UNITED STATES DEPARTMENT OF THE INTERIOR

THE MOLLUSCAN FAUNA OF THE ALUM BLUFF GROUP OF FLORIDA

PART III. LUCINACEA, LEPTONACEA, CARDIACEA

GEOLOGICAL SURVEY PROFESSIONAL PAPER 142–C

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THE MOLLUSCAN FAUNA OF THE ALUM BLUFF GROUP OF FLORIDA

BY

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PART III. LUCINACEA, LEPTONACEA, CARDIACEA

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CONTENTS

ILLUSTRATIONS

DISTRIBUTION OF THE FAUNA

The following list shows the localities cited by number in the text and tables:

75. 6 miles west of Gainesville, Alachua County, Fla.

322b. Nigger Sink, 8 miles north of Newmansville, Alachua County, Fla.

323. Near Hawthorn, Alachua County, Fla.

356. Sullivan's field, Levy County, Fla.

359. Chimney Rock Quarry, half a mile north of Gainesville, Alachua County Fla.

360. Preston's marl bed, 3½ miles north of Waldo, Alachua County, Fla.

361. Hogtown Creek, at old mill 2 miles northwest of Gainesville, Alachua County, Fla.

365. Johnsons Sink, 4 miles northwest of Hawthorn, Levy County, Fla.

369. Hammock west of Magnesia Springs, near Hawthorn, Alachua County, Fla.

373. Phosphate rock of the Devil's Mill Hopper, 5 miles northwest of Gainesville, Alachua County, Fla.

395. 50-foot well in Tallahassee, Leon County, Fla.

2116. Lapenotière's Hammock, on Sixmile Creek, 1½ miles south of Orient Station, Hillsborough County, Fla.

2211. Lower bed, Alum Bluff, Liberty County, Fla.

2212. Tenmile Creek, 1 mile west of Baileys Ferry, Calhoun County, Fla.

2213. 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.

2214. Tenmile Creek, 1 mile west of Baileys Ferry, Calhoun County, Fla.

2238. Flournoy's mill race, 2 miles east of Argyle, Walton County, Fla.

2302. 2 miles west of Tallahassee, Leon County, Fla.

2322. Sopchoppy Creek, Wakulla County, Fla.

2324. White Sulphur Springs (White Springs), Suwannee River, Hamilton County, Fla.

2380. Clay Springs, Orange County, Fla.

2564. McClelland farm, 1 mile below Baileys Ferry, Calhoun County, Fla.

2566. Upper bed at Rock Bluff, Apalachicola River, Liberty County, Fla.

2568. Lower or "Chipola" bed at Alum Bluff, Apalachicola River, Liberty County, Fla.

2611. West bank of Suwannee River, SW. ¼ NW. ¼ SE. ¼ sec. 8, T. 4 S., R. 11 E., near Dell, Lafayette County, and 15 miles south of Ellaville, Madison County, Fla.

2612. West bank of Suwannee River just below a sulphur spring 2½ miles below 2611, Lafayette County, 17 miles south of Ellaville, Madison County, Fla.

2645. McClellan farm, Shoal River, 5 miles west of Mossyhead, Walton County, Fla.

2646. Oak Grove, Yellow River, Okaloosa County, Fla.

2652. Horse Creek, 1½ miles south of Oak Grove, Okaloosa County, Fla.

2653. "Otaheite beds," on east Blackwater Creek, 15 miles west of Oak Grove, Okaloosa County, Fla.

2675. 1 mile south of railroad bridge at Milligan, Okaloosa County, Fla.

2823. West bank of Suwannee River just below sulphur spring 2½ miles below 2612, 19½ miles south of Ellaville, Madison County, Fla.

2868. Fuller's earth bed, Quincy, Gadsden County, Fla.

3173. "Fuller's earth" mines of Chesebrough Co., Quincy, Gadsden County, Fla.

3385. Gastropod Gulch, 4 miles southeast of Bainbridge, Decatur County, Ga.

3386. Roseland Plantation, 3½ miles southeast of Bainbridge, Decatur County, Ga.

3396. Sam Dickens's field, 7 miles southeast of Bainbridge, Decatur County, Ga.

3415. "Rock Bluff," east bank of Apalachicola River, 12 miles below railroad, Liberty County, Fla.

3417. Alum Bluff, 35 miles below railroad bridge over Apalachicola River, Liberty County, Fla.

3419. McClelland farm 1 mile below Baileys Ferry, Calhoun County, Fla.

3424. J. C. Henderson's well, western limits of Tallahassee, Leon County, Fla.

3704. Quincy, Gadsden County, Fla.

3731. Near Mossyhead, sec. 6, T. 3 N., R. 21 W., Walton County, Fla.

3732. Dave Adams Mill Creek, sec. 2, T. 3 N., R. 21 W., Walton County, Fla.

3733. Three-fourths mile west of Shell Bluff, Shoal River, Walton County, Fla.

3742. Shell Bluff, Shoal River, Walton County, Fla.

3747. 8 miles south of Lake De Funiak, Walton County, Fla.

3748. Summerville mill race, 1 mile east of Argyle, Walton County, Fla.

3749. Allen Senterfeit's mill, 3 or 4 miles north of Campton, Walton County, Fla.

3856. 6 miles west-northwest of Mossyhead, Walton County, Fla.

4966. 1,000 feet above Georgia, Florida & Alabama Railroad bridge over Ochlockonee River, Wakulla County, Fla.

4976. White Springs, Hamilton County, Fla.

4977. W. C. Rose's farm, West Sopchoppy, Wakulla County, Fla.

4978. Rose's Mill Creek, 3 miles west of Sopchoppy, Wakulla County, Fla.

4986. Miller's quarry, 1 mile from Ellenton, Manatee County, Fla.

4991. Ochlockonee River, 1 mile north of Holland, Leon County, Fla.

5079. One-half mile below Shell Bluff, Shoal River, Walton County, Fla.

5080. First ravine below Shell Bluff, Shoal River, Walton County, Fla.

5184. First ravine below Shell Bluff, Shoal River, Walton County, Fla.

5192. Folk's Creek, 4 miles south of Argyle, Walton County, Fla.

5193. Crowder's Crossing, 1½ miles below Shell Bluff, Shoal River, Walton County, Fla.

5194. 1½ miles below Shell Bluff, Shoal River, Walton County, Fla.

5195. First ravine below Shell Bluff, Shoal River, Walton County, Fla.

5613. Coronet phosphate mine, 5 miles southeast of Plant City, Hillsborough County, Fla.

5618. 3½ miles southwest of De Funiak Springs, Walton County, Fla.

5629. Coronet phosphate mine, 5 miles southwest of Plant City, Hillsborough County, Fla.

5630. 100 yards below Oak Grove Bridge, Yellow River, Okaloosa County, Fla.

5631. Oak Grove Bridge, Yellow River, Okaloosa County, Fla.

5632. Oak Grove, Yellow River, Okaloosa County, Fla.

5633. Oak Grove, Yellow River, Okaloosa County, Fla.

6175. Left bank of Suwannee River three-fourths mile above White Springs, Columbia County, Fla.

6196. Rock stratum lying immediately above fuller's earth at Ellenton, Manatee County, Fla.

6197. Limestone underlying fuller's earth at Ellenton, Manatee County, Fla.

6208. Marl underlying phosphate of Pierce Phosphate Co., Pierce, Polk County, Fla.

6209. 2½ miles southwest of Phosphate Mining Co.'s pit No. 4, Mulberry, Polk County, Fla.

6769. East bank of Suwannee River at wagon bridge at White Springs, Hamilton County, Fla.

6775. Spring on left bank of Suwannee River about 100 yards above Rock Island and about half a mile above White Springs, Columbia County, Fla.

6776. Spring on left bank of Suwannee River about 100 yards above Rock Island and about half a mile above White Springs, Columbia County, Fla.

6778. Spring on left bank of Suwannee River about 100 yards above Rock Island and about half a mile above White Springs, Columbia County, Fla.

6783. Langston's Sink, about 4 miles northwest of Lake City, on road to White Springs, Columbia County, Fla.

6800. Preston Sink, 3 miles north of Waldo, Alachua County, Fla.

6801. Lochloosa Creek, near Magnesia Spring, about 3 miles west of Hawthorn, Alachua County, Fla.

7054. 400 feet below bridge, Oak Grove, Okaloosa County, Fla.

7055. Old Senterfeit mill, 4½ miles southwest of Laurel Hill, Walton County, Fla.

7148. Gastropod Gulch, 5½ miles southeast of Bainbridge, Decatur County, Ga.

7151. Tenmile Creek, Calhoun County, Fla.

7183. Alum Bluff (lower bed), Liberty County, Fla.

7256. Look and Tremble Shoals, Chipola River, Calhoun County, Fla.

7257. Sexton's marl bed, sec. 11, T. 1 N., R. 10 W., Tenmile Creek, Calhoun County, Fla.

7261. Upper Alaqua Lethu (?) Bluff, near De Funiak Springs, Walton County, Fla.

7264. De Funiak *Cardium* beds, Alaqua Creek, Walton County, Fla.

7468. Sopchoppy, Wakulla County, Fla.

7847. Lake Butler, Bradford County, Fla.

7893. Boynton Landing, Choctawhatchee River, Washington County, Fla.

9957. Gully south of the road and east of the bridge over White's Creek, on road from Eucheeanna to Knox Hill, 6.7 miles south of Argyle, 1.7 miles southeast of Eucheeanna, Walton County, Fla.

9958. Site of Flournoy's old mill, about 1¼ miles northeast of Argyle, Walton County, Fla.

9959. One-fourth mile west by north of Pleasant Ridge Church, 5.2 miles southwest of De Funiak Springs, Walton County, Fla.

9960. Folk's Creek, sec. 21 or 22, T. 3 N., R. 18 W., 6 miles south of Argyle and 1.7 miles from Eucheeanna, Walton County, Fla.

9961. Horse Creek, 1½ miles south of Oak Grove, Okaloosa County, Fla.

9994. John M. P. McC elland's farm, Chipola River, Calhoun County, Fla.

10596. Waldon Bridge over Bruce Creek, 5 miles west of Red Bay, Walton County, Fla.

10603. Gully south of the road and east of the bridge over White's Creek, on road from Eucheeanna to Knox Hill, 6.7 miles south of Argyle, 1.7 miles southeast of Eucheeanna, Walton County, Fla.

10608. White's Creek, half a mile below bridge on Eucheeanna-Knox Hill road, Walton County, Fla.

10609. The Woodyard, three-fourths mile above Shell Landing, Holmes Creek, Washington County, Fla. (lower bed).

10610. The Woodyard, three-fourths mile above Shell Landing, Holmes Creek, Washington County, Fla. (upper limestone.)

10611. White's Creek near water's edge, half a mile below bridge over creek on road from Eucheeanna to Knox Hill, 6.7 miles south of Argyle, 1.7 miles southeast of Eucheeanna, Walton County, Fla.

10612. Chester Spence's farm, 5 miles southwest of De Funiak Springs, at head of Sconter's Mill Creek, Walton County, Fla.

10658. Shell Bluff, Shoal River, 6 miles west-northwest of Mossyhead, Walton County, Fla.

10659. Tanner's mill (Old Senterfeit mill), 4 miles southwest of Laurel Hill, Okaloosa County, Fla.

10660. Lower bed, Alum Bluff, Liberty County, Fla.

10661. Godwin Bridge over Shoal River, 5 to 6 miles nortnwest of Mossyhead, Walton County, Fla.

10662. Lower bed, Shoal River, between Godwin Bridge and Shell Bluff, 5 to 6 miles west-northwest of Mossyhead, Walton County, Fla.

10663. Crowder's Crossing, 1½ miles below Shell Bluff, Shoal River, Walton County, Fla.

10860. Boynton Landing, 4 miles east of Miller's Ferry, Washington County, Fla.

10869. Folk's Creek, 6 miles south of Argyle, Walton County, Fla.

THE MOLLUSCAN FAUNA OF THE ALUM BLUFF GROUP OF FLORIDA

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PART III. LUCINACEA, LEPTONACEA, CARDIACEA

INTRODUCTION

The species included under the three superfamilies Lucinacea, Leptonacea, and Cardiacea number an even hundred.

The general characters of the faunas of the three divisions of the Alum Bluff group have been discussed in Parts I and II. The fauna of the Chipola formation, the lowest of these divisions, is subtropical, from moderately shallow water, and remarkably diversified. The fauna of the succeeding formation, the Oak Grove sand, gives evidence of a lower temperature and even more shallow water. There is a decided decrease in the number of species and an increase in the number of individuals. In the uppermost formation of the group, Shoal River, the conditions prevailing during the Oak Grove epoch are in the main, continued with probably an increasing emergence of the sea bottom and possibly a slight rise in temperature. The number of species recognized in the Shoal River formation is decidedly less than half the number listed from the Chipola, whereas the Oak Grove fauna occupies an intermediate position.

Local distribution of species of Lucinacea, Leptonacea, and Cardiacea

[pr, prolific; a, abundant; c, common; p, present; r, rare. The localities within each formation are listed in geographic order from north to south and from west to east]

Species	Chipola formation																							Oak Grove sand									
	6 miles south of Argyle	6.7 miles south of Argyle	5 miles west of Red Bay	Lower bed, The Woodyard	Upper bed, The Woodyard	Boynton Landing	1 mile west of Baileys Ferry	Sexton's marl bed, Tenmile Creek	1 mile below Baileys Ferry				Tenmile Creek	Look and Tremble Shoals	Lower bed, Alum Bluff				2 miles west of Tallahassee	Sopchoppy Creek		Near White Springs	15 miles west of Oak Grove	Oak Grove, Yellow River						Horse Creek, south of Oak Grove	1½ miles south of Oak Grove	4½ miles southwest of Laurel Hill	4 miles southwest of Laurel Hill	3 or 4 miles north of Campton
	10869	10611	10596	10609	10610	7893	2212	7257	2213	2564	3419	9994	7151	7256	2211	2568	7183	10660	2302	2322	7468	6776	2653	2646	5632	5631	5630	5633	7054	2652	9961	7055	10659	3749
Codakia (Jagonia) erosa Dall	---	---	---	---	---	---	---	r	p	---	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
chipolana Dall	---	---	---	---	---	---	---	---	---	---	---	---	---	---	c	---	---	c	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Lucina corpulenta Dall	---	---	---	---	---	---	---	---	p	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
janus Dall	---	---	r	---	p	---	c	---	c	---	---	p	---	---	p	---	---	---	?p	?p	?p	---	---	---	---	---	---	---	---	---	---	---	---
santarosana Dall	---	---	---	---	---	c	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	pr	---	---	p	p	p	---	---	r	---	?r
Phacoides (Linga) glenni Dall	---	---	---	---	---	?r	r	---	p	r	r	---	---	---	a	---	a	c	---	---	r	---	---	---	---	---	---	---	---	---	---	---	---	---
densatus (Conrad)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	p	---	---	---	---	---	r	?r	---	---	---
sp. indet	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	r	---	---	---	---	---	---	---	---	---	---
Phacoides (Cardiolucina) trisulcatus (Conrad) Dall	---	---	---	---	---	p	---	---	---	r	p	---	r	---	r	---	---	r	---	---	?r	---	---	---	---	---	---	---	---	---	?r	---	---	---
parawhitfieldi Gardner, n. sp	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	c	r	---	---	r	r	---	?r	---	---	---
Phacoides (Lucinisca) calhounensis Dall	---	---	---	p	---	p	---	r	p	---	r	---	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
plesiolophus Dall	---	---	---	---	---	---	---	---	r	---	---	---	r	---	r	r	---	---	---	---	---	---	---	pr	a	c	r	r	c	---	---	---	---	---
Phacoides (Miltha) chipolanus Dall	---	---	---	---	---	---	---	---	p	r	r	---	r	---	---	---	---	---	---	---	---	---	---	r	---	---	---	---	r	p	p	---	---	---
heilprini Gardner, n. sp	---	---	---	---	---	---	r	---	---	---	---	---	---	---	---	---	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
xustris Gardner, n. sp	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Phacoides (Pseudomiltha) paranodonta Gardner, n. sp	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	?r	---	---
Phacoides (Parvilucina) sphaeriolus Dall	---	---	---	c	p	c	c	p	a	pr	c	---	p	---	c	---	---	p	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Phacoides (Parvilucina) sphaeriolus angaleus Gardner, n. sp	---	---	---	p	p	p	p	p	c	c	c	---	p	---	---	---	---	---	---	---	---	---	---	pr	pr	c	p	p	c	---	a	---	---	---
piluliformis Dall	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	?r	---	?r
flumenvadosa Gardner, n. sp	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
prunoides Maury	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
(Bellucina) eupheus Gardner, n. sp	---	---	---	---	---	---	---	---	---	---	p	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
(Bellucina) nereididetus Maury	---	---	?r	---	---	?r	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	r	---	---	---	---	---	---	---	---	---
Divaricella chipolana Dall	---	---	---	---	r	p	---	---	p	r	---	---	r	---	c	---	c	c	---	---	p	---	---	r	---	---	---	---	---	---	---	---	---	---
Diplodonta nucleiformis (Wagner)	---	---	---	---	---	---	---	---	---	---	---	---	?r	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
(nucleiformis subsp.?) sphaeromorpha Gardner, n. sp	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	r	---	---	---	---	---	---	r	---	---	---
radiata Dall	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	p	---	---	---	---	---	---	---	---	---	---
paralta Gardner, n. sp	---	---	---	---	---	---	---	---	p	---	---	---	---	---	p	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Diplodonta (Phlyctiderma) glos Gardner, n. sp	---	---	---	---	---	---	---	p	r	---	r	---	p	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Erycina undosa Dall	---	---	---	---	---	p	---	r	p	---	r	---	p	---	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
chipolana Dall	---	---	---	---	---	---	---	---	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
scaptera Gardner, n. sp	---	---	---	---	---	---	---	---	---	---	---	---	---	---	p	---	r	r	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
fabulina Dall	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	p	r	---	---	r	r	---	---	---	---	---
curtidens Dall	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	p	r	---	---	---	---	---	---	---	---	---
Erycina (Scacchia) actinophora (Dall)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	c	r	r	---	r	r	---	---	---	---	---
Bornia dodona Dall	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	p	r	---	---	---	---	---	---	---	---	---
floridana Dall	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	r	---	---	---	---	---	---	---	---	---	---
fluctusculpturata Maury	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

