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Upper Cretaceous Ostracoda  
of Arkansas

By  
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LITTLE ROCK

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## INTRODUCTION

Only those forms which it was felt could be readily distinguished are described in this paper. Species of *Cytherella* and typical *Cytheridea* are common throughout the Gulf series of Arkansas. *Nesidea* (*Bairdia*) is rare in the Tokio formation but common in the others. A few isolated specimens of *Paracypris* and *Bythocypris* (?) were also encountered. In generic treatment an attempt has been made to follow G. W. Müller.

An effort was made to consult all the papers on the Mesozoic and Tertiary Ostracoda and all the monographs on the Recent Ostracoda. The services of the Research Bureau, National Research Council, were especially valuable in supplying photostatic copies of papers not otherwise available.

The meager literature on the Ostracoda of the European Cretaceous has prevented any comparison of faunules. As will be seen in the descriptive text, few of our species compare closely with described forms. Comparisons are made only where some reasonably close resemblance exists.

In the samples submitted those from each formation excepting the Brownstown marl yielded an abundant microfauna. Ostracods were found in only two of a dozen samples examined from the Brownstown, and only a few *Gumbelina* and *Globotruncana* occur in the others.

Considering only the more or less commonly occurring forms we find *Cythereis hannai* n. sp., *Cythereis bicornis* n. sp., and *Cytheropteron tokiana* confined to the Tokio formation; *Cythereis ponderosana* n. sp. and *Cytheropteron ponderosana* n. sp. in the Ozan, Annona, and Marlbrook; *Cythereis spoori* n. sp. in the Brownstown and Ozan; *Cytheropteron ledaforma* n. sp., *Cythereis costatana* n. sp., and *Cythereis ivii* n. sp. in the Saratoga, Nacatoch, and Arkadelphia; and *Cythereis hazardi* n. sp. in the Nacatoch and Arkadelphia, the environment of the Saratoga chalk apparently being unfavorable to its existence.

L. W. Stephenson divides the Upper Cretaceous or Gulf series into five major divisions: The Woodbine and its equivalents, the Eagle Ford and its equivalents, the Austin chalk and its equivalents, all of which contain characteristic ammonites; the *Exogyra ponderosa* zone and the *Exogyra costata* zone, characterized respectively by these two large oyster-like forms.

No marine Woodbine nor Eagle Ford is known in Arkansas. The Austin chalk of Texas is represented by the Tokio formation. The *Exogyra ponderosa* zone is represented by the Brownstown marl, the Ozan formation, the Annona chalk, and the Marlbrook marl. The *Exogyra costata* zone is represented by the Saratoga chalk, the Nacatoch sand and marl, and the Arkadelphia marl.

It will be seen that the above common ostracods will fall into three groups corresponding to the three upper divisions as given by Stephenson, i. e., the Tokio (Austin), the *Exogyra ponderosa* zone, and the *Exogyra costata* zone, which are divisions based on the occurrence of mollusks.

While more information will doubtlessly show slightly greater ranges for some of these species, it is believed these three major zones will be found to hold.

The few samples available to the writer from northeast Texas show that the faunules occupy the same relative positions, the common Tokio forms being found in the Bonham clay, the *Exogyra ponderosa* forms occurring in the Taylor marl, and the *Exogyra costata* forms being found in the Navarro clay.

Special appreciation is due Mr. William Spooner, who collected most of the surface samples on which this report is based; Mr. Roy T. Hazard, who often accompanied Mr. Spooner in the field; Mr. Garland Grigsby, who picked a large number of the samples considered; Mr. Richard Norton, who permitted the study of Arkadelphia slides in his possession; Mr. Malcolm Helm, who drew the figures under the writer's direction; and Mr. John S. Ivy, who kindly gave permission for the publication of these notes.

In the check list the following abbreviations are used: c, common; fc, fairly common; r, rare. These letters do not

North Carolina Geol. and Econ. Survey, vol. 5, The Cretaceous formations of North Carolina, pl. 8, pt. 1, 1923, and other papers.

indicate the number of specimens found, but the frequency of occurrence of the species in samples.

*Upper Cretaceous Ostracoda found in Arkansas*

Species	Tokio	Exogyra Ponderosa Zone				Exogyra Costata Zone		
		Brownstown	Ozan	Annona	Marlbrook	Saratoga	Nacatoch	Arkadelphia
Cytherura spooneri n. sp.....			r		r			
Cytherura ? dubia n. sp.....						r		
Cytherura ? saratogana n. sp.....						r		
Cytheropteron sp. A.....	c		c	c		c	c	c
Cytheropteron sp. B.....			c		c	c	c	c
Cytheropteron ledaforma n. sp.....						fc	c	c
Cytheropteron tokiana n. sp.....	c							
Cytheropteron ponderosana n. sp..			fc	fc	fc			
Cytheropteron saratogana n. sp...						r		
Loxoconcha fletcheri n. sp.....						r		
Cythere bruceclarki n. sp.....					r			
Cytheridea ? saratogana n. sp.....						r		
Cytheridea ? hannai n. sp.....			r					
Cythereis ozanana n. sp.....			r					
Cythereis ponderosana n. sp.....			c	c	c			
Cythereis tridenta n. sp.....					r			r
Cythereis communis n. sp.....			c	c	c	c	c	c
Cythereis ivii n. sp.....						c		r
Cythereis saratogana n. sp.....						r		
Cythereis costatana n. sp.....						c	c	c
Cythereis hannai n. sp.....	c							
Cythereis spoori n. sp.....		fc	fc					
Cythereis bartoni n. sp.....						r		
Cythereis plummeri n. sp.....			r					
Cythereis hazardi n. sp.....							fc	c
Cythereis bicornis n. sp.....	c							

## DESCRIPTIONS OF SPECIES\*

**Cytherura spooneri n. sp.**

Plate IV A, figs. 7a, 7b

*Description.*—Viewed from the side, oblong-ovate; the anterior margin gently rounded, the dorsal nearly straight, the ventral nearly straight, the posterior somewhat attenuated, with the point lying above the medial line; the entire margin thickened; within the margins the surface is covered with polygonal pits, most of which appear to be pentagonal, except on the mammillate spine-bearing knob (spine missing on figured specimen) which lies below the median line near the posterior end of the ventral border; greatest height anterior.

