micaceous sandstone; sp gr ranges from 2.19 to 2.21. Core 7,106–7,113 feet,						Sandstone, white, grains fine to coarse in upper part, fine to medium below, and angular to subrounded; slightly calcareous, thick-bedded. Core 7,705–7,715 feet, recovered 10 feet, light-gray, fine-grained, silty, micaceous sandstone; sp gr ranges from 2.30 to 2.31-----				7,758	93
						Limestone and shale, interbedded. Limestone is light gray to white, finely crystalline, oölitic and phosphatic? at several levels, partly fossiliferous, in units up to 50 feet thick. Shale is gray and gray brown, fissile. Both shale and limestone are sandy and contain a little interbedded light-gray, fine- and medium-grained calcareous sandstone in lower 75 feet. A unit of sandy siltstone occupies upper 30 feet of the unit. Core					

Lower Cretaceous—Continued		Depth (feet)	Thickness (feet)	Upper Jurassic (?)—Continued		Depth (feet)	Thickness (feet)		
Beds of Trinity (?) and pre-Trinity (?) age undifferentiated—Continued				Beds of Schuler (?) age—Continued					
7,766–7,776 feet, recovered 6 feet 6 inches, light gray, sandy, micaceous siltstone; sp gr ranges from 2.38 to 2.43. Core 7,945–7,959 feet, recovered 2 feet, medium-gray sandy fossiliferous shale, sp gr 2.64. <i>Monoceratina?</i> sp. 8,200–8,210 feet				8,240	518	Swain, n. sp., 9,030–9,040 feet; <i>Schuleridea</i> cf. <i>S. acuminata</i> Swartz and Swain, 9,100–9,110 feet			
Sandstone, light gray and white, fine- to coarse-grained, conglomeratic in lower 50 feet, angular-grained, partly chloritic?, slightly feldspathic at several levels; interbedded gray, silty, fissile shale, and in lower 75 feet a little tan oolitic limestone. <i>Gomphocythere?</i> cf. <i>G. silvana</i> Martin, 8,430–8,440 feet. <i>Macrodentina?</i> <i>obliqua</i> Swain, n. sp. 8,330–8,340 feet				8,500	260	Conglomeratic sandstone and arkose. Above 9,475 feet sandstones are white and light gray, coarse-grained, conglomeratic, feldspathic, partly calcareous and are interbedded with gray, green, and red sandy shale. Below 9,475 feet sandstones are white or red and pink due to hematite coloring, arkosic, conglomeratic, and are interbedded with red and green sandy mudstone. Feldspar grains in red and pink sandstones, are reddish and kaolinic; in white sandstones, feldspars are fresh in appearance. Core 9,231–9,241 feet, recovered 9 feet 6 inches; top 3 feet 6 inches, light-gray, fine-grained, calcareous, argillaceous sandstone, bottom 6 feet, white fine- to medium-grained silty sandstone with pink grains; sp gr ranges from 2.30 to 2.57. Core 9,241–9,251 feet, recovered 18 inches, light-gray and pink, grains very coarse sand to fine conglomeratic sizes and subangular to subrounded, feldspathic. Core 9,251–9,261 feet, recovered 7 feet; top 2 feet, light-gray, very coarse-grained, porous, angular-grained, feldspathic sandstone; bottom 5 feet, medium- and greenish-gray, compact, sandy, micaceous shale; sp gr ranges from 2.56 to 2.59. Core 9,261–9,271 feet, recovered 3 feet, light greenish-gray and red, very sandy, compact, micaceous, chloritic? shale and argillaceous sandstone; sp gr 2.58. Core 9,271–9,281 feet, recovered 3 feet, light-gray, medium- to coarse-grained and finely conglomeratic, feldspathic, very silty sandstone. Core 9,281–9,291 feet; recovered 7 feet 6 inches; top 3 feet 6 inches medium-gray, medium- to coarse-grained, very shaly, micaceous, feldspathic sandstone; bottom 4 feet, gray, waxy, sandy, conglomeratic, feldspathic shale, and coarsely conglomeratic, feldspathic sandstone; sp gr 2.54. Core 9,291–9,298 feet, recovered 5 feet, white, fine- to coarse-grained and finely conglomeratic, very silty sandstone containing snow-white silt. Core 9,298–9,308 feet, recovered 6 feet, white, fine- to coarse-grained and finely conglomeratic, subrounded- to angular-grained, slightly feldspathic sandstone. Core 9,510–9,515 feet, recovered 3 feet, dark-red and green compact, sandy, shale; sp gr 2.58		9,150	210
Upper Jurassic (?). Beds of Schuler (?) age Dolomite, light-brown, sandy, coarsely crystalline, cavernous; tan, partly dolomitized, oolitic limestone in middle part				8,585	85				
Sandstone, light gray and white, fine-grained to conglomeratic, in part ferruginous and with nodular siderite; interbedded green and greenish-gray fissile shale and mudstone; brown, dense, conglomeratic, oolitic limestone from 8,750–8,770 feet				8,750	165				
Limestone, gray, dense, with a thin unit of brown, porous dolomite at top; a little interbedded gray calcareous shale. Core 8,763–8,768 feet, medium-gray, well-indurated, calcareous, fossiliferous shale and shaly limestone, sp gr 2.66				8,780	30				
Limestone, gray, dense, sandy and conglomeratic, dolomitic and oolitic in upper part; a layer of white sugary anhydrite 8,799–8,800 feet; lower 20 to 30 feet consists of light-gray, fine-grained, silty, argillaceous, calcareous sandstone				8,880	100				
Shale, light- and dark-gray and greenish-gray, sandy, partly carbonaceous, and pyritic, containing echinoid spines and poorly preserved ostracodes. Core 8,917–8,922 feet, recovered 5 feet, dark-gray, compact, sandy, micaceous, fossiliferous shale, sp gr 2.61				8,980	100				
Limestone, light and dark gray and brown, dense, argillaceous, partly oolitic limestone containing quartz pebbles in middle and lower parts, sandy in lower part; a little interbedded dark-gray, silty, indurated shale; white, slightly feldspathic, quartz conglomerate 9,100–9,110 feet. Core 9,115–9,116 feet, dark-gray argillaceous, conglomeratic, fossiliferous limestone with <i>Schuleridea</i> cf. <i>S. pentagonalis</i> Swartz and Swain, and the foraminifer <i>Choffatella</i> sp., sp gr 2.67. <i>Asciocythere?</i> <i>leguminoides</i>						Pre-Cambrian Granitic igneous rock, greenish-gray, stained red by hematite in upper 75 feet, medium- to coarse-grained, chloritic; highly fractured and containing calcite			

Upper Jurassic (?)—Continued

Pre-Cambrian—Continued

fracture-fillings; of syenitic or monzonitic composition in upper part, becoming more quartzose below. Core 9,876-9,882 feet, recovered 5 feet, reddish-brown and light-green granitic igneous rock, with considerable kaolinite? Core 9,912-9,921 feet, recovered 1 foot 6 inches, reddish and greenish-gray, fractured, medium- to coarse-grained, chloritic, kaolinitic? granitic igneous rock; sp gr 2.65. Core 9,941-9,943 feet, recovered 3 inches, granitic igneous rock as above..... 10,054 176

MESOZOIC ROCKS IN ESSO STANDARD OIL CO. NORTH CAROLINA ESSO WELL NO. 2

Upper Cretaceous

Peedee (?) formation

Sandstone, green and greenish gray, coarse-grained, sideritic, poorly consolidated. Spangler (1950, p. 112) reported *Globotruncana arca* (Cushman) at approximately 2,275 feet..... 2,224-2,280 50

Shale, light-gray and brown, silty and marly, glauconitic; with thin beds of medium-grained sandstone. *Brachyocythere arachoides* (Berry) 2,310-2,320 feet; *Cythereis? pamlicoensis* Swain, n. sp., 2,310-2,320 feet; *Krithe* cf. *K. postprojecta* Schmidt, 2,300-2,310 feet..... 2,380 100

Black Creek (?) formation

Shale, light-gray, marly, with thin beds of medium-grained sandstone. *Haplocytheridea monmouthensis* (Berry), 2,750-2,760 feet; *Brachyocythere nausiformis* Swain, n. sp., 2,750-2,760 feet; *Cythereis quadrialira* Swain, n. sp. 2,750-2,760 feet. *Inoceramus* prisms occur at 2,400-2,410 feet and below. Spangler (1950, p. 113) reported *Planulina taylorensis* (Carsey) at approximately 2,400 feet; *Kyphopyxa christneri* (Carsey) at approximately 2,460 feet, and *Vaginulina regina* Plummer (= *V. texana* Cushman) at approximately 2,600 feet..... 2,760 380

Beds of Eutaw (?) age

Conglomeratic sandstone, light-gray and white, poorly consolidated, partly glauconitic and containing chert pebbles in upper part, fragments of oyster shells and other molluscs..... 2,870 110

Sandstone, fine- and medium-grained, glauconitic in upper part, reddish at about 2,950 feet, with considerable interbedded gray micaceous shale from 3,090 to 3,225 feet; containing abundant oyster shell fragments throughout..... 3,285 415

Shale and limestone, interbedded. Shale is gray, micaceous, and contains abundant oyster shells. Limestones are gray oyster-shell coquinas, in part mottled with hematitic clay, are mostly in thin beds, and are most numerous in lower two-thirds of unit..... 3,515 230

Upper Cretaceous—Continued

Beds of Eagle Ford (?) age

Shale, gray, micaceous, containing abundant oyster shells below 3,575 feet and spherulites of siderite in middle part... 3,718 202

Limestone, white, sandy, glauconitic, fossiliferous, stained by hematite near top; with thin beds of gray shale and fine-grained, light-gray, glauconitic and chloritic? sandstone..... 3,795 77

Shale, gray, micaceous, slightly glauconitic and sideritic, containing oyster shells 3,890 95

Tuscaloosa (?) formation

Sandstone, interbedded with shale and a little limestone. Sandstone layers are white to light gray, partly calcareous, carbonaceous, and sideritic, and contains conglomeratic layers from 3,910-3,925 feet, 4,025-4,060 feet, 4,170-4,180 feet, 4,320-4,340 feet, and 4,750-4,760 feet; partly glauconitic in upper part. Shales are gray, sandy, micaceous, carbonaceous, chloritic?, and are inter-layered with pale-gray, green, red and brown mudstones. White, fossiliferous limestone beds occur from 4,490-4,510 feet and 4,770-4,785 feet. Oyster shells occur at many levels throughout the unit 4,923 1,033

Lower Cretaceous

Beds of Trinity (?) and pre-Trinity (?) age undifferentiated.

Shale, with thick beds of sandstone, and lesser amounts of limestone. Shales are mostly gray and greenish-gray carbonaceous mudstones, with layers of dark-gray fissile shale and of red shale at several levels. Oyster shells occur at several horizons. Sandstones are mostly fine-grained, light-gray and white, calcareous; the most prominent beds occur from 5,040-5,087 feet, 5,155-5,170 feet, 5,217-5,240 feet, and 5,455-5,495 feet. Limestones are white and gray, dense, and contain oyster shells; most prominent layers are from 4,950-4,970 feet, 5,010-5,015 feet, 5,110-5,122 feet, 5,255-5,260 feet, and 5,330-5,340 feet. *Schuleridea? lacustris* Swain, n. sp. 4,970-4,980 feet; *Schuleridea hatterasensis* Swain, n. sp., 5,330-5,340 feet 5,495 572

Limestone, white, light- and dark-gray and brown, soft and weathered in upper 10 feet, finely crystalline, sandy near top and bottom, partly oolitic and pseudo-oolitic (phosphatic?), fossiliferous, and with thin layers of white, sugary anhydrite in lower 50 feet; beds of light and dark gray and brown, fissile shale. *Apatocythere? lanceolata* Swain, n. sp. 5,520-5,530 feet, *Apatocythere? tumidosa* Swain, n. sp., 5,520-5,530 feet..... 5,718 223

	Depth (feet)	Thickness (feet)
Lower Cretaceous—Continued		
Beds of Trinity (?) and pre-Trinity (?) age undifferentiated—Continued		
Shale, gray and brownish-gray, soft, fissile, with layers of varicolored mudstone in lower part; beds of white, finely crystalline, slightly porous, recrystallized limestone 5,795–5,840 feet, and white, fine-grained, calcareous, argillaceous sandstone 5,890–5,925 feet	5,980	262
Limestone, white and light-gray, finely crystalline, fossiliferous, in part oolitic and phosphatic?, cavernous; and interbedded gray, fissile shale	6,118	138
Shale and sandstone, interbedded. Shale is mostly green, waxy-textured mudstone containing <i>Atopochara</i> sp.; a little gray fissile shale from 6,370–6,400 feet. Sandstone is white, fine-grained, slightly calcareous, chloritic?, and with spherulitic siderite; most conspicuous unit of sandstone is from 6,185–6,265 feet	6,410	292

STRATIGRAPHIC DISTRIBUTION OF THE OSTRACODA

The stratigraphic distribution of the ostracode species described in this paper is given in the table below. Only the highest occurrences of species obtained from well samples are recorded in the table, except for a few instances where the presence of the species at a deeper level seems reasonably certain. The specimens obtained from core samples have been recorded as occurring within the zone cored.

SYSTEMATIC DESCRIPTIONS

Order **PLATYCOPA** Sars, 1865

Family **CYTHERELLIDAE** Sars, 1865

Genus **CYTHERELLA** Jones, 1849

Cytherella navarroensis Alexander

Plate 8, figure 1

Cytherella navarroensis Alexander, 1929, Texas Univ. Bull. 2907, p. 63, pl. 2, figs. 1, 2.

Shell elongate-subovate in lateral view; greatest height slightly anterad of midlength; dorsal margin moderately convex, strongly truncate posterior to position of greatest height; ventral margin nearly straight, passing with broad curvature into anterior margin and with narrower curvature into posterior margin; anterior margin broadly and uniformly rounded; posterior margin more narrowly rounded. Right valve overlapping and extending beyond left around entire periphery; greatest extension mid-dorsal and in anterior half of shell.

A low, broad, dorso-ventrally elongated swelling occupies a position just posterior to midlength and marks area of greatest convexity. A low ridgelike swelling borders posterior margin of right valve; corresponding feature not clearly exhibited on left valve. Surface smooth. Internal features not observed.

Length of figured specimen 0.78 mm, height 0.49 mm, thickness 0.35 mm.

Remarks: Alexander (1929, p. 53) pointed out that this species may be distinguished from *C. austinensis* Alexander by its stronger mid-dorsal and ventral right valve overlap and more pronounced truncation of the dorsal marginal slopes. The present example has the external characteristics prescribed for *C. navarroensis*, but the internal features have not been observed.

Occurrence: Hatteras Light Well no. 1, 3,240–3,250 feet, Black Creek formation, U.S.N.M. 106906. In northeastern Texas the species has been found most commonly in the Navarro group, but also occurs rarely in the upper part of the underlying Taylor marl (Alexander, 1929, p. 53).

Cytherella cf. *C. obesa* Alexander

Plate 8, figure 2

Cytherella obesa Alexander, 1929, Texas Univ. Bull. 2907, p. 51, pl. 1, figs. 3, 6.

Shell ovate in lateral view; greatest height median; dorsal margin moderately convex; ventral margin slightly convex; anterior margin broadly and uniformly rounded; posterior margin a little more narrowly rounded and slightly truncate above midheight. Right valve much larger than left, overlapping and extending beyond the other around entire periphery; greatest extension dorsal and ventral. Valves moderately convex with greatest thickness in posterior half. Surface smooth. Internal features not observed.

Length of figured specimen 0.94 mm, height 0.62 mm, thickness 0.45 mm.

Remarks: The present example is more uniformly rounded anteriorly and slightly less convex ventrally than the form figured by Alexander, but otherwise is similar to it. *C. ovoidea* Alexander exhibits lesser convexity of the valves and greater dorsal and ventral extension of the right valve beyond the margin of the left than does the present species.

Occurrence: Hatteras Light well No. 1, 3,130–3,140 feet, Peedee (?) formation, U.S.N.M. 106907. In northeastern Texas *C. obesa* occurs in the upper part of the Taylor marl (Alexander, 1929, p. 51).

Genus **CYTHERELLOIDEA** Alexander, 1929

Cytherelloidea darensis Swain, n. sp.

Plate 8, figure 3

Shell subelliptical in lateral view, dorsal and ventral margins nearly straight, both slightly concave medially; terminal margins rounded, anterior somewhat broader than posterior; anterodorsally, margin of right valve somewhat elevated as a small shoulder. Right valve larger than left, but extends beyond the other conspicuously only in anterodorsal region.

Stratigraphic distribution of the Ostracoda described in this paper.

Species	Schuler(?) age	Trinity(?) and pre- Trinity(?) age	Fredericks- burg(?) age	Washita(?) age	Tusca- loosa(?) forma- tion	Eagle Ford(?) age	Eutaw(?) age	Black Creek(?) forma- tion	Peedee(?) forma- tion
Cytherellidae:									
<i>Cytherella navarroensis</i> Alexander								×	
<i>Cytherella</i> cf. <i>C. obesa</i> Alexander									×
<i>Cytherelloidea darensis</i> , n. sp.		×							
Cypridae:									
<i>Cypris?</i> sp.		×							
<i>Paracypris</i> sp.		×							
<i>Ilyocypris? tumida</i> , n. sp.		×							
Bairdiidae:									
<i>Bairdia?</i> cf. <i>B. alexandrina</i> Blake						×			
<i>Bairdoppilata pondera</i> Jennings						×	×	×	
<i>Bairdiocypris?</i> sp.		×							
Cytheridae:									
<i>Apatocythere? lanceolata</i> , n. sp.		×							
<i>Apatocythere? leguminoidea</i> , n. sp.		×							
<i>Apatocythere? tumidosa</i> , n. sp.		×							
<i>Schuleridea hatterasensis</i> , n. sp.		×							
<i>Schuleridea? lacustris</i> , n. sp.		×							
<i>Schuleridea</i> cf. <i>S. pentagonalis</i> Swartz and Swain	×								
<i>Schuleridea</i> cf. <i>S. acuminata</i> Swartz and Swain	×								
<i>Asciocythere rotunda</i> (Vanderpool)		×							
<i>Asciocythere?</i> cf. <i>A.? amygdaloides</i> (Cornuel)		×							
<i>Asciocythere? triangularis</i> , n. sp.		×							
<i>Asciocythere macropunctata</i> , n. sp.							×		
<i>Asciocythere? acuminata</i> , n. sp.							×		
<i>Asciocythere? leguminoides</i> , n. sp.	×								
<i>Haplocytheridea? graysonensis</i> (Alex- ander)		(1)	(1)	(1)	(1)	×			
<i>Haplocytheridea? berryi</i> , n. sp.								×	
<i>Haplocytheridea monmouthensis</i> (Berry)							(1)	×	
<i>Haplocytheridea? sp. aff. H? plummeri</i> (Alexander)							×	×	
<i>Brachythere darensis</i> , n. sp.								×	
<i>Brachythere sphenoides</i> (Reuss)								×	
<i>Brachythere nausiformis</i> , n. sp.							×	×	
<i>Brachythere arachoides</i> (Berry)									×
<i>Cythereis</i> sp. aff. <i>C. rugosissima</i> (Alex- ander)						×			
<i>Cythereis</i> sp. aff. <i>C. fredericksburgensis</i> Alexander		×							
<i>Cythereis pamlicoensis</i> , n. sp.									×
<i>Cythereis simulonuda</i> , n. sp.					×	×			
<i>Cythereis bicornis</i> Israelsky						×		×	
<i>Cythereis quadrialira</i> , n. sp.							×	(1)	
<i>Cythereis ornatissima</i> (Reuss)						×	×		
<i>Protocythere paratriplicata</i> , n. sp.					×			×	
<i>Pterygocythereis</i> cf. <i>P. tokiana</i> (Israel- sky)		(1)				×			
<i>Cytheropteron</i> (<i>Eocytheropteron</i>) <i>tumoides</i> , n. sp.		×	×						
<i>Cytheropteron</i> (<i>Eocytheropteron</i>) <i>trinitiensis</i> (Vanderpool)		×							
<i>Cytheropteron</i> (<i>Eocytheropteron</i>) <i>acaudatum</i> , n. sp.				×					
<i>Kriihe</i> cf. <i>K. postprojecta</i> Schmidt									×
<i>Gomphocythere</i> cf. <i>G. silvana</i> Martin		×							
<i>Monoceratina</i> sp. aff. <i>M. semiornata</i> Alexander							×		
<i>Hutsonia? microrugosa</i> , n. sp.		×							
<i>Macrodentina? obliqua</i> , n. sp.		×							

1 Occurrence in doubt as specimens may have caved from higher levels.

Terminal margins each provided with a row of small spines; anterior margin bears a narrow elevated rim. A narrow ridge rises near postdorsal marginal bend, trends anteriorly and ventrally and dies out about one-third from anterior end. A second narrow longitudinal ridge rises about one-fifth from anterior end, trends posteriorly to slightly postrad of midlength where it bends toward dorsum, extends to a position just ventrad of postdorsal marginal bend and terminates in a high, somewhat elongated, blunt node. A third, more ventral, longitudinal ridge rises about one-fourth from anterior end, continues posteriorly approximately to midlength where it jogs slightly toward dorsum and terminates in a small node near posterior margin. A shallow, rounded, median depression lies between dorsal and median longitudinal ridges. Surface coarsely pitted, but partly obscured by matrix in holotype. Internal features not observed.