Local distribution of species of Lucinacea, Leptonacea, and Cardiacea—Continued

Chipola formation

Species	6 miles south of Argyle	6.7 miles south of Argyle	5 miles west of Red Bay	Lower bed, The Woodyard	Upper bed, The Woodyard	Boynton Landing	1 mile west of Baileys Ferry	Sexton's marl bed, Tenmile Creek	1 mile below Baileys Ferry				Tenmile Creek	Look and Tremble Shoals	Lower bed, Alum Bluff				2 miles west of Tallahassee	Sopchoppy Creek		Near White Springs	15 miles west of Oak Grove
	10869	10611	10596	10609	10610	7893	2212	7257	2213	2564	3419	9994	7151	7256	2211	2568	7183	10660	2302	2322	7468	6776	2653
Sportella lioconcha Dall																							
leura Gardner, n. sp													p										
unicarinata Dall																							
lubrica Dall																							
obolus Dall																							
Hindsiella nephritica Dall															r								
Alveinus rotundus Dall					r				c		p		p										
Montacuta chipolana Dall									p	r					r								
Aligena pustulosa Dall									?r														
lineata Dall																							
Cardium (Acanthocardia) propeciliare Dall									r		r						r						
ctenolium Dall																							
acrocome Dall									r														
Cardium (Trachycardium) cestum Dall							p		c		p	p											
delphicum Dall																							
virile Dall						r	c		c	p	c		r										
parile Dall									p		r				a		c	c				?r	
malacum Dall																							
inconspicuum Guppy							r		r														
Cardium (Cerastoderma) panastrum Dall																							
druidicum Dall																							
chipolanum Dall			a	r	a	p	a	r	c		p	p	p					p					c
chipolanum alumen Gardner, n. subsp				r	c	?p									c		p	p			?c		
taphrium Dall																							
Cardium (Fragum) burnsii Dall								r	c	p	p		r				p	c					
aliculum Dall					p				c						a		a	a					
sellardsi Gardner, n. sp						p											r						
simrothi Dall			c						c	pr	pr	c						r					
apateticum Dall																							
Cardium (Papyridea) bulbosum Dall									r														
Cardium (Laevicardium) compressum Dall						p	p	p	c		r		p		c								

Oak Grove sand

Species	Oak Grove, Yellow River						Horse Creek, south of Oak Grove	1½ miles south of Oak Grove	4½ miles southwest of Laurel Hill	4 miles southwest of Laurel Hill	3 or 4 miles north of Campton
	2646	5632	5631	5630	5633	7054	2652	9961	7055	10659	3749
Sportella lioconcha Dall	p	r	r		r	r					
leura Gardner, n. sp											
unicarinata Dall	r	r			r			r			
lubrica Dall	r										
obolus Dall	p										
Hindsiella nephritica Dall											
Alveinus rotundus Dall											
Montacuta chipolana Dall											
Aligena pustulosa Dall	p										
lineata Dall	c	r			r	r					
Cardium (Acanthocardia) propeciliare Dall											
ctenolium Dall	r										
acrocome Dall											
Cardium (Trachycardium) cestum Dall											
delphicum Dall	r										
virile Dall											
parile Dall											
malacum Dall	p			r	r				r	r	
inconspicuum Guppy											
Cardium (Cerastoderma) panastrum Dall	r							r	r	p	r
druidicum Dall	c	r			p	r					
chipolanum Dall											
chipolanum alumen Gardner, n. subsp											
taphrium Dall	pr	p	r	c	c	c	r	r	r	c	
Cardium (Fragum) burnsii Dall											
aliculum Dall											
sellardsi Gardner, n. sp											
simrothi Dall											
apateticum Dall	a	a	p		r	c		p			
Cardium (Papyridea) bulbosum Dall											
Cardium (Laevicardium) compressum Dall	c										

Shoal River formation

Species	6 miles west-northwest of Mossyhead		Dave Adams Mill Creek	Shell Bluff, Shoal River		6 miles west-northwest of Mossyhead	First ravine below Shell Bluff			½ mile below Shell Bluff	5 or 6 miles northwest of Mossyhead		1½ miles below Shell Bluff	1½ miles below Shell Bluff		¾ mile west of Shell Bluff	2 miles east of Argyle	1¼ miles northeast of Argyle	1 mile northeast of Argyle station	8 miles south of Lake De Funiak	Upper Alaqua, Lethu (?) Bluff	De Funiak "*Cardium* beds," Alaqua	4 miles south of Argyle	6 miles south of Argyle	6.7 miles south of Argyle		3½ miles southwest of DeFuniak Springs		5 miles southwest of DeFuniak Springs	5.2 miles southwest of DeFuniak Springs
	3856	2645	3732	3742	3731	10658	5080	5184	5195	5079	10661	10662	10663	5193	5194	3733	2238	9958	3748	3747	7261	7264	5192	9960	10603	10608	5618	9957	10612	9959
Lucina santarosana Dall	p					r				p				r					c	?r					?r					
Myrtaea waltonensis Gardner, n. sp	p																													
Phacoides (Cardiolucina) parawhitfieldi Gardner, n. sp																														
Phacoides (Pseudomiltha) paranodonta Gardner, n. sp										r				r	r	r						r					p			r
Phacoides (Parvilucina) vaughani Gardner, n. sp						r				pr	c	c				c		p			r	p		p	a	c	c			
piluliformis Dall																												c		
flumenvadosa Gardner, n. sp	a		r	c														p	a	p				p					p	
(Bellucina) nereididetus Maury																														
Divaricella waltonia Gardner, n. sp				c		r		r	r									r	r	r		r		r			p			p
Diplodonta leptodoma Gardner, n. sp	a			c			r	r	r	r							r		r				p							
acclinis Conrad																r	r										r			r
Bornia dodona Dall						r				c																				
virgata Gardner, n. sp	c			r																										
Sportella lioconcha Dall	r			p						p						r														
Alveinus micculus Gardner, n. sp				r															r							r		r		
Aligena pustulosa Dall																			r											
lineata Dall				r						p	r								r						r					
sp																			r											
Cardium (Trachycardium) plectopleura Gardner, n. sp	r	r	r	a			r	p																	c			c		
ustrix Gardner, n. sp	p			r																										
Cardium (Cerastoderma) panastrum Dall																									p	p				
taphrium Dall	r						?r	?r	?r	c				p										?r	p					r
waltonianum Dall	a			a	r	p	p	c	p						r	r	c	p	a	r	r	p					a			c
Cardium (Fragum) burnsii Dall																														
simrothi Dall																														
apateticum Dall										p																				
Protocardia sp				r																										
sp																											r			

SYSTEMATIC DESCRIPTIONS

Phylum MOLLUSCA

Class PELECYPODA

Order TELEODESMACEA

Superfamily LUCINACEA

Family LUCINIDAE

Genus CODAKIA Scopoli

1777. *Codakia* Scopoli, Introductio ad historiam naturalem, p. 398.

Type: *Chama codok* Adanson. (Recent off the coast of Senegal.)

Shell suborbicular or obliquely oval, reticulately sculptured; ligament covered with a calcareous coating and inset with the resilium or entirely external and mounted on a narrow nymph; hinge normal, though the tendency toward obsolescence is commonly seen both in the cardinals and laterals.

The Tertiary representatives of this genus are rather restricted both in the number of species and of individuals. The Recent members are chiefly tropical and inhabit the Pacific and Indian oceans and the Caribbean Sea.

The genus has a meager representation in the Chipola and Oak Grove formations. No determinable member of the group has yet been noted in the Shoal River formation.

Subgenus JAGONIA Récluz

1869. *Jagonia* Récluz, Mélanges malacologiques: Soc. linnéenne Bordeaux Actes, vol. 27, p. 37.

Type: *Pectunculus jagon* Adanson = *Lucina pecten* Lamarck. (Recent off the west coast of Africa.)

Dall [1] described this subgenus as follows:

Shells small, light, frequently tumid, and very inequilateral; beaks more prominent and lunule relatively often larger; ligament and resilium external, on a narrow nymph, not coated with shelly matter; posterior laterals distinct; margins usually crenulate; foot differing little from the ordinary pelecypod type. * * * In these forms the radial part of the sculpture is usually more pronounced than in *Codakia*.

Outline subcircular:
- Dorsal areas not differentiated; radial sculpture not incised, undulatory in character, evanescing toward the ventral margin ..... *Codakia* (*Jagonia*) *erosa* Dall.
- Dorsal areas feebly differentiated; radial sculpture incised, usually more distinct toward the ventral margin:
  - Valves relatively compressed. *Codakia* (*Jagonia*) *chipolana* Dall.
  - Valves relatively inflated. *Codakia* (*Jagonia*) *actinoides* Maury.

Outline transversely elliptical. *Codakia* (?*Jagonia*) *magnolioides* Maury.

[1] Dall, W. H., Contributions to the Tertiary fauna of Florida: Wagner Free Inst. Sci. Trans., vol. 3, pt. 6, p. 1345, 1903.

Codakia (Jagonia) erosa Dall

Plate XVIII, Figure 1

1903. *Codakia* (*Jagonia*) *erosa* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 6, p. 1348, pl. 52, fig. 7.

Dall described this species as follows:

Shell small, slightly inequilateral, moderately plump, suborbicular; beaks small and prominent; surface sculptured with a dozen or less obscure, hardly elevated, broad, flattish radials, corresponding to fascicles of radial threads in *C. vendryesi*, crossed by incremental lines and near the base by somewhat more widely spaced concentric grooves; lunule lanceolate, moderately impressed; hinge well developed, anterior right lateral present, the other laterals obsolete; margins rather strongly crenulate. Height 6.5, length 7.0, diameter 3.5 millimeters.

If this species grows to a larger size it is probable that the additional surface will be distinctly concentrically sulcate.

Type: U. S. Nat. Mus. No. 114688.

Type locality: No. 2213, 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.

The radial sculpture is very obscure and irregular and least feeble upon the umbone. With the initiation of the concentric sculpture toward the ventral margin it becomes obsolete altogether. The species is apparently restricted to the single horizon.

A closely allied but not specifically identical form occurs in the environs of De Funiak Springs in Walton County.

Occurrence: Chipola formation, localities 7257[r], 2213[p], 3419[r].

Codakia (Jagonia) chipolana Dall

Plate XVIII, Figure 2

1903. *Codakia* (*Jagonia*) *chipolana* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 6, p. 1349, pl. 52, fig. 9.

Dall described this species as follows:

Shell rounded, slightly inequilateral, the posterior side shorter, moderately convex, with small, pointed, distinct, but not elevated beaks; sculpture of close-set, flattish, narrow, concentric ridges more distinct on the umbones and below the middle of the disk, crossed by numerous, even, nonbifurcate, radial grooves, whose interspaces are about as wide as the concentric ridges; the posterior area is set off by a wide, shallow sulcus, beyond which there are several radials, and the concentric sculpture becomes more or less lamellose; anteriorly, too, the radials become more pronounced, and there is a small lanceolate anterior dorsal area; the lunule is subglobular, small, and deeply impressed; the hinge and marginal crenulations are strong, the anterior cardinals are effaced by the lunule and the scars are normal. Height 7.5, length 8.2, diameter 5.0 millimeters.

The well-defined dorsal areas and stronger distal sculpture throw a doubt on the proper place of this species, which in some respects recalls *Lucinisca*. It is a well-defined form and not uncommon in the Chipola marl.

Type: U. S. Nat. Mus. No. 114691.

Type locality: No. 2211, lower bed, Alum Bluff, Liberty County, Fla.

This species seems to be restricted to the type locality. The specimens listed from Chipola River are filled with the characteristic Alum Bluff matrix, whereas the valve from Oak Grove passing under this name is quite worn and certainly represents a more inflated and more sharply sculptured species.

Occurrence: Chipola formation, localities 2211[c], 10660[c].

(?) Codakia (Jagonia) actinoides (Maury)

1910. *Phacoides actinoides* Maury, Bull. Am. Paleontology, vol. 4, No. 21, p. 35, pl. 9, fig. 4.

Miss Maury described this species as follows:

Shell resembling *P. actinus* Dall from the Oligocene of Bowden, Jamaica, but larger, more inequilateral, and with more strongly recurved beaks than that species, from which it also differs in sculpture. The Oak Grove species is a plump, fairly solid shell, with the anterior end longer than the posterior but compressed as though pinched, lunule cordate, distinct; shell with three types of sculpture—namely, very near the beak are about three concentric lamellae, which form the only sculpture for a distance of about half a millimeter; beyond this radial ribs begin to appear and form with the succeeding half dozen concentric lamellae a beautiful cancellation like that over the whole disk of the Pliocene *P. waccamawensis* Dall. This cancellation continues for a distance of about 1 millimeter, after which the concentric lamellae become fainter and more irregular and the six or seven primary ribs continue only faintly to the ventral margin of the shell; a large number of interstitial, radial lines appear (about 32 in the margin of the shell) and cover the larger part of the disk, replacing the earlier cancellation. It is an interesting fact that this species began but almost immediately abandoned the style of ornamentation which in the Miocene and Pliocene became so characteristic of shells of the *Bellucina* type. Hinge with well-developed teeth; inner margin of shell finely crenulated.

Length of shell 7, height 6.5, diameter of one valve 2 millimeters.

Oak Grove, Santa Rosa [now Okaloosa] County, Fla.
Cornell University collection.

Type locality: Oak Grove, Okaloosa County, Fla.

This is probably the same form as that listed by Dall under the name *Codakia (Jagonia) chipolana* Dall. It differs from the young of that species in its more inflated outline and more sharply defined sculpture.

Occurrence: Oak Grove sand.

Codakia (?Jagonia) magnolioides Maury

1910. *Codakia magnolioides* Maury, Bull. Am. Paleontology, vol. 4, No. 21, p. 34, pl. 9, fig. 2.

Miss Maury described this species as follows:

"Shell small, fragile, very inequilateral, moderately inflated; general outline elliptical; beaks low but prominent; sculpture of very fine, even, radial ribs, extending from the beak to the margin, and crossed by equal, fine, rounded concentric threads. A delicate and beautiful cancellation is thus made which, however, can scarcely be seen without the aid of a lens. Inner margin crenulate; the ribs of the exterior are more or less visible in the interior of the shell; hinge delicate, but teeth very distinct. Length of largest shell 9, height 7, diameter of one valve 2 millimeters. The usual size is, however, much smaller.

Chipola marls, Baileys Ferry, Fla.
Cornell University collection.

This very elegant species resembles *C. magnoliana* Dall from the Upper Miocene of Magnolia, N. C., but the Chipola species can be distinguished at a glance by its much more inequilateral form.

Type locality: Chipola River, Calhoun County, Fla.

The species has not been observed in any of the available collections.

Occurrence: Chipola formation, Baileys Ferry, Chipola River, Calhoun County, Fla.

Codakia (Jagonia) sp. indet.

1903. *Codakia (Jagonia)* sp. indet. Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 6, p. 1349.