Viewed from below the carapace appears as an elongated diamond truncated anteriorly, the anterior portion longer than the rear.

Hinge without teeth.

*Length.*—82 mm.

*Remarks.*—A closely related but distinct species is *Cythere umbonata* Williamson<sup>1</sup> of the English Cretaceous.

Specimens found after figure was drawn show spines on knob are normal to the length of the shell.

Named for Mr. William C. Spooner, at whose instigation this paper was written.

*Holotype.*—80233 U. S. Nat. Mus.

*Type locality.*—Ozan formation, Sec. 20, T. 10 S., R. 26 W., Arkansas.

*Known occurrence.*—Ozan formation (rare) and Marlbrook marl (rare).

**Cytherura? dubia n. sp.**

Plate IV A, fig. 6

*Description.*—Seen from the side, subrhomboidal; anterior and posterior margins sharply rounded, dorsal and ventral margins gently rounded; a weak medial ridge slopes slightly upward from before to behind; strong pits above and below ridge; margins thickened; anterior dorsal tubercle present.

*Length.*—44 mm.

*Remarks.*—This form is somewhat similar to Kuiper's<sup>2</sup> figure of *Cythereis truncata* Reuss, reported from the Oligo-

\*The figured specimens are deposited in the United States National Museum.

<sup>1</sup>Jones, T. R., Mon. Entom. Cret. Form. of England, Paleoc. Soc., London, 1849, p. 12, pl. 2, figs. 2a-3g.

<sup>2</sup>Kuiper, Oligocäne und Miocäne Ostrac. Nederlanden, Groningen, 1918, pl. 3, fig. 31.

cene, Miocene, and Pliocene of Europe. *Cytherura clathrata* O. Sars,<sup>3</sup> a Recent and Pleistocene species, is less closely allied, but an examination of examples of this species shows that it lacks hinge teeth. According to Müller<sup>4</sup> its generic position is doubtful. The anterior dorsal tubercle of *C? dubia* suggests *Cythereis*.

*Holotype*.—80234 U. S. Nat. Mus.

*Type locality*.—Saratoga chalk, NW.¼ Sec. 3, T. 9 S., R. 22 W., Arkansas.

*Known occurrence*.—Saratoga chalk (rare).

***Cytherura? saratogana* n. sp.**

Plate IV A, fig. 8

*Description*.—Shell thin, glassy, outline as seen from side, elongate subovate; dorsal margin nearly straight, ventral gently curved, anterior sharply rounded, posterior bluntly pointed; ornamented with irregular discontinuous, gently rounded ridges and corresponding furrows, which tend to be concentric with the periphery.

*Length*.—.67 mm.

*Remarks*.—*Cytherura costulata* Lienenklaus,<sup>5</sup> a Tertiary species, is ornamented with longitudinal ridges and furrows and also has a quite different outline.

*Holotype*.—80235 U. S. Nat. Mus.

*Type locality*.—Saratoga chalk, NW.¼ Sec. 3, T. 9 S., R. 22 W., Arkansas.

*Known range*.—Saratoga chalk (rare).

***Cytheropteron* sp. A.**

Plate I A, figs. 1a, 1b, 1c

*Description*.—Viewed from the side, subvoid; higher before than behind. Viewed from above or below, outline is broadly fusiform, slightly attenuated before and behind; valve contact sinuous dorsally, but slightly sinuous ventrally.

*Length*.—.99 mm.

*Remarks*.—As it seems likely that with more material it will be found that this form as here treated is a composite, no specific determination has been attempted. As no closely allied forms have come to the writer's attention from the Comanchean, specimens are figured, as their presence at least suggests a post-Comanchean age.

<sup>3</sup>Brady, G. S., Trans. Linn. Soc. London, vol. 26, p. 446, pl. 29, figs. 43-46.

<sup>4</sup>Müller, G. W., Das Tierreich, vol. 31, Ostracoda, Berlin, July, 1912, p. 372.

<sup>5</sup>Lienenklaus, Zeitschr. deutschen geol. Gesell., Bd. 46, 1894, pl. 17, figs. 1a-1c.

*Plesiotype*.—80236 U. S. Nat. Mus.

*Locality*.—Saratoga chalk, NW.¼ Sec. 3, T. 9 S., R. 22 W., Arkansas.

*Known occurrence*.—Tokio formation, Ozan formation, Annona chalk, Saratoga chalk, Nacatoch sand, Arkadelphia marl (common throughout).

**Cytheropteron sp. B.**

Plate I A, figs. 2a, 2b, 2c, 3

*Description*.—Seen from the side, subquadrangular; anterior margin gently rounded, posterior sharply rounded, spinose; dorsal margin gently rounded, ventral sharply curved and carrying a slightly raised ridge; other margins thickened; surface slopes rapidly from thin dorsal edge to wide ventral surface; strong anterior-dorsal tubercle with pit behind. Seen on edge, fusiform; valve contact sinuous ventrally, nearly straight dorsally.

*Length*.—77 mm. (Saratoga species).

*Remarks*.—Those applied to the preceding species apply equally well here.

*Plesiotype*.—80237 U. S. Nat. Mus.

*Locality*.—Saratoga chalk, NW.¼ Sec. 3, T. 9 S., R. 22 W., Arkansas.

*Plesiotype*.—(Lost) Ozan formation.

*Known occurrence*.—Ozan formation, Marlbrook marl, Saratoga chalk, Nacatoch sand, Arkadelphia marl (common throughout).

**Cytheropteron ledaforma n. sp.**

Plate I A, figs. 5, 6, 7

*Description*.—Viewed from side, rostrate, having the appearance of a *Leda*<sup>6</sup>; dorsal margin gently bowed, lower sinuous, anterior margin gently rounded, posterior attenuate. In edge view female subovate, male slightly fusiform. Shell smooth.

*Length*.—66 mm.

*Remarks*.—Specimens from the Nacatoch and Arkadelphia exhibit fine longitudinal striae on the ventral surface. These were probably destroyed in removing the figured specimens from the chalk in which they occurred.