Length of holotype 0.57 mm, height 0.31 mm, thickness 0.22 mm.

Relationships: In its pitted surface and prominent posterior nodes this form resembles *C. granulosa* (Jones) as identified by Alexander (1929, p. 58) from the Grayson formation of Texas and *C. reticulata* Alexander from the Weno and Denton formations of Texas. In both of the latter species, however, there are only two longitudinal ridges, and the dorsal posterior node is connected to a ridge lying near the dorsum rather than to a more median ridge as in the present species. *C. howei* Swain (1948, p. 191) from the subsurface Eocene of Maryland has a similar number and arrangement of longitudinal ridges, but they are broader than in the present species. *C. castleberryensis* Howe and Law (1936, p. 20) from the Byram marl, Oligocene, of Mississippi is pitted, and has a spinose anterior margin as does the new species, but has only two high longitudinal ridges, and bears other short longitudinal ridges in median and ventral areas.

Occurrence: Hatteras Light well No. 1, Dare County, N. C., 7,500–7,510 feet, beds of Trinity (?) and pre-Trinity (?) age, undifferentiated, U.S.N.M. 106908.

Order **PODOCOPA** Sars, 1865

Family **CYPRIDAE** Baird, 1846

Genus **CYPRIS** Müller, 1776

Cypris? sp.

Plate 8, figure 4

Left valve subovate in lateral view; greatest height about one-third from anterior end; dorsal margin moderately arched; ventral margin nearly straight to slightly concave medially; anterior margin rounded, extended below; posterior margin narrowly rounded, most extended a little below midheight. Valve strongly

convex in ventral half; swollen ventral surface overhangs margin.

Surface periphery ornamented by fine concentric ridges; medial portion bears similar ridges arranged more or less longitudinally.

Internal features concealed by matrix.

Length 1.00 mm, height 0.49 mm, thickness of left valve 0.39 mm.

Remarks: In general outline this form is related to *Cypris* Müller. Its concentric ornamentation, its general shape, and its strongly convex ventrum are reminiscent of *Cytheropteron concentricum* (Reuss), and particularly of *C. concentricum virginea* (Jones) from the Cretaceous of Europe, but the present form does not have the ends strongly compressed. Lack of knowledge concerning the internal features of the present specimen prevents its certain classification.

Occurrence: Hatteras Light well No. 1, 6,460–6,470 feet, beds of Trinity (?) and pre-Trinity (?) age, undifferentiated, U.S.N.M. 106909.

Genus **PARACYPRIS** Sars, 1865

Paracypris sp.

Plate 8, figure 7

Shell sublanceolate in side view; greatest height about median; dorsal margin moderately arched; ventral margin nearly straight, slightly concave medially; anterior margin broadly rounded; posterior margin narrowly rounded, strongly extended ventrally. Left valve larger than right, extending beyond the other around entire periphery. Valves moderately convex, greatest convexity median. Surface of single specimen at hand poorly preserved but probably was smooth. Internal features not observed.

Length 0.73 mm, height 0.33 mm, thickness 0.24 mm.

Remarks: This form can not be definitely placed in a described species. It is less elongate and less acuminate posteriorly than most species of *Paracypris*. The poor preservation of the present specimen and the lack of information about the internal features prevent more exact classification.

Occurrence: Hatteras Light well No. 1, 6,700–6,710 feet, beds of Trinity (?) and pre-Trinity (?) age, undifferentiated, U.S.N.M. 106911.

Genus **ILYOCYPRIS** Brady and Norman, 1889

Ilyocypris? *tumida* Swain, n. sp.

Plate 8, figures 5, 6

Shell subelliptical in lateral view; hinge margin nearly straight, hinge, a little more than half of shell length; ventral margin nearly straight and subparallel to dorsum, slightly concave medially; anterior margin rounded, subtruncate above; posterior margin more uniformly and broadly rounded. Left valve larger

than right; greatest extension beyond right is in dorsal and posterior regions. Convexity of valves moderate, greatest thickness slightly posterior to midlength.

A shallow, broad, oblique sulcus occurs anterodorsally in each valve and is separated from margin of valve by a low but distinct eye-lobe. Anterior end of each valve strongly compressed as a distinct marginal border. General surface coarsely pitted; the surface of the holotype is abraded, but there is a suggestion of minute secondary pitting; this may be the result of recrystallization of the shell material.

Internal features not observed.

Length of holotype 0.87 mm, height 0.45 mm, thickness 0.37 mm.

Relationships: This species differs from typical members of *Ilyocypris* in having only one dorsal sulcus rather than two, and in having the anterior end strongly compressed, but the subelliptical outline, straight hinge and pitted surface, in addition to the conspicuous sulci, ally it to *Ilyocypris*. Several species of middle Mesozoic ostracodes referred to *Metacypris* Brady, particularly *M. ventrosa* Swain (1946) from the nonmarine Upper Jurassic of Brazil are similar in shape and ornamentation to the present species. However, the typical metacyprids are more convex even in male dimorphs, the sulci are narrower, and the anterior end is not strongly compressed. In most metacyprids the larger sulcus (in species that bear two) is farther back than the sulcus of the new species.

Occurrence: Hatteras Light well No. 1, 6,350–6,360 feet, beds of Trinity (?) and pre-Trinity (?) age, undifferentiated U.S.N.M. 106910. A closely similar species occurs in the Schuler formation, Upper Jurassic of Louisiana (Swain, 1949, pl. 3, fig. 30).

Family BAIRDIIDAE Sars, 1887

Genus BAIRDIA McCoy, 1862

Bairdia? cf. *B. alexandrina* Blake

Plate 8, figure 13

Bairdia subdeltoidea (Münster), Alexander, 1927, Jour. Paleontology, vol. 1, pp. 29–33, pl. 1.

Alexander 1929, Univ. Texas Bull. 2907, p. 61, pl. 3, fig. 5.

(Not) Münster, 1830, Neues Jahrbuch f. Min. u. Geol. p. 64.

Bairdia alexandrina Blake, 1931, Jour. Paleontology, vol. 5, p. 162.

Shell subtriangular in lateral view; greatest height slightly anterad of midlength; dorsal margin very strongly arched, obtusely angled at position of greatest height in left valve; anterodorsal slope of left valve forms an angle of about 40° with a line tangent to apex of dorsum and parallel to greatest length; postdorsal slope forms an angle of about 35° with such a line. Ventral margin of left valve moderately convex, that of right valve sinuous, concave medially. Anterior margin narrowly rounded, posterior margin acuminate,

strongly extended, caudate. Left valve larger than right, extending strongly beyond the other dorsally and ventrally, less strongly anteriorly; posteriorly, overlap not noticeable. Surface sparsely and weakly pitted. Internal features not observed.

Length of figured specimen 1.18 mm, height 0.76 mm, thickness 0.60 mm.

Remarks: The present form evidently is conspecific with that figured and described by Alexander (1929, p. 61, pl. 3, fig. 5) as *B. subdeltoidea* (Münster). Blake (1931, p. 162) considered *B. subdeltoidea* to be a Tertiary species and renamed Alexander's example *B. alexandrina*; but did not demonstrate it to be different from *B. subdeltoidea*. The validity of *B. alexandrina* Blake might be doubted except that Howe (1934, p. 388) figured and described a specimen believed to represent typical *B. subdeltoidea* that is of different shape than *B. alexandrina*. Howe's specimen is less strongly arched dorsally, less extended posteriorly, and more convex ventrally than *B. alexandrina*.

The generic assignment of the species is tentative because the internal features are unknown. If the dorsal slopes are found to contain denticulations, it will be necessary to transfer the species to *Bairdopilata* Coryell, Sample, and Jennings.

Occurrence: In Texas the species has been found only in the Eagle Ford shale (Alexander, 1929, p. 61). The figured example is from the Hatteras Light well No. 1, 4,750–4,760 feet, and its highest observed occurrence in that well is 4,470–4,480 feet, beds of Eagle Ford (?) age, U.S.N.M. 106916.

Genus BAIRDOPILATA Coryell, Sample, and Jennings, 1935

Bairdopilata pondera Jennings

Plate 8, figures 8–12

Bairdopilata pondera Jennings, 1936, Bull. Am. Paleontology, vol. 23, No. 78, p. 45, pl. 6, fig. 9.

Schmidt, 1948, Jour. Paleontology, vol. 22, p. 408, pl. 61, figs. 21, 22.

Shell subtriangular in lateral view; greatest height slightly anterad of midlength; dorsal margin strongly convex, obtusely angulate at position of greatest height in left valve; anterodorsal slope of left valve forms an angle of approximately 40° with a line tangent to position of greatest height and parallel to greatest length; posterodorsal slope forms an angle of approximately 30° with such a line. Ventral margin of left valve moderately convex, of right valve sinuous, concave medially; anterior margin narrowly rounded and extended just ventrad of midheight; posterior margin acuminate and strongly extended below midheight. Left valve much larger than right extending strongly beyond the other dorsally and ventrally, less strongly at ends. Valves rather strongly convex, greatest thickness slightly anterad of midlength. Surface bears

scattered, small, inconspicuous pits that mark external openings of pore canals.

Hinge of right valve consists of a groove in the rather broad hinge face, into which fits a corresponding ridge on left valve. Inner lamellae rather broad, line of concrescence and inner margin nearly coincide. Muscle scar not observed; according to Schmidt (1948, p. 408) the muscle scar consists of about 10 spots: 7 large irregularly disposed spots, and 3 smaller ones.

Length of a figured specimen (plate 8, figure 8) 1.04 mm, height 0.73 mm, thickness 0.54 mm.

Occurrence: Hatteras Light well No. 1, 3,410-3,420 feet, Black Creek formation and below, U.S.N.M. 106912-106915. The species also occurs in the Mount Laurel and Navesink formations of New Jersey (Jennings, 1936), and with *Exogyra cancellata* in the Mount Laurel sand of Delaware and New Jersey (Schmidt, 1948).

Genus **BAIRDIOCYPRIS** Kegel, 1931

Bairdiocypris? sp.

Plate 8, figure 14

Shell subtriangular in lateral view; greatest height about median; dorsal margin strongly arched with posterior slope steeper than anterior; ventral margin of left valve slightly convex, of right valve nearly straight; anterior margin broadly rounded, extended below midheight; posterior margin acuminate rounded, strongly extended below. Left valve larger than right, the umbonate midportion of dorsum extending strongly beyond the flattened hinge-section of right valve. Valves not strongly convex, greatest thickness median. Surface of present specimen poorly preserved but probably was smooth originally. Internal features unknown.

Length 0.67 mm, height 0.46 mm, thickness 0.33 mm.

Remarks: In its general outline, umbonate left valve and lack of anterodorsal sulcus this form is closely related to *Bairdiocypris* Kegel particularly *B. morrisonensis* Roth. It differs from *Schuleridea* Swartz and Swain in the lack of an anteromedian sulcus and in the shortness of the hinge. The single specimen at hand is poorly preserved, making establishment of a new species inadvisable.

Occurrence: Hatteras Light well No. 1, 7,910-7,920 feet, beds of Trinity(?) and pre-Trinity(?) age, undifferentiated U.S.N.M. 106917.

Family **CYTHERIDAE** Baird, 1850

Genus **APATOCY THERE** Triebel, 1940

The following description is adapted from Triebel (1940, p. 169):

Shell of medium size; subtriangular in lateral view; anterior margin broadly rounded; posterior margin more narrowly rounded. Left valve larger than right, overlapping it around entire periphery, greatest extension of left is along dorsal and ventral margins. Greatest convexity approximately

median. Surface lacks coarse ornamentation; it is either smooth or finely punctate. Eye tubercle weakly developed, bordered by a shallow sulcus.

Anterior inner lamellae broadest anteriorly, pierced by numerous, closely spaced simple radial canals which are curved strongly upward in the dorsal third of anterior end; inner margin and line of concrescence coincide. Muscle scar consists of a vertical row of four small spots and larger spot in front.

Hinge of right valve consists of an anterior rounded tooth, an interterminal bar, and a posterior elongate tooth, none of which exhibits crenulations. Hinge elements situated beneath the dorsal margin and separated from it by rabbit-shelf. Hinge of left valve consists of an anterior rounded socket, an interterminal groove and a posterior elongate socket, all defined dorsally by an overhang of margin. Between hinge and dorsal marginal line occurs a more or less well developed accommodation groove (Ausweichfurche). The selvage in both valves lies near the outer margin and parallel with it. Midportion of ventral margin of right valve broadened and separated from outer surface of shell by a strongly developed outer ridge (Auslenke). Relatively elongate specimens, probably male dimorphs, occur with comparatively short and rounded female shells.

Type species: *Apatocythere simulans* Triebel (1940, p. 169).

Occurrence: Lower Cretaceous and Upper Cretaceous(?).

Remarks: This genus is close to *Haplocytheridea* Stephenson in shape and general hinge features, but the hinge surface is not crenulate, and there is an antero-dorsal sulcus that defines the eye tubercle. Like *Apatocythere* some species of *Haplocytheridea* bear the accommodation groove above the hinge surface in the left valve. In the muscle scar of *Haplocytheridea* there are two spots anterad to the main group, but only one in *Apatocythere*. *Schuleridea* Swartz and Swain (1946) is closely similar to *Apatocythere* but the terminal hinge teeth and sockets are crenulate in *S. acuminata* Swartz and Swain, the genotype. The interterminal portion of the left valve hinge of *S. acuminata* consists of a bar rather than a groove, and the interterminal area of the right valve hinge consists of the simple valve edge that either is opposed to the corresponding edge of the left valve or slightly overlaps it. The presence of the accommodation groove above the hinge in the left valve of *Schuleridea* suggests that the left does not overlap the right along the hinge, but the exact relationships are not clear.

Schuleridea umbonata Swartz and Swain lacks observable crenulation of the terminal teeth, and perhaps should be placed in *Apatocythere* but the interterminal area of the left valve consists of a bar rather than a groove, and in the right the midportion of the hinge apparently slightly overlaps the edge of the left.

Apatocythere? lanceolata Swain, n. sp.

Plate 9, figures 39, 41, 42, 46

Shell subovoid-acuminate in lateral view; greatest height about median, dorsal margin moderately convex; ventral margin slightly convex, somewhat sinuous in

right valve; anterior margin broadly rounded, subtruncate above; posterior margin narrowly rounded, most extended a little below midheight. Left valve larger than right, extending beyond the other around entire periphery, forming a small umbo in mid-dorsal region. Valves moderately convex; greatest thickness median.

Surface of valves finely punctate. A shallow, oblique, anterodorsal sulcus defines a small superjacent swelling that probably represents the eye tubercle. Anterior sixths of valves compressed to form a curving marginal zone.

Internal features not observed.

Length of holotype (pl. 9, fig. 39) 0.83 mm, height 0.50 mm, thickness 0.37 mm.

Relationships: In its general outline, umbonate left valve, eye tubercle, and anterodorsal oblique sulcus this species is related both to *Apatocythere* Triebel and to *Schuleridea* Swartz and Swain. Differences in hingement serve to distinguish these genera but the hinge features of *A. lanceolata* are not known. A more strongly arched dorsum makes *Schuleridea* typically more triangular in outline than *Apatocythere*. The elongate shell, together with the other features noted above indicate that the new species belongs in the genus *Apatocythere*.

The type of the genus, *Apatocythere simulans* Triebel, (1940, p. 170) from the upper Hauterivian and lower Barremian of Europe is somewhat less elongate, has a smaller left valve umbo and bears anteromarginal spines, but otherwise is close to the new species.

Occurrence: In the Hatteras Light Well No. 1 the species was obtained from 6,930–6,940 feet, beds of Trinity (?) and pre-Trinity (?) age undifferentiated, U.S.N.M. 106974.

Apatocythere? leguminoidea Swain, n. sp.

Plate 9, figures 40, 43, 45

Shell subelliptical in lateral view; greatest height anterad of midlength; hinge margin gently convex with rounded, very obtuse but distinct cardinal angles; ventral margin slightly convex in left valve, nearly straight to slightly sinuous in right; anterior margin broadly rounded, truncate above midheight; posterior margin more narrowly but also more uniformly rounded. Left valve larger than right and extending beyond the other except in truncated dorsal portion of anterior margin more narrowly but also more uniformly rounded. Convexity moderate, greatest thickness slightly posteromedian.

Anterior and postventral marginal portions of valves compressed to form a flattened border. Elongated eye tubercle at anterodorsal margin bend, subjoined by a shallow oblique sulcus. Surface of single specimen at hand poorly preserved, but fine pitting can be observed in dorsal half of right valve and ventral portion of left valve. Internal features unknown.

Length of holotype 0.93 mm, height 0.55 mm, thickness 0.35 mm.

Relationships: This species is less pointed posteriorly than *A. lanceolata*, n. sp., and is more elongate and lacks the ventral swelling of *A. tumidosa*, n. sp., but like those two species has the anterior end compressed and bears a well-defined anterodorsal oblique sulcus and eye tubercle. *Apatocythere ellipsoidea* Triebel from the Lower Cretaceous of Germany is similar to *A. leguminoidea* in general shape but is slightly more pointed posteriorly and the anterodorsal eye tubercle and sulcus are not so strongly developed.

Occurrence: The holotype is from the Hatteras Light well No. 1, 6,350–6,360 feet, beds of Trinity (?) and pre-Trinity (?) age undifferentiated, U.S.N.M. 106976. In the North Carolina Esso well No. 2 a specimen was obtained from 5,560–5,570 feet in the undifferentiated beds of Trinity (?) and pre-Trinity (?) age, U.S.N.M. 106975.

Apatocythere? tumidosa Swain, n. sp.

Plate 9, figure 44

Shell subovoid in lateral view; greatest height about median; dorsal margin moderately arched, hinge portion nearly straight and slightly more than half of shell length; ventral margin gently convex, that of right valve slightly sinuous; anterior margin broadly rounded, subtruncate above; posterior margin slightly narrower but more uniformly rounded. Left valve larger than right, strongly umbonate along hinge, and otherwise extending strongly beyond right along dorsal slopes and midventrally.

Convexity of possible male dimorphs moderate, that of possible females strong; greatest convexity in ventral half of shell where surface of females is more or less tumid and produces a slight midventral overhang.

Anterior border of shell compressed to form a flattened shelf on each valve. Anterodorsally in right valve and parallel to margin is a low, short ridge that bears eye tubercle at its anterior end; subjacent to ridge is a shallow oblique sulcus. Corresponding ridge in left valve is shorter. Entire surface ornamented by small pits averaging about 0.03 mm in diameter, separated by interspaces of about equal width.

Muscle scar lies just anterad of midlength and consists of a vertical row of 3 or 4 spots with an additional more anterior spot. Hingement and other internal features not observed.

Length of holotype 0.77 mm, height 0.53 mm, thickness 0.37 mm.

Relationships: In general shape, compressed anterior end, and anterodorsal eye tubercle and sulcus this species is close to *A. leguminoidea*, n. sp. which, however, lacks the swollen ventral surface, and the umbonation of the left valve is less pronounced.

Occurrence: The holotype is from the North Carolina Esso well No. 2, 8,300–8,310 feet, beds of Trinity (?)

and pre-Trinity(?) age undifferentiated, U.S.N.M. 106977. Other examples that probably represent the species were obtained from the Hatteras Light well No. 1, 7,640–7,650 feet, 8,020–8,030 feet and 8,110–8,120 feet, all undifferentiated beds of Trinity(?) and pre-Trinity(?) age, and from the North Carolina Esso well No. 2, 5,520–5,530 feet, Trinity(?) group and pre-Trinity(?), undifferentiated.

Genus SCHULERIDEA Swartz and Swain, 1946

Schuleridea hatterasensis Swain, n. sp.

Plate 9, figures 35–38

?*Cytheridea* (*Haplocytheridea*) aff. *C. (H.) thorenensis* Triebel, 1938, *Senckenbergiana*, vol. 20, No. 6, p. 483, pl. 2, figs. 30–34.