Dall described this species as follows:

Several specimens of a nepionic *Jagonia*, distinct from any of the described species and resembling the delicately scupltured forms of *C. orbiculata* but too young for positive identification were obtained.

Locality: No. 2211, lower bed, Alum Bluff, Liberty County, Fla.

The shell is transversely ovate in outline, the umbones set far back of the median horizontal. It may be the young of *C. magnolioides* Maury, though it is only one-third the size of Miss Maury's species and does not exhibit the marks of youth.

Occurrence: Chipola formation, locality 2211[p].

Genus LUCINA (Bruguière) Lamarck

1798. *Lucina* Bruguière, Tableau encyclopédique et méthodique, vol. 1, pls. 284–286 (name only).

1799. *Lucina* Lamarck, Prodrome d'une nouvelle classification des coquilles: Soc. hist. nat. Paris Mém., p. 84.

Monotype: *Venus edentula* Linnaeus. (Recent in the Indian Ocean?)

Dall [2] described this genus as follows:

Shell inflated, thin, concentrically striated, anterior and posterior dorsal areas obsolete; lunule deep and narrow, no visible escutcheon; ligament and resilium deeply inset but not occluded; margins entire, anterior adductor scar long, hinge wholly edentulous. * * *.

Lucina, in the strict sense, appears at least as early as the Eocene, is very abundant in the Oligocene, retreated before the colder Miocene waters, and increased again in the warmer climate of the Pliocene. The southern Pleistocene included, like the recent fauna, one or two species. The bullet-like internal casts of this genus are among the most characteristic fossils of the southern Tertiaries, their rounded form seeming to preserve them better than the more irregular and thinner casts of other genera.

Lucina, by reason of its rather large size and relative abundance, is one of the more prominent genera in the Alum Bluff faunas, particularly in the Oak Grove sand and the Shoal River formation.

[2] Dall, W. H., Contributions to the Tertiary fauna of Florida: Wagner Free Inst. Sci. Trans., vol. 3, pt. 6, p. 1352, 1903.

Posterior and anterior dorsal margins obscurely or not at all differentiated by the elevation of the concentric lamellae:
Diameter approximately three-fourths the altitude of the shell ..... *Lucina corpulenta* Dall.
Diameter decidedly less than three-fourths the altitude of the shell ..... *Lucina janus* Dall.
Posterior and anterior dorsal margins rather sharply differentiated by the elevation of the concentric lamellae. *Lucina santarosana* Dall.

Lucina corpulenta Dall

Plate XVIII, Figures 3–4

1903. *Lucina corpulenta* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 6, p. 1354, pl. 51, figs. 7, 8.

Dall described this species as follows:

This form resembles the *L. janus*, but is more inflated, with more elevated and incurved beaks, a shorter and smaller lunule, and no anterior alation. Height 35, length 42, diameter 30 millimeters. A fragment of a specimen, probably of this species, is 80 millimeters in length.

Type: U. S. Nat. Mus. No. 114719.

Type locality: No. 2213, 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.

The large specimen mentioned, which is no more than a fragment of a cast, lacks the turgid outline so characteristic of *corpulenta*.

Occurrence: Chipola formation, locality 2213^{p}.

Lucina janus Dall

Plate XVIII, Figure 5

1903. *Lucina janus* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 6, p. 1353, pl. 51, fig. 9.

Dall described this species as follows:

Shell orbicular, plump, nearly equilateral; beaks low, slightly prosogyrate over a small, deeply impressed, narrowly lanceolate lunule; anterior hinge line somewhat ascending, suddenly rounding into the curve of the anterior end, forming an ill-defined wing, which has irregular marks of compression where it joins the body of the shell; the posterior dorsal [margin] descends slightly in a right line, meeting the curve without any angle or alation; base nearly semicircular; surface, when perfect, somewhat shining, with very fine, rather irregular concentric wrinkles and incremental lines, which cross fine, microscopic, slightly vermicular, radial striation all over the shell; hinge edentulous; posterior adductor scar lucinoid but rather short. Height of an average specimen 37, length 42, diameter 25 millimeters.

This species is very abundant in the Chipola formation. The radial sculpture is less evident than in *L. subveza*, the surface is smoother, and the shell less inflated.

Type: U. S. Nat. Mus. No. 114718.

Type locality: No. 2213, 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.

Adult specimens of *Lucina corpulenta* have a diameter equal to approximately three-fourths the altitude, whereas the diameter of *L. janus* is but little more than two-thirds the altitude. This higher inflation is especially noticeable in the umbonal region. There is also a more decided wrinkling of the surface toward the distal margins in *corpulenta*, the anterior and posterior areas are quite obsolete, and there is a suggestion of a radial sculpture upon the disk which is absent in *janus*. The forms from the Sopchoppy are doubtfully referred to *L. janus* Dall. They occur only as casts and seem rather more compressed and relatively lower than the normal representatives of the species.

Occurrence: Chipola formation, localities 10596^{r}, 10610^{p}, 2212^{c}, 2213^{c}, 9994^{p}, 2211^{p}, ?2302^{p}, ?2322^{p}, ?7468^{p}.

Lucina santarosana Dall

Plate XVIII, Figure 6

1903. *Lucina santarosana* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 6, p. 1354, pl. 51, fig. 6.

Dall described this species as follows:

Shell much resembling *L. janus*, but with the beaks slightly more anterior, the posterior dorsal area distinct, the anterior more emphatic, the concentric striation stronger, the lunule shorter and wider, and the surface retaining traces of four or five color zones alternately lighter and darker. The scar of the posterior adductor is also rather longer. Height 36, length 41, diameter 25 millimeters. A large fragment is 65 millimeters long, and the interior, except in the middle of the disk, is rather conspicuously radially striate. The best preserved specimens show a fine, even, concentric lamellation on the dorsal areas.

Type: U. S. Nat. Mus. No. 135858.

Type locality: No. 2646, Oak Grove, Yellow River, Okaloosa (formerly Santa Rosa) County, Fla.

Lucina santarosana Dall is one of the more conspicuous elements both in the Oak Grove and in the Shoal River faunas.

Occurrence: Chipola formation, locality 7893^{c}; Oak Grove sand, localities 2646^{pr}, 5630^{p}, 5633^{p}, 7054^{p}, 7055^{r}, ?3749^{r}; Shoal River formation, localities 3856^{p}, 10658^{r}, 5079^{p}, 5193^{r}, 3748^{c}, ?3747^{r}, ?10603^{r}.

Genus MYRTAEA Turton

1822. *Myrtaea* Turton, Conchylia insularum britannicarum, p. 133.

Type: *Venus spinifera* Montagu. (Recent off the western coast of Europe.)

Dall [3] described this genus as follows:

Shell elongate-oval or subrectangular, moderately convex or compressed, dorsal areas obsolete, the sculpture of the disk chiefly concentric and lamellar; the sculpture less pronounced in the middle of the disk and frequently exhibiting a serrate appearance when the lamellae cross the bounding carina of lunule or escutcheon; internally with the left laterals usually obsolete and only one right cardinal tooth; cardinals entire; ligament and resilium deep-set but not internal; interior adductor scar lucinoid but rather short; inner margins entire.

This group is paralleled in *Phacoides* by several others which want the anterior right cardinal in the adult, but in *Myrtaea* the single right cardinal seems to be normal, while in the subdivisions of *Phacoides* its absence is due to degeneration during the growth of the individual or to the dynamic results of the inthrusting of the lunule, which occupies the space where the anterior cardinal would otherwise develop.

[3] Dall, W. H., Contributions to the Tertiary fauna of Florida: Wagner Free Inst. Sci. Trans., vol. 3, pt. 6, p. 1357, 1903.

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The genus has a limited distribution from the Oligocene to the Recent. Only a single species has been reported from the Alum Bluff.

Myrtaea waltonensis Gardner, n. sp.

Plate XVIII, Figures 7–9

Shell of normal dimensions for the genus, thin, inflated, transversely ovate in outline. Umbones low, rounded, the tips acute, prosogyrate and almost contiguous. Lunule elongate, cordate, almost twice as wide in the right valve as in the left, extending the length of the concave anterior dorsal margin. Escutcheon not developed. Posterior dorsal margin oblique, very gently sloping. Both the anterior and posterior lateral margins truncate. Base line strongly and evenly rounded. Anterior area vaguely defined by a slight undulation of the valve, the truncation of the margin, and a slight strengthening of the concentric sculpture. Posterior area similarly but more distinctly defined. Surface sculpture very fine and faint; concentric laminae least faint and most regular upon the umbones and the anterior and posterior dorsal areas, abruptly elevated along the posterior and lunular margins, thus giving to the dorsal portion of the valve the serrate aspect characteristic of the genus; a microscopically fine radial lineation also developed, least faint toward the margins. Ligament linear, extending a little more than half the length of the posterior dorsal margin. A single small, sharp, delicate cardinal developed in each valve. Dorsal margins modified to function as laterals, the margins of the left valve being received in short, shallow grooves near the extremities of the dorsal margins of the right valve. Muscle scars and pallial line rather obscure. Anterior adductor linguiform, about two-thirds the length of the scar being contained within the pallial line; posterior adductor scar very small, reniform. Pallial line remote from the basal margin. Inner margins entire.

Dimensions: Altitude, 7.1 millimeters; latitude, 8.2 millimeters; semidiameter, 2.4 millimeters.

Type: U. S. Nat. Mus. No. 352501.

Type locality: No. 3856, 5 to 6 miles west-northwest of Mossyhead, Walton County, Fla.

The species is characterized by the elevation of the concentric lamellae along the margin of the lunule and the posterior dorsal margin into a series of small scales with free, sharp edges. The portion of the lunule in the right valve is conspicuously wider than that in the left.

Occurrence: Shoal River formation, locality 3856 P.

Genus PHACOIDES Blainville

1825. *Phacoides* Blainville, Manuel de malacologie, vol. 1, p. 550.

Type: *Lucina jamaicensis* Lamarck. (Recent in the West Indies.)

Shell more or less lenticular; compressed, as a rule, or slightly tumid; umbones low, subcentral, erect or prosogyrate; sculpture dominantly concentric; anterior and posterior dorsal areas usually differentiated; lunule commonly profound; escutcheon obsolete; ligament external, in many specimens deeply sunken; normal dentition of right valve consisting of a simple anterior cardinal, a bifid posterior cardinal and anterior and posterior laterals; normal dentition of left valve consisting of a bifid anterior cardinal, a simple posterior cardinal, and anterior and posterior lateral grooves; laterals in many specimens and the cardinals in some specimens obsolete; muscle impressions strongly marked, the anterior elongate, the posterior oval; inner margins smooth or crenulated; pallial line entire.

The genus is abundantly represented in the Tertiary, the Mesozoic, and, if it be made to include the *Prolucina* of Dall, may be traced as far back as the Silurian. The living species number more than a hundred, and though they are most prolific in the Tropics, they are present in the temperate seas as well.

The Alum Bluff *Phacoides* number 18 species, including some of the most prolific forms of the entire fauna. As in so many of the other groups, the Chipola representatives are the most diversified, but those from Oak Grove and particularly from the Shoal River formation, while less numerous in species, are apparently more prolific in individuals. Out of the 18 species, 11, distributed among 6 subgenera and sections, have been recognized in the Chipola marl. The same subgenera and sections are represented in the Oak Grove by 10 species, whereas in the Shoal River the number is reduced to three—a *Pseudomiltha*, the only one of its kind in the Alum Bluff, and two prolific *Parvilucina*.

Laterals present; adults generally exceeding 7.0 millimeters in altitude; lunule funicular in the smaller forms:
- External sculpture dominantly concentric, with or without a feeble radial lineation:
  - Altitude of adult exceeding 10.0 millimeters:
    - Altitude usually exceeding the latitude; valves relatively inflated ..... *Phacoides* (*Linga*) *glenni* Dall.
    - Altitude rarely exceeding the latitude; valves compressed ..... *Phacoides* (*Linga*) *densatus* (Conrad).
  - Altitude of adult not exceeding 10.0 millimeters:
    - Concentric sculpture and resting stages conspicuously prominent; valves not depressed in front of the dorsal margin. *Phacoides* (*Cardiolucina*) *trisulcatus* (Conrad).
    - Concentric sculpture and resting stages not conspicuously prominent; valves depressed in front of the dorsal margin. *Phacoides* (*Cardiolucina*) *parawhitfieldi* Gardner, n. sp.

External sculpture reticulate:
Valves moderately inflated; concentric laminae produced at the intersection with the radials into short, subspinose processes ---- *Phacoides* (*Lucinisca*) *calhounensis* Dall.
Valves compressed; concentric laminae not produced at the intersection with the radials into short, subspinose processes ---- *Phacoides* (*Lucinisca*) *plesiolophus* Dall.
Laterals absent; adults exceeding 15.0 millimeters in altitude:
Cardinals not altogether obsolete:
Adult usually exceeding 60.0 millimeters in altitude; surface not warped; external sculpture commonly obsolete upon the medial portion of the disk ---- *Phacoides* (*Miltha*) *chipolanus* Dall.
Adult rarely exceeding 60.0 millimeters in altitude; surface warped:
Posterior dorsal margin squarely truncate; concentric laminae rather prominent, overlapping. *Phacoides* (*Miltha*) *heilprini* Gardner, n. sp.
Posterior dorsal margin obscurely truncate; concentric lamellae fine, sharp, elevated, especially toward the lateral margins ---- *Phacoides* (*Miltha*) *xustris* Gardner, n. sp.
Cardinals altogether obsolete ---- *Phacoides* (*Pseudomiltha*) *paranodonta* Gardner, n. sp.
Laterals present; adults rarely exceeding 7.0 millimeters in altitude; lunule impressed but not funicular:
Radial sculpture feeble or absent altogether:
Radial sculpture feeble:
Outline normally transversely ovate; concentric sculpture fine but sharp; radials distinct. *Phacoides* (*Parvilucina*) *sphaeriolus* Dall.
Outline subcircular; both the concentric and radial sculpture obscure:
Adult rarely exceeding 3.5 millimeters in altitude; shell relatively thin; elevated concentric lamellae rarely developed upon the dorsal areas ---- *Phacoides* (*Parvilucina*) *sphaeriolus angaleus* Gardner, n. subsp.
Adult usually exceeding 3.5 millimeters in altitude; shell relatively solid; elevated concentric lamellae commonly developed upon the dorsal areas:
Valves moderately inflated ---- *Phacoides* (*Parvilucina*) *vaughani* Gardner, n. sp.
Valves strongly inflated ---- *Phacoides* (*Parvilucina*) *piluliformis* Dall.
Radial sculpture obsolete or absent:
Concentric sculpture obscure:
Adult rarely exceeding 3.5 millimeters in altitude; shell relatively thin; concentric lamellae rarely developed upon the dorsal areas ---- *Phacoides* (*Parvilucina*) *sphaeriolus angaleus* Gardner, n. subsp.
Adult usually exceeding 3.5 millimeters in altitude; shell relatively solid; concentric lamellae commonly developed upon the dorsal areas ---- *Phacoides* (*Parvilucina*) *vaughani* Gardner, n. sp.
Concentric sculpture fine but distinct:
Adult rarely exceeding 5.0 millimeters in altitude:
Valves inflated ---- *Phacoides* (*Parvilucina*) *piluliformis* Dall.
Valves compressed ---- *Phacoides* (*Parvilucina*) *flumenvadosa* Gardner, n. sp.
Adult exceeding 5.0 millimeters in altitude ---- *Phacoides* (*Parvilucina*) *prunoides* Maury.
Radial sculpture well developed:
Radials not exceeding 12 in number; valves moderately inflated. *Phacoides* [*Parvilucina* (*Bellucina*)] *eupheus* Gardner, n. sp.
Radials exceeding 12 in number; valves compressed ---- *Phacoides* [*Parvilucina* (*Bellucina*)] *nereidideditus* Maury.

Subgenus LINGA De Gregorio

1884. *Linga* De Gregorio, Soc. mal. ital. Boll., vol. 10, p. 217= *Here* Gabb of authors, not *Here* Gabb, California Geol. Survey, Paleontology, vol. 2, pt. 1, p. 28, 1869.

Type: *Lucina columbella* Lamarck. (Miocene of southern France and northern Italy.)

Shell solid, inflated, with strong concentric sculpture, well-defined dorsal areas, and impressed lunule; the right anterior cardinal small and rude, the other teeth usually well developed.

The subgenus is well represented in the Chipola and occurs in the Oak Grove. Not even fragments, however, of these rather striking forms have been observed in the Shoal River.

Phacoides (Linga) glenni Dall

Plate XVIII, Figure 10

1903. *Phacoides* (*Here*) *glenni* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 6, p. 1366, pl. 50, fig. 17.