A species somewhat resembling this, but differing in having a much lesser relative height and also in being punctate, is *Cythere* (?) *shattucki* Ulrich and Bassler.<sup>7</sup>

<sup>6</sup>Leda, a genus of the Paleocyprida.

<sup>7</sup>Ulrich and Bassler, Maryland Geol. Survey, Miocene, 1904, pl. 38, fig. 10.



*Cotypes*.—80238 A, B, C, U. S. Nat. Mus.

*Type locality*.—Saratoga chalk, NW.¼ Sec. 3, T. 9 S., R. 22 W., Arkansas.

*Known occurrence*.—Saratoga chalk (fairly common), Nacatoch sand (common), Arkadelphia marl (common).

***Cytheropteron tokiana* n. sp.**

Plate I A, figs. 8, 9a, 9b

*Description*.—Viewed from side, ovoid-oblong; the anterior and posterior margins gently rounded, the dorsal and ventral margins nearly straight; the alar projection at its apex extending but slightly below the ventral margin at the valve contact; a large tubercle occurs at the confluence of the dorsal and anterior margin. The shell surface slopes gently from the dorsal margin to the point of the alar projection. Viewed from above or below the outline is hastate, the head long, the shaft short, the barbs rounded.

*Length*.—1 mm.

*Remarks*.—The most closely comparable figure is that referred to *Cythere serrulata* (Bosquet) by Reuss.<sup>3</sup>

Called *C. tokiana* because of its apparent restriction to the Tokio formation.

*Cotypes*.—80239 A, B, U. S. Nat. Mus.

*Type locality*.—Tokio formation, NE. cor. SE.¼ Sec. 23, T. 10 S., R. 28 W., Arkansas.

*Known occurrence*.—Tokio formation (common).

***Cytheropteron ponderosana* n. sp.**

Plate II A, figs. 1a, 1b, 1c

*Description*.—Viewed from the side, oblong ovoid; the anterior margin gently rounded, the posterior more sharply rounded, with broad, irregular spines at the rear, dorsal margin slightly curved, the ventral nearly straight and terminated behind by the sharp declivity which descends to the semicircular posterior shelf; the surface of the shell slopes gently upward from the dorsal to the ventral margin, where it joins the ridge of the alar projection. Seen from above or below the outline is sharply sagittate, the barbs slightly bent inward, the head long and flaring, the shaft short and compressed. A large tubercle occurs at the confluence of the dorsal and anterior margins.

*Length*.—.88 mm.

<sup>3</sup>Reuss, *Paleontographica*, Bd. 20, 1871-75, pl. 27, fig. 8. Not *Cypridina serrulata* Bosquet, *Mem. Soc. Roy. Liege*, Tome 4, 2d. part., 1848-49, p. 370, pl. 4, fig. 3.

*Remarks.*—*Cytheropteron alatum* (Bosquet) var. *robust* Jones and Hinde<sup>9</sup> is close to our species, but lacks the spine-like projection of the wing, as well as differing in detail of outline.

Even closer is *Cythereis cornuta* var. *americana* Ulrich and Bassler,<sup>10</sup> but the two may be distinguished readily in edge position.

Called *C. ponderosana* because of its apparent restriction to the *Exogyra ponderosa* zone.

*Holotype.*—80240 U. S. Nat. Mus.

*Type locality.*—Ozan formation, SE.¼ Sec. 28, T. 8 S., R. 22 W., Arkansas.

*Known occurrence.*—Ozan formation, Annona chalk, Marlbrook marl (fairly common throughout).

#### ***Cytheropteron saratogana* n. sp.**

Plate II A figs. 4a, 4b, 4c

*Description.*—Viewed from side, roughly oblong; the anterior margin gently rounded, the posterior sharply rounded with broad, irregular spines along the lower portion, the dorsal slightly curved, the ventral nearly straight and terminated behind by the sharp declivity which descends to the semicircular posterior shelf; surface of the shell slopes gently from the dorsal to the ventral margin, along which is a ridge; other margins thickened; a strong tubercle at the confluence of the anterior and dorsal margins. Seen from above or below the outline is sharply hastate, the anterior portion long, the posterior short and compressed, the barbs rounded. The alar projection is strongly bent downward.

*Length.*—99 mm.

*Remarks.*—A closely allied species is *Cytheropteron alatum* (Bosquet) var. *robusta* T. R. Jones and Hinde,<sup>11</sup> which differs in detail.

Called *C. saratogana* because of its apparent limitation to the Saratoga formation.

*Holotype.*—80241 U. S. Nat. Mus.

*Type locality.*—Saratoga chalk, NW.¼ Sec. 3, T. 9 S., R. 22 W., Arkansas.

*Known occurrence.*—Saratoga chalk (rare).

<sup>9</sup>Suppl. Mon. Cret. Entom. England and Ireland, London, 1890, p. 35, pl. 2, figs. 24-27.

<sup>10</sup>Maryland Geological Survey, Miocene, 1904, pl. 37, figs. 29-33.

**Loxoconcha fletcheri n. sp.**

Plate II A, figs. 2, 3

*Description.*—Seen from side, subquadrangular; gently rounded anteriorly and posteriorly; nearly straight dorsally and ventrally, these margins subparallel; marginal rim broad; surface coarsely pitted.

*Length.*—44 mm.

*Remarks.*—If our reference of this species to *Loxoconcha* is correct, the species is noticeable for its relatively great length in proportion to its height.

Named for Mr. Corbin D. Fletcher of Shreveport, La.

*Cotypes.*—80242 A, B, U. S. Nat. Mus.

*Type Locality.*—Saratoga chalk, NW.  $\frac{1}{4}$  Sec. 3, T. 9 S., R. 22 W., Arkansas.

*Known range.*—Saratoga chalk (rare).

**Cythere bruceclarki n. sp.**

Plate II A, figs. 5, 6

*Description.*—Seen from side, the outline is subovoid; surface punctate, a shallow transverse groove anterior to the center (overemphasized as figured), giving the shell the outward appearance of a *Cytheridea*. The hingement of the left valve consists of a well-developed anterior socket and a feebly developed posterior socket, with no teeth present. The pore canals appear to be simple.

*Length.*—44 mm., 48 mm.

*Remarks.*—The hinge characters and the simple pore canals place the species in *Cythere*.