Shell subovoid in side view; greatest height about median; hinge margin slightly convex, a little more than half of shell length, with broadly obtuse cardinal angles; ventral margin gently convex, anterior margin broadly and nearly uniformly rounded, slightly truncate above; posterior margin narrowly rounded, extended below. Left valve overlaps and extends beyond right around entire periphery; along hinge, left valve slightly umbonate, extending strongly beyond the right. Valves moderately convex; greatest thickness slightly posteromedian.

Anterior end of right valve strongly compressed, the surface rising steeply behind compressed area; anterior end of left valve less strongly compressed. A shallow oblique sulcus lies venterad of anterocardinal angle and of rounded eye tubercle. Posteroventral marginal areas of each valve compressed. Entire surface of valves ornamented with pits of varied size and spacing; those in central portion widely spaced.

Hinge of left valve consists of an anterior elongate socket with 5 or 6 denticles, an interterminal thick apparently noncrenulate bar and a posterior elongate crenulate socket; dorsad of bar is a wide groove (accommodation groove, "Ausweichfurche") that is externally visible in complete shells; it apparently is unoccupied except when valves are open (see Sylvester-Bradley, 1948, p. 793; Triebel, 1940, p. 213, fig. 103). Hinge of right valve observed in a single, possibly immature, specimen; it consists of simple edge of valve bearing terminal, weakly crenulate, low, elongate, toothlike elevations; the interterminal hinge-edge of right valve probably overlaps interterminal bar of left valve, but the relationship is not clear.

Muscle scar not clearly observed but seems to consist mainly of a median subvertical row of 3 or 4 spots. Inner lamellae of moderate width, broadest anteriorly; line of concrescence and inner margin coinciding.

Length of holotype 0.72 mm, height 0.50 mm, thickness 0.35 mm.

Relationships: In general outline, straight hinge,

umbonate left valve, and anterodorsal short sulcus, this species conforms to characteristics prescribed for *Schuleridea* Swartz and Swain (1946, p. 363). The hinge in that genus was described as consisting of terminal elongate teeth and sockets, crenulate in *S. acuminata* Swartz and Swain, the type species, but not crenulate in *S. umbonata* Swartz and Swain. *S. umbonata* and *S. pentagonalis* Swartz and Swain possibly should be excluded from *Schuleridea*; they are close to *Apatocythere* Triebel (1940, p. 169) but differ slightly from that genus in the nature of the interterminal portion of the hinge.

The hinge of the left valve of *Schuleridea hatterasensis*, like that of *Clithrocytheridea* Stephenson, consists of terminal crenulate sockets separated by a bar. *Clithrocytheridea*, however, lacks the anterodorsal sulcus, the umbonation of the left valve, and at least in typical members of the genus has crenulations along the interterminal portion of the hinge. *S. hatterasensis* differs from other described species in having the anterior end strongly compressed, but otherwise is close to *S. acuminata* Swartz and Swain from the Upper Jurassic of the Gulf region.

Cytheridea (*Haplocytheridea*) *thorenensis* Triebel from the Valanginian of Germany is closely similar to the new species but apparently is not compressed anteriorly. *C. (H.)* sp. aff. *C. (H.) thorenensis* Triebel (1938, p. 483, pl. 2, figs. 30–34) appears to be compressed anteriorly and may be identical to *S. hatterasensis*.

Occurrence: The holotype is from the Hatteras Light well No. 1, 6,477–6,482 feet, U.S.N.M. 106967; other specimens were obtained from the same well at a depth of 6,300–6,310 feet as well as from deeper levels, all in undifferentiated beds of Trinity(?) and pre-Trinity(?) age, U.S.N.M. 106968–106970. In the North Carolina Esso No. 2 well the species was obtained from 5,330–5,340 feet and deeper, in undifferentiated beds of Trinity(?) and pre-Trinity(?) age.

Schuleridea? lacustris Swain, n. sp.

Plate 9, figure 48

Shell subovate-triangular in lateral view; highest medially; dorsal margin strongly convex, gently and obtusely angulate at, and slightly truncate on either flank of, position of greatest height; ventral margin gently convex; anterior margin broadly rounded; posterior margin narrow, slightly extended medially, truncate above. Left valve larger than right, extending strongly beyond the other mid-dorsally and along ventrum, less strongly elsewhere. Valves moderately convex, greatest thickness slightly behind middle.

Surface of each valve bears prominent, broad low ridges parallel to terminal margins; at anterior end, a furrow lies between valve margin and ridge; dorsad

of midheight each ridge bears a rounded low node; behind dorsal half of anterior ridge is an oblique shallow sulcus; a small low node lies just behind sulcus near its ventral termination. General surface of valves finely punctate. Internal features not observed.

Length of holotype and only known example 0.61 mm, height 0.42 mm, thickness 0.30 mm.

Relationships: This species is very close to *S. hatterasensis*, n. sp. in outline, overlap, anterior marginal furrow, and anterodorsal sulcus. It differs from *S. hatterasensis* in possessing prominent, nodose, terminal marginal ridges. Strong ridges and nodes are a characteristic feature of several groups of nonmarine ostracodes, including species of *Metacypris*, *Cypridea*, *Ilyocypris*, and *Cytherissa*. The present example suggests a fresh- or brackish-water environment for the containing sediments. *S. hatterasensis* may represent its marine morphological equivalent.

Occurrence: N. C. Ezzo No. 2 well, 4,970–4,980 feet, beds of Trinity (?) and pre-Trinity (?) age undifferentiated, U.S.N.M. 106979.

Schuleridea cf. *S. pentagonalis*, Swartz and Swain

Plate 9, figure 49

Schuleridea pentagonalis, Swartz and Swain, 1946, Jour. Paleontology, vol. 20, p. 368, pl. 53, figs. 1–8.

Shell subovoid in lateral view; highest medially; dorsal margin strongly convex; ventral margin gently convex; anterior broadly rounded, extended below, posterior margin more narrowly rounded, strongly extended below. Left valve larger than right and completely extending beyond it; greatest extension in umbonate dorsum and midventrally. Convexity of valves moderate, greatest thickness median.

Anterior end of right valve very slightly compressed to form a flattened border. Anterodorsally a low ridge parallels margin and probably contains eye spot; subjacent to ridge is a broad, shallow, oblique sulcus. Surface minutely and weakly punctate. Internal features not observable.

Length of figured specimen 0.80 mm, height 0.53 mm, thickness 0.44 mm.

Remarks: In shape, anterodorsal sulcus, and weakly pitted surface this form is much like *Schuleridea pentagonalis* Swartz and Swain and is here provisionally included in that species. The slight compression of the anterior end in the present form is atypical of *S. pentagonalis*. Lack of knowledge of its internal features, and its rather poor preservation prevent certain classification.

Occurrence: Hatteras Light well No. 1, core 9,115–9,116 feet, Upper Jurassic (?) U.S.N.M. 106980. *S. pentagonalis* occurs in the Schuler formation, Upper Jurassic of the central Gulf region (Swartz and Swain, 1946, p. 368; Swain, 1949, p. 1,236).

Schuleridea cf. *S. acuminata* Swartz and Swain

Plate 9, figure 47

Schuleridea acuminata Swartz and Swain, 1946, Jour. Paleontology, vol. 20, p. 366, pl. 52, figs. 1–10, text figures 1 a–c.

Shell subtriangular in side view; greatest height slightly anterad of midlength; dorsal margin very strongly arched; ventral margin gently convex; anterior margin broadly rounded, most extended a little below midheight; posterior margin acuminate, strongly extended below. Left valve much larger than right, overlapping and extending beyond the other around entire periphery, greatest extension in umbonate middorsal region and midventrally. Valves moderately convex, greatest thickness median.

Terminal edges of right valve bear low ridgelike swellings; corresponding features not observed on left valve. Anterodorsal low eye tubercle and subjacent shallow oblique sulcus clear in right valve, but are much less distinct on left. Surface of single specimen at hand poorly preserved, but part is ornamented with small, closely spaced pits. Internal features not observed.

Length 0.83 mm, height 0.56 mm, thickness 0.40 mm.

Remarks: This specimen is like *S. acuminata* Swartz and Swain from the Schuler formation, Upper Jurassic of Arkansas in general shape, posterior marginal swelling on right valve, pitted surface, and anterodorsal sulcus, although the Schuler specimens do not have the dorsal margin of the left valve so strongly arched and lack the anteromarginal swelling on the right valve.

Occurrence: Hatteras Light well No. 1, 9,100–9,110 feet, beds of Schuler (?) age. U.S.N.M. 106978 *S. acuminata* occurs in the Schuler formation, Upper Jurassic of Louisiana and Texas (Swartz and Swain, 1946, p. 366; Swain, 1949, p. 1,236).

Genus *ASCIOCYTHERE* Swain, n. gen.

Shell subovate in lateral view; highest near middle; dorsal margin moderately convex; ventral margin gently convex; ends rounded. Left valve typically larger than right. Convexity of valves moderate; surface smooth or pitted.

Hinge of right valve consists of terminal crenulate, elongate teeth; the intervening valve edge faintly grooved for reception of opposing left valve bar. Hinge of left valve consists of terminal crenulate, elongate sockets, separated by a smooth or denticulate bar, dorsad of which is a well-defined accommodation groove. Inner lamellae narrow; line of concrescence and inner margin nearly coincide. Numerous simple radial canals occur around entire free margin. Muscle scar consists of an anteromedian vertical row of four spots, together with two additional more anterior spots.

Type species: *Bythocypris rotundus* Vanderpool.

Geologic range: Upper Jurassic?, Lower Cretaceous, and Upper Cretaceous (?).

Relationships: The hinge of this genus differs from that in *Clithrocytheridea* Stephenson (1936) in lacking a well defined crenulated groove in the right valve, and in possessing a broader accommodation groove. *Clithrocytheridea* also has the dorsal slopes typically more truncated than in the present form. *Haplocytheridea* Stephenson (1936) has the posterior end more acuminate and the interterminal portions of its hinge are different. The Cretaceous representatives of *Haplocytheridea* possess some atypical hinge features that are in need of further study.

Asciocythere rotunda (Vanderpool)

Plate 8, figures 22-33

Bythocypris rotundus Vanderpool, 1928, Jour. Paleontology, vol. 2, p. 102, pl. 13, figs. 5, 6.

? *Cytheridea amygdaloides brevis* (Cornuel), Alexander, 1929, Texas Univ. Bull. 2907, p. 70, pl. 4, fig. 13.

? *Cytheridea rotundus* Vanderpool, 1933, Jour. Paleontology, 1933, vol. 7, p. 411.

Shell subovate in lateral view; greatest height about median; dorsal margin strongly and nearly uniformly convex; ventral margin slightly convex in left valve, nearly straight to slightly sinuous in right valve; anterior margin broadly rounded, truncate in dorsal half; most extended medially, posterior margin more narrowly rounded, slightly truncate above, most extended a little ventrad of midheight. Left valve much larger than right, extending strongly beyond the other dorsally and ventrally, less strongly terminally. Valves rather strongly convex, greatest thickness median. Surface bears faint, widely separated small pits, otherwise smooth. Right valve in well preserved specimens bears a very weak groove parallel to anterior margin, and a faint ridge along ventral portion of posterior margin; corresponding features not observed on left valve.

Hinge of left valve consists of an anterior, elongate, shallow, rather coarsely but weakly denticulate socket, an interterminal, high, apparently nondenticulate bar, and a posterior elongate, shallow, weakly denticulate socket; dorsad of median bar is a broad accommodation groove for reception of mid-portion of dorsal margin of right valve; complete hinge 0.7 and interterminal bar 0.5 of shell length, respectively. Hinge of right valve not clearly observed. Inner lamellae narrow, steeply inclined inward; line of concrescence and inner margin coincide. Muscle scar not observed.

Length of a figured specimen (pl. 8, fig. 22) 0.67 mm, height 0.44 mm, thickness 0.35 mm.

Relationships: The present species is closely similar in outline and convexity to several species of *Cytheridea*, including *C. reniformis* van Veen, *C. limburgensis* van Veen and *C. fortior* van Veen from the late Upper Cretaceous Maestrichtian stage of the Netherlands (van Veen, 1934). The writer does not know whether the hinging of the Netherlands forms is more

closely allied to *Cytheridea* or to *Asciocythere*. The form identified as *Cytheridea* (*Haplocytheridea*?) *amygdaloides brevis* (Cornuel) by Alexander (1929) and Schmidt (1948) is, among American species, very close to *Asciocythere rotunda*. The example figured by Alexander from the Kiamichi formation and upper part of Goodland limestone of Texas is slightly more convex ventrally and has the ventral overlap more closely restricted to the midportion of the shell, but otherwise seems to be the same as the present species. The writer is not acquainted with the hinge of the species from Texas, but external characteristics suggest that it may be considered conspecific with *A. rotunda*.

The examples described and figured as *Haplocytheridea*? *amygdaloides brevis* (Cornuel), by Schmidt (1948, p. 426, pl. 62, figs. 20-22) have the interterminal portion of the hinge crenulate rather than unornamented as in the present species, have broader and flatter inner lamellae, and are more strongly pitted.

Many years ago *Cythere amygdaloides brevis* Cornuel was placed in synonymy with *Cytherella ovata* (Roemer) (Jones, 1849, p. 28; Jones and Hinde, 1890, p. 45).

Occurrence: Hatteras Light well No. 1, 6,300-6,310 feet, and below, beds of Trinity (?) and pre-Trinity (?) age, undifferentiated, U.S.N.M. 106923-106931.

Asciocythere? cf. *A.?* *amygdaloides* (Cornuel)

Plate 8, figures 37-39

Cythere amygdaloides Cornuel, 1846, Soc. Geol. France, Mem. ser. 2, vol. 1, p. 197, pl. 7, figs. 1-9.

Cytheridea amygdaloides (Cornuel), Alexander, 1929, Texas Univ. Bull. 2907, p. 69, pl. 4, figs. 16, 17.

Shell elongate-subreniform in lateral view; greatest height slightly anterad of middle; dorsal margin moderately convex, anterior slope steeper; ventral margin slightly sinuous; anterior margin broadly rounded; posterior margin slightly more narrowly rounded. Left valve larger than right, and extending more or less uniformly beyond the other around entire periphery. Valves moderately convex, greatest thickness median.

Terminal margins of right valve bear narrow low rims; surface bears scattered large very weak pits.

Hinge of left valve consists of an anterior elongate socket bearing 5 or 6 transverse denticles, an interterminal high non-denticulate bar, dorsad of which is a conspicuous accommodation groove, and a posterior elongated socket; in two separated left valves at hand, posterior socket filled with matrix which obscures possible denticulations. Hinge of right valve observed in only one abraded specimen; it bears a faint groove along hinge margin but does not have other hinge features preserved. Inner lamellae narrow, sloping steeply toward interior of valve; line of concrescence and inner margin apparently coincide. Muscle scar consists of an anteromedian vertical row of four spots, together with a single, more anterior spot.

Length of a figured specimen (pl. 8, fig. 38) 0.83 mm, height 0.46 mm, thickness 0.34 mm.

Remarks: This species conforms to characteristics prescribed for *Asciocythere* in shape, ornamentation and hingement. The present specimens are similar in external appearance to *Cytheridea amygdaloides* (Cornuel) as figured and described by Alexander (1929) from the Kiamichi formation of Texas, but there is uncertainty about the generic status of both Alexander's and Cornuel's specimens. Cornuel's original figures show no denticulation of the terminal teeth and sockets nor does he mention it in his description, so the species may be more closely related to *Apatocythere* than to *Asciocythere*.

As compared to *Asciocythere rotunda* (Vanderpool) the present specimens are more elongate and lack the strong dorsal and ventral left valve overlap of that species. Otherwise the two are so similar that it may prove desirable to consider them as dimorphs of a single species.

Occurrence: Hatteras Light well No. 1, core sample 6,132–6,137 feet and in several drill-cutting samples below that level down to 6,760–6,770 feet, beds of Trinity (?) and pre-Trinity (?) age, undifferentiated, U.S.N.M. 106935–106937.

Asciocythere? *triangularis* Swain, n. sp.

Plate 8, figure 34

Shell subtriangular in lateral view; greatest height slightly behind middle of shell; dorsal margin strongly convex; ventral margin moderately convex; anterior margin broadly rounded, somewhat extended below; posterior margin more broadly rounded, extended below. Left valve larger than right, extending strongly beyond the other dorsally and ventrally, less strongly at ends. Valves moderately convex; thickest slightly behind center. Surface of holotype poorly preserved, but seems to have lacked ornamentation.

Internal features not observable because shell is filled with recrystallized matrix.

Length of holotype 0.58 mm, height 0.43 mm, thickness 0.37 mm.

Relationships: In general shape, overlap, and lack of anterodorsal eye node and sulcus this species conforms to *Asciocythere*, but lack of knowledge as to its internal characteristics prevents definite classification. There is also uncertainty as to the orientation of the form. As it is here oriented the greatest height and more broadly rounded end are posterior in position whereas in typical *Asciocythere* the reverse is true. Alexander and Alexander (1933) observed reversal of valve size and hingement in a species of *Cytheridea*, and it is possible the present form may also be an example of such reversal. The strongly arched dorsum of the larger valve precludes assignment to *Cytherella* Jones. *Cytheridea ovata* Bosquet, as figured by van

Veen (1935) is like the present species in the posterior position of the greatest height and the broader rounding of the posterior end and, although *Asciocythere triangularis* is somewhat shorter and higher, may prove to be conspecific with the species figured by van Veen and with the example herein assigned to *A. macropunctata*.

Occurrence: Hatteras Light well No. 1, 6,430–6,440 feet, beds of Trinity (?) and pre-Trinity (?) age, undifferentiated, U.S.N.M. 106932.

Asciocythere macropunctata Swain, n. sp.

Plate 8, figure 21

?*Cytheridea ovata* Bosquet. Van Veen, 1935, *Natuurhist. Maandblad*, Jaargang 24, No. 9, p. 106, pl. 3, figs. 1–24.

Shell subovate in lateral view; greatest height slightly behind center of shell; dorsal margin moderately convex; anterior slope slightly flattened; ventral margin gently convex; anterior margin rounded, slightly extended below midheight; posterior margin more broadly rounded, slightly angulate and extended at midheight. Left valve larger than right, overlapping and extending strongly beyond the other around entire periphery. Valves moderately convex, greatest thickness slightly posterior to middle. Surface bears widely separated rather large pits; interspaces equaling two to four times width of pits.

Hinge not clearly seen, but in left valve it consists of terminal sockets, both of which apparently are crenulate, and an interterminal bar that is not visibly crenulate; dorsal of bar is a narrow accommodation groove. Other internal features not observed.

Length of holotype 0.58 mm, height 0.36 mm, thickness 0.27 mm.

Relationships: The hingement (although incompletely known), the general outline, and overlap relationships of this species ally it with *Asciocythere*. As compared to *A. rotunda* (Vanderpool), it is more coarsely pitted and the greatest height is postmedian rather than median. *Cytheridea ovata* Bosquet as figured by van Veen (1935) is very close to the present example and the two may be conspecific. Lack of knowledge of the hinge of the species from the Netherlands prevents a definite comparison.

Occurrence: Hatteras Light well No. 1, core 3,693–3,703 feet, beds of Eutaw (?) age, U.S.N.M. 106933.

Asciocythere? *acuminata* Swain, n. sp.

Plate 8, figure 20

Shell elongate subovate in lateral view; highest medially; dorsal margin moderately arched, slightly truncated before and behind point of greatest height and along posterior slope; ventral margin of left valve gently convex, of right valve nearly straight; anterior margin rather broadly rounded, slightly extended below; posterior margin narrowly rounded extended

below. Left valve much larger than right, overlapping and extending beyond the other around entire periphery. Valves strongly convex, greatest thickness slightly postmedian.

Posterior termination of left valve thickened to form a slight protuberance at position of greatest length; posterior end of right valve bears a similar small protuberance that lies slightly ventrad of corresponding feature on left valve. Ventral third of right valve slopes steeply toward margin. Narrow marginal border of left valve slopes rather sharply to the contact with right valve. Surface smooth except for a few widely spaced small shallow pits.

Hinge not observed in the single specimen at hand. Muscle scar as viewed by reflected light is seen to consist of a subvertical row of four spots near middle of shell, together with two more anterior spots.

Length of holotype 0.71 mm, height 0.40 mm, thickness 0.35 mm.

Relationships: In outline, convexity, strong left valve overlap and generally smooth surface this form is close to *Asciocythere?* cf. *A. amygdaloides* (Cornuel) of this paper, but incomplete knowledge of the internal features precludes definite classification of both species. *A. acuminata* is somewhat more pointed posteriorly and lacks the terminal low marginal rims found in the right valve of *A. amygdaloides*. *Cytheridea ovata* Bosquet as figured by van Veen (1935, pl. 3, figs. 1-25) is similar in overlap and convexity, and general outline but has the greatest height markedly posterior in position.