Dall described this species as follows:

Shell of moderate size and convexity, solid, polished, with small prosogyrate rather elevated beaks, rounded or subovate outline, and strongly marked dorsal areas; the young begin with a subrhomboidal shell, in which the projecting anterior and posterior ends recall *P. cariniferus;* the exterior is elegantly and rather closely concentrically rippled; the lunule is deep and cavernous, much more excavated in proportion than in the adult, and the dorsal areas are larger in proportion to the whole shell. In the course of growth the concentric sculpture becomes feebler and more distant, the strong, cordlike carina below the centrally convex anterior dorsal area becomes less conspicuous, and the outline of the valve changes to subovate,

rather higher than long, and the lunule is so obscured by the gyrate beaks that it is no longer noticeable. An average specimen measures: Altitude 32, longitude 30, diameter 16 millimeters.

The margins are elegantly minutely crenulate. The shell is named in honor of Prof. L. C. Glenn, who has done much work on the Tertiaries of Maryland and Virginia.

Type: U. S. Nat. Mus. No. 114613.

Type locality: No. 2211, lower bed, Alum Bluff, Liberty County, Fla.

The species is peculiarly characteristic of the sands at Alum Bluff:

Occurrence: Chipola formation, localities ?7893[r], 2212[r], 2213[p], 2564[r], 3419[r], 2211[a], 7183[a], 10660[c], 7468[r].

Phacoides (Linga) densatus (Conrad)

1856. *Lucina pennsylvanica* Tuomey and Holmes, Pleiocene fossils of South Carolina, p. 56, pl. 18, fig. 3.
Not *Venus pennsylvanica* Linnaeus, Systema naturae, 10th ed., p. 688, 1758.
1867. *Lucina densata* Conrad, Am. Jour. Conchology, vol. 3, p. 13.
1903. *Phacoides* (*Here*) *densatus* Conrad. Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 6, p. 1367.

Tuomey and Holmes described this species as follows:

Shell subglobose, thick, solid, concentrically ribbed; anal side with a conspicuous channel; lunule impressed, oblong, cordate.

This is a well-characterized species. The deep channel on the anal side, which produces a notch in the pallial margin, the flat concentric ribs on the disks, the well-defined ovate lunule, and the angle on the buccal side, are characters that distinguish this species from all its congeners.

With age the shell becomes very thick and the muscular impressions deep. Toward the pallial margin the lines of growth become somewhat lamellose.

Type locality: Darlington district, South Carolina.

Conrad isolated this species in 1867 as follows:

The Miocene species is comparatively more elevated than *L. pennsylvanica*. The posterior margin is nearly direct and obtusely rounded or abrupt; the sinus has a greater downward slope, and the dorsal margins are much more oblique than in the Recent *L. pennsylvanica*.

Phacoides densatus Conrad is well characterized by the heavy lenticular but not globose valves, the dorsal areas, so strongly depressed and so sharply delimited by the sulcus on the inner boundary that the margins of the valve are abruptly contracted, the external sculpture of about 30 concentric plates overlapping ventrally and more crowded toward the base, and by the rude, half obsolete dentition. The anterior adductor muscle impression is narrow and obliquely descending just within the pallial line.

The forms of the Alum Bluff group are badly worn and are of somewhat doubtful specific identity. They may represent a species differing from *densatus* in the higher, less rounded, posterior dorsal margin, the greater relative latitude, the shorter, broader lunule, and possibly in the more obscure concentric sculpture. The Chipola *glenni* is smaller, as a rule, relatively higher and heavier, with a more deeply impressed lunule and posterior area and a deeper dent at the base.

Occurrence: Oak Grove sand, localities 2646[p], 2652[r], ?9961[r].

Outside occurrence: Miocene, Duplin marl of North Carolina and South Carolina.

Phacoides (Linga) sp. indet.

1903. *Phacoides* (Here) sp. indet. Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 6, p. 1367.

Dall described this specimen as follows:

A single immature valve of what appears to be a species of *Phacoides* different from any of which adults have been described was found with the other Oak Grove fossils. The shell is rather longer than high, with the nepionic portion of the beak closely concentrically ribbed but the rest nearly smooth; the anterior dorsal area is small, limited by a rather obscure, shallow, but narrow sulcus; the posterior area is set off by a broad, well-marked sulcus; the lunule is deep and wide, forming an excavation which intrudes across the hinge line between the anterior lateral and the cardinals. All the teeth are well developed. Altitude 4.0, longitude 4.5, diameter (double) 2.0 millimeters.

The sculpture alters so with growth that I think it best not to name this species until more material comes to hand.

Locality: No. 2646, Oak Grove, Yellow River, Okaloosa County, Fla.

No further material is available for the amplification of these characters.

Occurrence: Oak Grove sand, locality 2646[r].

Subgenus CARDIOLUCINA Sacco

1901. *Cardiolucina* Sacco, I molluschi dei terreni terziarii dei Piemonte e della Liguria, pt. 29, p. 89=*Cavilucina* of most American authors, not *Cavilucina* Fisher, 1887.

Type: *Cardium agassizii* Michelotti. (Miocene of northern Italy.)

Shell small, inflated, anteriorly produced; lunule small, impressed; anterior and posterior dorsal areas obscure; sculpture concentric; two cardinals and anterior and posterior laterals developed in each valve.

Phacoides (Cardiolucina) trisulcatus (Conrad)

Plate XVIII, Figures 11–13

1841. *Lucina trisulcata* Conrad, Am. Assoc. Geologists and Naturalists Trans., vol. 1, p. 110.
1841. *Lucina trisulcata* Conrad, Am. Jour. Sci., 1st ser., vol. 41, p. 346.
1845. *Lucina trisulcata* Conrad, Fossils of the medial Tertiary of the United States, p. 71, pl. 40, fig. 5
1856. *Lucina trisulcata* Tuomey and Holmes, Pleiocene fossils of South Carolina, p. 62, pl. 18, figs. 18, 19.
1860. *Lucina trisulcata* Conrad. Holmes, Post-Pleiocene fossils of South Carolina, p. 28, pl. 6, fig. 4.
1863. *Lucina trisulcata* Conrad, Acad. Nat. Sci. Philadelphia Proc. for 1862, p. 577.
1864. *Lucina trisulcata* Conrad. Meek, Checklist of the invertebrate fossils of North America, Miocene; Smithsonian Misc. Coll., No. 183, p. 8.

1894. (?) *Lucina trisulcata* Conrad. Whitfield, U. S. Geol. Survey Mon. 24, p. 64, pl. 10, figs. 1–4.
1903. *Phacoides (Cavilucina) trisulcatus* Conrad. Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 6, p. 1369.
1903. *Phacoides (Cavilucina) recurrens* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 6, p. 1369 (part; fig. excluded).
1904. *Phacoides (Here) trisulcatus* (Conrad) Glenn, Maryland Geol. Survey, Miocene, p. 337, pl. 90, figs. 7–9 (part).
1915. *Phacoides (Cavilucina) recurrens* Dall, U. S. Nat. Mus. Bull. 90, p. 138 (part; fig. excluded).

Conrad described this species in 1841 as follows:

Obovate, convex; with concentric lines and two or three distant concentric furrows; lunule profound. Differs from *L. alveata* of the lower Tertiary in being less ventricose and in the much more profoundly impressed lunule; the cardinal teeth are also very different.

Type locality: Natural Well, Duplin County, N. C.

Shell small, rudely circular or ellipsoidal, moderately gibbose. Lunule very small but very deeply excavated. Escutcheon absent. Umbones usually a little behind the median line, acute, prosogyrate, thrown into prominence by the profound lunular pit in front of them. Anterior end somewhat produced, very broadly rounded or obscurely but squarely truncated laterally. Posterior end the shorter; posterior dorsal margin oblique or slightly convex; lateral margin broadly rounded or squarely truncate. Base line more depressed, as a rule, toward the anterior end. Posterior dorsal area defined by a more or less obscure carina. External surface sculptured with 25 to 35 subequal, concentric lirae separated by linear interspaces; numerous strongly defined resting stages and radial striation absent in the *P. trisulcatus* sensu stricto. Normally a simple anterior cardinal and a bifid posterior cardinal in the right valve; a bifid anterior and a simple posterior cardinal in the left valve; anterior cardinals becoming obsolete with age and in some specimens even the posterior cardinals affected. Laterals rude but very prominent; short anterior and posterior lateral denticles in the right valve; anterior and posterior lateral grooves in the left valve, the inner margins raised into toothlike prominences. Adductor impressions commonly obscure, the anterior linguiform, the posterior oval. Pallial line simple. Marginal denticulation very fine.

The aspect of the interior of the valve of *P. trisulcatus* is characteristic, the posterior dorsal margin ascending with a slight convexity to the acute apices, the small but almost semicircular lunule pit in front of the umbones, and the anterior dorsal margin sloping gently to the lateral truncation.

The Bowden species, which has been confused with this form, differs in the smaller, less deeply impressed lunule and the much more delicate hinge. The Chipola specimens are not separable from the younger Miocene forms.

Phacoides parawhitfieldi Gardner, n. sp., from the Oak Grove, is less strongly sculptured, the valves are normally transversely elliptical in outline and depressed directly in front of the posterior margin.

Occurrence: Chipola formation, localities 7893^{p}, 2564^{r}, 3419^{p}, 7151^{r}, 2211^{r}, 10660^{r}, ?7468^{r}. Oak Grove sand, locality ?9961^{r}.

Outside occurrence: Miocene: Marks Head marl, Georgia; Calvert formation, Maryland; Choptank formation, Maryland; St. Marys formation, Virginia and North Carolina; Yorktown formation, Virginia and North Carolina; and Duplin marl, North Carolina and South Carolina. Pliocene: Waccamaw formation, North Carolina and South Carolina; and Caloosahatchie marl, Florida. Pleistocene: South Carolina and Florida. Recent: Hatteras to Cape St. Roque in 0 to 18 fathoms.

Phacoides (Cardiolucina) parawhitfieldi Gardner, n. sp.

Plate XVIII, Figures 14–15

1903. *Phacoides (Cavilucina) trisulcatus* var. *whitfieldi* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 6, p. 1370 (part).

Shell small, solid, subcircular to transversely elliptical in outline, moderately compressed. Umbones small, acutely pointed, prosogyrate, thrown into prominence by the excavated lunule in front of them. Posterior dorsal area defined by a broad, shallow depression wider than the area between it and the dorsal margins. Lunule small but very deep. An elongate, cordate dorsal anterior area more than twice the length of the lunule which it includes, vaguely defined by a slight depression, feebly and irregularly incised line, and a slight change in the character of the growth lines. Surface sculptured with low, closely appressed lamellae, commonly with one or more pronounced resting stages. Ligament deep set but not internal. Hinge rather heavy. Anterior cardinal of right valve obsolete in the adult forms. Posterior cardinal rather slender, feebly sulcate. Laterals of right valve small, stout denticles, each with a deep pit on the inner margin for the reception of the teeth of the opposite valve. Anterior and posterior cardinals of left valve subequal laminae, somewhat arcuate by reason of the invasion of the lunule. Left laterals low, stout, cut off from the margins by deep pits which receive the laterals of the right valve. Muscle scars distinct, rather small for the genus, the anterior extending not more than half the distance from the pallial line to the medial horizontal. Pallial line distinct, ragged, relatively remote from the base line. Inner margin very finely crenate from the lunule to the ligament area.

Dimensions of right valve: Altitude, 8.0 millimeters; latitude, 8.2 millimeters; semidiameter, 2.5 millimeters. Dimensions of left valve: Altitude, 8.2 millimeters; latitude. 8.7 millimeters· semidiameter, 2.5 millimeters.

Cotypes: U. S. Nat. Mus. No. 352497.

Type locality: No. 2646, Oak Grove, Yellow River, Okaloosa County, Fla.

Phacoides parawhitfieldi was first thought to be a subspecies of the protean *P. trisulcatus* (Conrad), to which it is doubtless intimately related. Like the New Jersey subspecies *whitfieldi*, it differs from the type in the less pronounced concentric sculpture and the fewer and much less prominent resting stages. The relatively lower altitude and transversely elliptical outline is even more marked in the Oak Grove species than in the New Jersey form. The differences in the character of the lunule exclude the possibility of uniting the Florida form with the end members of *P. trisulcatus*, which it most closely resembles. The most characteristic feature of *P. parawhitfieldi* is possibly the shallow depression a little in front of the dorsal margin. In *P. trisulcatus* the dorsal area is cut off from the disk by an obtuse keel, but it is not undulated.

Phacoides parawhitfieldi is rather common at the type locality and its environs, but it has not been recognized elsewhere.

Occurrence: Oak Grove sand, localities 2646^{c}, 5632^{r}, 5633^{r}. 7054^{r}.

Subgenus LUCINISCA Dall

1901. *Lucinisca* Dall, U. S. Nat. Mus. Proc., vol. 23, p. 805.
1903. *Lucinisca* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 6, p. 1361.

Type: *Lucina nassula* Conrad. (Recent off the southeastern coast of the United States.)

Dall described this subgenus in 1901 as follows:

Shell lentiform, white, with well-marked dorsal areas, the sculpture reticulate and muricate, the right anterior cardinal obsolete.

The Chipola and Oak Grove have each a single rather abundant species, but the group has not been reported from the Shoal River.

Phacoides (Lucinisca) calhounensis Dall

Plate XVIII, Figure 16

1903. *Phacoides* (*Lucinisca*) *calhounensis* Dall, Wagner Free Inst. Sci. Trans., vol 3, pt. 6, p. 1371, pl. 52, fig. 16. (Forms from Tampa silex bed excluded.)
1915. *Phacoides* (*Lucinisca*) *calhounensis* Dall, U. S. Nat. Mus. Bull. 90, p. 139, pl. 24, fig. 5 (part).

Dall described this species in 1903 as follows:

Shell resembling *P. cribrarius* Say in its general features, but with the sculpture more dense, the reticulation finer and more even, the radial ribs being of about the same strength and prominence as the concentric ridges, except near the umbones; the umbonal concentric ridges are less distant and prominent and those close to the beaks are heavier and broader relatively to the size of the shell, the anterior dorsal area is more conspicuous, the lunule proportionately longer and larger, the crenulations of the inner margins of the valves finer and more numerous. Altitude 10.0, longitude 10.0, diameter 4.5 millimeters.

This is in every way a smaller, finer, and more delicate shell than *P. cribrarius*. The siliceous pseudomorphs from Ballast Point appear to have lost nearly all their prominent sculpture and were probably consequent upon the fossilization of worn, dead valves, which have a very different aspect from the perfect shell.

Type: U. S. Nat. Mus. No. 114684.

Type locality: No. 2213, 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.

Not only the sculpture of the Ballast Point individuals differs from those of the Chipola but the outline is distinct by reason of the higher posterior dorsal margin and the more angular posterior extremity.

The Oak Grove *Lucinisca plesiolopha* is a larger, more compressed shell with a coarser, more distant concentric sculpture and relatively less prominent radials. In perfectly preserved specimens of *P. calhounensis* the concentric lamellae in the umbonal region are sharp and prominently elevated. Away from the umbones they form at the intersection with the radials a very regular series of short subspinose processes.

Occurrence: Chipola formation, localities 10609^{p}, 7893^{p}, 7257^{r}, 2213^{p}, 3419^{r}, 7151^{r}. Oak Grove sand, locality ?9961^{r}.

Phacoides (Lucinisca) plesiolophus Dall

Plate XIX, Figures 1–2

1900. *Lucina plesiolophus* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, pl. 40, figs. 2, 5.
1903. *Phacoides* (*Lucinisca*) *plesiolophus* Dall, idem, pt. 6, p. 1371.
1915. *Phacoides* (*Lucinisca*) *plesiolophus* Dall, U. S. Nat. Mus. Bull. 90, p. 138.

Dall described this species as follows.

Shell thin, suborbicular, compressed, with high, pointed, prosogyrate beaks and conspicuous dorsal areas; concentric sculpture of low, rather strong, moderately elevated ribs, tending to become obsolete toward the base and on the anterior third of the disk; they are also rather distant, more so than in any of the other Tertiary species of this group; radial sculpture of rather close set, rounded, low, even threads increasing by intercalation rather than divarication, and stronger toward the ends of the valve; the posterior dorsal area is bounded in front by a rather strong radial rib; on this the concentric ridges rise into little, triangular leaflets, and similarly but less conspicuously on the posterior dorsal margin; there is a wider shallow sulcus on each side of this rib; the anterior dorsal area is very small and narrow with one or two radials upon it; the lunule is lanceolate, small, and emphatically excavated, larger in the left than in the right valve; hinge normal, the internal margins of the valve finely crenulate. Altitude 15.5, longitude 5.5 millimeters [error for 15.5 millimeters].