*Cotypes.*—80243 A, B, U. S. Nat. Mus.

*Type locality.*—Marlbrook marl, NW. cor. NE.  $\frac{1}{4}$  Sec. 32, T. 11 S., R. 27 W., Arkansas.

*Known occurrence.*—Marlbrook marl (rare).

Named for Prof. Bruce L. Clark of the University of California.

**Cytheridea? saratogana n. sp.**

Plate II A, figs. 7, 8, 9

*Description.*—Viewed from side, broadly subovate; dorsal, anterior, and ventral margins gently rounded, posterior pointed, rostrate; shell thin at dorsal valve contact, thick below, with slight ridge at the confluence of the lateral and ventral surfaces. Viewed on edge broadly subovate, broadest anterior to the center. The hinge is like that of *Cytheridea*.

The external shell layer is missing; therefore its ornamentation, if any, is unknown.

*Length.*—50 mm.

*Remarks.*—Except for its hinge this species fits poorly into *Cytheridea*.

A form incorrectly figured under the name of *Cytherop-teron concentricum* (Reuss<sup>12</sup>) bears a general resemblance but is readily distinguished. Another allied form is *Cytheridea trinitense* Vanderpool,<sup>13</sup> which shows the same type of hinge. As Vanderpool remarks, *C. trinitense* is very common in the Trinity. It also occurs in the Fredericksburg. Closely related species abound in the Washita. In contrast to the abundance of this group in the Comanchean, *C. saratogana* is the only species encountered in the Gulf series of Arkansas, and it but rarely.

Called *C. saratogana* because of its apparent restriction to the Saratoga formation.

*Cotypes.*—80244 A, B, C, U. S. Nat. Mus.

*Type locality.*—Saratoga chalk, center Sec. 8, T. 11 S., R. 25 W., Arkansas.

*Known occurrence.*—Saratoga chalk (rare).

#### *Cytheridea? hannai* n. sp.

Plate II A, figs. 10a, 10b

*Description.*—Seen from side, subrhomboidal; valve margins slightly sinuous except the dorsal, which is nearly straight; ornamented with large tubercles; whole surface, including tubercles, finely pitted. The hinge is of the *Cytheridea* type.

*Length.*—56 mm.

*Remarks.*—Like the preceding species, this fits but poorly into *Cytheridea*. The tubercles serve to distinguish it from the preceding species and likewise from those in the Comanchean.

A few species of *Iliocypris* vaguely resemble this species in side view but are otherwise quite distinct.

Named for Dr. Marcus A. Hanna, of Houston, Texas.

*Holotype.*—80245 U. S. Nat. Mus.

<sup>12</sup>Egger, J. G. Abh. k. bayer. Akad. der Wiss., II Cl., 21 Bd., 1 Abth., 1899, pl. 27, fig. 57. Not *Cytherina concentrica* Reuss, Verstein. bohm. Kreidform., 2 Abth., 1846, pp. 104-105, pl. 24, figs. 22a-22c.

<sup>13</sup>Vanderpool, H. C., Journal of Paleontology, vol. 2, no. 2, June, 1928, p. 106, pl. 14, figs. 3, 4, 5, 6.

*Type locality*.—Ozan formation, SE.¼ Sec. 28, T. 8 S., R. 22 W., Arkansas.

*Known occurrence*.—Ozan formation (rare).

***Cythereis ozanana* n. sp.**

Plate III A, figs. 1, 2, 3

*Description*.—Seen from side, subovate; higher before than behind; dorsal margin slightly sinuous, ventral margin gently curved, the anterior gently rounded, the posterior sharply rounded; marginal ridge noticeably thicker anteriorly and dorsally than posteriorly and ventrally, the dorsal portion of the ridge being separated from the anterior by a shallow groove and turning downward anteriorly; the marginal ridge bounded on the inside by a discontinuous shallow groove, above which, on its ventral course, are shallow pits; a somewhat comma-shaped median ridge runs from behind the anterior groove to about two-thirds the distance to the rear margin; the “head” of the “comma” is bounded below and behind by a deep depression; another depression occurs near the anterior extremity of the dorsal marginal ridge above the “tail” of the comma-shaped ridge; the dorsal anterior tubercle lies in the groove between the anterior and dorsal marginal ridges. Seen from above or below the outline is ovate-sagittate, the head long, the shaft short; valve contacts slightly sinuous; from above the dorsal marginal ridges have the appearance of reflexed lips.

*Length*.—82 mm.

*Remarks*.—This species is rather close to *Cythereis ponderosana* n. sp., but may readily be distinguished by its sharply bent dorsal ridge and shorter median ridge.

*Cotypes*.—80246 A, B, C, U. S. Nat. Mus.

*Type locality*.—Ozan formation, NE.¼ Sec. 23, T. 11 S., R. 29 W., Arkansas.

*Known occurrence*.—Ozan formation (rare).

***Cythereis ponderosana* n. sp.**

Plate III A, figs. 5, 6, 7, 8

*Description*.—Seen from side, subovate; much higher in front than behind; anterior extremity broadly rounded, ornamented with short spines, posterior extremity narrow, acutely rounded, dorsal margin slightly curved, with a small sinus behind anterior-dorsal tubercle, ventral margin gently curved; strong medial ridge widening anteriorly and merg-

ing into smooth area occupying forward third of shell; weak dorsal and ventral ridges present, with pits on their inward slopes. In edge view subovate, pointed before and behind; from above the dorsal ridges have the appearance of reflexed lips.

*Length.*—88 mm., .66 mm.

*Remarks.*—*Cythereis triplicata* Roemer<sup>14</sup> is slightly suggestive of this species in side view only.

Called *C. ponderosa* because of its apparent limitation to the *Exogyra ponderosa* Zone.

*Cotypes.*—80247 A, B, U. S. Nat. Mus.

*Type locality.*—Annona chalk, center NE.¼ NE.¼ Sec. 29, T. 11 S., R. 27 W., Arkansas.

*Known occurrence.*—Ozan formation, Annona chalk, Marlbrook marl (common throughout).