Occurrence: Hatteras Light well No. 1, 3,780-3,790 feet, beds of Eutaw (?) age, U.S.N.M. 106922.

Asciocythere? *leguminoides* Swain, n. sp.

Plate 8, figure 36

Cytheridea sp. Swain, 1949, Am. Assoc. Petroleum Geologists Bull., vol. 33, p. 1,236, pl. 33, figs. 9, 10.

Shell subovate in lateral view; highest medially; dorsal margin moderately convex; ventral margin of right valve nearly straight, of left valve slightly convex; anterior margin uniformly rounded; posterior margin, somewhat extended a little ventrad of mid-height, truncate above. Left valve larger than right, extending beyond the other around entire periphery. Valves strongly convex, with greatest thickness slightly posterior to midlength. Surface smooth. Internal features not observed.

Length of holotype 0.64 mm, height 0.40 mm, thickness 0.35 mm.

Relationships: In general outline and strong convexity this species is related to *Asciocythere*, but lack of knowledge of its internal characters precludes definite classification. An apparently identical form occurs in the Dorcheat member of the Schuler formation of Louisiana (Swain, 1949, p. 1,236, pl. 3, figs. 9, 10).

Occurrence: Hatteras Light well No. 1, 9,030-9,040 feet, beds of Schuler (?) age, U.S.N.M. 106934.

Genus *HAPLOCYTHERIDEA* Stephenson, 1936

Haplocytheridea? *graysonensis* (Alexander)

Plate 8, figures 16, 17

Cytheridea graysonensis Alexander, 1929, Texas Univ. Bull. 2907, p. 72, pl. 5, figs. 3, 4.

Shell subovate-acuminate in lateral view; greatest height approximately median; dorsal margin moderately convex; ventral margin nearly straight, slightly sinuous, with slight concavity in posterior half; anterior margin broadly rounded; posterior margin narrowly rounded, extended below. Left valve larger than right, extending beyond the other rather strongly except posteriorly. Convexity of valves moderate with greatest thickness median to slightly posteromedian. Surface smooth.

A separated pair of valves is available for study in the present material, but neither shell clearly reveals the internal features. In the left valve the hinge seems to have terminal crenulate sockets, but the area between them is poorly preserved; there is, however, a well-defined accommodation groove dorsad of the interterminal area. In the right valve, terminal elongate toothlike elevations separated by a bar formed of valve edge are preserved. Other internal features not observable.

Length of a figured specimen (pl. 8, fig. 17) 0.70 mm, height 0.40 mm, thickness 0.24 mm.

Remarks: The observed hinge features, the shell outline, and the overlap relationships ally the present species with *Haplocytheridea* Stephenson and it is tentatively placed in that genus.

Occurrence: Hatteras Light well No. 1, core 4,485-4,495 feet, beds of Eagle Ford (?) age (U.S.N.M. 106919) and in samples as deep as 7,310-7,320 feet, in the undifferentiated beds of Trinity (?) and pre-Trinity (?) age. Alexander (1929, p. 72) recorded it in the upper part of the Washita group and lower part of the Woodbine formation in northern Texas, and found it to be most abundant in the Grayson formation.

Haplocytheridea? *berrysi* Swain, n. sp.

Plate 8, figure 18

Shell elongate-subovate in lateral view; highest approximately two-fifths from anterior end; dorsal margin moderately convex; ventral margin nearly straight; anterior margin broadly rounded; posterior margin very narrowly rounded, strongly extended below. Left valve larger than right, overlapping and extending beyond the other conspicuously except at position of greatest height along dorsum where the overlap is much less. Convexity of valves moderate, greatest thickness median or slightly anteromedian.

Surface ornamented by closely but somewhat irregularly spaced shallow pits. Anterior end compressed to form a narrow shelf paralleling margin of each valve. Posterior narrowly rounded termination of right valve, thickened to form slight protuberance.

Hingement not observed. Muscle scar not clearly visible but the main element is a vertical anteromedian row of four spots.

Length of holotype 0.73 mm, height 0.39 mm, thickness 0.30 mm.

Relationships: In general shape, compressed anterior marginal zone and slight posterior protuberance on the right valve, this species is close to *H. monmouthensis* (Berry). *H. ? berryi* is more densely pitted and somewhat longer in proportion to height than *H. monmouthensis*.

Occurrence: Hatteras Light well No. 1, core 3,380–3,390 feet, Black Creek formation, U.S.N.M. 106920.

Haplocytheridea monmouthensis (Berry)

Plate 8, figure 19

Cytheridea monmouthensis Berry, 1925, Am. Jour. Sci., 5th ser., vol. 9, p. 486, fig. 10. Alexander, 1929, Texas Univ. Bull. 2907, p. 74, pl. 5, figs. 11–14.

Cytheridea (Haplocytheridea) monmouthensis Berry. Swain, 1948, Maryland Dept. Geol. Mines, and Water Res., Bull. 2, p. 212, pl. 14, fig. 14.

Shell subtriangular in lateral view; highest about two-fifths from anterior end, dorsal margin strongly convex, truncate on either side of point of greatest height; ventral margin gently convex in left valve, nearly straight in right valve; anterior margin broadly rounded, slightly extended medially; posterior margin acuminate rounded, strongly extended ventrally. Left valve larger than right, extending strongly beyond the other except in anterior and posterior portions of ventrum. Valves strongly convex, greatest thickness median.

Surface bears scattered pits; right valve bears three medial subvertical furrows lined with pits; corresponding furrows much weaker or absent in left valve. Posterior acuminate termination of both valves bear small protuberances; one on right valve slightly more ventral in position.

Internal features of present specimens not observed.

Length of figured specimen 0.75 mm, height 0.45 mm, thickness 0.36 mm.

Remarks: In shape, sparsely pitted surface, median vertical pitted grooves, and posteroventral flangelike expansions the present specimens resemble *Haplocytheridea monmouthensis* (Berry).

The internal features of the species have been observed in specimens from the Blufftown formation at Union Springs, Ala. The right valve hinge consists of terminal, elongate, crenulate teeth, an interterminal low, narrow bar of which the dorsal flank is crenulate,

and a narrow groove lying dorsad of the bar and teeth. The hinge of the left valve consists of terminal elongate crenulate sockets passing into an interterminal narrow crenulate groove, dorsad of groove, and separated from it by a narrowed ridgelike extension of the valve edge is a weak accommodation groove. The muscle scar consists of an anteromedial vertical row of four spots, together with two slightly more anterior spots. Inner lamellae of moderate width anteriorly and ventrally, narrow posteriorly; line of concrescence and inner margin separate. Radial canals numerous and closely spaced anteriorly, few and widely spaced ventrally and posteriorly.

Occurrence: North Carolina Esso well No. 2, 2,750–2,760 feet, Black Creek formation, U.S.N.M. 106921. The species occurs also in the Monmouth formation of Maryland (Berry, 1925, Swain, 1948) in the upper two-thirds of the Navarro group of northern Texas (Alexander, 1929, p. 75) and in the Blufftown, Demopolis, Ripley, Prairie Bluff, and Providence formations of Alabama.

In examples of this species from the Blufftown formation of Alabama are numerous instances of reversal of overlap and hingement. Alexander and Alexander (1933) have pointed out other instances of reversal in Cretaceous *Cytheridea*.

Haplocytheridea? sp. aff. H. ? plummeri (Alexander)

Plate 8, figure 15

Shell elongate-subtriangular in side view; highest about two-fifths from anterior end; dorsal margin moderately convex, obtusely angulated at point of greatest height; ventral margin of left valve slightly convex, of right valve nearly straight to slightly sinuous; anterior margin broadly rounded; posterior margin acuminate, strongly extended below, subtruncate above. Left valve larger than right, extending strongly beyond the other along ventrum, somewhat less strongly elsewhere. Valves moderately convex, greatest thickness slightly anteromedian.

Surface sparsely set with small pits; medially, pits arranged in two or three crude subvertical short rows. Anterior end of right valve bears a weak furrow parallel to margin. At posterior acumination of right valve in some examples shell thickened to form a small protuberance.

Internal features of present specimens not observed.

Length of figured specimen 0.68 mm, height 0.40 mm, thickness 0.28 mm.

Remarks: The present examples are close to *Cytheridea plummeri* Alexander (1929, p. 73) in shape and sparsely pitted surface but differs in possessing a anterior marginal furrow on the right valve and in lacking the median vertical pitted grooves commonly found in *C. plummeri*.

The hinge in Alexander's Texas examples of *Cyther-*

idea plummeri is unknown but specimens from the Middle Atlantic region ascribed to the species by Schmidt (1948, p. 425) have the left valve hinge composed of terminal sockets and an intervening bar. Although in other respects the species is like *Haplocytheridea* Stephenson, the left valve hinge of that genus bears an interterminal groove rather than a bar, hence the tentative assignment of *C. plummeri* to *Haplocytheridea*.

Occurrence: Hatteras Light well No. 1, 3,550–3,560 feet, Black Creek(?) formation and below. The figured specimen (pl. 8, fig. 15) is from a drill-cutting sample, 3,990–4,000 feet in beds of Eutaw(?) age, U.S.N.M. 106918.

Genus **BRACHYCYTHERE** Alexander, 1933

Brachycythere darensis Swain, n. sp.

Plate 8, figures 40, 41

Shell rather large and thick-walled, subovate in lateral view; greatest height about two-fifths from anterior end; dorsal margin moderately convex; ventral margin slightly less convex; anterior margin broadly rounded and most extended a little ventrad of mid-height, subtruncate above, medial and ventral portions of each valve weakly crenulate; posterior margin narrowly rounded, extended ventrad of midheight. Left valve larger than right, extending beyond the other except midventrally; most pronounced extension along dorsum. Valves strongly convex, greatest thickness in ventral third of shell and slightly back of middle.

Midportion of ventrum in each valve strongly inflated to form blunt alae that slightly overhang ventral margins; a broad but distinct and high ridge forms crest of each ala. Anterior end somewhat compressed; posterior and postventral area of each valve more strongly compressed. Each valve bears a low anterodorsal eye tubercle bordered ventrally by a weak, oblique furrow. General surface smooth and shiny.

Internal features not observed.

Length of holotype 1.04 mm, height (including alae) 0.72 mm; thickness 0.61 mm.

Relationships: Like *B. sphenoides* (Reuss) (Alexander, 1933, p. 206) from the Upper Cretaceous, and *B. hadleyi* Stephenson (1946, p. 333) from the Eocene *B. darensis* bears a conspicuous ridge along the crest of each ala; it is much less pointed posteriorly than *B. sphenoides*, and has less ventral overhang of the alae beyond the margin of the shell than *B. hadleyi*. In general outline of the shell it is similar to *B. ovata* (Berry) (1925, p. 484) from the Upper Cretaceous but the latter lacks ridges surmounting the alae. A form identified as *B. hadleyi* Stephenson (Swain, 1951) from the Paleocene(?) in the North Carolina Esso No. 2 well is very close to the present species and may be identical, but has a more narrowly rounded posterior

margin, in which the dorsal slope is more truncate, and a slightly more convex dorsum.

Occurrence: Hatteras Light well No. 1, 3,200–3,210 feet, Black Creek(?) formation, U.S.N.M. 106938.

Brachycythere sphenoides (Reuss)

Plate 8, figures 42, 43

Cythere sphenoides Reuss, 1854, Denkschr. K. Akad. Wissen. Wien, vol. 7, p. 141, pl. 26, fig. 2.

Alexander, 1929, Texas Univ. Bull. 2907, p. 81, pl. 7, figs. 9, 14.

Cytheropteron sphenoides (Reuss), Jones and Hinde, 1889, Suppl. Mono. Cret. Entom., England, Ireland, Palaeontographical Soc. London, p. 33, pl. 1, figs. 18–20.

Cytheropteron sp. B., Israelsky, 1929, Arkansas Geol. Survey, Bull. 2, p. 8, pl. 1A, figs. 2a–c.

Brachycythere sphenoides (Reuss), Alexander 1933, Jour. Paleontology, vol. 7, p. 205, pl. 25, figs. 3a–c, 14a, b, pl. 26, figs. 7a, b, pl. 27, fig. 19.

Shell subtriangular in lateral view; highest about two-fifths from anterior end; dorsal margin strongly arched, with posterior slope truncated and slightly concave, ventral margin gently convex; anterior margin broadly rounded; posterior margin acuminate rounded, strongly extended submedially. Left valve much larger than right, extending strongly beyond the other as a small umbo in mid-dorsal region.

Midportion of each valve strongly convex, with ventrum expanded to form short alae, crest of each ala surmounted by a broad rather high ridge parallel to margin; shell triangular in end view. Posterior end of shell strongly compressed; anterior end less strongly compressed. Anterodorsally each valve bears a low eye tubercle subjoined by a short oblique sulcus. General surface of valves smooth except for scattered shallow pits. Internal features not observed.

Length of a figured specimen 0.91 mm, height 0.58 mm, thickness 0.50 mm.

Remarks: The present examples are slightly less acuminate posteriorly, and most do not have preserved tiny terminal spines characterizing the forms identified as this species by Alexander (1929, p. 81, 1933, p. 206) from the Austin chalk and lower part of the Taylor marl of northern Texas; in other respects they are similar. *B. taylorensis* (Alexander) from the upper part of the Austin chalk and lower part of the Taylor marl is a nearly identical species but bears a punctate ridge at the crests of the alae and is more broadly rounded posteriorly.

Occurrence: Hatteras Light well No. 1, core, 3,500–3,510 feet, Black Creek(?) formation, U.S.N.M. 106939.

Brachycythere nausiformis Swain, n. sp.

Plate 8, figures 44–47

Shell subtriangular to subovate-acuminate in lateral view; greatest height a little more than one-third from anterior end; dorsal margin strongly arched, long

posterior slope truncated and slightly concave; ventral margin gently to moderately convex; anterior margin broadly rounded, bearing tiny denticulations on each valve in well preserved specimens; posterior margin acuminate, strongly extended medially, truncate and slightly concave above.

Left valve larger than right, extending very strongly beyond the other as a short umbo anteromid-dorsally, less strongly elsewhere. Median surface of valves strongly convex with ventrum swollen to produce short alate expansions, and projecting beyond ventral contact of valves; crest of each ala bears a low longitudinal ridge with a broad furrow about it; a second weak longitudinal ridge lies dorsad of furrow. A prominent elongate eye tubercle lies at anterodorsal angle; ventrad of tubercle in right valve is a short oblique sulcus, corresponding feature in left valve is deeper, wider and more pit-like. Anterior sixth of shell compressed, sharply defined with respect to median swollen portion, and in some specimens a narrow groove separates the two areas. Posterior end strongly compressed but passes gradually into median surface except at postero-ventral terminations of alae where an abrupt change of slope occurs. General surface bears widely spaced deep pits.

Muscle scar consists of a slightly anteromedian, sub-vertical row of four or five spots and a single more anterior spot. Other internal features not seen.

Length of cotype (male dimorph, U.S.N.M. 106940) 0.91 mm, height 0.56 mm, thickness 0.43 mm; length of cotype (female dimorph, U.S.N.M. 106941) 1.05 mm, height 0.57 mm, thickness 0.51 mm.

Relationships: Although the hinge of this species has not been seen, the general outline, overlap relationships, ventral alation, and musculature ally it with *Brachythere*. In comparison to *B. sphenoides* (Reuss) the new species is more strongly pitted, and has its greatest height more anterior in position. *B. jerseyensis* Jennings (1936, p. 48) from the Navesink marl of New Jersey is a strongly pitted form, but the posterodorsal slope is not truncated and the posterior terminations of the alae are more strongly elevated. *B. infundibuliformis* van Veen (1935, p. 28) from the Cretaceous of Holland bears close resemblance to the present example in outline, but is more weakly alate, lacks the ventral longitudinal ridge and furrow and lacks the deep surface pits.

Occurrence: Hatteras Light well No. 1, 3,640–3,650 (U.S.N.M. 106942) Black Creek(?) formation, and 3,780–3,790 feet (U.S.N.M. 106940), beds of Eutaw(?) age; North Carolina Esso well No. 2, 2,750–2,760 feet (U.S.N.M. 106941), beds of Eutaw(?) age or Black Creek(?) formation.

Brachythere arachoides (Berry)

Plate 9, figure 22

Cythere arachoides Berry, 1925, Am. Jour. Sci., 5th ser., vol. 9, p. 484, fig. 5.

Cythere rectangulapora Berry, 1925, Am. Jour. Sci., 5th ser., vol. 9, p. 483, fig. 4.

Brachythere arachoides (Berry), Schmidt, 1948, Jour. Paleontology, vol. 22, p. 415, pl. 62, figs. 13–16.

Shell subpyriform in lateral view; highest about one-third from anterior end; dorsal margin sinuous, about three-fourths of shell length and with broadly obtuse cardinal angles; ventral margin gently convex, posteriorly converging strongly with dorsum; anterior margin broadly rounded, finely spinose in ventral two-thirds; posterior margin bluntly acuminate, extended medially. Left valve larger than right, extending beyond the other along ventrum and at cardinal angles; posteriorly, right valve extends slightly beyond left.

Ends compressed; swollen midportion of each valve bears a broad ventral ridgelike longitudinal swelling, a median longitudinal ridge, and a dorsal longitudinal ridge that projects beyond edge of valve medially and is transected by an oblique furrow just behind antero-cardinal angle. A large, rounded, median pit, bordered anteriorly by a narrow ridge, lies between middle and dorsal longitudinal ridges. General surface rather coarsely punctate. Internal features not observed.

Length of figured specimen 0.83 mm, height 0.52 mm, thickness 0.49 mm.

Remarks: The shape and surface ornamentation of this species ally it with *Protocythere* Triebel (1938, p. 180) but the hingement in examples from other localities is closer to that of *Brachythere* Alexander.

The hinge of a left valve from the Marlbrook marl (late Taylor age) of Arkansas, kindly loaned by C. I. Alexander, shows the following features: an anterior deep, rounded socket, postjacent high blunt tooth, long interterminal crenulate bar, formed of the thickened valve-edge, and a posterior elongate, shallow, crenulate socket. Opposing right valve hinge features are displayed on a specimen illustrated by Schmidt (1948, pl. 62, fig. 13) from the Monmouth formation of Maryland and Delaware.

Occurrence: Esso Standard Oil Company North Carolina Esso well No. 2, 2,310–2,320 feet, Peedee(?) formation, (U.S.N.M. 106958).

Genus CYTHEREIS Jones, 1849

Cythereis sp. aff. *C. rugosissima* Alexander

Plate 9, figure 5

Shell small, subquadrate in lateral view; highest about one-fifth from anterior end; dorsal margin nearly straight, cardinal areas of left valve slightly elevated; ventral margin gently convex, posteriorly converging with dorsum; anterior margin broadly rounded,

slightly extended below, finely spinose around ventral marginal bend; posterior margin more narrowly rounded, with a notchlike concavity just ventrad of cardinal angle. Left valve larger than right, extending beyond the other along ventrum and at cardinal angles.

Anterior end of each valve bears a narrow moderately elevated marginal rim that lies closer to edge of valve ventrally than dorsally, and at anterior cardinal angle passes into a rounded eye tubercle; posterior end provided with a lower marginal rim. Posterior fourth of shell bears a strongly compressed area that marks termination of following longitudinal elements of ornamentation: a longitudinal ridge sending short spurs ventrally lies close to dorsal margin; a second high, narrow, longitudinal ridge occupies middle half of valve and has short spurs projecting from either flank. Along midportion of ventrum are two strongly elevated narrow ridges that merge anteroventrally; several spurs extend from the dorsal flank of the more dorsal of the two ridges; a short cross ridge connects their posterior terminations and two additional cross ridges lie anterior to midlength. General surface finely pitted. Internal features not observed.

Length of figured specimen 0.47 mm, height 0.29 mm, thickness 0.17 mm.

Remarks: This specimen probably represents an immature individual. It has less strongly elevated dorsal, ventral and anterior ridges, and a more strongly elevated median longitudinal ridge than *C. rugosissima* Alexander (1929, p. 101) from the Taylor formation of Texas but is similar to it in general outline and pattern of surface ornamentation. It may represent an immature molt of that species, but its relationships are not entirely clear. *Cythereis elegans* (Bosquet) from the Maestrichtian of Holland also is similar to the present form but the transverse short spurs from the longitudinal ridges are weaker and the ridges themselves are much broader. Comparisons with *C. elegans* were made on the basis of specimens kindly loaned by C. I. Alexander.