This is the largest and most feebly sculptured of the east American Tertiary species of this group.

Type: U. S. Nat. Mus. No. 107392.

Type locality: No. 2646, Oak Grove, Yellow River, Okaloosa County, Fla.

Lucinisca plesiolopha is one of the most prolific species in the entire Oak Grove fauna. Though the

variation in the relative prominence of the radial and the concentric sculpture is rather wide, the species is, on the whole, remarkably well characterized and not to be confused with any other of the Alum Bluff forms. The individuals from the "silex bed" of the Tampa formation are well preserved and apparently identical.

Occurrence: Oak Grove sand, localities 2646[pr], 5632[a], 5631[c], 5630[r], 5633[r], 7054[c].

Outside occurrence: Miocene: Tampa formation ("silex bed"), Hillsborough County, Fla.

Subgenus MILTHA H. and A. Adams

1857. *Miltha* H. and A. Adams, Genera of Recent Mollusca, vol. 2, p. 468.

Type: *Lucina childreni* Gray. (Recent off the coast of Brazil.)

Dall[5] described this subgenus in 1903 as follows:

Shell solid, usually compressed, concentrically striate, with a conspicuous periostracum, narrow impressed lunule, inconspicuous anterior and posterior dorsal areas, deeply inset ligament and resilium; hinge with two cardinals in each valve, the inner pair bifid; margins entire; anterior adductor scar prolonged; the valves sometimes diversely convex.

Only two Recent species of this type are known, but there are numerous fossil species. * * *

This group is very abundant in the Eocene Tertiaries, dwindling until it is represented in existing faunas, so far as known, only by two living species, one in the Gulf of California and one in the Indian Ocean.

The typical section comprises species in which the cardinal teeth are clear-cut and well developed. It again comprises three groups of species represented in most horizons down to the Pliocene and two of which are known to survive. These are:

A. Species of which the surface sculpture is characterized by concentric lamellation like *P.* (*M.*) *disciformis* and *hillsboroensis* of Heilprin.

B. Species compressed, high, and with fine concentric striation, like *P.* (*M.*) *childreni* Gray and *caloosaensis* Dall.

C. Species with sculpture similar to the last but more convex and elongated and with a somewhat sinuous basal profile, like *P.* (*M.*) *pandatus* Conrad and *voorhoevii* Deshayes.

The large and rather fragile forms which represent this subgenus are quite widely, though by no means abundantly, distributed in the Chipola and Oak Grove formations.

Phacoides (Miltha) chipolanus Dall

Plate XIX, Figures 3–6

1903. *Phacoides* (*Miltha*) *chipolanus* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 6, p. 1375, pl. 51, fig. 11.

1903. *Phacoides* (*Miltha*) *heracleus* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 6, p. 1376, pl. 51, fig. 10 (part).

1915. *Phacoides* (*Miltha*) *heracleus* Dall, U. S. Nat. Mus. Bull. 90, p. 139 (part).

Dall described *Phacoides chipolanus* in 1903 as follows:

Shell large, rather thin, compressed, with small, pointed, recurved beaks, over a small, narrow, rather deeply impressed lunule; there is no anterior dorsal area; the posterior area is long, narrow, and divided into two nearly equal parts by an impressed line; sculpture of fine, slightly irregular concentric raised threads, stronger distally, sublamellose on the dorsal area, fainter in the middle of the disk, and rather close-set; radial sculpture of faint, obscure, slightly vermicular markings, hardly visible except in the middle of the disk; anterior adductor scar elongate; posterior short, ovate; cardinal teeth well developed; ligament short, deeply inset. Altitude 75, longitude 71, diameter about 11 millimeters.

The figure of this species is restored from a number of fragments which give practically all the characters except in the hinge of the left valve. It is a large, very compressed form belonging in group B.

Dall described *Phacoides heracleus* in 1903 as follows:

Shell large, convex, subequilateral, rather thick, with small, pointed, prosogyrate beaks over an arcuately impressed, small, sublanceolate lunule; anterior dorsal area narrow and rather short, defined by a shallow sulcus; posterior area narrow elongate, divided by a second longitudinal sulcus into two parts, of which the anterior is wider; sculpture of fine concentric lines, feebler in the middle of the disk, and of faint, nearly obsolete, sparser radial striations; ligament deeply inset, rather long; cardinals normal, rather small and slender. Altitude 80, latitude 77, diameter 30 millimeters.

This large species recalls the *Pseudomiltha gigantea* of the Parisian Eocene, but the teeth are developed. Only one right valve and a fragment have so far been obtained.

Type: U. S. Nat. Mus. No. 114712.

Type locality: No. 2213, 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.

The species occurs but sparingly at Oak Grove. The material is so perfectly preserved, however, that a valve has been figured to supplement the rather fragmentary type. Apparently the Chipola and Oak Grove forms are specifically identical and apparently *chipolanus* and *heracleus* are synonyms. No double valves have been found, but except for the greater compression of *chipolanus* there are no characters, even to the finer details of sculpture, by which the forms may be separated. The type of *P. chipolanus* is much worn and the anterior dorsal area obscured. It shows up very clearly, however, on the equally thin and compressed figured specimen from Oak Grove. The relative width of the areas defined by the secondary longitudinal sulcus varies on both the compressed and the more convex forms. It is possible that the thickening of the shell in this species is a senile character. It is certainly not a character restricted to the shells of any one horizon or locality, for both the thin and heavier forms are found at Alum Bluff, the type locality of *P. heracleus*, and at Oak Grove, the locality at which the most perfect specimen of *P. chipolanus* has been collected.

Occurrence: Chipola formation, localities 2213[r], 7151[r], 2211[r], 2568[r]. Oak Grove sand, localities 2646[r], 7054[r], 2652[p], 9961[p].

[5] Dall, W. H., Contributions to the Tertiary fauna of Florida: Wagner Free Inst. Sci. Trans., vol. 3, pt. 6, pp. 1361, 1374, 1903.

Phacoides (Miltha) heilprini Gardner, n. sp.

Plate XIX, Figures 7, 8

1903. *Phacoides (Miltha) hillsboroensis* Heilprin. Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 6, p. 1376.
Not *Lucina hillsboroensis* Heilprin, Wagner Free Inst. Sci. Trans., vol. 1, p. 117, 1887.
1915. *Phacoides (Miltha) hillsboroensis* Heilprin. Dall, U. S. Nat. Mus. Bull. 90, p. 139 (part; figure excluded).

Dall described *Miltha hillsboroensis* in 1903 as follows:

This fine species is notable for its rather irregular concentric lamellation with the interspaces concentrically striated. The teeth are well developed, the lunule quite narrow and deep. The specimens from the marl are generally deprived of the outer coat, thus removing all the lamellation, and exhibit a faint radial striation which makes them hardly recognizable as the same species as a complete specimen. The quite young shell is thin, convex, more transverse, and has the aspect of a young *Lucina*.

Shell large, rather thick, moderately compressed, strongly rounded ventrally, rudely ovate in outline, peculiarly subject to surface irregularities so that the form rarely fails to exhibit a warped and somewhat pathologic aspect. Umbones small but full, not very prominent, prosogyrate, acute at the proximate tips. Lunule short but very deep, invading the hinge area. Escutcheon not defined. Anterior dorsal area moderately wide, depressed, the concentric sculpture of the disk continuing across it to the anterior margin, though changing abruptly in direction. Posterior dorsal area defined by a distinct but not conspicuous incised line, squarely truncate. External surface covered with sharp-edged lamellae, overlapping one another at regular intervals, usually rendered more or less obtuse by decortication, persisting across both the lunule and the posterior area. Radial sculpture manifested in an obscure, largely subcutaneous lineation. Ligament submarginal, opisthodetic, the groove coextensive with the posterior dorsal margin. Dentition normal for the subgenus, rather delicate for so heavy a shell. Hinge area invaded in the full adult by the lunule, with the consequent partial obliteration of the anterior cardinals. Muscle scars and sinus conspicuous. Anterior adductor a ribbon half as long as the shell is high, placed almost entirely within the pallial line and produced parallel to it. Posterior adductor much smaller, irregular in outline. Pallial line simple, distinct, parallel, and proximate to the base line. Inner margins entire.

Type: U. S. Nat. Mus. No. 114708.

Dimensions: Altitude, 56.5 millimeters; latitude, 57.5 millimeters; semidiameter, 17.0 millimeters.

Type locality: No. 2212, Tenmile Creek, 1 mile west of Baileys Ferry, Calhoun County, Fla.

The Chipola species is higher and more angular than that described by Heilprin from the "silex beds," and it exhibits a curious warping of the surface not indicated in the individuals from Ballast Point. The lunule, furthermore, is shorter and wider in the later forms and less deeply impressed. The species is not uncommon in the environs of the type locality and is preserved almost exclusively in the form of double valves.

Occurrence: Chipola formation, localities 2212^{r}, 2213^{p}, 2564^{r}, 3419^{r}, 7151^{r}.

Phacoides (Miltha) xustris Gardner, n. sp.

Plate XX, Figures 1, 2

Shell moderately large and heavy, a little higher than wide, warped but rudely discoidal in outline. Delimitation of dorsal areas suggested by a slight constriction of the shell cutting off the posterior third; shell obviously injured, the anterior portion of the right valve depressed. Umbones small, acute, prosogyrate, slightly anterior in position. Lunule very small, depressed, elongate cordate, even more narrow in the left valve than in the right. Escutcheon not defined. External surface sculptured with crowded, concentric lamellae, worn down upon the medial portion of the disk but very fine and sharp toward the lateral margins. Ligament and resilium deep set but not internal. Hinge delicate. Anterior cardinal of right valve and posterior cardinal of left laminar; posterior cardinal of right valve broad, deeply grooved to its point of origin directly beneath the base of the umbones; anterior cardinal of left valve also bifid but much more slender. Laterals not developed. Inner surface thickened within the pallial line. Anterior muscle scar podshaped, its ventral extremity lying behind the median horizontal and near to the pallial line; posterior muscle scar smaller, irregular in outline, set near the dorsal margin, more than half of it lying above the median vertical. Pallial line very distinct, somewhat ragged very close to the ventral margin. Inner margins entire.

Dimensions: Altitude, 37.0 millimeters; latitude, 36.5 millimeters; diameter, 15.5 millimeters.

Type: U. S. Nat. Mus. No. 352496.

Type locality: No. 7183, lower bed, Alum Bluff, Liberty County, Fla.

Phacoides xustris is set off from all the coexistent members of the genus by the sharp rasping of the surface. In no other congenetic species are the lamellae so thin and so closely overlapping. The warping of the lunule is doubtless a pathologic character. *Phacoides heilprini* Gardner, n. sp., exhibits a similar general outline and relative proportions excepting for the marked posterior truncation and sinuous anterior dorsal margin.

Occurrence: Chipola formation, locality 7183^{r}.

Subgenus PSEUDOMILTHA Fischer

1887. *Pseudomiltha* Fischer, Manuel de conchyliologie, p. 1144.

Type: *Lucina gigantea* Deshayes. (Eocene of the Paris Basin.)

Shell rather solid and compressed, concentrically striate, with a narrow impressed lunule, inconspicuous anterior and posterior dorsal areas, deeply inset ligament and resilium; hinge teeth wholly obsolete.

It is rather remarkable that this subgenus should be restricted to the Shoal River formation. The single species is, indeed, with the exception of two *Parvilucina* the only *Phacoides* reported from the marl.

Phacoides (Pseudomiltha) paranodonta Gardner, n. sp.

Plate XX, Figures 3–5

Shell of moderate dimensions, rather thin, compressed, subcircular in outline. Posterior dorsal margin feebly arched. Posterior lateral margin obscurely truncate. Anterior and dorsal margins smoothly rounded. Umbones small, inconspicuous, acutely pointed at the tips, prosogyrate and proximate. Posterior area rather obscure, feebly depressed. Anterior area small, sharply delimited by an incised groove. Lunule minute, somewhat funnel-shaped, expanding toward the interior. External surface finely and rather irregularly wrinkled and striated, the sculpture least feeble toward the distal extremities and upon the anterior and posterior areas; an amorphous ridge commonly developed upon the inner margin of the anterior area by means of a series of puckerings on the shell surface; surface also shagreened with a microscopically fine, irregular radial striation. Ligament internal, the groove deep-set and extending but little more than half the length of the dorsal margin. Dentition obsolete. Anterior adductor scar much elongated, though less than half as long as the shell is high, its outer margin almost but not quite fused with the pallial line; posterior adductor scar much shorter and broader. Pallial line simple, rather remote from the basal margin.

Dimensions: Altitude, 26.0 millimeters; latitude, 27.0 millimeters; diameter, 10.0 millimeters.

Type: U. S. Nat. Mus. No. 352484.

Type locality: No. 5618, 3½ miles southwest of De Funiak Springs, Walton County, Fla.

This species is apparently a precursor of *P. anodonta* Say, a larger, heavier form of ruder sculpture and characterized constantly by a broader lunule and broader adductor scars. Were it not for these differences in the character of the lunule and muscle scars the other differences would be considered of doubtful specific value.

Occurrence: Oak Grove sand, locality ?7055[r]. Shoal River formation, localities 5079[r], 5193[r], 5194[r], 3733[r], 7264[r], 5618[p], 9959[r].

Subgenus PARVILUCINA Dall

1901. *Parvilucina* Dall, Proc. U. S. Nat. Mus., vol. 23, p. 806.
1903. *Parvilucina* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 6, p. 1362.

Type: *Lucina tenuisculpta* Carpenter. (Recent on the west coast from Bering Sea to the Coronado Islands.)

Dall described this subgenus as follows:

Shell small, plump, often inequilateral; sculpture more or less reticulate but not muricate, teeth small, but all usually present.

In number of individuals *Parvilucina* is probably as well represented in the Oak Grove and Shoal River formations as any group in the entire molluscan fauna. *Parvilucina piluliformis* in the Oak Grove and *P. vaughani* and *P. flumenvadosa* in the Shoal River are exceedingly prolific; *P. sphaeriola* and its subspecies in the Chipola formation are abundant.

Phacoides (Parvilucina) sphaeriolus Dall

Plate XX, Figure 6

1903. *Phacoides (Parvilucina) sphaeriolus* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 6, p. 1382, pl. 52, fig. 15.

Dall described this species as follows:

Shell small, plump, rounded, subequilateral, with small, somewhat prosogyrate beaks; lunule small, lanceolate, moderately excavated; escutcheon linear or none; dorsal areas indicated by the absence of radial sculpture, hardly impressed; disk with 24 or more rounded radial riblets, of variable strength, but not bifurcate, crossed by rather sparse, thin, little elevated lamellae which are higher on the dorsal areas; hinge normal, strong; inner margins strongly crenulate. Altitude 4.0, longitude 4.2, diameter 2.75 millimeters.

A larger and more solid shell with stronger radials, larger lunule, and less close and regular concentric sculpture than in *P. yaquensis*.

Type: U. S. Nat. Mus. No. 114686.

Type locality: No. 2213, 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.

P. sphaeriola Dall is more strongly sculptured radially than any of the other species of Alum Bluff *Parvilucina*. The limits of individual variation are wide and the age variation wider than in any other member of the subgenus. The concentric sculpture is relatively strong, as a rule, upon the umbones, evanescing toward the ventral margin, whereas the radial sculpture commonly does not begin until the form is half grown. The end members segregated under the subspecies *angalea* are relatively higher, as a rule, and nearly smooth. Young *P. sphaeriola* are similar in outline and general characters to *P. prunoides* Maury, but the concentric lamellae are finer and sharper in *P. sphaeriola*. *P. piluliformis* from Oak Grove and *P. vaughani* from Shoal River run larger and relatively higher. *P. flumenvadosa* has much the same general dimensions but does not develop a radial sculpture.

Occurrence: Chipola formation, localities 10609[c], 10610[p], 7893[c], 2212[c], 7257[p], 2213[a], 2564[pr], 3419[c], 7151[p], 2211[c], 10660[p].

Phacoides (Parvilucina) sphaeriolus angaleus Gardner, n. subsp.