***Cythereis tridenta* n. sp.**

Plate III A, figs. 4a, 4b, 4c

*Description.*—Outline viewed from side, subovoid; higher before than behind; the anterior and posterior margins gently rounded, the dorsal and ventral nearly straight; the whole circumference thickened, most broadly at the anterior and posterior margins; three longitudinal ridges present, the dorsal short, extending from about the center to a short distance behind, the medial and ventral extend from before the center to behind the center, the medial being nearly straight, the ventral slightly bowed; a small tubercle occurs at the confluence of the dorsal and anterior margins. From above or below the outline appears irregularly ovoid, attenuated before and behind and slightly indented just behind the middle; the marginal ridge appears liplike dorsally.

*Length.*—66 mm.

*Holotype.*—80248 U. S. Nat. Mus.

*Type locality.*—Marlbrook marl, NW. corner NE.¼ NE.¼ Sec. 32, T. 11 S., R. 27 W., Arkansas.

*Known occurrence.*—Marlbrook marl (rare), Arkadelphia marl (rare).

***Cythereis communis* n. sp.**

Plate III A, figs. 9, 10, 11, 12, 13

*Description.*—Shell seen from side, oblong; scarcely higher in front than behind; anterior extremity rounded, with short, blunt spines below the middle; posterior extremity

<sup>14</sup>Roemer, Verstein. Kreideberg. 1840. pl. 16, fig. 16.

gently rounded, with short, blunt spines below the middle, dorsal margin nearly straight, nodose, ventral margin straight, somewhat noded; a median ridge with strong anterior and posterior nodes with constriction between; the tubercle at the junction of the anterior and dorsal margins not prominent; the whole surface excepting the nodes and ridges finely pitted. Viewed from above or below the outline is roundly sagittate, attenuated before and behind, with V-shaped reentrants at the extremities; dorsally the marginal ridges along the valve contact are thick, nodose.

*Length.*—77 mm. (average).

*Remarks.*—A species close to this form, if not identical, occurs in the Washita.

*Cotypes.*—80249 A, B, C, D, E, U. S. Nat. Mus.

*Type locality.*—Nacatoch sand, SE.  $\frac{1}{4}$  Sec. 2, T. 9 S., R. 22 W., Arkansas.

*Known occurrence.*—Ozan formation, Annona chalk, Marlbrook marl, Saratoga chalk, Nacatoch sand, Arkadelphia marl (common throughout).

#### *Cythereis ivii* n. sp.

Plate III A, figs. 14a, 14b, 14c

*Description.*—Viewed from the side, elongate subovoid, dorsal margin nearly straight, anterior and ventral margins gently rounded, posterior pointed. Valve margins thick, a slight ridge above the medial line starting about one third the way back from the anterior margin and extending to about an equal distance from the rear; a deep elongate pit is found above and before the anterior extremity of the ridge; surface coarsely pitted. Viewed on edge roundly sagittate, the head long, the shaft very short; the overlap of the valves more prominent dorsally than ventrally.

*Length.*—77 mm. (average).

*Remarks.*—Named for Mr. John S. Ivy, Chief Geologist of the Palmer Corporation, Shreveport, La., to whom I am indebted for permission to publish these notes.

*Holotype.*—20250 U. S. Nat. Mus.

*Type locality.*—Saratoga chalk, NW.  $\frac{1}{4}$  Sec. 3, T. 9 S., R. 22 W., Arkansas.

*Known occurrence.*—Saratoga chalk (common), Arkadelphia (rare).

**Cythereis saratogana n. sp.**

Plate III A, figs. 15a, 15b, 15c

*Description.*—Seen from side, elongate, subovate; dorsal and ventral margins nearly straight, anterior and posterior margins gently rounded; a slight ridge around the entire perimeter bounded on the inside by a discontinuous groove; ornamented within the groove by coarse pitting and a conspicuous rounded tubercle lying below the median line and about one third the distance from the center to the rear margin. Viewed from above or below the outline is roundly hastate, the head long, the shaft short.

*Length.*—66 mm.

*Remarks.*—Named *C. saratogana* because of its apparent restriction to the Saratoga chalk.

*Holotype.*—80251 U. S. Nat. Mus.

*Type locality.*—Saratoga chalk (rare), NW.¼ Sec. 3, T. 9 S., R. 22 W., Arkansas.

**Cythereis costatana n. sp.**

Plate III A, figs. 16a, 16b, 16c

*Description.*—Viewed from side, outline subovate; higher before than behind; gently rounded anteriorly, slightly more abruptly rounded behind, with a few short digitations; dorsal and ventral margins but slightly rounded; the dorsal-anterior tubercle elongate, the posterior tubercle rounded; the whole of the surface within the marginal ridge is pitted. Viewed on edge the outline is narrowly sagittate, the head long, the shaft short. Valve contacts sinuous.

*Length.*—72 mm.

*Remarks.*—*Cythereis lonsdaleana* Jones<sup>15</sup> has a somewhat similar outline, but the ornamentation is quite different.

Named *C. costatana* because of its apparent restriction to the *Exogyra costata* zone.

*Holotype.*—80255 U. S. Nat. Mus.

*Type locality.*—Nacatoch sand, SE.¼ Sec. 2, T. 9 S., R. 22 W., Arkansas.

*Known occurrence.*—Saratoga chalk, Nacatoch sand, Arkadelphia marl (common throughout).

**Cythereis hannai n. sp.**

Plate IV A, figs. 1a, 1b, 1c

*Description.*—Viewed from side, the outline is subovate; anterior margin gently rounded, ornamented with low

<sup>15</sup>Jones T., R. op. cit., pl. 5, fig. 12.



tubercle; posterior margin less gently rounded, ridged; dorsal margin slightly sinuous, ornamented with low tubercles except at the extremities, where prominent tubercles occur; ventral margin gently curved, ridged; within the marginal ridge is found a depression limiting the central coarsely pitted area; pits polygonal; in this area a tubercle occurs below the anterior-dorsal tubercle and above the median line, another is found below the median line and slightly anterior to the posterior dorsal tubercle.

Viewed on edge outline is irregularly hastate, with the valve contacts nearly straight.

*Length*.—55 mm.

*Remarks*.—Named for Dr. G. Dallas Hanna of the California Academy of Sciences.

*Holotype*.—80253 U. S. Nat. Mus.