Occurrence: Hatteras Light well No. 1, 4,600-4,610 feet, beds of Eagle Ford (?) age, U.S.N.M. 106946.

Cythereis sp. aff. *C. fredericksburgensis* Alexander

Plate 9, figure 6

The present example is believed to be somewhat distorted by compaction, but its main external features are as follows:

Shell elongate-subquadrate; much higher near anterior end than elsewhere; hinge margin long, slightly sinuous, with a strong anterocardinal elevation; ventral margin concave, perhaps as a result of distortion; anterior margin broadly rounded; posterior margin narrowly rounded, extended ventrally and bearing four

blunt spines. Left valve larger than right, extending beyond it in cardinal areas.

A broad marginal ridge begins anterodorsally on each valve, and occupies anterior end and anterior three-fourths of ventrum, terminating posteriorly in a low node; a low narrow ridge parallels hinge margin; anteromedially is a broad elongate swelling, posterior to which is a narrow, longitudinal, median ridge. A low eye tubercle occurs at anterodorsal angle. Posterior fifth of shell compressed. Smaller details of surface ornamentation obscured by recrystallization of shell material, but some portions are finely punctate.

Internal features not observed.

Length of a figured specimen 0.88 mm, height 0.41 mm, thickness 0.30 mm.

Remarks: In its general outline, ventral extension of posterior margin, strong left valve overlap in the cardinal areas, and major surface ornamental features this species is much like *C. fredericksburgensis* Alexander (1929, p. 89) from the Fredericksburg group of northern Texas. Examples of that species kindly loaned by C. I. Alexander are higher with respect to length, have a more strongly elevated dorsal longitudinal ridge, a spinose anterior margin, and both coarse reticulations and fine pits covering the surface. The poor preservation of the present specimen prevents a complete understanding of its relationships.

Occurrence: Hatteras Light well No. 1, 7,310-7,320 feet, beds of Trinity (?) and pre-Trinity (?) age, undifferentiated, U.S.N.M. 106947.

Cythereis? *pamlicoensis* Swain, n. sp.

Plate 9, figure 4

Shell subquadrate in lateral view; highest near anterior end; hinge margin nearly straight, slightly more than four-fifths of shell length, with broadly obtuse cardinal angles; ventral margin nearly straight, posteriorly converging with dorsum; anterior margin broadly rounded, slightly extended below; posterior margin more narrowly rounded, slightly extended medially. Left valve larger than right, extending beyond the other along ventrum and in cardinal areas. Convexity of valves low, greatest thickness back of center.

Anterior end bears a marginal rim that is highest and broadest ventrally; posterior end and posterior two-thirds of ventrum provided with a marginal rim that is broad and rather strongly elevated around postventral marginal bend; blunt projections, perhaps representing spines, occur on rims. Anterodorsally on each valve is an elongate swelling that probably represents an eye tubercle; a narrow ridge extends from anterior end of swelling nearly to midshell; two short spurs project from ventral flank of swelling. Mid-dorsally is a marginal ridge that bears three or four protuber-

ances. About one-fifth from posterior end is a prominent transverse ridge that extends from dorsal margin to midheight. An obscure, narrow, longitudinal, ridgelike swelling begins at midheight about one-fourth from anterior end, converges slightly with dorsum in a posterior direction, and dies out about one-fourth from posterior end; a second obscure and shorter longitudinal swelling lies ventrad of midheight. General surface of valves coarsely and strongly reticulate.

Internal features not observed.

Length of holotype 0.74 mm, height 0.39 mm, thickness 0.24 mm.

Relationships: In general shape, reticulate surface and short transverse posterodorsal ridge *C. pamblicoensis* resembles *C. austinensis* Alexander (1929, p. 97) from the upper part of the Austin chalk of northern Texas, but the latter has a conspicuous median longitudinal ridge, whereas the corresponding feature in the present species is obscure. A posterodorsal transverse ridge, or plate, occurs in several species of Tertiary ostracodes including *Trachyleberis stenzeli* (Stephenson), *T. exanthemata* (Ulrich and Bassler), and *Cythereis midwayensis* Alexander, from the Gulf and Atlantic coastal regions.

Although its internal characteristics are unknown, the present species is tentatively placed in *Cythereis* because of its subquadrate outline and the organization of its surface features. It shows some relationship to *Isocythereis* Triebel (1940, p. 208) in outline, compressed valves, and posterodorsal ridge. That genus has broader inner lamellae, more numerous spots in the muscle scar, and simpler anterior hinge teeth and sockets than *Cythereis* Jones. Several species of Cretaceous ostracodes, including *Cythereis austinensis* Alexander, *C. paraustinensis* Swain, *C. worthensis* Alexander and the present one may prove to belong in *Isocythereis* when more is known about their internal structures.

Occurrence: Esso Standard Oil Co., North Carolina Esso No. 2, 2,310–2,320 feet, Peedee(?) formation, U.S.N.M. 106945.

Cythereis simulonuda Swain, n. sp.

Plate 9, figures 32–34

Shell subquadrate in side view; highest about one-fifth from anterior end; dorsal margin somewhat sinuous, with high anterocardinal projection formed by eye tubercle of left valve; ventral margin nearly straight, slightly sinuous; anterior margin broadly rounded, fringed with small spines, slightly truncate above; posterior margin acuminate pointed, strongly extended below, truncated above, and bearing several blunt spines or nodes. Left valve larger than right, extending beyond the other terminally and at cardinal angles.

Ends compressed; anterior margin bears a well-defined strongly elevated rim; posterior marginal rim less elevated. Midventral surface expanded to form short alae, surmounted by weakly serrate ridges that near their posterior termination bend dorsally for a short distance. Mid-dorsal margins bear serrate ridges that bend ventrad for a short distance near their posterior terminations. Rounded eye tubercles occur at anterocardinal angles. A low broad ridgelike longitudinal swelling occupies midportion of each valve. General surface smooth. Internal features not observed.

Length of holotype 0.95 mm, height 0.51 mm, thickness 0.44 mm.

Relationships: In general shape and surface ornamentation this species is close to *C. ornatissima nuda* Jones and Hinde from the Cenomanian (Lower Chalk) and perhaps younger Cretaceous of England (Jones and Hinde, 1890, p. 23). In that form, however, there is a prominent anteromedian node and postjacent short longitudinal ridge that are lacking in the present species.

Occurrence: Hatteras Light well No. 1, 4,780–4,790 feet, beds of Eagle Ford(?) age, (U.S.N.M. 106966), 5,340–5,350 feet, Tuscaloosa(?) formation (U.S.N.M. 106965).

Cythereis bicornis Israelsky

Plate 9, figure 31

Cythereis bicornis Israelsky, 1929, Arkansas Geol. Survey, Bull. 2, p. 19, pl. 4A, fig. 10.

Alexander, 1929, Texas Univ. Bull. 2907, p. 11, pl. 8, fig. 5. Swain, 1948, Maryland Dept. Geol., Mines, and Water Res., Bul. 2, p. 200, pl. 13, figs. 15, 16.

The external features of the species have been described in detail. The present specimens are entirely typical and nearly identical with specimens from the Brownstown marl of Arkansas kindly loaned by C. I. Alexander.

The hinge of the left valve consists of an anterior deep socket bearing a few coarse denticles, a postjacent high rounded nondenticulate tooth, an interterminal bar formed of the thickened valve edge, and a posterior socket partly obscured by matrix. Vestibule lacking, that is, the inner margin and line of concrescence coincide. Muscle scar not observed.

Length 0.63 mm, height 0.35 mm.

Occurrence: Hatteras Light well No. 1, 3,625 feet, Black Creek(?) formation; 4,320–4,330 feet, beds of Eagle Ford(?) age (U.S.N.M. 106964). The species also occurs in the Tokio and Brownstown formations of Arkansas, the lower part of the Taylor marl and upper part of the Austin chalk of northern Texas, and the lower part of the Matawan formation, subsurface, of Maryland.

Cythereis quadrialira Swain, n. sp.

Plate 9, figures 27-30

? "*Archicythereis*" cf. *Cythereis pidgeoni* Schmidt, 1948, Jour. Paleontology, vol. 22, p. 417, pl. 62.

Shell subquadrate-acuminate in lateral view; highest about one-fifth from anterior end; hinge margin nearly straight, about two-thirds of shell length, with well-defined but broadly obtuse cardinal angles, anterior angle strongly extended; ventral margin nearly straight, slightly sinuous, subparallel to dorsum; anterior margin broadly rounded, finely spinose; posterior margin narrower, acuminately extended medially, and bearing several thick spines just below midheight. Left valve larger than right, extending beyond the other along ventrum and along dorsal slopes. Valves rather weakly convex, greatest thickness behind middle of shell.

Posterior fifth of shell strongly compressed. Ventral surface of each valve bears a narrow ridge, rising at posterior end and dying out about one-third from anterior end. Dorsad of this ridge, a second longitudinal ridge occupies middle three-fifths of valve, bears transverse grooves on its flanks in posterior portion, and bends obliquely toward dorsum near its posterior termination. A median narrow longitudinal ridge occupies middle three-fifths of valve, is thickened anterad of midshell (probably representing cythereisid submedian node) and at each of its ends; other minor thickened spots occur along ridge. Dorsomedian two-fifths of valve bears a slightly serrate marginal ridge. Anterior end bears a narrow ridge lying a short distance within valve margin and terminating near antero-cardinal angle in a rounded eye tubercle. General surface between ridges minutely pitted. Internal features not observed.

Length of holotype 0.68 mm, height 0.33 mm, thickness 0.29 mm.

Relationships: This species may not belong in *Cythereis* Jones, in which terminal hinge elements are crenulate, or in *Trachyleberis* Brady which lacks similar crenulation of the hinge teeth and sockets. The hinge of *Cythereis pidgeoni* Berry, a closely related upper Cretaceous species, is not crenulate (Schmidt, 1948, pl. 62, fig. 4) and a reassignment of it to *Trachyleberis* seems necessary. On the other hand *Cythereis bonnemai* Triebel from the Albian of Germany, also close to the present species, is said by Triebel (1940, p. 205) to have the hingement of *Cythereis*. The "*Archicythereis*" considered by Schmidt (1948, p. 417) to be a probable immature molt of "*Cythereis*" (*Trachyleberis*) *pidgeoni* seems identical with the present examples except for the presence of an oblique anterodorsal ridge not seen in the new species. *Cythereis worthensis* Alexander from the Fort Worth limestone (lower Washita)

of Texas has double ventral ridges rather than two more widely separated ventral ridges, and has stronger spur-like extensions from the median ridge than does the present form, but otherwise the two are closely similar.

Occurrence: Hatteras Light well No. 1, 3,750-3,760 feet, beds of Eutaw (?) age, U.S.N.M. 106962; North Carolina Esso No. 2, 2,750-2,760 feet, beds of Eutaw (?) age or Black Creek (?) formation, U.S.N.M. 106963.

Cythereis ornatissima (Reuss)

Plate 9, figures 24-26

Cytherina ornatissima Reuss, 1846, Verstein, böhm. Kreidef., pt. 2, p. 104, pl. 24, figs. 12, 18.

Cytherina ciliata Reuss, *ibid.*, fig. 17.

Cytherina echinulata Williamson, 1847, Trans. Manchester Lit. Phil. Soc., vol. 8, pl. 4, figs. 75, 76.

Cythereis ciliata Jones, 1849, Monogr. Cret. Entom. Eng., Palaeontographical Soc. London, p. 19, pl. 4, figs. 11a-h.

Cypridina muricata Reuss, 1851, Haidinger's Nat. Abhandl., vol. 4, pt. 1, p. 50, pl. 5, figs. 12a-c.

Cythere ornatissima (Reuss), Bosquet, 1854, Mem. Comm. Carte Geol. Neerlande, vol. 2, pp. 107-110, pl. 9, figs. 6a-d.

Cythere (Cythereis) ornatissima (Reuss) Williamson, 1872, Trans. Lit. Phil. Soc. Manchester, ser. 3, vol. 5, p. 136.

Cythereis ornatissima reticulata Jones and Hinde, 1890, Suppl. Monogr. Cret. Entom. Eng. and Ire., Palaeontographical Soc. London, p. 24, pl. 1, figs. 67, 68, 77, pl. 4, figs. 9-12.

Cythereis ornatissima (Reuss), Chapman, 1917, Geol. Survey Western Australia, Bull. 72, p. 55, pl. 14, fig. 10.

Alexander, 1933, Jour. Paleontology, vol. 7, p. 210, pl. 25, fig. 18, pl. 26, figs. 11a, b, pl. 27, figs. 16a, b.

Triebel, 1940, Senckenbergiana, vol. 22, p. 174, pl. 2, figs. 27-30.

Sylvester-Bradley, 1948, Jour. Paleontology, vol. 22, p. 795, pl. 122, figs. 20-22.

Cythereis dallasensis Alexander, 1939, Texas Univ. Bull. 2907, p. 99, pl. 8, figs. 8, 9.

Shell subquadrate in side view; highest about one-sixth from anterior end; hinge margin nearly straight, about three-fourths of shell length; ventral margin slightly convex, subparallel to dorsum, but with slight posterior convergence; anterior margin broadly rounded, bearing one row of blunt spines in right valve, two rows in left; posterior margin narrower, bluntly acuminate medially, strongly truncate and slightly concave above, spinose below. Left valve larger than right, extending beyond the other terminally and at cardinal angles.

Anterior end somewhat compressed, bearing a narrow marginal rim on which occur the fringing marginal spines. Posterior fourth of shell compressed with narrow spinose marginal rims in ventral half. Midventral portion of each valve expanded, resulting in a pronounced flattening of midventral surface; a coarsely spinose longitudinal ridge extends along crest of ventral expansion. A large, rounded, spinose median node lies slightly anterad of midlength; behind node is a short longitudinal row of blunt spines. Along dorsal margin, a large bluntly spinose eye tubercle lies near antero-

cardinal angle; a single short spine occurs near mid-length and several short spines are present slightly anterad of postcardinal angle. General surface coarsely reticulate in posterior half, pustulose in anterior half. Internal features not observed in present specimens.

Length of figured specimen 0.85 mm, height 0.46 mm, thickness excluding spines, 0.39 mm.

Remarks: Possible topotype specimens of *C. ornatissima* from the Turonian of Bohemia were made available by C. I. Alexander. They are more completely reticulate than the North Carolina examples, but otherwise indistinguishable.

Occurrence: Hatteras Light well No. 1, 4,260–4,270 feet, beds of Eutaw(?) age, and 4,410–4,420 feet, beds of Eagle Ford(?) age, U.S.N.M. 106960. A specimen from the same well, 4,640–4,650 feet (pl. 2, fig. 26) in the beds of Eagle Ford(?) age (U.S.N.M. 106961) has a very high anterocardinal angle and a more strongly expanded, subalate ventrum. This form resembles the more typical examples of "*Cythereis ciliata*" Jones (= *C. ornatissima* (Reuss)) from the Cretaceous of England (Jones, 1849, pl. 4, figs. 11a–d). It is uncertain whether these more strongly alate forms should be considered a distinct species or variety, or whether they are dimorphic examples of *C. ornatissima*.

Genus **PROTOCYTHERE** Triebel, 1938

Protocythere paratriplicata Swain, n. sp.

Plate 9, figure 18–21

?*Cythere foersteriana* Bosquet, Alexander, 1929 Univ. Texas Bull. 2907, p. 82, pl. 6, figs. 1, 11.

(Not) Bosquet, 1847, Mem. Soc. Roy. Sci. Liege, vol. 4, p. 364, pl. 2, figs. 4a–d.

Shell subpyriform in side view; highest about one-fourth from anterior end; dorsal margin sinuous due to projection of surface of shell beyond hinge, medially, and to high anterocardinal projection of left valve; actual hinge margin nearly straight and about four-fifths of shell length; ventral margin gently converging posteriorly with dorsum; anterior margin broadly rounded, finely spinose on both valves; posterior margin acuminately pointed, truncate above, that of right valve bearing several small spines. Left valve larger than right, extending beyond the other along ventrum and at cardinal angles. Valves strongly convex, greatest thickness median.

Anterior fourth and posterior fifth of shell compressed. Median, more convex portion of each valve bears a dorsal, somewhat irregular longitudinal ridge that extends beyond line of valve contact medially; a median shorter longitudinal ridge; and a ventral longitudinal ridge that is swollen medially to overhang ventral edge. Between median and dorsal ridge and slightly anterad of midlength is a large depression, be-

hind which are two pits. General surface smooth except for a few small pustules that mark position of some of the normal canals; most of canals not represented by such tubercles. Internal features not observed.

Length of holotype 0.70 mm, height 0.44 mm, thickness 0.37 mm.

Remarks: This form differs from *P. triplicata* (Roemer) in having the posterior end of the left valve more acuminate, the longitudinal ridges less broad and the anterior margin of each valve denticulate. The examples from the Taylor marl of northern Texas identified by Alexander as *Cythere foersteriana* Bosquet evidently belong with the present specimens. Although *C. foersteriana* is not completely understood it probably represents a *Protocythere* allied to *P. triplicata* but with the anterior end less broadly rounded. Earlier descriptions and illustrations of specimens assigned to *P. triplicata* (Jones, 1849, p. 18; Jones and Hinde, 1840, p. 19) show surface pitting of the shell, but according to Triebel (1938, p. 182) the general shell surface is smooth.

Occurrence: The holotype is from the Hatteras Light well No. 1, 3,240–3,250 feet, Black Creek(?) formation (U.S.N.M. 106956). Paratype from 4,480–4,490 feet, Tuscaloosa formation (U.S.N.M. 106957).

Genus **PTERYGOCYTHEREIS** Blake, 1929

Pterygocythereis cf. *P. tokiana* (Israelsky)

Plate 9, Figures 1–3

Cytheropteron tokiana Israelsky, 1929, Arkansas Geol. Surv. Bull. 2 (Supplement), p. 9, pl. IA, figs. 8, 9.

Shell subquadrate in side view; highest near anterior end; dorsal margin nearly straight, except for high anterodorsal portion that projects beyond rest of margin; ventral margin nearly straight, converging slightly posterior toward dorsum; anterior margin broadly rounded, slightly extended below; posterior margin more narrowly rounded, sharply truncated above, extended medially. Left valve slightly larger than right and overlapping it.

Midventral portion of shell expanded to form distinct alae; ventral surface of each valve flattened and bearing a ridge parallel to margin. High narrow longitudinal ridges lie along crests of alae and extend toward anteroventral margin; dorsad of each ridge in anterior half is a broad groove. Behind anterodorsal angle is a shallow sulcus. Anterodorsal and anterior margin of each valve bears a finely denticulate narrow rim; eye tubercle interrupts this rim near its anterodorsal termination. Posterior valve margins provided with narrow rims that bear about six or seven short thick spines in ventral two-thirds and at postdorsal angle. Mid-dorsally is a short, longitudinal, somewhat serrate ridge. General surface of valves smooth.

Most internal features not observable. Muscle scar as seen by reflected light in one specimen consists of an anteromedian subvertical row of perhaps four spots and an additional more anterior, horseshoe-shaped spot.

Length of a figured specimen (pl. 9, fig. 1) 0.85 mm, height 0.40 mm, thickness 0.40 mm (including alae).

Remarks: In its subquadrate outline, conspicuous alae with superposed longitudinal ridges, and the spinose margins the present examples are like *Cytheropteron tokiana* Israelsky from the Upper Cretaceous Tokio formation of Arkansas. As illustrated by Israelsky (1929, pl. IA, figs. 8, 9) the species lacks the sharp truncation along the postdorsal slope that characterizes the present forms. The straight hinge and lack of conspicuous posterior caudal extension ally the species to *Pterygocythereis* Blake rather than to *Cytheropteron* Sars.

Occurrence: Hatteras Light well No. 1, 4,440–4,450, beds of Eagle Ford(?) age (U.S.N.M. 106944) and 6,310–6,320 feet, beds of Trinity(?) and pre-Trinity(?) age undifferentiated (U.S.N.M. 106943).

Genus **CYTHEROPTERON** Sars, 1865

Subgenus **EOCYTHEROPTERON** Alexander, 1933

Cytheropteron (*Eocytheropteron*) *tumoides* Swain, n. sp.

Plate 9, figures 7, 8

Shell ovate-acuminate in lateral view; highest slightly anterad of midlength; dorsal margin moderately convex; ventral margin gently convex; anterior margin broadly rounded, slightly extended below mid-height; posterior margin narrowly rounded with a slightly ventromedian, bluntly pointed, compressed caudate extension. Left valve a little larger than right, extending beyond the other along dorsal and anterior margins.