Plate XX, Figure 7

Shell small, commonly polished, subcircular, moderately inflated. Umbones rather full, subcentral, the tips acute and prosogyrate. Lunule elongate-cordate,

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wider in the right valve than in the left, impressed and bordered by an acute keel, smooth except for incrementals. Escutcheon linear, smooth. Anterior dorsal area obscurely defined by a shallow depression; posterior dorsal area obliquely flattened. Posterior lateral margin truncate, rounding rather abruptly into the arcuate base; anterior lateral margin obscurely truncate, in many specimens slightly indented by the depression which defines the anterior area. External surface of type sculptured with faint concentric striae and a very feeble radial lineation. Ligament deeply inset. Anterior cardinal of right valve obsolete; right posterior cardinal moderately robust, cuneate; anterior and posterior cardinals of left valve laminar. Adductor and pallial scars distinct. Anterior adductor scar small for the genus, somewhat reniform in outline, the posterior adductor irregularly ovate. Pallial line ragged; rather remote from the base line. Inner margins finely crenate.

Dimensions: Altitude, 3.2 millimeters; latitude, 3.2 millimeters; semidiameter, 0.9 millimeter.

Type: U. S. Nat. Mus. No. 352487.

Type locality: No. 7257, Sexton's marl bed, Tenmile Creek, Calhoun County, Fla.

The end members of the species and subspecies are widely separated both in outline and sculpture. *P. sphaeriola* Dall s. s. is decidedly produced anteriorly, whereas in the subspecies the beaks are subcentral. Both concentric and radial sculpture are clearly though not strongly developed in the typical form, but in *angalea* the sculpture is almost entirely obsolete. Both forms are widely distributed in the Chipola but apparently are restricted to it. *P. vaughani* is very similar to the subspecies in outline and surface, but it is a larger, more solid, and generally more inflated shell with a more squarely truncate posterior margin and a stronger tendency toward the development of elevated concentric lamellae upon the dorsal areas.

Occurrence: Chipola formation, localities 10609^{p}, 10610^{p}, 7893^{p}, 2212^{p}, 7257^{p}, 2213^{c}, 2564^{c}, 3419^{c}, 7151^{p}.

Phacoides (Parvilucina) vaughani Gardner, n. sp.

Plate XX, Figures 8–9

Shell small, polished, subcircular, inflated. Umbones central, rather prominent, full, incurved, prosogyrate. Lunule small, elongate-cordate, impressed, sharply delimited, slightly wider in the right valve than in the left. Escutcheon little more than linear, but distinctly impressed and extending the length of the posterior dorsal margin. Anterior area obscurely defined by a shallow sulcus, the posterior by an obtuse keel and the oblique flattening of the valve behind the keel. Anterior margin gently rounded or somewhat truncate; posterior margin squarely truncate. Base line strongly arcuate. External ornamentation obscure; concentric sculpture incremental in character, commonly less feeble upon the dorsal area than upon the disk; radial lineation exceedingly faint, in many specimens obsolete upon the dorsal area. Ligament area linear, deeply inset. Dentition vigorous for so small a shell. Anterior cardinal of right valve obsolete, the posterior cuneate and rather stout; anterior cardinal of left valve also cuneate but not so stout; posterior cardinal of left valve laminar; anterior and posterior laterals developed in both valves, stronger in the right valve than in the left; the anterior teeth conical, the posterior, particularly in the right valve, more produced. Adductor and pallial scars commonly obscure. Anterior adductor reniform, very short for the genus; posterior adductor small, irregular in outline. Pallial line ragged, remote from the base line. Inner margins finely but quite sharply crenate.

Dimensions: Altitude, 4.0 millimeters; latitude, 4.0 millimeters; semidiameter, 1.6 millimeters.

Type: U. S. Nat. Mus. No. 352488.

Type locality: No. 5079, half a mile below Shell Bluff, Shoal River, Walton County, Fla.

This species is quite similar to *P. piluliformis* Dall and occupies an analogous position in the fauna which it characterizes. It is a more highly polished little form than the Oak Grove species and less strongly sculptured both radially and concentrically. *Parvilucina sphaeriola angalea* Gardner, n. subsp., from the Chipola formation, runs smaller and thinner. The posterior margin is more evenly rounded and the concentric sculpture is less commonly accentuated upon the dorsal margins.

The species is named in honor of Dr. T. Wayland Vaughan, who by his extensive collections and his stratigraphic and faunal studies has so widely increased our knowledge of the South Atlantic coastal plain.

Occurrence: Shoal River formation, localities 10658^{r}, 5079^{pr}, 10661^{c}, 10662^{c}, 3733^{c}, 9958^{p}, 7261^{r}, 7264^{p}, 9960^{p}, 10603^{a}, 10608^{c}, 5618^{c}.

Phacoides (Parvilucina) piluliformis Dall

Plate XX, Figure 10

1903. *Phacoides (Parvilucina) piluliformis* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 6, p. 1382, pl. 52, fig. 6.

Dall described this species as follows:

Shell small, plump, rounded, with small inconspicuous beaks; lunule lanceolate, small, impressed and clearly delimited; escutcheon narrow, depressed, elongated, bordered by a sharply angular keel; dorsal areas large, distinctly impressed, sinuating the margin; radial sculpture faint or obsolete; concentric sculpture irregular, like strong incremental lines, tending to become lamellose over the dorsal areas; hinge strong, marginal crenulation rather fine. Altitude 4.0, longitude 4.5, diameter 4.0 millimeters.

A convex little shell with almost exactly the sculpture of the recent *P. tenuisculptus* Carpenter.

Type: U. S. Nat. Mus. No. 157633.

Type locality: No. 2646, Oak Grove, Yellow River, Okaloosa County, Fla.

Parvilucina piluliformis Dall is exceedingly abundant in the fauna which it characterizes. It is more highly inflated than any other of the Alum Bluff Parvilucinas and offers a range of variation in the concentric and radial sculpture second only to *P. sphaeriola* Dall. The concentric sculpture is, however, never so sharp as that of *P. flumenvadosa* nor the radial sculpture so pronounced as that of *P. sphaeriola* Dall. From *P. vaughani*, its closest analog, it may be separated by the more inflated valves and the more regularly developed concentric sculpture, particularly toward the basal margins.

Occurrence: Oak Grove sand, localities 2646^{pr}, 5632^{pr}, 5631^{c}, 5630^{p}, 5633^{p}, 7054^{c} 9961^{a}. Shoal River formation, locality 9957^{c}.

Phacoides (Parvilucina) flumenvadosa Gardner, n. sp.

Plate XX, Figure 11

Shell small, subcircular, rather compressed. Umbones central, moderately inflated, acute and prosogyrate. Lunule short, impressed, cordate, possibly a trifle wider in the right valve than in the left, delimited by an obtuse keel and the abrupt disappearance of the sculpture of the disk. Escutcheon narrow, lanceolate, extending the length of the dorsal margin, smooth and sharply delimited. Anterior area almost or entirely obsolete, commonly suggested by a faint sulcus. Posterior area defined by an obscure flattening of the valve and a change in the character of the sculpture. Anterior and ventral margins rounded, the posterior squarely truncate laterally. External surface sculptured with numerous fine, sharp laminae, numbering about 30 in the type, approximately regular in size and spacing from the umbones to the ventral margin, changing in character directly in front of the dorsal area, the alternate laminae abruptly elevated, whereas the other laminae become obsolete; a similar abrupt elevation of the concentric ridges occurring directly in front of the dorsal margin; the anterior and medial portion of the dorsal area smooth except for incrementals; radial sculpture not developed. Ligament attachment linear, deeply inset. Dentition normal for the group, rather delicate; a single cuneate cardinal in the right valve which fits between the cuneate anterior and laminar posterior cardinals of the left valve; anterior and posterior laterals developed in either valve, cut off from the dorsal margins by well-defined sockets. Muscle scars and pallial line obscure. Anterior adductor scar short for the genus, reniform; posterior irregularly ovate. Pallial line entire, ragged, rather remote from the base line. Inner margins finely and sharply dentate.

Dimensions: Altitude, 3.0 millimeters; latitude, 3.0 millimeters; semidiameter, 1.4 millimeters.

Type: U. S. Nat. Mus. No. 352486.

Type locality: No. 3742, Shell Bluff, Shoal River, Walton County, Fla.

Parvilucina flumenvadosa is a smaller and more compressed species than either *P. vaughani* or *P. piluliformis* and differs from them both in the relatively stronger concentric sculpture. In all these characters it approaches *P. sphaeriola* from the Chipola formation, though it is not so small nor as a rule so compressed and is less produced anteriorly. The concentric sculpture is relatively more flattened upon the disk, though more elevated than that of *P. sphaeriola* on the posterior area, and radial sculpture is not developed.

Occurrence: Oak Grove sand, localities ?7055^{r}, ?3749^{r} (slightly higher than outcrops near Oak Grove). Shoal River formation, localities 3856^{a}, 3732^{r}, 3742^{c}, 9958^{p}, 3748^{a}, 3747^{p}, 9960^{p}, 10612^{p}.

Phacoides (Parvilucina) prunoides Maury

1910. *Phacoides prunoides* Maury, Bull. Am. Paleontology, vol. 4, No. 21, p. 35, pl. 9, fig. 3.

Miss Maury described this species as follows:

Shell resembling *P. prunus* Dall of the Miocene of Maryland but more inequilateral, with a decided sulcus extending from the beak to the margin of the shell, and with more recurved beaks. Concentric sculpture of regular, low, flat-topped ribs with very narrow interspaces; inner margin of shell finely crenulated.

Height of shell 7, length 7.5, diameter 4 millimeters.

Chipola marls, Baileys Ferry, Fla.

Cornell University collection.

The type of Miss Maury's species has not been available for consultation and the form has not been recognized in the material under study. A few specimens of the young of *P. sphaeriola* present an outline and sculpture similar to that of *P. prunoides*, but the adults are quite distinct and do not attain the dimensions of Miss Maury's species.

Section BELLUCINA Dall

1901. *Bellucina* Dall, U. S. Nat. Mus. Proc., vol. 23, p. 806.
1903. *Bellucina* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 6, p. 1362.

Type: *Parvilucina eucosmia* Dall = *Lucina pisum* Reeve 1850, not Sowerby, 1837. (Recent in the South China Sea.)

Dall characterized this group as follows: "Dorsal areas and sculpture strong."

The presence of this group in the Alum Bluff fauna is established by a single rare species in the Oak Grove sand and two in the Chipola formation.

Phacoides [Parvilucina (Bellucina)] eupheus Gardner, n. sp.

Plate XX, Figure 12

Shell small, solid, compressed, transversely ovate in outline. Umbones low, central, the tips acute and prosogyrate. Lunule very small, sharply defined, deeply impressed but not funicular, smooth except for incrementals. Escutcheon linear. Lateral mar-

gins obtusely truncate. Base line arcuate. Dorsal areas defined chiefly by a change in the character of the sculpture. Both radial and concentric ornamentation well developed. Concentric sculpture of strong, flattened cords, uniform in size and spacing from the umbones to the base and upon the costal and intercostal areas, almost or altogether obsolete upon the dorsal area excepting that directly behind the dorsal margin each alternate cord is indicated by a minute node; about 12 concentric cords, though probably none of the specimens under study have come to maturity; from 8 to 10 radial costals, broadening rapidly away from the umbones but not increasing in number either by bifurcation or intercalation, elevated, rounded upon their summits, straight sided, separated by angular intercostals, usually narrower than the costals; a very fine secondary threading developed on both the radials and interradials, the lirae numbering about three upon the summits of each of the medial radials; radials absent upon the posterior dorsal area and feeble upon the anterior. Ligament area very short and narrow. Anterior right cardinal obsolete; posterior right cardinal cuneate, moderately stout; anterior left cardinal more slender, cuneate; posterior left cardinal laminar; both anterior and posterior laterals developed in each valve, all of them low, obtuse denticles. Interior fluted by the radial costae. Muscle and pallial scars commonly obscure. Anterior adductor elongated, the posterior rudely quadrate. Pallial line distant from the base. Inner margins fluted in harmony with the radial costae and dentated in harmony with the radial lirae.

Dimensions: Altitude, 3.0 millimeters; latitude, 3.2 millimeters; semidiameter, 0.8 millimeter.

Type: U. S. Nat. Mus. No. 352485.

Type locality: No. 3419, McClelland farm, 1 mile below Baileys Ferry, Calhoun County, Fla.

In the general outline and character of sculpture *Parvilucina euphea* is more suggestive of the later Miocene and Pliocene forms than it is of the Oak Grove *nereididedita*, a larger, more compressed form with more numerous and less prominent radials.

Occurrence: Chipola formation, locality 3419[p].

Phacoides [Parvilucina (Bellucina)] nereidideditus Maury

1910. *Phacoides (Bellucina) nereidideditus* Maury, Bull. Am. Paleontology, vol. 4, No. 21, p. 36, pl. 9, fig. 5.

Miss Maury described this species as follows:

Shell nearly circular, small, resembling *P. waccamawensis* Dall from the Pliocene of South Carolina and Florida but smaller, more alate and with an additional set of fine radiating riblets which alternate with the series of broad ribs similar to those of *P. waccamawensis*. Hinge strong, teeth well-developed, interior fluted by the exterior ribs, inner margin finely and rather deeply crenulated.

Length of the single specimen found 4, height 4 millimeters.

Oak Grove, Fla.

Cornell University collection.

The species is remarkable for its compressed outline and the numerous unequal and inequispaced radials. The single valve from Boynton Landing doubtfully referred to this species is more inflated than those from Oak Grove, and the radials are narrower, more numerous, and more regular. It probably represents a closely allied but at least subspecifically distinct species.

Occurrence: Chipola formation, localities ?10609[r], ?7893[r]. Oak Grove sand, locality 5632[r].

Genus DIVARICELLA Von Martens

1880. *Divaricella* Von Martens, Beitrage zur Meeresfauna der Insel Mauritius und der Seychellen, Mollusken, p. 321.

Type: *Lucina angulifera* von Martens = *Lucina ornata* Reeve. (Recent off Mauritius.)

Dall[6] described this genus in 1903 as follows:

This group presents many of the characters of *Lucina* proper, but is well distinguished by its extremely characteristic sculpture. There are several Recent species requiring close examination to discriminate. Nearly all these, together with most of the Tertiary species, were lumped together by early writers under the name of *Lucina divaricata*. The hinge when fully developed has the following formula: $\frac{\text{L.lol.io}\frac{1}{2}\text{o.l}}{\text{R.olo.o}\frac{1}{2}\text{oi.l}}$. The laterals are variable, especially the posterior laterals, which in some species are obsolete; the anterior laterals are more persistent, though usually feeble, and are situated near the cardinals at the anterior end of the lunule. The anterior and posterior dorsal areas are usually absent; the lunule small and deeply impressed, unequal in the valves, as in many Lucinas, and larger in the right valve. The adductor scars are lucinoid, the internal margins crenulate, the shell more or less orbicular, and generally rather convex. The species of the early Tertiary very often have the internal margin of the valves entire and some of them by their form indicate a transition toward the Lucinas.

The genus is conspicuous by reason of its peculiar external sculpture—a deep grooving, divergent at a somewhat low angle along a line extending from the umbones to the ventral margin.

The genus is rather rare in both the Tertiary and the post-Tertiary waters.

Already in the Alum Bluff fauna *Divaricella* had assumed the relative position which it has maintained to the present day. Never abundant in number of species or of individuals, this group of curiously sculptured shells has, nevertheless, a moderate representation at nearly all the middle and later Tertiary warm water horizons. In the Chipola and Shoal River formations there is a single fairly common species. The Chipola form *D. chipolana* Dall occurs also in the Oak Grove sand, but it is very rare. This same species is very closely allied to a form from the Caloosahatchee Pliocene and is quite possibly its precursor.

[6] Dall, W. H., Contributions to the Tertiary fauna of Florida: Wagner Free Inst. Sci. Trans., vol. 3, pt. 6, pp. 1387-1388, 1903.

Width of adult normally exceeding 15.0 millimeters; posterior lateral margin rounded----------*Divaricella chipolana* Dall.
Width of adult normally not exceeding 15.0 millimeters; posterior lateral margin obtusely truncate.
Divaricella waltonia Gardner, n. sp.

Divaricella chipolana Dall

Plate XX, Figure 15

1903. *Divaricella chipolana* Dall. Wagner Free Inst. Sci. Trans., vol. 3, pt. 6, p. 1389, pl. 51, fig. 2.

Dall described this species as follows:

Shell solid, subcircular, rounded in front and behind, equilateral, with inconspicuous beaks; sculpture of concentric incremental lines and an arcuate excavated sculpture (common to the genus and somewhat variable in minor detail in the species) as figured, and some obscure irregularly radial impressions on the anterior slope; lunule in the right valve short, small, rather broad; in the left valve none or hardly any; escutcheon none; resting stages variable, not conspicuous; hinge with strong cardinals and faint traces of the laterals, of which the right anterior lateral is best developed. Altitude 17, longitude 19, diameter 10 millimeters.