*Type locality*.—Tokio formation, NE. cor. SE.  $\frac{1}{4}$  Sec. 23, T. 10 S., R. 28 W., Arkansas.

*Known occurrence*.—Tokio formation (common).

***Cythereis spoori n. sp.***

Plate IV A, figs. 4, 5

*Description*.—Viewed from the side the outline is ovate-oblong; anterior margin gently rounded, with fluted rim, posterior gently rounded, with fluted rim, dorsal and ventral margins subparallel and slightly sinuous; surface covered with coarse polygonal pits; strong tubercle lies about one-third the length from the anterior margin, slightly above the median line; strong dorsal-anterior tubercle present.

Viewed on edge, broadly hastate; dorsal margins tuberculate.

*Length*.—49 mm., .66 mm.

*Remarks*.—Named for Mr. Harry C. Spoor of Shreveport, La.

*Cotypes*.—80254 A, B, U. S. Nat. Mus.

*Type locality*.—Brownstown marl, SW.  $\frac{1}{4}$  Sec. 33, T. 10 S., R. 27 W.

*Known occurrence*.—Brownstown marl (fairly common), Ozan formation (fairly common).

***Cythereis bartoni n. sp.***

Plate III A, figs. 17a, 17b

*Description*.—Seen from the side, the outline is elongate, subovate; dorsal and ventral margins but slightly curved,

anterior and posterior margins gently rounded; margin slightly thickened all around; strong dorsal-anterior tubercle present; surface coarsely pitted, with the intervening ridges beset with fine spines (broken off most specimens); posterior extremity slightly shelving. Seen in edge view hastate, somewhat diamond shaped.

*Length.*—73 mm.

*Remarks.*—Readily distinguished from *Cythereis plummeri* n. sp., by the lack of the prominent anterior-median tubercle.

Named for Dr. Donald C. Barton of Houston, Texas, in appreciation of the aid and encouragement given the writer in his early microscopic work.

*Holotype.*—80255 U. S. Nat. Mus.

*Type locality.*—Saratoga chalk, NW.¼ Sec. 3, T. 9 S., R. 22 W., Arkansas.

*Known occurrence.*—Saratoga chalk (rare).

### ***Cythereis plummeri* n. sp.**

Plate IV A, figs. 2, 3

*Description.*—Outline from side, subquadrate; anterior and posterior margins gently rounded, heavily ridged and digitate; the dorsal and ventral margins nearly straight, the ventral having a heavy ridge; posterior extremity slightly shelving; surface coarsely pitted, with a prominent tubercle anterior to the center; a few fine spines remain near the posterior end of the better preserved specimen figured, the surface evidently having been covered with them; anterior and posterior margins digitate.

*Length.*—78 and .88 mm.

*Remarks.*—*Cythere ericea* Brady<sup>10</sup> is somewhat similar in appearance but lacks the strong anterior tubercle and the posterior shelf.

Named for Mr. Frederick B. Plummer in remembrance of his kindly interest and co-operation in the writer's early microscopic work.

*Cotypes.*—80256 A, B, U. S. Nat. Mus.

*Type locality.*—Ozan formation, NE.¼ NE.¼ Sec. 23, T. 11 S., R. 29 W., Arkansas.

*Known occurrence.*—Ozan formation (rare).

<sup>10</sup>Brady, G. S., Voyage Challenger, Zool. v. 1, 1880, p. 107, pl. 17, figs. 1a-1b.

**Cythereis hazardi n. sp.**

Plate IV A, fig. 9

*Description.*—Outline from side, subquadrate; anterior end greatly rounded, with a few broad spines; posterior gently rounded, with broad spines along entire margin; dorsal margin nearly straight, with a notch about one-third the distance from the anterior end, gently reentrant before, sharply behind; ventral margin gently rounded, with a slight projection near the rear extremity; the median ridge irregularly constricted, bordered by irregular elongate pits whose major axes are more or less normal to the median ridge; irregular ridges border the pits, connecting the medial ridge to the low dorsal ridge and to the ventral ridge, which rises gently from before to behind and is terminated by an elongate depression, which extends from the termination of the medial ridge downward onto the ventral surface; the ventral ridge ends posteriorly in a broad platform.

*Length.*—71 mm.

*Remarks.*—*Cythere polytrema* Brady and allied forms have some resemblance to *C. hazardi*<sup>17</sup> but are easily distinguished.

Named for Mr. Roy T. Hazard of Shreveport, La., who frequently accompanied Mr. Spooner in the field.

*Holotype.*—20257 U. S. Nat. Mus.

*Type locality.*—Nacatoch sand, NW. cor. NE.¼ NE.¼ Sec. 17, T. 11 S., R. 25 W., Arkansas.

*Known occurrence.*—Nacatoch sand (fairly common), Arkadelphia marl (common).

**Cythereis bicornis n. sp.**

Plate IV A, figs. 10a, 10b, 10c

*Description.*—Viewed from side, outline is ovate-oblong; anterior end gently rounded, the posterior more sharply rounded, dorsal slightly curved downward medially, ventral slightly curved downward medially; the strong, sinuous medial ridge is tuberculate anteriorly and at about the middle of its length; ridges extend dorsally to that margin and ventrally to another less pronounced sinuous ridge; a strong tubercle appears behind the center and below the medial ridge. In edge view outline is sagittate, the head broad and sinuous, terminated by the prominent tubercles; the shaft compressed.

*Length.*—66 mm.

<sup>17</sup>Brady, G. S., op. cit., p. 87, pl. 21, figs. 5a-5h.

*Remarks.*—This form appears to be unique.

*Holotype.*—80258 U. S. Nat. Mus.

*Type locality.*—Tokio formation, NE. cor. SE.¼ Sec. 23,  
T. 10 S., R. 28 W., Arkansas.

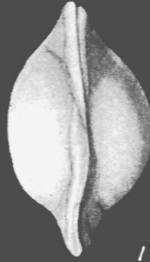
*Known occurrence.*—Tokio formation (common).