Ventral half of valves strongly swollen to form rounded alate expansions; along ventrum, surface slightly overhangs valve margins. Anterior edge of right valve bears a narrow weak marginal rim; a broad, shallow, curved depression lies parallel to anterior margin in dorsal half to three-fifths of valves; behind this depression in dorsal half of each valve is a subvertical low ridge that merges with general surface ventrally; behind ridge in dorsal two-fifths of valve is a broad, rounded, very shallow depression. Ventral portion of shell bears weak longitudinal striae, and median portion is ornamented by weak markings in a pseudoreticulate pattern.

Internal features not observed.

Length of holotype, believed to represent a female dimorph 0.88 mm, height 0.50 mm, thickness 0.47 mm.

Relationships: In general shape, overlap relationships, rounded alate expansions and median position of the posterior caudate extension, this species is similar to *C. (Eocytheropteron) tumidum* Alexander from the

Kiamichi formation and underlying Goodland limestone of northern Texas (Alexander, 1933, p. 198). That species, however, lacks the anterodorsal shallow depressions and ridge of the present form, and the ventral margin is more convex. *C. (E.) paenorbiculatum* Alexander (1933, p. 197) from the same stratigraphic horizons in Texas bears a shallow dorsomedian depression like that in the new species but the left valve extends strongly beyond the right along the dorsum.

Occurrence: Hatteras Light well No. 1, 6,340–6,350 feet (U.S.N.M. 106949) and 6,760–6,770 feet (U.S.N.M. 106948), beds of Trinity(?) and pre-Trinity(?) age, undifferentiated.

Cytheropteron (*Eocytheropteron*) *trinitiensis* (Vanderpool)

Plate 9, figures 9, 10

Cytheridea trinitiensis Vanderpool, 1928, Jour. Paleontology, vol. 2, p. 106, pl. 14, figs. 3–6.

Cytheropteron (*Eocytheropteron*) *trinitiensis* (Vanderpool), Vanderpool, 1933, Jour. Paleontology, vol. 7, p. 410, pl. 49, figs. 16–19.

Shell subhemispherical in side view; highest medially; dorsal margin strongly convex; ventral margin slightly convex; anterior end broadly rounded, slightly extended and angulate at its ventral bend; posterior margin somewhat more narrowly rounded, with a median, very short compressed caudate extension. Left valve slightly larger than right, extending beyond the other along dorsum.

Ventral portions of valves strongly swollen as short alate expansions that slightly overhang ventral edges of valves; ventral surface of shell slightly concave in end view. Crest of each ala bears a low longitudinal ridge; dorsad of this ridge in ventral half of shell are four short, low longitudinal ridges. General surface very weakly punctate. Internal features not observed.

Length of figured specimen, possibly a female dimorph, 0.68 mm, height 0.47 mm, thickness 0.44 mm.

Relationships: The present examples were compared with Vanderpool's types from the Glen Rose formation of Texas, and found to be conspecific. Among other described species, *Cytheropteron* (*Eocytheropteron*) *howelli* Alexander (1933, p. 196) from the Goodland and Kiamichi formations of Texas is close to *C. (E.) trinitiensis* in outline, character of the alae and presence of a low ventral longitudinal ridge along the crest of each ala. However, the posterior caudate extension of that species is slightly longer and the ventral ridge is more strongly elevated and bears several large pits on its dorsal flank.

Occurrence: Hatteras Light well No. 1, 6,170–6,180 feet and below, beds of Trinity(?) and pre-Trinity(?) age, undifferentiated. The figured specimen is from a drill-cutting sample 6,340–6,350 feet (U.S.N.M. 106950).

Cytheropteron (Eocytheropteron) acaudatum Swain, n. sp.

Plate 9, figures 15, 16

Shell small, subovate in side view; highest about three-eighths from anterior end; dorsal margin moderately convex, steeper in front of position of greatest height than behind; ventral margin slightly convex; anterior margin broadly rounded, extended below; posterior margin more narrowly rounded, slightly extended medially. Left valve slightly larger than right.

Ventral surface of shell greatly expanded, strongly overhanging edges of valves along midportion of ventrum. Median portion of anterior end of right valve bears a shallow groove parallel to margin. General surface of shell bears obscure concentrically arranged grooves and intervening ridges, together with very weak, widely spaced large pits. Internal features not observed.

Length of holotype 0.55 mm, height 0.33 mm, thickness 0.30 mm.

Relationships: In its lack of a caudate extension of the posterior end, and surface ornamentation, this species is close to undescribed examples of *C.* (*Eocytheropteron*) from the Schuler formation, Upper Jurassic of Louisiana (Swain, 1949, pl. 3, figs. 11-13). The Jurassic forms, however, are more convex dorsally and bear well-defined longitudinal ridges along the flattened ventrum.

Occurrence: Hatteras Light well No. 1, 5,640-5,650 feet, beds of Washita (?) age U.S.N.M. 106954.

Genus KRITHE Brady, Crosskey and Robertson, 1874**Krithe cf. *K. postprojecta* Schmidt**

Plate 9, figure 11

Krithe postprojecta Schmidt, 1948, Jour. Paleontology, vol. 22, p. 409, pl. 61, fig. 8, text fig. 2d.

Shell subelliptical in side view; dorsal margin slightly convex; ventral margin nearly straight and subparallel to dorsum; anterior margin uniformly rounded; posterior margin slightly narrower, extended ventrally and subtruncate above. Left valve slightly larger than right, extending beyond the other, except posteriorly. Valves rather weakly convex, greatest thickness in posterior third. Surface smooth.

As viewed posteriorly, posteroventral end of each valve projects slightly beyond contact-line of valves. On either side of contact line, midportion of posterior end of each valve bears an oval pit which is bordered by a slight ridgelike thickening of the valve. Internal features not seen.

Length of figured specimen 0.66 mm, height 0.30 mm, thickness 0.24 mm.

Remarks: In general outline and left valve overlap this species conforms with features prescribed for *Krithe*. All of the species at present assigned to the genus differ only in small details of outline and of the

posterior end of the shell. The present example is close to *K. postprojecta* Schmidt, although that form possibly is more extended posteroventrally and the terminal posterior pits were not mentioned in the original description (Schmidt, 1948, p. 409).

Occurrence: North Carolina Esso well No. 2, 2,300-2,310 feet, Peedee (?) formation, U.S.N.M. 106951.

Genus GOMPHOCY THERE Sars, 1924**Gomphocythere? cf. *G. silvana* Martin**

Plate 9, figure 23

Gomphocythere silvana Martin, 1940, Senckenbergiana, vol. 22, p. 345, pl. 6, figs. 87, 88, pl. 9, figs. 144-147, pl. 12, fig. 175.

Shell small, subquadrate in side view; greatest height about one-fourth from anterior end; hinge margin nearly straight, about two-thirds of shell length; anterior cardinal angle widely obtuse, posterior cardinal angle only slightly obtuse; ventral margin slightly convex, converging posteriorly toward dorsum; anterior margin broadly rounded, slightly truncated above; posterior margin more narrowly rounded, slightly extended above. Left valve slightly larger than right, extending beyond it along dorsum. Convexity of valves low, greatest thickness in posterior third of shell.

Anterodorsal surface of each valve folded into two short subvertical shallow sulci and intervening rounded low lobe. Posterodorsal corner of shell compressed. In single specimen at hand general surface is too poorly preserved to retain other details. Internal features not observed.

Length 0.51 mm, height 0.32 mm, thickness 0.20 mm.

Remarks: In external shell characteristics the present form closely resembles *Gomphocythere silvana* Martin from the Wealden beds (Neocomian) of northern Germany. The surface pitting of the Wealden examples could not be seen in this specimen, perhaps because of its poor preservation. The Wealden specimens also bear a post-median node or short spine on each valve, a feature not identified with certainty on the present example, although there is a small elevation on the right valve that is probably extraneous material. The bisulcate, straight-hinged character of the present form causes it to resemble *Hutsonia* Swain (1946) from the Upper Jurassic, *Jonesina* Ulrich and Bassler (1908) from the late Paleozoic, and *Ilyocypris* Brady and Norman (1889) from the Cenozoic. *Hutsonia* typically is more acuminate posteriorly and has a distinct marginal rim. *Ilyocypris* and *Jonesina* can be distinguished from each other mainly on the basis of hingement and musculature, although these features in *Jonesina* are not clearly understood. As viewed dorsally, *Jonesina* has the anterior portion of the hingeline obscurely carinate, a feature apparently lacking in *Ilyocypris*. *Gomphocythere* Sars (1924) was established for straight-hinged, unisulcate or bisulcate Ostracoda with the posterior portion of the shell, even in male dimorphs.

swollen, features that are reminiscent of *Metacypris* Brady and Robertson (1870). The distinction between the two genera is not clearly understood, and *G. silvana*, lacking the posterior tumidity, can be assigned only tentatively to this genus.

Occurrence: Hatteras Light well No. 1, 8,430–8,440 feet, beds of Trinity(?) and pre-Trinity(?) age, undifferentiated, U.S.N.M. 106959.

Genus **MONOCERATINA** Roth, 1928

Monoceratina sp. aff. *M. semiornata* Alexander

Plate 9, figures 12, 13

The single, incomplete specimen at hand exhibits the following characteristics.

Shell subquadrate in lateral view; highest near anterior end; hinge margin nearly straight, more than three-fourths of shell length, with well-defined, obtuse cardinal angles; ventral margin gently convex, converging posteriorly toward dorsum; anterior margin broadly rounded, forming an obtuse angle with ventral margin, approximately equal to corresponding cardinal angle; posterior margin narrowly rounded with the stump of a broad caudate extension dorsad of midheight. Left valve extends slightly beyond right anteriorly and ventrally; dorsally, right valve projects slightly beyond left. Valves not strongly convex; thickest portion of shell slightly posteromedian at position of spinose expansions of shell.

Dorsal margin of each valve bears a narrow marginal rim that dies out in posterior third of shell, and is elevated to form a small protuberance at anterior cardinal angle; anterior margin provided with very narrow rimlike elevation; ventral margins have rims that are broad posteriorly, narrow medially, and broader and more strongly elevated in anterior fourth. Ends compressed. Anteromedian surface of each valve swollen to form a rounded lobe; between lobe and midlength is a deep vertical sulcus that opens on dorsum and terminates ventrally at midheight; surface postventrad of sulcus imperfect in each valve but elevations of surface just behind ventral end of sulci probably represent bases of spinose projections characteristic of this group of ostracodes. General surface of each valve, except sulcus and marginal rims pitted in a reticulate pattern, with some dominant elements of the reticulum oriented concentrically about sulcus.

Internal characteristics mostly not observed. Muscle scar consists in part of a subvertical row of three or four longitudinally elongated spots lying near ventral end of median sulcus.

Length of a figured specimen 0.55 mm, height 0.27 mm, thickness, excluding ala involved in spinose expansion which is incomplete, 0.23 mm.

Remarks: In shape, surface pitting and sulcation of the shell this form is similar to *M. semiornata* Alex-

ander (1933, p. 63) from the upper part of the Austin chalk, Travis County, Tex. That species differs in bearing a broad, denticulate, anterior marginal rim, a dorsal longitudinal ridge in posterior half of shell, and in lacking surface pits in the posterior portion. *M. umbonata* Alexander (1933, p. 62) from the Navarro group and Taylor marl of northern Texas has the entire surface pitted, but has a rather weak median sulcus. The present example perhaps lies midway between these two species with respect to its shell characteristics, but its poor preservation precludes accurate classification.

Occurrence: Hatteras Light well No. 1, 3,800–3,810 feet, beds of Eutaw(?) age, U.S.N.M. 106952.

Genus **HUTSONIA** Swain, 1946

Hutsonia? *microrugosa* Swain, n. sp.

Plate 9, figure 14

Shell minute, subquadrate in side view; highest about one-fourth from anterior end; hinge margin nearly straight with slight elevation at anterior cardinal angle, about two-thirds of shell length; ventral margin nearly straight for two-thirds of its length, bending abruptly into ventral portion of posterior margin; anterior margin broadly rounded, truncated above; posterior margin narrowly rounded, extended medially, strongly truncate below. Valves approximately equal in size, strongly compressed.

Anterior end and ventral portion of posterior end in each valve bear narrow marginal rims. A broad verticle sulcus lies slightly antrad of midlength and extends from dorsum to about one-third from ventral margin; a second shorter sulcus, separated from the preceding by a rounded lobe, extends anteroventrally from anterior cardinal angle; posterior to median sulcus is a third short, vertical sulcus, bounded on its posterior side by a low rounded node. A narrow longitudinal ridge lies in posterior two-thirds of shell, about one-third of shell height from ventral margin. General surface of shell roughly sculptured with irregular elevations and depressions, and in some portions minute pits. Internal features not seen.

Length 0.41 mm, height 0.21 mm, thickness 0.01 mm.

Relationships: The subquadrate outline, sulcation, and ventral longitudinal ridge ally this form to *Hutsonia* Swain, but lack of knowledge of the internal features prevents definite generic classification. It resembles *Hutsonia rugosa* Swain (1946, p. 129) in sulcation and general rugose surface but that species has the posterior portion of the shell rather strongly inflated with respect to the anterior portion, a long anterior sulcus, and a broad rimlike elevation of the anterior end.

Occurrence: Hatteras Light well No. 1, 6,260–6,270 feet, beds of Trinity(?) and pre-Trinity(?) age, undifferentiated, U.S.N.M. 106953.

Genus *MACRODENTINA* Martin, 1940*Macrodentina? obliqua* Swain, n. sp.

Plate 9, figure 17

The holotype, a right valve, subovate in side view; highest about one-fourth from anterior end; hinge margin nearly straight, about two-thirds of shell length; ventral margin gently convex converging with dorsum in a posterior direction; anterior margin broadly rounded, extended below, and passing with sharp curvature into ventral margin; posterior margin narrowly rounded, extended above midheight, passing uniformly into ventral margin. Overlap relationships unknown. Right valve moderately convex, greatest thickness in posterior and ventral portions; along posterior two-thirds of ventrum surface of valve overhangs margin.

A short sulcus begins near anterior cardinal angle and trends subparallel to anterior margin approximately to midheight. A large rounded pit occurs slightly below midheight and about one-fourth from anterior end. Ventral portion of valve bears coarse concentric ridges with intervening pitted grooves; anterior and antero-ventral portions bear three especially strong concentric ridges; dorsal portion coarsely pitted.

Internal features not observable in the one specimen at hand.

Length 0.54 mm, height 0.33 mm.

Relationships: The general ovoid shape and concentric ornamentation of this species ally it with *Loxoconcha* Sars, but the strong anterior and ventral concentric ridges perhaps indicate a closer relationship to *Macrodentina* Martin. A closely similar if not identical species from the Cotton Valley group, Upper Jurassic of Louisiana was referred to as *Loxoconcha?* sp. (Swain, 1949, pl. 3, fig. 28).

Occurrence: Hatteras Light well No. 1, 8,330–8,340 feet, beds of Trinity(?) and pre-Trinity(?) age, undifferentiated, U.S.N.M. 106955.

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INDEX

[Italic numbers indicate descriptions]

A

<i>acaudatum</i> , <i>Cytheropteron</i> (<i>Eocytheropteron</i>)	64, 69, 87, pl. 9
Acknowledgements for aid	59
<i>acuminata</i> , <i>Asciocythere</i>	63, 69, 77, 78, pl. 8
<i>Schuleridea</i>	66, 69, 72, 74, 75, pl. 9
<i>alexandrina</i> , <i>Bairdia</i>	63, 69, 71, pl. 8
<i>amygdaloides</i> , <i>Asciocythere</i>	64, 69, 76, 78, pl. 8
<i>Cythere</i>	76, 77
<i>Cytherella</i>	76
<i>Haplocytheridea</i>	76
<i>amygdaloides brevis</i> , <i>Cythere</i>	76
<i>Cytheridea</i>	76
<i>Cytheridea</i> (<i>Haplocytheridea?</i>)	76
<i>Apatocythere</i>	59, 72, 73, 77
<i>ellipsoidea</i>	73
<i>lanceolata</i>	65, 67, 69, 72, 73, pl. 9
<i>leguminoidea</i>	64, 66, 69, 73, pl. 9
<i>simulans</i>	72, 73
<i>tumidosa</i>	65, 67, 69, 73, pl. 9
<i>arachoides</i> , <i>Brachyocythere</i>	67, 69, 81, pl. 9
<i>Cythere</i>	81
<i>arca</i> , <i>Globotruncana</i>	62, 67
" <i>Archicythereis</i> " cf. <i>Cythereis pigeoni</i>	84
<i>Asciocythere</i>	59, 75, 78
<i>acuminata</i>	63, 69, 77, 78, pl. 8
<i>amygdaloides</i>	64, 69, 76, 78, pl. 8
<i>leguminoidea</i>	64, 66, 69, 78, pl. 8
<i>macropunctata</i>	63, 69, 77, pl. 8
<i>rotunda</i>	64, 69, 76, 77, pl. 8
<i>triangularis</i>	64, 69, 77, pl. 8
<i>Atopochara</i> sp.	68
<i>austiniensis</i> , <i>Cythereis</i>	83
<i>Cytherella</i>	68

B

<i>Bairdia</i>	59, 71
<i>alexandrina</i>	63, 69, 71, pl. 8
<i>subdeltoidea</i>	71
<i>Bairdiidae</i>	69, 71-72
<i>Bairdiocypris</i>	59
<i>morrisonensis</i>	72
sp.	69, 72, pl. 8
<i>Bairdopillata</i>	59, 71
<i>pondera</i>	62, 69, 71, pl. 8
<i>berryi</i> , <i>Haplocytheridea</i>	62, 69, 78, 79, pl. 8
<i>bicornis</i> , <i>Cythereis</i>	62, 63, 69, 83, pl. 9
Black Creek formation	59, 61, 62, 67
<i>bonnemai</i> , <i>Cythereis</i>	84
<i>Brachyocythere</i>	59, 80, 81
<i>arachoides</i>	67, 69, 81, pl. 9
<i>darensis</i>	62, 69, 80, pl. 8
<i>hadleyi</i>	80
<i>infundibuliformis</i>	81
<i>jerseyensis</i>	81
<i>nausiformis</i>	62, 63, 67, 69, 80, pl. 8
<i>sphenoides</i>	62, 69, 80, 81, pl. 8
<i>taylorensis</i>	80
<i>brevis</i> , <i>Cythere amygdaloides</i>	76
<i>Cytheridea amygdaloides</i>	76
<i>Cytheridea</i> (<i>Haplocytheridea?</i>) <i>amygdaloides</i>	76
<i>Bythocypris rotundus</i>	75, 76

C

<i>cancellata</i> , <i>Ezogyr</i>	72
<i>castleberryensis</i> , <i>Cytherelloidea</i>	70
<i>Choffatella</i>	66
<i>christneri</i> , <i>Kyphopyga</i>	62, 67
<i>ciliata</i> , <i>Cythereis</i>	84
<i>Cytherina</i>	84
<i>Oolithrocytheridea</i>	74, 75
<i>concentricum</i> , <i>Cytheropteron</i>	70

<i>concentricum virginea</i> , <i>Cytheropteron</i>	70
<i>Cypridae</i>	69, 70-71
<i>Cypridea</i>	75
<i>Cypridina muricata</i>	84
<i>Cypris</i>	59, 70
sp.	64, 69, 70, pl. 8
<i>Cythere amygdaloides</i>	76, 77
<i>amygdaloides brevis</i>	76
<i>arachoides</i>	81
<i>foersteriana</i>	85
<i>ornatissima</i>	84
<i>rectangulapora</i>	81
<i>sphenoides</i>	80
(<i>Cythereis</i>) <i>ornatissima</i>	84
<i>Cythereis</i>	59, 81
<i>austiniensis</i>	83
<i>bicornis</i>	62, 63, 69, 83, pl. 9
<i>bonnemai</i>	84
<i>ciliata</i>	84
<i>dallasensis</i>	84
<i>elegans</i>	82
<i>fredericksburgensis</i>	65, 69, 82, pl. 9
<i>midwayensis</i>	83
<i>ornatissima</i>	63, 69, 84, 85, pl. 9
<i>ornatissima nuda</i>	83
<i>ornatissima reticulata</i>	84
<i>pamlicoensis</i>	67, 69, 82, 83, pl. 9
<i>paraustiniensis</i>	83
<i>pigeoni</i>	84
<i>pigeoni</i> , cf. " <i>Archicythereis</i> "	84
<i>quadrialira</i>	63, 67, 69, 84, pl. 9
<i>rugosissima</i>	63, 69, 81, pl. 9
<i>simulonuda</i>	63, 69, 83, pl. 9
<i>worthensis</i>	83, 84
(<i>Cythereis</i>) <i>ornatissima</i> , <i>Cythere</i>	84
<i>Cytherelloidea</i>	68, 69, 70
<i>Cytherella</i>	59, 68, 70, 77
<i>amygdaloides</i>	76
<i>austiniensis</i>	68
<i>navarroensis</i>	62, 68, 69, pl. 8
<i>obesa</i>	62, 68, 69, pl. 8
<i>ovata</i>	76
<i>ovoides</i>	68
<i>Cytherelloidea</i>	59, 70
<i>castleberryensis</i>	70
<i>darensis</i>	65, 68, 69, pl. 8
<i>granulosa</i>	70
<i>howei</i>	70
<i>reticulata</i>	70
<i>Cytheridae</i>	69, 72
<i>Cytheridea</i>	77
<i>amygdaloides brevis</i>	76
<i>fortior</i>	76
<i>graysonensis</i>	78
<i>limburgensis</i>	76
<i>monmouthensis</i>	79
<i>ovata</i>	77, 78
<i>plummeri</i>	79, 80
<i>reniformis</i>	76
<i>rotundus</i>	76
<i>trinitiensis</i>	86
sp.	78
<i>Cytheridea</i> (<i>Haplocytheridea</i>) <i>monmouthensis</i>	79
<i>thorensis</i>	74
<i>amygdaloides brevis</i>	76
<i>Cytherina ciliata</i>	84
<i>echinulata</i>	84
<i>ornatissima</i>	84
<i>Cytherissa</i>	75
<i>Cytheropteron</i>	59, 86
<i>concentricum</i>	70
<i>virginea</i>	70
<i>sphenoides</i>	80
<i>tokiana</i>	85
sp. B.	80