This species is especially characterized by its lunule, by the rounded, not angular, ends of the hinge line, the absence of any denticulation of the margins due to the excavated sculpture, and the extremely fine crenulations of the rather broad margins.

Absent during the cold-water period of the Miocene, this form appears to return with the warmer Pliocene waters, again to disappear finally with the renewed cooling off of the waters in Pleistocene time.

Type: U. S. Nat. Mus. No. 114635.

Type locality: No. 2211, lower bed, Alum Bluff, Liberty County, Fla.

The Pliocene species which has later been recognized by Dall to be distinct, at least subspecifically, is more inflated, obtusely truncate posteriorly, and rather more coarsely sculptured. The Shoal River species *D. waltonia* is decidedly smaller, more angular, and more coarsely sculptured.

Occurrence: Chipola formation, localities 10610^{r}, 7893^{p}, 2213^{p}, 2564^{r}, 7151^{r}, 2211^{c}, 7183^{c}, 10660^{c}, 7468^{p}. Oak Grove sand, locality 2646^{r}.

Divaricella waltonia Gardner, n. sp.

Plate XX, Figures 13–14

Shell smaller than *Divaricella chipolana* and more strongly and evenly inflated; subcircular, the circle truncated by the nearly straight dorsal margins. Umbones small, central, acute at their tips, overtopping the dorsal margins. Posterior lateral margin obtusely truncate, the anterior extremity broadly rounded, the base line quite strongly arcuate. Concentric lamellae about 40, quite sharply elevated, the fine edges dorsally directed, converging in concentric angles pointing toward the umbones along a line about one-third the distance from the anterior to the posterior extremity. Ligament submarginal, opisthodetic. Dentition normal for the genus; two cardinals and feeble anterior and posterior laterals in each valve, the anterior laterals much nearer to the umbones than the posterior. Anterior adductor elongated, arcuate; posterior adductor semielliptical. Pallial line simple.

Altitude, 11.0 millimeters; latitude, 11.5 millimeters; diameter, 7.5 millimeters.

Type: U. S. Nat. Mus. No. 352491.

Type locality: No. 3742, Shell Bluff, Shoal River, Walton County, Fla.

Divaricella waltonia is smaller than *D. chipolana* and more convex, with a more angular posterior margin and a relatively coarser, more rasping sculpture.

The species has a wide distribution in the single horizon at which it occurs.

Occurrence: Shoal River formation, localities 3742^{c}, 10658^{r}, 5184^{r}, 5195^{r}, 9958^{r}, 3748^{r}, 3747^{r}, 7264^{r}, 9960^{r}, 5618^{p}, 9959^{p}.

Family DIPLODONTIDAE

Genus DIPLODONTA Bronn

1831. *Diplodonta* Bronn, Italiens Tertiär-Gebilde, p. ix.

Type: *Venus lupina* Brocchi. (Miocene and Pliocene of the Piedmont of Italy.)

Shell suborbicular, inequilateral; external surface smooth or concentrically sculptured; lunule and escutcheon not clearly delimited; ligament chiefly external; hinge of right valve armed with a simple anterior and a bifid posterior cardinal; hinge of left valve armed with a bifid anterior and a simple posterior cardinal; laterals absent; adductor impressions oval; pallial line entire; inner margins of valves smooth.

The genus is first noted in the Cretaceous; from that time on it has constituted one of the less conspicuous elements in the bivalve faunas. The forty odd recent species have a wide distribution in the warmer waters of the globe.

The seven species of *Diplodonta* which have been recognized in the Alum Bluff are rather evenly distributed among the three formations, though individuals are rare in the Oak Grove and common only in the Shoal River. It is remarkable that two of the seven are apparently identical with later Miocene forms—*D. nucleiformis* Wagner from the Chipola formation and *D. acclinis* Conrad from the Shoal River—whereas *D. glos* Gardner, n. sp., is exceedingly close to a species that occurs in the Pleistocene of Simmons Bluff, S. C.

Valves strongly inflated, almost hemispherical; adults not exceeding 10.0 millimeters in latitude:
Adults normally exceeding 5.0 milimeters in latitude; shell relatively thin--*Diplodonta nucleiformis* (Wagner).
Adults commonly not exceeding 5.0 milimeters in latitude; shell relatively heavy.
Diplodonta (*nucleiformis* n. subsp.?) *sphaeromorpha* Gardner, n. sp.

Valve compressed or moderately inflated; adults generally exceeding 10.0 millimeters in latitude:
Inner margins of adult lirate:
Latitude of adult usually exceeding 15.0 millimeters; dorsal margins very gently sloping.
Diplodonta radiata Dall.
Latitude of adult rarely exceeding 15.0 millimeters; dorsal margins quite steeply sloping.
Diplodonta leptodoma Gardner, n. sp.
Inner margins of adult not lirate:
External surface not punctate:
Shell thin, produced at the posterior basal margin.
Diplodonta paralta Gardner, n. sp.
Shell heavy, not produced at the posterior basal margin.....*Diplodonta acclinis* Conrad.
External surface punctate.
Diplodonta glos Gardner, n. sp.

Section DIPLODONTA s. s.

Type: *Venus lupina* Brocchi. (Miocene and Pliocene of the Piedmont of Italy.)

Dall[7] described this group as follows:

Shell rotund, equilateral, externally concentrically striated or smooth, with inconspicuous epidermis; two cardinal teeth in each valve, of which the right posterior and left anterior are distally sulcate or bifid; no lateral teeth; the hinge-plate when developed is usually excavated distally; there is no circumscribed lunule or escutcheon; the adductor scars are subequal, continuous with the pallial line, and close to the hinge plate: the margin is entire, the pallial line simple, the pallial area often radiately striate; anatomically the genus is separated from *Lucinidae* by its double gills and absence of siphon, and from *Cryptodontidae* by its generative and digestive glands being contained within the general mass of the body.

Diplodonta nucleiformis (Wagner)

Plate XX, Figures 16–19

1838. *Mysia nucleiformis* Wagner, Acad. Nat. Sci. Philadelphia Jour., 1st ser., vol. 8, p. 52, pl. 1, fig. 4.
1845. *Loripes elevata* Conrad, Fossils of the medial Tertiary formations of the United States, p. 73, pl. 41, fig. 8.
1845. *Cytherea sphaerica* H. C. Lea, Am. Philos. Soc. Trans., new ser., vol. 9, p. 241, pl. 34, fig. 22.
1858. *Diplodonta elevata* Conrad, Acad. Nat. Sci. Philadelphia Proc. for 1857, p. 166.
1863. *Mysia elevata* Conrad, Acad. Nat. Sci. Philadelphia Proc. for 1862, p. 577.
1864. *Mysia elevata* Conrad, Meek, Checklist of invertebrate fossils of North America, Miocene: Smithsonian Misc. Coll., No. 183, p. 8. (Name only.)
1875. *Mysia carolinensis* Conrad, in Kerr, W. C., Report of the Geological Survey of North Carolina, vol. 1, appendix A, p. 21, pl. 4, fig. 5.
1900. *Diplodonta nucleiformis* (Wagner). Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1185.

Wagner described this species as follows:

Shell suborbicular, ventricose, lines of growth very distinct on the inferior half of the disk; posterior margin direct. Locality: Mehering (Meherrin) River, N. C.

[7] Dall, W. H., Contributions to the Tertiary fauna of Florida: Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1180, 1900.

This is the smallest of the Diplodontas within the area and the most globose. The shell is moderately heavy, the altitude and the latitude are approximately equal, the umbones inflated and central, the anterior and posterior ends evenly rounded and subequal, the anterior a little the broader. The incremental sculpture is usually microscopic. The ligament is external, the groove deep, the nymph short and inconspicuous. The hinge is very much concentrated, the dentition normal, the teeth short but rather rude and strong. The adductor impressions and simple pallial line are usually indistinct.

A single valve of a juvenile indistinguishable from those occurring in the late Miocene has been collected in the Chipola formation. The form is, however, too young to definitely establish the presence of this species in the Alum Bluff.

The figured specimen is from the Waccamaw marl at Neill's Eddy Landing on Cape Fear River, N. C.

Occurrence: Chipola formation, locality ?7151[r].

Outside occurrence: Miocene: Yorktown formation Virginia; and Duplin marl, N. C. Pliocene: Waccamaw formation, N. C. Recent: Off Cape Lookout in less than 50 fathoms.

Diplodonta (nucleiformis subsp.?) sphaeromorpha Gardner, n. sp.

Plate XX, Figures 20–21

1900. *Diplodonta nucleiformis* (Wagner). Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1185 (part).
Not *Mysia nucleiformis* Wagner, 1838.

Shell small, subcircular, globose. Umbones inflated, the tips acute and set a little in front of the median line. Slope of anterior dorsal margin less gentle than that of the posterior. Lateral margins and base broadly rounded. External surface smooth except for incrementals, which are least feeble toward the anterior dorsal margin. Ligament external, opisthodetic. Dentition normal, a laminar anterior cardinal and bifid posterior cardinal in the right valve and a bifid anterior and laminar posterior cardinal in the left. Adductor scars small, obscure. Pallial line entire, at some little distance from the base.

Dimensions: Altitude, 4.7 millimeters; latitude, 4.6 millimeters; semidiameter, 1.5 millimeters.

Type: U. S. Nat. Mus. No. 135865.

Type locality: No. 2646, Oak Grove, Yellow River, Okaloosa County, Fla.

Diplodonta sphaeromorpha seems to be distinct from *D. nucleiformis* Wagner, but the material is so meager that its relation to the later species can not be conclusively determined. Apparently it is a smaller, heavier, higher, and more nearly circular shell.

Occurrence: Oak Grove sand, localities 2646[r], 9961[r].

Diplodonta radiata Dall

Plate XX, Figures 22–23

1900. *Diplodonta radiata* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1184, pl. 44, fig. 11.

Dall says:

Shell large, very thin, finely concentrically sculptured with minutely wrinkled silky striae; anterior end shorter and narrower, slightly produced below, posterior end wider, rounded; hinge plate narrow, channeled in front, cardinals small, short, normal; ligamentary groove very short, beaks low, inconspicuous; adductor scars and pallial line normal; pallial area smooth, with, toward the base, numerous obscure lirae which appear on the basal margin as short elevated lines with abrupt terminations, somewhat as in *Propeamusium*. Altitude 18, latitude 20, diameter 10 millimeters.

This is a peculiar species and, so far as the lirae are concerned, appears to be unique. They are entirely distinct from the radiating striae not uncommon on the pallial area of lucinoid bivalves, being most elevated at their distal termination, and found in both the young and mature shells.

Type: U. S. Nat. Mus. No. 135864.

Type locality: No. 2646, Oak Grove, Yellow River, Okaloosa County, Fla.

The young are more compressed and more elongated transversely than the coexistent juveniles allied to *D. paralta*. *D. leptodoma* from the Shoal River formation, another exceedingly thin shell reinforced by lirae along the inner margins, is smaller and more trigonal in outline than *D. radiata* Dall.

Occurrence: Oak Grove sand, locality 2646^{p}.

Diplodonta leptodoma Gardner, n. sp.

Plate XX, Figures 25–26

Shell thin and exceedingly fragile, of moderate dimensions, rather compressed, rounded trigonal. Posterior area obliquely flattened. Umbones full, prominent, subcentral, the tips slightly prosogyrate, acute, and proximate. Dorsal margins rather steeply sloping, the anterior more so than the posterior. Anterior lateral margin rounding into the base; posterior lateral margin obscurely truncate. External surface smooth except for incrementals, which are least feeble anteriorly. Traces of the original color pattern probably preserved in the darker bands of irregular width that persist on most of the specimens. Ligament inset, opisthodetic, seated upon a rather short and slender nymph. Dentition normal for the genus but very delicate. A laminar anterior and deeply bifid posterior cardinal in the right valve and a deeply bifid posterior and slender laminar anterior cardinal in the left valve. Adductor scars small and very obscure. Pallial line simple. Inner surface lirate toward the base, the lirae increasing in prominence to their pustulose terminations at the margin.

Dimensions: Altitude, 12.0± millimeters; latitude 12.5 millimeters; diameter, 6.8 millimeters.

Cotypes: U. S. Nat. Mus. No. 352502.

Type locality: No. 3742, Shell Bluff, Shoal River, Walton County, Fla.

In the thin and delicate shell, the character of the external surface, and the peculiar liration of the inner surface *Diplodonta leptodoma* is closely allied to *D. radiata* Dall. It is, however, a smaller and more compressed shell with a decidedly trigonal outline. The lirate inner margins doubtless serve in both species to reinforce the unusually thin and fragile shells.

D. leptodoma is rather abundant in the Shoal River formation, though perfect specimens are exceedingly difficult to obtain.

Occurrence: Shoal River formation, localities 3856^{a}, 3742^{c}, 5080^{r}, 5184^{r}, 5195^{r}, 5079^{r}, 2238^{r}, 3748^{r}, 5192^{p}.

Diplodonta paralta Gardner, n. sp.

Plate XX, Figure 24

1900. *Diplodonta alta* Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 5, p. 1183, pl. 44, fig. 19 (part).

Dall described this species as follows:

Shell large, thin, concentrically striated, beaks small, not elevated; anterior end short, rounded, posterior end longer, larger, more arcuate above, the lower portion near the base produced; groove for the ligament very narrow; hinge plate narrow, slightly excavated; teeth and adductors normal; margin simple. Altitude 27, latitude 26, diameter 12.5 millimeters.

The specimen figured from the silex beds being defective at the posterior margin, a much finer specimen from the Chipola beds, subsequently acquired, has been figured to show the normal form of the species. A form from the sands at Oak Grove seems to be the same, but differs by the presence of a minute lunule or incised line in front of the beaks as in *Sphaerella;* the adductor scars, however, are normal. As the Oak Grove specimens are all young, I prefer to regard them as a variety of *D. alta* until more information is available.

Type: U. S. Nat. Mus. No. 114717.

Type locality: No. 2213, 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.

The Chipola species is produced along the diagonal from the umbones to the posterior basal margin and has a peculiar lop-sided appearance, which the Ballast Point individuals do not present. The Oak Grove juveniles are quite certainly distinct, but as no adults have yet appeared their true relationships can not be determined. *Diplodonta acclinis* Conrad is much heavier and thickened in the adults along the adherent mantle surface. The incremental sculpture is much more conspicuous in the later species, and the posterior basal margin is not produced.

Occurrence: Chipola formation, localities 2213^{p}, 2211^{p}.

Diplodonta sp. indet.

Under this caption are included those juveniles to which reference has already been made under the discussion of *Diplodonta paralta* Dall.

Occurrence: Oak Grove sand, locality 2646^{c}.

Diplodonta acclinis Conrad

1832. *Lucina acclinis* Conrad, Fossil shells of the Tertiary formations of North America, p. 21, pl. 6, fig. 2.
1838. *Mysia americana* Conrad, Fossils of the medial Tertiary formations of the United States, p. 30, pl. 16, fig. 2.
Not *Lucina americana* Defrance, Dictionnaire des sciences naturelles, vol. 27, p. 276, 1823.
1858. *Diplodonta acclinis* Conrad, Acad. Nat. Sci. Philadelphia Proc. for 1857, p. 166.
1863. *Mysia acclinis* Conrad, Acad. Nat. Sci. Philadelphia Proc. for 1862, p. 577.
1864. *Mysia acclinis* Conrad. Meek, Checklist of the invertebrate fossils of North America, Miocene: Smithsonian Misc. Coll., No. 183, p. 8. (Name only.)
1894. *Lucina acclinis?* Conrad. Whitfield, U. S. Geol. Survey Mon. 24, p. 62, pl. 10, figs. 5, 6.
1898. *Diplodonta acclinis* Conrad. Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 4, pl. 28, figs. 2, 13.
1900. *Diplodonta acclinis* Conrad. Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1186.
1904. *Diplodonta acclinis* Conrad. Glenn, Maryland Geol. Survey, Miocene, p. 334, pl. 89, figs. 6a, 6b.
1909. *Diplodonta acclinis* Conrad. Grabau and Shimer, North American index fossils, vol. 1, p. 558, figs. 763, a, b.

Conrad described this species in 1832 as follows:

Suborbicular, or lentiform, a little oblique, with strong lines of growth; hinge with two diverging teeth in each valve; posterior tooth of the right valve bifid; anterior muscular impression not profoundly elongated.

Type locality: Yorktown, Va.