### Explanation of Plate I A

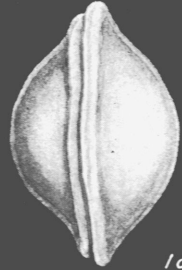
- FIGURE 1a. *Cytheropteron* sp. A. Figured specimen No. 80,236 U. S. Nat. Mus.  
View left side.
- FIGURE 1b. Same specimen. Dorsal view.
- FIGURE 1c. Same specimen. Ventral view.
- FIGURE 2a. *Cytheropteron* sp. B. Figured specimen lost. View right side.
- FIGURE 2b. Same specimen. Dorsal view.
- FIGURE 2c. Same specimen. Ventral view.
- FIGURE 3. *Cytheropteron* sp. B. Figured specimen No. 80,237 U. S. Nat. Mus.  
View left side.
- FIGURE 5. *Cytheropteron ledaforma* n. sp. Cotype No. 80,238-A U. S. Nat. Mus.  
View right side.
- FIGURE 6. Same species. Cotype No. 80,238-B U. S. Nat. Mus. Dorsal view.
- FIGURE 7. Same species. Cotype No. 80,238-C U. S. Nat. Mus. Ventral view.
- FIGURE 8. *Cytheropteron tokiana* n. sp. Cotype No. 80,239-A U. S. Nat. Mus.  
View right side.
- FIGURE 9a. *Cytheropteron tokiana* n. sp. Cotype No. 80,239-B U. S. Nat. Mus.  
Dorsal view.
- FIGURE 9b. Same specimen. Ventral view.



1a



1b



1c



2a



2b



2c



3



5



6



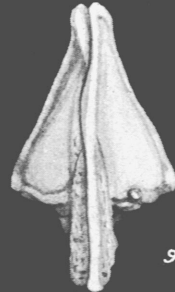
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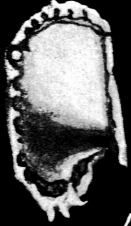
9a



9b

### Explanation of Plate II A

- FIGURE 1a. *Cytheropteron ponderosana* n. sp. Holotype No. 80,240 U. S. Nat. Mus. View right side.
- FIGURE 1b. Same specimen. Dorsal view.
- FIGURE 1c. Same specimen. Ventral view.
- FIGURE 2. *Loxococoncha fletcheri* n. sp. Cotype No. 80,242-A U. S. Nat. Mus. View right side.
- FIGURE 3. Same species. Cotype No. 80,242-B U. S. Nat. Mus. View left side.
- FIGURE 4a. *Cytheropteron saratogana* n. sp. Holotype No. 80,241 U. S. Nat. Mus. View left side.
- FIGURE 4b. Same specimen. Dorsal view.
- FIGURE 4c. Same specimen. Ventral view.
- FIGURE 5. *Cythere bruceclarki* n. sp. Cotype No. 80,243-A U. S. Nat. Mus. View left side.
- FIGURE 6. Same species. Cotype No. 80,243-B U. S. Nat. Mus. Inside view left valve showing hinge characters.
- FIGURE 7. *Cytheridea ? saratogana* n. sp. Cotype No. 80,244-A U. S. Nat. Mus. View left side.
- FIGURE 8. Same species. Cotype No. 80,244-B U. S. Nat. Mus. Ventral view of left valve.
- FIGURE 9. Same species. Cotype No. 80,244-C U. S. Nat. Mus. Inner view of left valve showing hinge characters.
- FIGURE 10a. *Cytheridea ? hannai* n. sp. Holotype No. 80,245 U. S. Nat. Mus. View left side.
- FIGURE 10b. Same specimen. Inside view left valve showing hinge characters.



1a



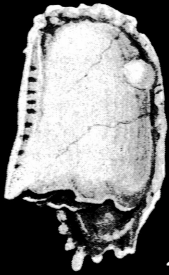
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1c



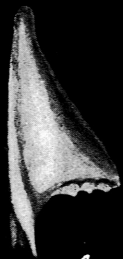
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4a



4b



4c



3



5



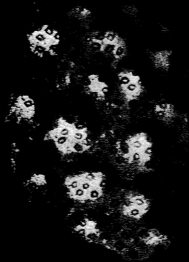
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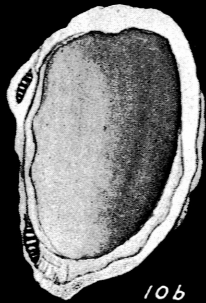
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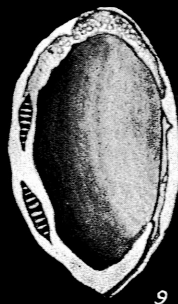
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10a



10b

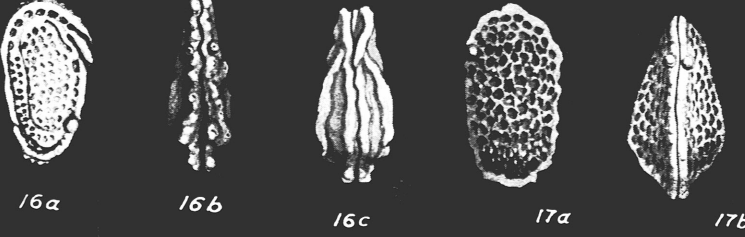
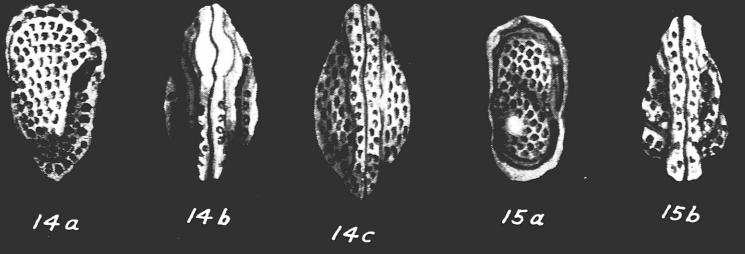
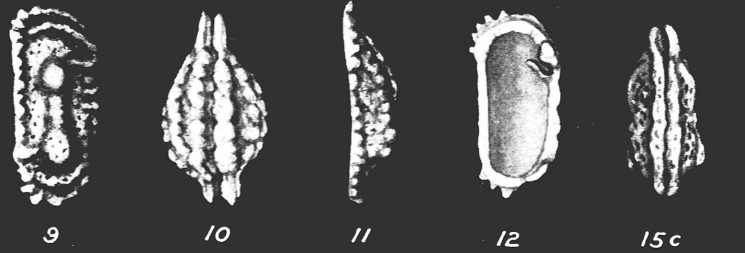
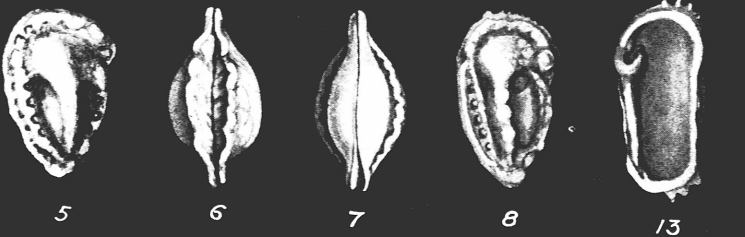