- Cytheropteron* (*Eocytheropteron*) *acaudatum*----- 64, 69, 87, pl. 9
howelli----- 86
paenorbiculatum----- 86
trinitensis----- 64, 69, 86, pl. 9
tumidum----- 60, 64, 86
tumoides----- 64, 69, 86, pl. 9
- D**
- dallasensis*, *Cythereis*----- 84
darensis, *Brachyocythere*----- 62, 69, 80, pl. 8
Cytherelloidea----- 65, 68, 69, pl. 8
- E**
- Eagle Ford formation----- 59, 61, 62, 67
echinulata, *Cytherina*----- 84
elegans, *Cythereis*----- 82
ellipsoidea, *Apatocythere*----- 73
Eocytheropteron----- 59, 86
(*Eocytheropteron*) *acaudatum*, *Cytheropteron*----- 64, 69, 87, pl. 9
howelli, *Cytheropteron*----- 86
paenorbiculatum, *Cytheropteron*----- 86
trinitensis, *Cytheropteron*----- 64, 69, 86, pl. 9
tumidum, *Cytheropteron*----- 60, 64, 86
tumoides, *Cytheropteron*----- 64, 69, 86, pl. 9
Eutaw formation----- 59, 61, 62, 63, 67
exanthemata, *Trachyleberis*----- 83
Exogyra cancellata----- 72
- F**
- fortior*, *Cytheridea*----- 76
foersteriana, *Cythere*----- 85
Fredericksburg formation----- 59, 60, 61, 64
fredericksburgensis, *Cythereis*----- 65, 69, 82, pl. 9
- G**
- Globotruncana arca*----- 62, 67
Gomphocythere----- 59, 87
silvana----- 69, 87, pl. 9
granulosa, *Cytherelloidea*----- 70
graysonensis, *Cytheridea*----- 78
Haplocytheridea----- 63, 69, 78, pl. 8
- H**
- hadleyi*, *Brachyocythere*----- 80
Haplocytheridea----- 59, 72, 75, 78
amygdaloides----- 76
berryi----- 62, 69, 78, 79, pl. 8
graysonensis----- 63, 69, 78, pl. 8
monmouthensis----- 67, 69, 79, pl. 8
plummeri----- 62, 63, 69, 79, pl. 8
(*Haplocytheridea*?) *amygdaloides brevis*, *Cytheridea*----- 76
monmouthensis, *Cytheridea*----- 79
thorensis, *Cytheridea*----- 74
hatterasensis, *Schuleridea*----- 64, 67, 69, 74, 75, pl. 9
howei, *Cytherelloidea*----- 70
howelli, *Cytheropteron* (*Eocytheropteron*)----- 86
Hutsonia----- 59, 87, 88
microrugosa----- 64, 69, 88, pl. 9
- I**
- Ilyocypris*----- 59, 70, 71, 75, 87
tumida----- 64, 69, 70, pl. 8
injundibuliformis, *Brachyocythere*----- 81
Inoceramus----- 62
Introduction----- 59
Isoocythereis----- 83
- J**
- jerseyensis*, *Brachyocythere*----- 81
Jonesina----- 87
Jurassic, late----- 61, 62
- K**
- Krithe*----- 59, 87
postprojecta----- 67, 69, 87, pl. 9
Kyphopyga christneri----- 62, 67
- L**
- lacustris*, *Schuleridea*----- 67, 74, pl. 9
lanceolata, *Apatocythere*----- 65, 67, 69, 72, 73, pl. 9
leguminoidea, *Apatocythere*----- 64, 66, 69, 73, pl. 9
leguminoidea, *Asciocythere*----- 64, 66, 69, 78, pl. 8
limburgensis, *Cytheridea*----- 76
Loxoconcha----- 89
- M**
- Macrodentina*----- 59, 89
obliqua----- 66, 69, 89, pl. 9
macropunctata, *Asciocythere*----- 63, 69, 77, pl. 8
Metacypris----- 75, 88
ventrosa----- 71
microrugosa, *Hutsonia*----- 64, 69, 88, pl. 9
midwayensis, *Cythereis*----- 83
monmouthensis, *Cytheridea*----- 79
Cytheridea (*Haplocytheridea*)----- 79
Haplocytheridea----- 67, 69, 79, pl. 8
Monoceratina----- 59, 88
semiornata----- 63, 69, 88, pl. 9
umbonata----- 88
sp----- 66
morrisonensis, *Bairdiocypris*----- 72
muricata, *Cypridina*----- 84
- N**
- nausiformis*, *Brachyocythere*----- 62, 63, 67, 69, 80, pl. 8
navarroensis, *Cytherella*----- 62, 68, 69, pl. 8
nuda, *Cythereis ornatissima*----- 83
- O**
- obesa*, *Cytherella*----- 62, 68, 69, pl. 8
obliqua, *Macrodentina*----- 66, 69, 89, pl. 9
ornatissima, *Cythere*----- 84
Cythere (*Cythereis*)----- 84
Cythereis----- 63, 69, 84, 85, pl. 9
Cytherina----- 84
nuda, *Cythereis*----- 83
reticulata, *Cythereis*----- 84
ovata, *Cytherella*----- 76
Cytheridea----- 77, 78
ovoidea, *Cytherella*----- 68
- P**
- Paleocene----- 61
pamlicoensis, *Cythereis*----- 67, 69, 82, pl. 9
Paracypris----- 59, 70
sp----- 65, 69, 70, pl. 8
paratriplicata, *Protocythere*----- 62, 69, 85, pl. 9
parustinensis, *Cythereis*----- 83
Peedee formation----- 59, 61, 62, 67
pentagonalis, *Schuleridea*----- 66, 69, 75, pl. 9
pidgeoni, *Archicythereis cf. Cythereis*----- 84
Cythereis----- 84
Cythereis cf. "Archicythereis"----- 84
Planulina taylorensis----- 62, 67
Platycopa----- 68-70
plummeri, *Cytheridea*----- 79, 80
Haplocytheridea----- 62, 63, 69, 79, pl. 8
Podocopa----- 70-90
pondera, *Bairdopillata*----- 62, 69, 71, pl. 8
postprojecta, *Krithe*----- 67, 69, 87, pl. 9
Pre-Cambrian----- 59, 60, 66, 67
Protocythere----- 59, 81, 85
paratriplicata----- 62, 69, 85, pl. 9
triplicata----- 85
Pterygocythereis----- 59, 85, 86
tokiana----- 63, 64, 69, 85, 86, pl. 9
- Q**
- quadrialira*, *Cythereis*----- 63, 67, 69, 84, pl. 9

R

rectangulapora, *Cythere*..... 81
 References..... 89
regina, *Vaginulina*..... 62, 67
reniformis, *Cytheridea*..... 76
reticulata, *Cythereis ornatissima*..... 84
 Cytherelloidea..... 70
rotunda, *Asciocythere*..... 64, 69, 76, 77, pl. 8
rotundus, *Bythocypris*..... 75, 76
 Cytheridea..... 76
rugosissima, *Cythereis*..... 63, 69, 81, pl. 9

S

Schuler formation..... 59, 66
Schuleridea..... 59, 72, 73, 74
 acuminata..... 66, 69, 72, 74, 75, pl. 9
 hatterasensis..... 64, 67, 69, 74, 75, pl. 9
 lacustris..... 67, 74, pl. 9
 pentagonalis..... 66, 69, 75, pl. 9
 umbonata..... 72, 74
seniornata, *Monoceratina*..... 63, 69, 88, pl. 9
silvana, *Gomphocythere*..... 69, 87, pl. 9
simulans, *Apatocythere*..... 72, 73
simulonuda, *Cythereis*..... 63, 69, 83, pl. 9
sphenoides, *Brachyocythere*..... 62, 69, 80, 81, pl. 8
 Cythere..... 80
 Cytheropteron..... 80
stenzeli, *Trachyleberis*..... 83
 Stratigraphic section, well no. 1..... 61-67
 well no. 2..... 61, 67-68
subdeltoidea, *Bairdia*..... 71
 Summary, stratigraphic..... 59

T

taylorensis, *Brachyocythere*..... 80
 Planulina..... 62, 67
tasana, *Vaginulina*..... 62, 67
thorensis, *Cytheridea (Haplocythereidea)*..... 74
tokiana, *Cytheropteron*..... 85
 Pterygocythere..... 63, 64, 69, 85, 86, pl. 9
Trachyleberis..... 84
 exanthemata..... 83
 stenzeli..... 83
triangularis, *Asciocythere*..... 64, 69, 77, pl. 8
trinitiensis, *Cytheridea*..... 86
 Cytheropteron (Eocytheropteron)..... 64, 69, 86, pl. 9
 Trinity formation..... 59, 60, 61, 64, 65, 66, 67, 68
triplicata, *Protocythere*..... 85
tumida, *Ilyocypris*..... 64, 69, 70, pl. 8
tumidosa, *Apatocythere*..... 65, 67, 69, 73, pl. 9
tumidum, *Cytheropteron (Eocytheropteron)*..... 60, 64, 86
tumoides, *Cytheropteron (Eocytheropteron)*..... 64, 69, 86, pl. 9
 Tuscaloosa formation..... 59, 60, 61, 63, 67

U

umbonata, *Monoceratina*..... 88
 Schuleridea..... 72, 74

V

Vaginulina regina..... 62, 67
 tasana..... 62, 67
ventrosa, *Metacypris*..... 71
virginea, *Cytheropteron concentricum*..... 70

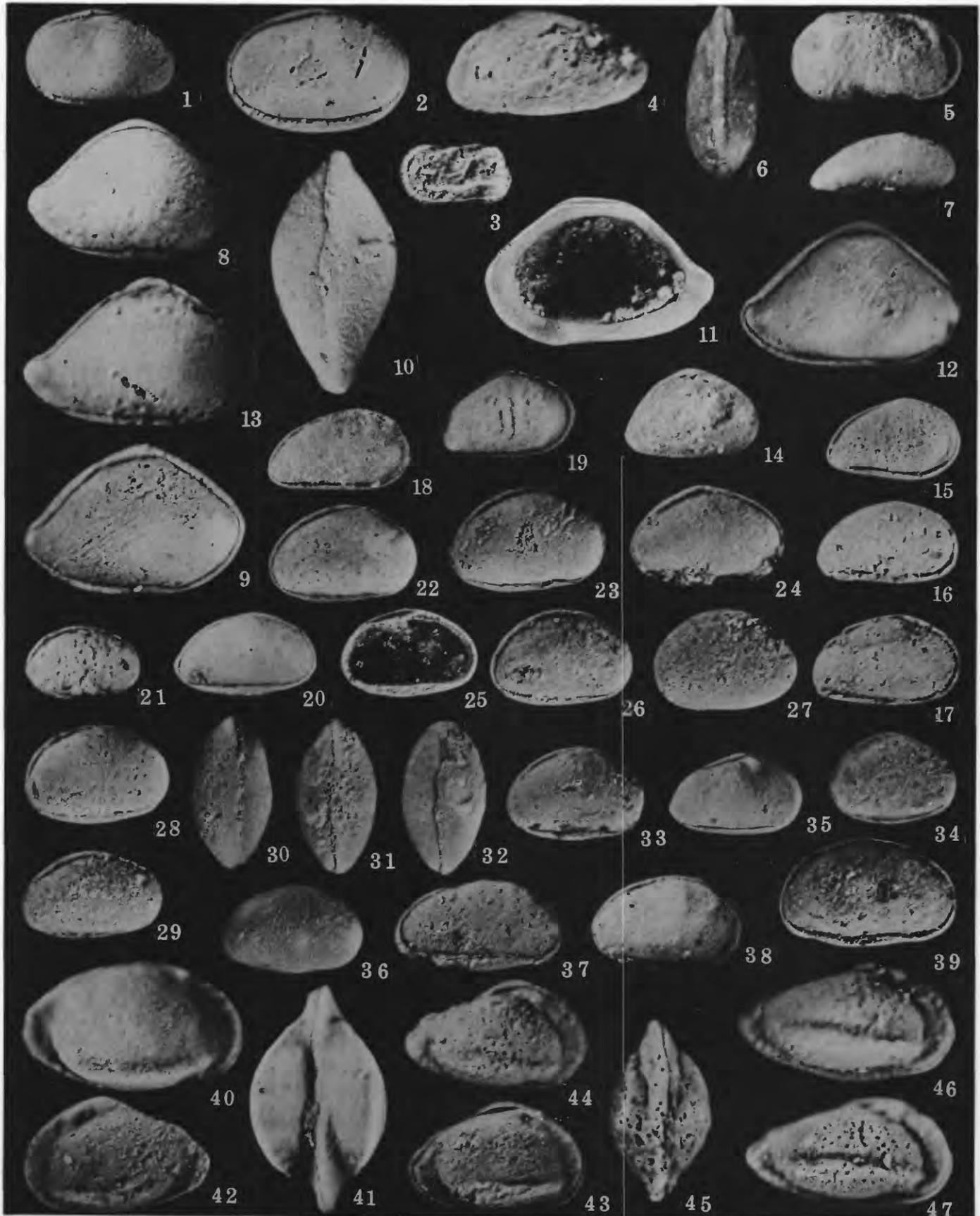
W

Washita formation..... 59, 60, 61, 64
 Wells, location..... 60
worthensis, *Cythereis*..... 83, 84

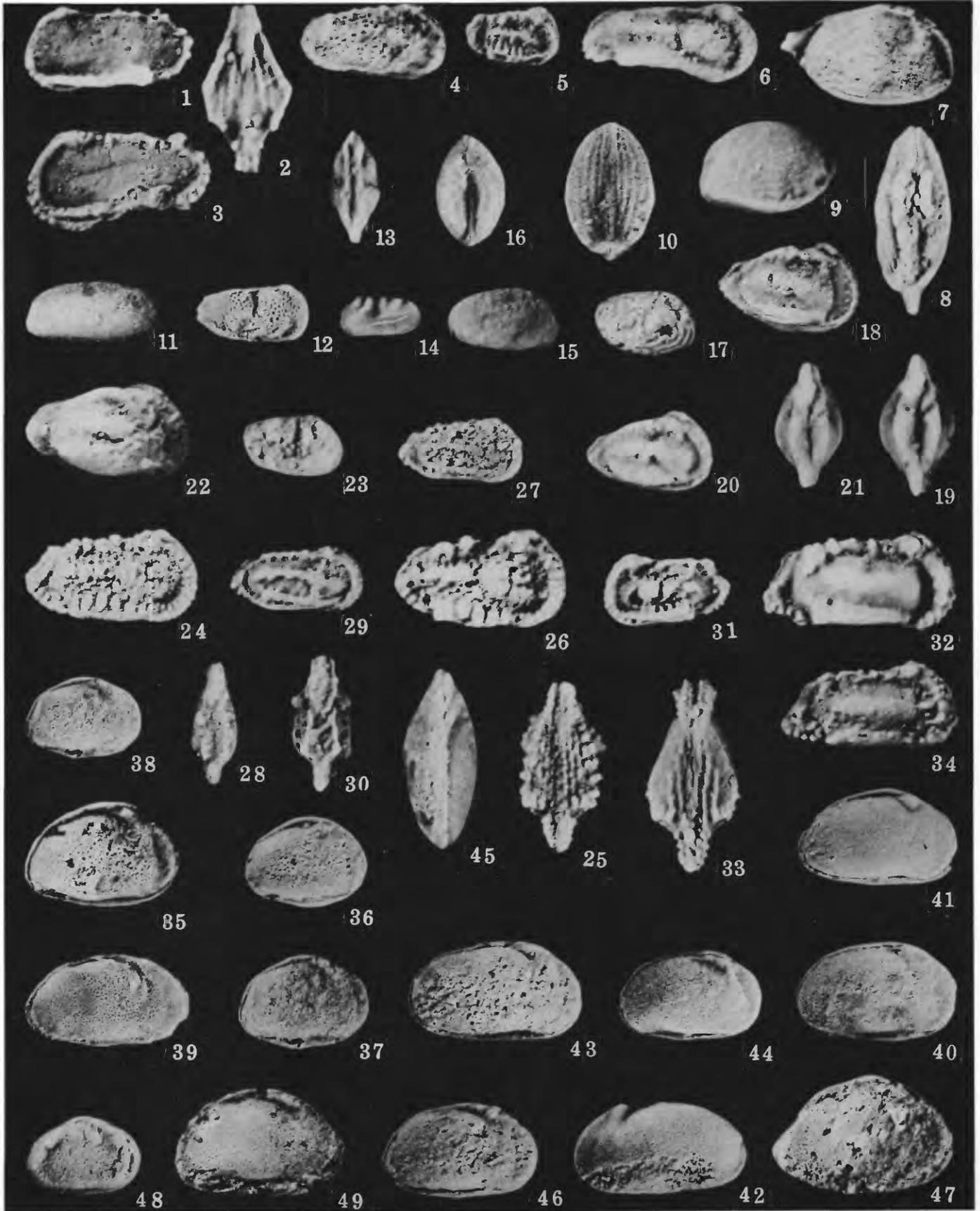
PLATES

PLATE 8

- FIGURE 1. *Cytherella navarroensis* Alexander. Left side of a complete shell, $\times 37$. Hatteras Light well no. 1, 3,240–3,250 feet, Black Creek(?) formation. U.S.N.M. 106906. (p. 68)
2. *Cytherella* cf. *C. obesa* Alexander. Left side of a complete shell, $\times 37$. Hatteras Light well no. 1, 3,130–3,140 feet, Peedee(?) formation. U.S.N.M. 106907. (p. 68)
 3. *Cytherelloidea darensis* Swain, n. sp. Left side of holotype, $\times 37$. Hatteras Light well no. 1, 7,500–7,510 feet, beds of Trinity(?) and pre-Trinity(?) age, undifferentiated. U.S.N.M. 106908. (p. 68)
 4. *Cypris?* sp. Exterior of a left valve, surface of which bears fine concentric striations, $\times 37$. Hatteras Light well no. 1, 6,460–6,470 feet, beds of Trinity(?) and pre-Trinity(?) age, undifferentiated. U.S.N.M. 106909. (p. 70)
 - 5, 6. *Ilyocypris? tumida* Swain, n. sp. Right side and dorsal views of holotype, $\times 37$. Hatteras Light well no. 1, 6,350–6,360 feet, beds of Trinity(?) and pre-Trinity(?) age, undifferentiated. U.S.N.M. 106910. (p. 70)
 7. *Paracypris* sp. Right side of a complete specimen, $\times 38$. Hatteras Light well no. 1, 6,700–6,710 feet, beds of Trinity(?) and pre-Trinity(?) age, undifferentiated. U.S.N.M. 106911. (p. 70)
 - 8–12. *Bairdopillata pondera* Jennings. 8, Right valve view, $\times 38$. Hatteras Light well no. 1, 4,640–4,650 feet, beds of Eagle Ford(?) age, U.S.N.M. 106912. 9, 12, Right valve views, $\times 37$. Hatteras Light well no. 1, 3,780–3,790 feet, beds of Eutaw(?) age, U.S.N.M. 106913, 106915. 10, Ventral view, $\times 37$. Hatteras Light well no. 1, 3,550–3,560 feet, beds of Eutaw(?) age or Black Creek(?) formation, specimen lost. 11, Right valve view of a specimen that is more strongly produced posteriorly than the other, $\times 37$. Hatteras Light well no. 1, 3,410–3,420 feet, Black Creek(?) formation, U.S.N.M. 106914. (p. 71)
 13. *Bairdia?* cf. *B. alexandrina* Blake. Right side of a complete example, $\times 37$. Hatteras Light well no. 1, 4,750–4,760 feet, beds of Eagle Ford(?) age. U.S.N.M. 106916. (p. 71)
 14. *Bairdocypris?* sp. Right side of a complete specimen, $\times 39$. Hatteras Light well no. 1, 7,910–7,920 feet, beds of Trinity(?) and pre-Trinity(?) age, undifferentiated. U.S.N.M. 106917. (p. 72)
 15. *Haplocytheridea?* sp. aff. *H? plummeri* (Alexander). Right side of a complete shell, $\times 37$. Hatteras Light well no. 1, 3,990–4,000 feet, beds of Eutaw(?) age. U.S.N.M. 106918. (p. 79)
 - 16, 17. *Haplocytheridea? graysonensis* (Alexander). Right valve views of two examples, $\times 40$. Hatteras Light well no. 1, core sample, 4,485–4,495 feet, beds of Eagle Ford(?) age. U.S.N.M. 106919. (p. 78)
 18. *Haplocytheridea? berryi* Swain, n. sp. Right side of holotype, $\times 37$. Hatteras Light well no. 1, core sample, 3,380–3,390 feet, Black Creek(?) formation. U.S.N.M. 106920. (p. 78)
 19. *Haplocytheridea monmouthensis* (Berry). Right side of a complete shell, $\times 35$. North Carolina Esso well no. 2, 2,750–2,760 feet, beds of Eutaw(?) age or Black Creek(?) formation. U.S.N.M. 106921. (p. 79)
 20. *Asciocythere? acuminata* Swain, n. sp. Right side of holotype, $\times 38$. Hatteras Light well no. 1, 3,780–3,790 feet, beds of Eutaw(?) age. U.S.N.M. 106922. (p. 77)
 21. *Asciocythere macropunctata* Swain, n. sp. Right side of holotype, $\times 37$. Hatteras Light well no. 1, core sample, 3,693–3,703 feet, beds of Eutaw(?) age. U.S.N.M. 106933. (p. 77)
 - 22–33. *Asciocythere rotunda* (Vanderpool), 22, 26, Right valve views of possible females, U.S.N.M. 106923, 106927; 27, left valve view of possible female, U.S.N.M. 106927; 29, right valve view of possible male, U.S.N.M. 106923; 32, ventral view of possible female, U.S.N.M. 106923; $\times 42$, Hatteras Light well no. 1, 6,300–6,310 feet. 23, Right side of a possible female, $\times 42$, Hatteras Light well no. 1, 7,330–7,340 feet, U.S.N.M. 106924. 24, Right side of a possible male, $\times 42$, Hatteras Light well no. 1, 6,430–6,440 feet, U.S.N.M. 106930. 25, Interior of a left valve, $\times 42$, showing anterior slightly denticulate elongate hinge socket, interterminal bar, and prominent mid-dorsal accommodation groove, Hatteras Light well no. 1, 6,420–6,430 feet, U.S.N.M. 106925. 28, 30, Right side and dorsal views of possible females, $\times 42$, Hatteras Light well no. 1, 6,340–6,350 feet, U.S.N.M. 106931, 106928. 31, Ventral view of a possible female, $\times 42$, Hatteras Light well no. 1, 7,450–7,460 feet, U.S.N.M. 106929. 33, Right side of a possible female, $\times 42$, Hatteras Light well no. 1, 6,350–6,360 feet, U.S.N.M. 106926. All from beds of Trinity(?) and pre-Trinity(?) age, undifferentiated. (p. 76)
 34. *Asciocythere? triangularis* Swain, n. sp. Right side of holotype, $\times 42$. Hatteras Light well no. 1, 6,430–6,440 feet, beds of Trinity(?) and pre-Trinity(?) age, undifferentiated. U.S.N.M. 106932. (p. 77)
 35. *Cytheridea washitaensis* Alexander. Right side of a specimen from the Grayson formation of Texas, $\times 41$, introduced as an example of a cytherideid typical of Washita group in Texas. Note lack of oblique sulcus postjacent to anterodorsal node, and compare with *Schuleridea hatterasensis*, n. sp., which may be a predecessor of the group of *Cytheridea washitaensis*. Specimen loaned through courtesy of C. I. Alexander.
 36. *Asciocythere? leguminoides* Swain, n. sp. Right side of holotype, $\times 42$. Hatteras Light well no. 1, 9,030–9,040 feet, Upper Jurassic(?). U.S.N.M. 106934. (p. 78)
 - 37–39. *Asciocythere? cf. A. amygdaloides* (Cornuel). 37, Right side of an imperfectly preserved specimen, $\times 35$, Hatteras Light well no. 1, core sample, 6,132–6,137 feet, U.S.N.M. 106935. 38, Right side of a complete shell, $\times 35$, Hatteras Light well no. 1, 6,250–6,260 feet, U.S.N.M. 106936. 39, Right side of a partly exfoliated example that exhibits the muscle scar, retouched, $\times 35$, Hatteras Light well no. 1, 6,190–6,200 feet, U.S.N.M. 106937. All from beds of Trinity(?) and pre-Trinity(?) age, undifferentiated. (p. 76)
 - 40, 41. *Brachycythere darensis* Swain, n. sp. Right side and dorsal views of holotype, $\times 40$. Hatteras Light well no. 1, 3,200–3,210 feet, Black Creek(?) formation. U.S.N.M. 106938. (p. 80)
 - 42, 43. *Brachycythere sphenoides* (Reuss). Left and right sides of two complete shells, $\times 37$. Hatteras Light well no. 1, core sample, 3,500–3,510 feet, Black Creek(?) formation. U.S.N.M. 106939. (p. 80)
 - 44–47. *Brachycythere nausiformis* Swain, n. sp. 44, 45, Right side and dorsal views of male cotype, $\times 38$, Hatteras Light well no. 1, 3,780–3,790 feet, beds of Eutaw(?) age, U.S.N.M. 106940. 46, Right side of a female cotype, $\times 38$, North Carolina Esso well no. 2, 2,750–2,760 feet, beds of Eutaw(?) age or Black Creek(?) formation, U.S.N.M. 106941. 47, Right side of a female cotype, $\times 38$, Hatteras Light well no. 1, 3,640–3,650 feet, Black Creek(?) formation, U.S.N.M. 106942. (p. 80)



CYTHERELLIDAE, CYPRIDAE, BAIRDIIDAE AND CYTHERIDAE



CYTHERIDAE

CONTENTS

	Page
Part 1, Cenozoic Ostracoda (Published in August 1952).....	1
Part 2, Mesozoic Ostracoda (Published in June 1952).....	59

ILLUSTRATIONS

	Page
Plates 1-7. Cytherellidae, Cypridae, Bairdiidae, and Cytheridae.....	Follow 58
8. Cytherellidae, Cypridae, Bairdiidae, and Cytheridae.....	Follows 93
9. Cytheridae.....	Follows 93
Figure 1. Index map showing eastern North Carolina localities studied.....	2
2. Stratigraphic relationships of Cenozoic rocks in Esso Standard Oil Co. Hatteras Light Well No. 1 and North Carolina Esso Well No. 2, Eastern Dare County, N. C.....	5
3. Cytherellidae and Cytheridae.....	15
4. Index map showing locations of wells.....	60
5. Stratigraphic sections of the Upper Cretaceous rocks in Hatteras Light Well No. 1 and North Carolina Esso Well No. 2.....	61
6. Stratigraphic sections of the Lower Cretaceous rocks in Hatteras Light Well No. 1 and North Carolina Esso Well No. 2.....	61
7. Stratigraphic section of Upper Jurassic(?) and pre-Cambrian rocks in Hatteras Light Well No. 1.....	62

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Ostracoda From Wells in North Carolina

By FREDERICK M. SWAIN

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Part 1, Cenozoic Ostracoda

Part 2, Mesozoic Ostracoda



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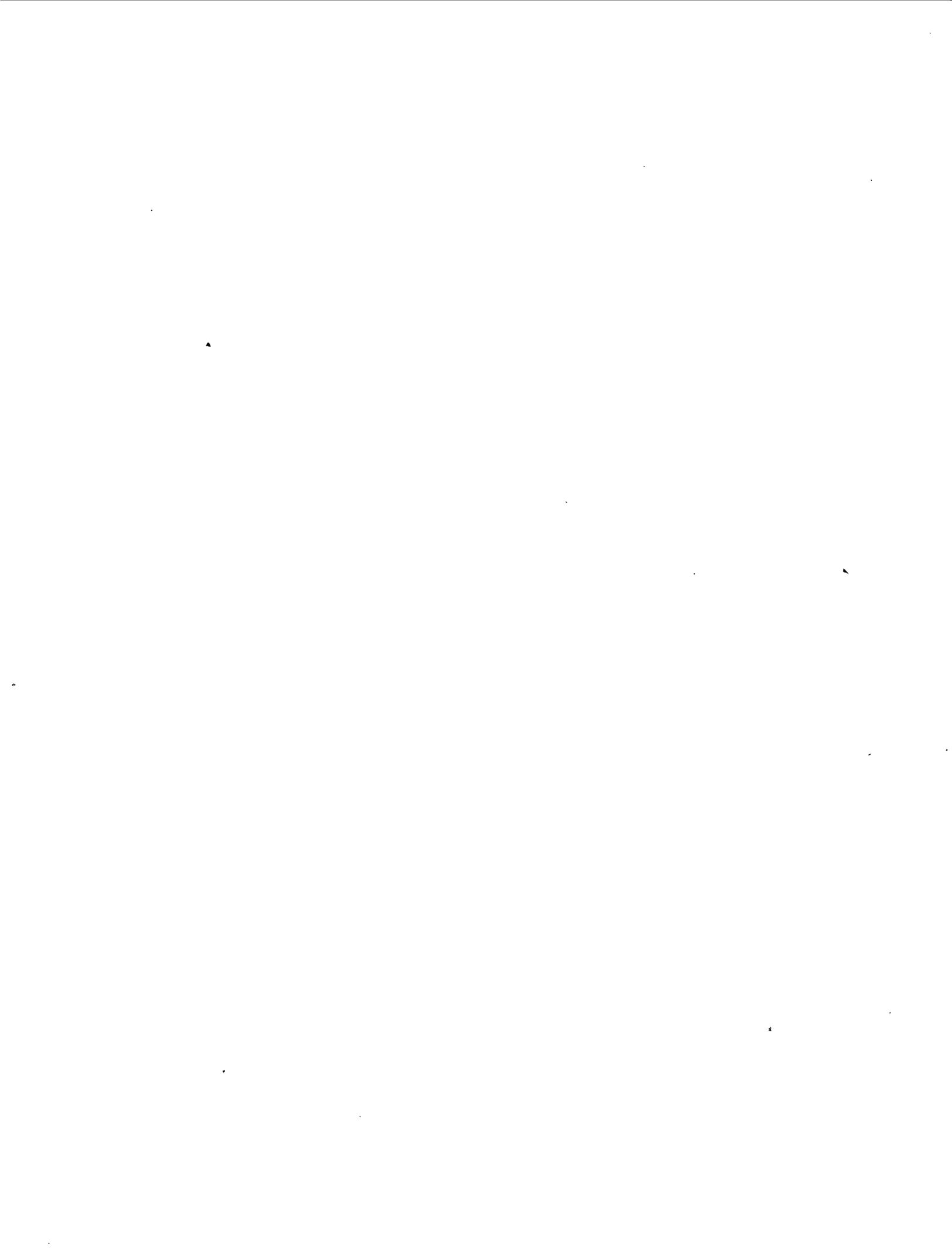


PLATE 9

- FIGURE 1-3. *Pterygocythereis* cf. *P. tokiana* (Israelsky). 1, 2, Left side and ventral views of a complete shell, × 37. Hatteras Light well no. 1, 6,310-6,320 feet, beds of Trinity(?) and pre-Trinity(?) age, undifferentiated; U.S.N.M. 106943, possibly represents a specimen caved from a higher level. 3, Exterior of a crushed left valve, × 37. Hatteras Light well no. 1, 4,440-4,450 feet, beds of Eagle Ford(?) age, U.S.N.M. 106944. (p. 85)
4. *Cythereis?* *pamlicoensis* Swain, n. sp. Right side of holotype, × 36. North Carolina Esso well no. 2, 2,310-2,320 feet, Peedee(?) formation. U.S.N.M. 106945. (p. 82)
5. *Cythereis* sp. aff. *C. rugosissima* Alexander. Right side of a complete shell, × 37. Hatteras Light well no. 1, 4,600-4,610 feet, beds of Eagle Ford(?) age. U.S.N.M. 106946. (p. 81)
6. *Cythereis* sp. aff. *C. fredericksburgensis* Alexander. Right side of a specimen made elongate by compaction, × 37. Hatteras Light well no. 1, 7,310-7,320 feet, beds of Trinity(?) and pre-Trinity(?) age, undifferentiated. U.S.N.M. 106947. (p. 82)
- 7, 8. *Cytheropteron* (*Eocytheropteron*) *tumoides* Swain, n. sp. 7, Right side of holotype, × 38, Hatteras Light well no. 1, 6,760-6,770 feet, U.S.N.M. 106948. 8, Dorsal view of a paratype, × 38, Hatteras Light well no. 1, 6,340-6,350 feet, beds of Trinity(?) and pre-Trinity(?) age, undifferentiated, U.S.N.M. 106949. (p. 86)
- 9, 10. *Cytheropteron* (*Eocytheropteron*) *Trinitensis* (Vanderpool). Left side and dorsal views of a complete shell, × 38. Hatteras Light well no. 1, 6,340-6,350 feet, beds of Trinity(?) and pre-Trinity(?) age, undifferentiated. U.S.N.M. 106950. (p. 86)
11. *Krithe* cf. *K. postprojecta* Schmidt. Right side of a complete shell, × 38. North Carolina Esso well no. 2, 2,300-2,310 feet, Peedee(?) formation. U.S.N.M. 106951. (p. 87)
- 12, 13. *Monoceratina* sp. aff. *M. semiornata* Alexander. Right side and dorsal views of a specimen that is imperfect post-mid-ventrally, × 38. Hatteras Light well no. 1, 3,800-3,810 feet, beds of Eutaw(?) age. U.S.N.M. 106952. (p. 88)
14. *Hutsonia?* *microrugosa* Swain, n. sp. Left side of holotype, × 38. Hatteras Light well no. 1, 6,260-6,270 feet, beds of Trinity(?) and pre-Trinity(?) age, undifferentiated. U.S.N.M. 106953. (p. 88)
- 15, 16. *Cytheropteron* (*Eocytheropteron*) *acaudatum* Swain, n. sp. Right side and ventral views of holotype, × 38. Hatteras Light well no. 1, 5,640-5,650 feet, beds of Washita(?) age. U.S.N.M. 106954. (p. 87)
17. *Macrodenina?* *obliqua* Swain, n. sp. Right side of holotype, × 35. Hatteras Light well no. 1, 8,330-8,340 feet, beds of Trinity(?) and pre-Trinity(?) age, undifferentiated. U.S.N.M. 106955. (p. 89)
- 18-21. *Protocythere paraventricata* Swain, n. sp. 18, 19, Right side and dorsal views of holotype, × 38, Hatteras Light well no. 1, 3,240-3,250 feet, Black Creek(?) formation, U.S.N.M. 106956. 20, 21, Right side and dorsal views of paratype, × 38, Hatteras Light well no. 1, 4,840-4,850 feet, Tuscaloosa(?) formation, U.S.N.M. 106957. (p. 85)
22. *Brachycythere arachoides* (Berry). Right side of a complete shell, × 37. North Carolina Esso well no. 2, 2,310-2,320 feet, Peedee(?) formation. U.S.N.M. 106958. (p. 81)
23. *Gomphocythere?* cf. *G. silvana* Martin. Right side of a complete shell, × 37. Hatteras Light well no. 1, 8,430-8,440 feet, beds of Trinity(?) age and pre-Trinity(?) age, undifferentiated. U.S.N.M. 106959. (p. 87)
- 24-26. *Cythereis ornatisima* (Reuss). 24, 25, Right side and ventral views of a complete shell, × 38, Hatteras Light well no. 1, 4,410-4,420 feet, beds of Eagle Ford(?) age, U.S.N.M. 106960. 26, Right side of a shell having slightly longer spines, and a more strongly elevated anterior cardinal angle, × 38, Hatteras Light well no. 1, 4,640-4,650 feet, beds of Eagle Ford(?) age, U.S.N.M. 106961. (p. 84)
- 27-30. *Cythereis quadrialira* Swain, n. sp. 27, 28, Right side and dorsal views of a somewhat abraded paratype, × 37, Hatteras Light well no. 1, 3,750-3,760 feet, Eutaw formation, U.S.N.M. 106962. 29, 30, Right side and dorsal views of holotype, × 37, North Carolina Esso well no. 2, 2,750-2,760 feet, beds of Eutaw(?) age or Black Creek(?) formation U.S.N.M. 106963. (p. 84)
31. *Cythereis bicornis* Israelsky. Exterior of a left valve, × 36. Hatteras Light well no. 1, 4,320-4,330 feet, beds of Eagle Ford(?) age, U.S.N.M. 106964. (p. 83)
- 32-34. *Cythereis similonuda* Swain, n. sp. 32, 33, Right side and ventral views of holotype, × 38, Hatteras Light well no. 1, 5,340-5,350 feet, Tuscaloosa(?) formation, U.S.N.M. 106965. 34, Right side of a paratype, × 38, Hatteras Light well no. 1, 4,780-4,790 feet, beds of Eagle Ford(?) age, U.S.N.M. 106966. (p. 83)
- 35-38. *Schuleridea hatterasensis* Swain, n. sp. 35, Right side of holotype, × 40, Hatteras Light well no. 1, 6,477-6,482 feet, U.S.N.M. 106967. 36, 37, 38, Right sides of three paratypes, × 37, Hatteras Light well no. 1, from depths of 7,430-7,440 feet, 6,480-6,490 feet, and 6,380-6,390 feet, respectively, U.S.N.M. 106968-106970. All from beds of Trinity(?) and pre-Trinity(?) age, undifferentiated. (p. 74)
- 39, 41, 42, 46. *Apatocythere? lanceolata* Swain, n. sp. 39, Right side of holotype, a specimen that is slightly imperfect anteroventrally, × 37, Hatteras Light well no. 1, 7,250-7,260 feet, U.S.N.M. 106971. 41, Right side of a paratype, imperfect terminally, × 37, Hatteras Light well no. 1, 7,310-7,320 feet, U.S.N.M. 106972. 42, Left side of a paratype shell, imperfect dorsally, × 37, Hatteras Light well no. 1, 7,560-7,570 feet, U.S.N.M. 106973. 46, Right side of a paratype, × 37, Hatteras Light well no. 1, 6,930-6,940 feet, U.S.N.M. 106974. All from beds of Trinity(?) and pre-Trinity(?) age, undifferentiated. (p. 72)
- 40, 43, 45. *Apatocythere? leguminoides* Swain, n. sp. 40, Right side of a paratype, × 37, North Carolina Esso well no. 2, 5,560-5,570 feet, U.S.N.M. 106975. 43, 45, Right side and dorsal views of holotype, × 37, Hatteras Light well no. 1, 6,350-6,360 feet, U.S.N.M. 106976. Both from beds of Trinity(?) and pre-Trinity(?) age, undifferentiated. (p. 73)
44. *Apatocythere? tumidosa* Swain, n. sp. Right side of holotype, × 33. Hatteras Light well no. 1, 8,300-8,310 feet, beds of Trinity(?) and pre-Trinity(?) age, undifferentiated. U.S.N.M. 106977. (p. 73)
47. *Schuleridea* cf. *S. acuminata* Swartz and Swain. Right side of a complete shell, in which the surface is poorly preserved, × 40. Hatteras Light well no. 1, 9,100-9,110 feet, Upper Jurassic(?). U.S.N.M. 106978. (p. 75)
48. *Schuleridea? lacustris* Swain, n. sp. Right side of holotype, × 35. North Carolina Esso well no. 2, 4,970-4,980 feet, beds of Trinity(?) and pre-Trinity(?) age, undifferentiated. U.S.N.M. 106979. (p. 74)
49. *Schuleridea* cf. *S. pentagonalis* Swartz and Swain. Right side of a somewhat imperfect specimen, × 41. Hatteras Light well no. 1, core sample, 9,115-9,116 feet, Upper Jurassic(?). U.S.N.M. 106980. (p. 75)