9



### Explanation of Plate III A

- FIGURE 1. *Cythereis ozanana* n. sp. Cotype No. 80,246-A U. S. Nat. Mus.  
View left side.
- FIGURE 2. Same species. Cotype No. 80,246-B U. S. Nat. Mus. Dorsal view.
- FIGURE 3. Same species. Cotype No. 80,246-C U. S. Nat. Mus. Ventral view.
- FIGURE 4a. *Cythereis tridenta* n. sp. Holotype No. 80,248 U. S. Nat. Mus.  
View left side.
- FIGURE 4b. Same specimen. Dorsal view.
- FIGURE 4c. Same specimen. Ventral view, somewhat tilted.
- FIGURE 5. *Cythereis ponderosuna* n. sp. Cotype No. 80,247-A U. S. Nat. Mus.  
View left side.
- FIGURE 6. Same species. Cotype lost.
- FIGURE 7. Same species. Cotype lost.
- FIGURE 8. Same species. Cotype No. 80,247-B U. S. Nat. Mus. View left side.
- FIGURE 9. *Cythereis communis* n. sp. Cotype No. 80,249-A U. S. Nat. Mus.  
View left side.
- FIGURE 10. Same species. Cotype No. 80,249-B U. S. Nat. Mus. Dorsal view.
- FIGURE 11. Same species. Cotype No. 80,249-C U. S. Nat. Mus. Ventral view  
of left valve.
- FIGURE 12. Same species. Cotype No. 80,249-D U. S. Nat. Mus. Inside view  
right valve showing hinge characters.
- FIGURE 13. Same species. Cotype No. 80,249-E U. S. Nat. Mus. Inside view  
left valve showing hinge characters.
- FIGURE 14a. *Cythereis ivii* n. sp. Holotype No. 80,250 U. S. Nat. Mus. View  
left side.
- FIGURE 14b. Same specimen. Dorsal view.
- FIGURE 14c. Same specimen. Ventral view.
- FIGURE 15a. *Cythereis saratogana* n. sp. Holotype No. 80,251 U. S. Nat. Mus.  
View left side.
- FIGURE 15b. Same specimen. Dorsal view.
- FIGURE 15c. Same specimen. Ventral view.
- FIGURE 16a. *Cythereis costatana* n. sp. Holotype No. 80,252 U. S. Nat. Mus.  
View left side.
- FIGURE 16b. Same specimen. Dorsal view.
- FIGURE 16c. Same specimen. Ventral view.
- FIGURE 17a. *Cythereis bartoni* n. sp. Holotype No. 80,255 U. S. Nat. Mus.  
View right side.
- FIGURE 17b. Same specimen. Dorsal view.

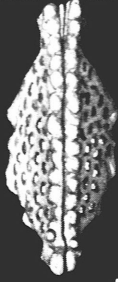


### Explanation of Plate IV A

- FIGURE 1a. *Cythereis hannai* n. sp. Holotype No. 80,253 U. S. Nat. Mus. View right side.
- FIGURE 1b. Same specimen. Dorsal view.
- FIGURE 1c. Same specimen. Ventral view.
- FIGURE 2. *Cythereis plummeri* n. sp. Cotype No. 80,256-A U. S. Nat. Mus. Outline left side, given to show anterior digitations.
- FIGURE 3. Same species. Cotype No. 80,256-B U. S. Nat. Mus. View left side.
- FIGURE 4. *Cythereis spoori* n. sp. Cotype No. 80,254-A U. S. Nat. Mus. View right side.
- FIGURE 5. Same species. Cotype No. 80,254-B U. S. Nat. Mus. Dorsal view.
- FIGURE 6. *Cytherura ? dubia* n. sp. Holotype No. 80,234 U. S. Nat. Mus. View left side.
- FIGURE 7a. *Cytherura spooneri* n. sp. Holotype No. 80,233 U. S. Nat. Mus. View left side.
- FIGURE 7b. Same specimen. Ventral view.
- FIGURE 8. *Cytherura ? saratogana* n. sp. Holotype No. 80,235 U. S. Nat. Mus. View right side.
- FIGURE 9. *Cythereis hazardi* n. sp. Holotype No. 80,257 U. S. Nat. Mus. View left side.
- FIGURE 10a. *Cythereis bicornis* n. sp. Holotype No. 80,258 U. S. Nat. Mus. View left side.
- FIGURE 10b. Same specimen. Dorsal view.
- FIGURE 10c. Same specimen. Ventral view.



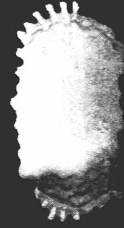
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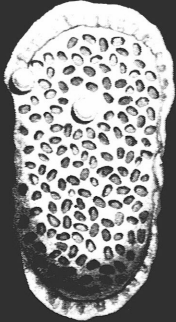
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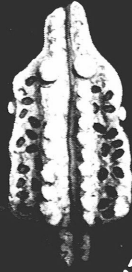
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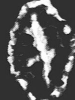
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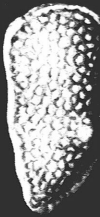
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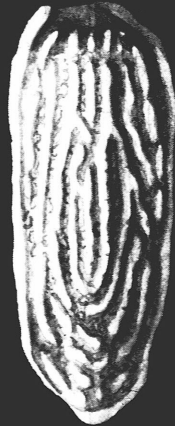
6



3



7a



8



9



7b



10a



10b



10c