Shell heavy, moderately compressed, subcircular. Umbones rather low and flattened, subcentral, pointed and prosogyrate at the tips. Dorsal margins slightly oblique, the anterior a little the shorter and higher. Anterior lateral margin broadly and obscurely truncated; posterior lateral margin somewhat produced and rounded. Base line strongly arcuate. Incremental sculpture strong, uneven, conspicuous. Ligament mostly external. Ligamentary groove oblique and very deep. Nymph rather heavy, elongated. Dentition normal, the posterior right cardinal and the anterior left cardinal deeply sulcated; simple cardinals rather thin and laminar. Adductor impressions prominent, irregular, elongated, the anterior obscurely reniform. Pallial line simple, distinct. Area of the adherent mantle usually thickened.

Diplodonta acclinis Conrad, the most widely distributed and most abundant representative of the genus in the later Miocene and Pliocene of the middle and south Atlantic coasts, is represented in the Alum Bluff collections by only a few valves from the Shoal River formation. The closest analog in the lower Alum Bluff faunas is *Diplodonta paralta* from the Chipola formation, a quite similar shell in general proportions and irregularity of outline but much thinner, both externally and internally, more delicately sculptured incrementally, and invariably more or less produced at the posterior basal margin.

Occurrence: Shoal River formation, localities 3733[r], 2238[r], 5618[r], 9959[r].

Outside occurrence: Miocene: Calvert formation, New Jersey, Maryland, Virginia; Choptank formation, Maryland; St. Marys formation, Maryland, Virginia, North Carolina; Yorktown formation, Virginia, North Carolina; and Duplin marl, North Carolina, Georgia. Pliocene: Waccamaw formation, North Carolina, South Carolina; Caloosahatchee marl, Florida.

Section PHLYCTIDERMA Dall

1899. *Phlyctiderma* Dall, Jour. Conchology, Leeds, vol. 9, p. 224.

Type: *Diplodonta semiaspera* Philippi. (Recent from Cape Hatteras, N. C., to Rio Janeiro, Brazil.)

Dall characterized this group as follows: "Shell like *Diplodonta*, but with the surface more or less punctate or pustulate."

Diplodonta (Phlyctiderma) glos Gardner, n. sp.

Plate XXI, Figure 22

Shell of moderate dimensions for the group, moderately compressed, thin and somewhat polished. Umbones subcentral, well rounded, acute and prosogyrate at their tips. Dorsal margins gently sloping, the posterior the more produced and rounding more abruptly into the lateral margin; lateral margins rounding smoothly into the feebly arcuated base. External surface crowded with microscopically fine and silky incrementals; the medial and ventral portions of the valves of the adults and adolescents minutely punctate. Internal surface highly polished. Ligament deeply inset, opisthodetic. Dentition delicate; anterior cardinal of right valve and posterior cardinal of left very thin and laminar; posterior cardinal of right valve and anterior cardinal of left deeply sulcate; anterior dorsal and lateral margins reinforced by shallow grooves. Adductor scars distinct, placed at the extremities of the dorsal margins, irregular in outline, the anterior the more elongated. Pallial line distinct, minutely ragged.

Dimensions: Altitude, 15.0 millimeters; latitude, 16.0 millimeters; semidiameter, 4.0 millimeters.

Type: U. S. Nat. Mus. No. 352499.

Type locality: No. 7257, Sexton's marl bed, Tenmile Creek, Calhoun County, Fla.

Diplodonta glos is very closely allied to *D. soror* C. B. Adams of the late Tertiary and Cenozoic faunas and its probable precursor. The Recent Jamaican species is, however, a heavier, more convex, and less evenly rounded shell with more steeply sloping dorsal margins. Some of the Pleistocene forms from Simmons Bluff, S. C., are with difficulty distinguishable from the type of *D. glos*.

They are, however, more elongated transversely, as a rule, with even more gently sloping dorsal margins.

It is probable that the name *kiawahensis* Tuomey and Holmes should be retained for the Pleistocene individuals.

Occurrence: Chipola formation, localities 7257p, 2213r, 3419r, 7151p.

Superfamily LEPTONACEA

The latest and most careful work upon this very large and difficult group has been done by William H. Dall, and I quote at considerable length from his monograph of the genera of the Leptonacea:[8]

The Leptonacea form a very interesting and puzzling group. Their characters combine features characteristic in other teleodonts of immaturity with such as are more probably due to environmental modifications. Without being in themselves prototypes, they exhibit features which we may readily suppose might have been characteristic of prototypic teleodonts. Groups which are really starting points for numerous subsequently developed genera are usually notable for their tendency to vary and interchange characters. In the present case perhaps the very general habit of commensalism, or parasitism, has produced degeneration or afforded an excessive protection, inducing or accompanied by a revival of atavistic primary characters. The fact that authors, struck by similarity of dental features to those of immature specimens of genera of widely different origin, have too hastily referred species of Leptonacea to such families as the Mactridae or Cyrenidae is significant in this connection.

It must be confessed at the outset that our knowledge of the anatomy of recent Leptonacea is lamentably deficient. We have to assume (which is never safe) that forms with similar shell characters are generally similar in other points of structure, except where we know to the contrary. We find, moreover, that the dentition is frequently indistinctly developed or somewhat amorphous, rendering it difficult to make out the homologies of the different parts of the hinge. It is certainly unsafe to assume, as Bernard has sometimes done, that the position of a dental lamina is sufficient to settle its homology. The dynamic reactions of teeth upon each other are, I am confident, of the utmost importance in the development of the hinge. As in the vertebrate skeleton, pressure and friction in localized areas will produce directly a response in facets and buttresses. In fact, to the eye trained to take such matters into account, every hinge shows more or less evidence of the mutability of hinge structure and its responses to stress, as well as inherited tendencies of form. In no group are these more obvious than in the Leptonacea.

The prototypic hinge of the group—or that which with slight modifications will exhibit any of the various types of hinge structure found in the group—is very simple and has been figured by Bernard in his illustrations of a minute form which he has named *Pachykellya*. His invaluable researches upon the early features of the hinge have shown that among the Teleodesmacea the so-called laterals and cardinals are dissevered parts of an originally single lamina sharply bent at its proximal, or umbonal, end and having somewhat the form of a figure 7. In *Pachykellya* the hinge is composed of an internal resilium not obviously separated from the ligament and inclined obliquely backward, as in many nepionic teleodonts. On each side of this in each valve is a pair of the ⌐-shaped lamellae, of which most have developed more or less distinctly the proximal or cardinal "hook." The lower ones are less engaged in the various stresses to which the laminae are subjected in use, and hence, as might be expected, the hook is less evident or even undeveloped.

From this type of hinge all the others can be developed by trifling modifications. The laminae may be long or short; when the outer limb is short we have a Λ-shaped tooth; if the angle proceeds to that stage of development when its continuity is lost, we may have a hinge like that of *Cyamiomactra;* the severed hook may be modified by pressure to a petaloid shape, which again by degeneration may be reduced to two obscure minute conical projections, as in some species of *Galeomma.* Any part or the whole of the hinge may become obsolete; the resilium and ligament may separate or continue in connection; the latter frequently becomes external and often obsolete, though traces of it almost always exist.

Family LEPTONIDAE

Genus ERYCINA Lamarck

1804. *Erycina* Lamarck, Mus. hist. nat. Annales, vol. 6, p. 413.

Type: *Erycina pellucida* Lamarck. (Calcaire grossier of the Paris Basin.)

Shell small, thin, elongate-oval, usually subequilateral; external surface smooth as a rule, though rarely with a concentric or more rarely radial sculpture; external ligament feeble; internal ligament lodged in a triangular resilial pit placed behind the umbones and near the dorsal margin; cardinals minute, subumbonal, one or two in each valve; strong laminated laterals developed both in front of and behind each umbone; adductor impressions small, oval; pallial line entire or slightly sinuated.

The genus apparently both originates and culminates in the Eocene. In the Paris Basin alone there are 47 described species. In North America, although *Erycina* is most abundantly represented in the Gulf Eocene, it also occurs throughout the Tertiary section of the east coast.

The Erycinas form an inconspicuous element in the molluscan faunas of the Chipola formation and Oak Grove sand but have not yet been observed in the Shoal River formation. Three of the five species of *Erycina* s. s. are restricted to the earlier horizon and two to the later horizon, and none of them are abundant. *E.* (*Scacchia*) *actinophora* (Dall) is not at all rare at the type locality at Oak Grove but has not been reported from any other horizon.

Subgenus ERYCINA s. s.

Type: *Erycina pellucida* Lamarck. (Calcaire grossier of the Paris Basin.)

Dall[9] described this group as follows:

Shell small, somewhat compressed or not very convex, exterior concentrically striate, smooth, or rarely with partially radial sculpture, sometimes punctate or sagrinate; hinge with an obsolete external ligament, sometimes hardly traceable, and a well-marked internal resilium which is attached to the shell in an oblique fossette behind the beaks and close to the cardinal border; teeth, normally, one or two minute cardinals and two lateral laminae in each valve, the latter near and sometimes

[8] Dall, W. H., Contributions to the Tertiary fauna of Florida: Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, pp. 1114-1116, 1900.

[9] Idem, p. 1141.

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confounded with the dorsal margin of the valve, usually long, low proximally, more elevated distally, and often recurved upon themselves, like a segment of a cylinder; in the right valve sometimes double with the socket for the laminae of the opposite valve between them. Pallial line with a slight insinuation.

Lateral laminae developed:

External surface regularly sculptured with numerous, closely appressed, concentric lamellae.

Erycina undosa Dall.

External surface smooth or sculptured with more or less irregular, in some species pustulose incrementals:

Umbones strongly posterior---*Erycina chipolana* Dall.

Umbones subcentral or slightly posterior:

Adult shell commonly exceeding 6.0 millimeters in latitude, faintly lineated radially.

Erycina scaptera Gardner n. sp.

Adult shell not exceeding 6.0 millimeters in latitude, not lineated radially:

Pustulose sculpture commonly developed upon the anterior ventral portion; hinge dissipated----------*Erycina fabulina* Dall.

Pustulose sculpture not developed; hinge concentrated-------*Erycina curtidens* Dall.

Lateral laminae not developed.

Erycina (*Scacchia*) *actinophora* (Dall).

Erycina undosa Dall

Plate XXI, Figure 1

1900. *Erycina undosa* Dall, Wagner Free Inst. Sci. Trans., vol 3, pt. 5, p. 1144, pl. 45, fig. 3.

Dall described this species as follows:

Shell small, compressed, polished, *Semele*-form, anterior end rounded, longer; posterior end shorter and more bluntly rounded; beaks low but rather pointed; surface with equidistant concentric impressed lines separating wider, flattish interspaces; hinge strong, teeth normal; adductor scars large, the pallial impression wide and slightly irregular. Longitude 3.5, altitude 2.8, diameter 1.5 millimeters.

The shell varies somewhat in proportional length and some specimens may reach 4.5 millimeters.

Type: U. S. Nat. Mus., No. 114677.

Type locality: No. 2213, 1 mile below Bailey's Ferry, Chipola River, Calhoun County, Fla.

This small species has the outline of *Semele* and the sculpture of *Dosinia*. It is further remarkable for its delicacy and high polish.

Occurrence: Chipola formation, localities 7893^{p}, 7257^{r}, 2213^{p}, 3419^{r}, 7151^{p}, 2211^{r}.

Erycina chipolana Dall

Plate XXI, Figure 2

1900. *Erycina chipolana* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1144, pl. 45, fig. 17 (not pl. 45, fig. 15, =*E. scaptera* Gardner, n. sp.).

Dall described this species as follows:

Shell small, compressed, smooth, polished, donaciform; posterior end shorter and with more abrupt descent of the dorsal margin; beaks rather low, hinge strong, the distal portion of the laminae prominent with a marked groove above them; posterior adductor scar larger and lower down than the anterior; basal margin arcuate. Longitude 4.1, altitude 3.0, diameter 2 millimeters.

The principal characteristic of this small species is its trigonal shape; the laminae are also more prominent than usual.

Type: U. S. Nat. Mus., No. 114676.

Type locality: No. 2213, 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.

The Chipola River species has been curiously confused with a quite distinct form from the lower bed at Alum Bluff—*E. scaptera* Gardner, n. sp. *E. chipolana* is a highly inflated little shell not much more than half as large as the compressed species from Alum Bluff. The umbones are relatively more prominent and more posterior, the anterior extremity being consequently more produced and the anterior dorsal slope relatively more gentle. The base line is straighter in *E. chipolana* and more nearly parallel to the anterior dorsal margin. This character is much more prominent in the specimen than in the illustration. The dentition of *E. chipolana* is conspicuously robust for so small a shell, that of *E. scaptera* conspicuously delicate. The left laterals of *E. chipolana* are indistinct from the dorsal margin, whereas in *E. scaptera* they are cut off from it by a shallow groove. *E. chipolana* suggests the much more compressed and regularly sculptured *E. undosa*, though it is much more produced anteriorly.

The species is rare even at the type locality.

Occurrence: Chipola formation, locality 2213^{r}.

Erycina scaptera Gardner, n. sp.

Plate XXI, Figure 18

1900. *Erycina chipolana* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, pl. 44, fig. 15 (text excluded).

Shell of moderate dimensions for the group, compressed, inequilateral, transversely ovate in outline. Umbones small, slightly posterior, not inflated, but relatively prominent by reason of their overtopping the dorsal margin; the minute but solid and highly polished prodissoconchs capping the tips of the umbones of even the adult conch. Posterior dorsal slope much steeper than the anterior, the anterior lateral margin broader and more produced than the posterior. Base line arcuate. External surface sculptured with incrementals, stronger and more regular toward the posterior margin; an exceedingly fine, faint, and irregular radial lineation also developed upon the adult conch. External ligament attachment obsolete. Resilial pit very narrow, produced downward and backward from underneath the umbones. A single delicate, subumbonal cardinal developed in each valve. Anterior and posterior laterals thin and sharp, those of the right valve cut off from the dorsal margin by a socket for the reception of the laterals of the left valve. Adductor and pallial scars very obscure, the anterior adductor scar apparently elongated, the posterior shorter and placed at the extremity of the posterior lateral. Pallial line simple.

Dimensions: Altitude, 5.5 millimeters; latitude, 7.0 millimeters; diameter, 2.1 millimeters.

Type: U. S. Nat. Mus. No. 114605.

Type locality: No. 2211, lower bed, Alum Bluff, Liberty County, Fla.

It seems strange that there should have been any confusion between two forms so unlike as those figured under the name of *E. chipolana*. The Alum Bluff species is decidedly larger and more compressed and has a more produced anterior extremity and a straighter base line. There is no trace of a radial lineation upon the Chipola River species, and the incrementals, though quite as fine, are more regular. The dentition of the smaller form is very much less delicate, and instead of distinct laterals in the left valve as in *E. scaptera* the laterals of *E. chipolana* are confused with the dorsal margins.

The species is restricted in its known distribution to the type locality.

Occurrence: Chipola formation, localities 2211[p] 7183[r], 10660[r].

Erycina fabulina Dall

Plate XXI, Figures 5–6

1900. *Erycina fabulina* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1145, pl. 45, fig. 1.

Dall described this species as follows:

Shell small, ovate, subequilateral, moderately convex, with low umbones; surface polished, with numerous faint incremental striae; dorsal margin and base nearly equally arcuate, ends rounded, the anterior slightly longer and higher; hinge normal, the laminae rather long and somewhat recurved; adductor scars small, subequal. Longitude 5, altitude 3.6, diameter 2 millimeters.

Cotypes: U. S. Nat. Mus. No. 135878.

Type locality: No. 2646, Oak Grove, Yellow River, Okaloosa County, Fla.

Perhaps the most peculiar feature of this species is the patch of pustulose sculpture developed upon the anterior ventral portion of the shell in many adults. This feature, together with the relatively delicate and dissipated hinge separates it from *E. curtidens* Dall, a congenetic species of very similar general aspect.

Occurrence: Oak Grove sand, localities 2646[p], 5632[r], 5633[r], 7054[r].

Erycina curtidens Dall

Plate XXI, Figures 3–4

1900. *Erycina curtidens* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1145, pl. 45, figs. 14, 15.

Dall described this species as follows:

Shell small, thin, smooth, polished, moderately convex, with ow beaks, rounded ovate varying to suborbicular, slightly inequilateral; hinge in the right valve with notably short and strong laminae, the dorsal margin above them thickened so as almost to form a second pair in some cases; laminae of the left valve longer and narrower; adductor scars small, subequal, and pretty high up. Longitude 3.66, altitude 3, diameter 1.2 millimeters.

This little species is brilliantly polished and the different valves vary considerably in rotundity, some being almost orbicular.

Cotypes: U. S. Nat. Mus. No. 135877.

Type locality: No. 2646, Oak Grove, Yellow River, Okaloosa County, Fla.

Erycina curtidens closely approximates *E. fabulina* in general dimensions and outline, but it does not develop a pustulose sculpture and differs further in the stronger and more concentrated hinge.

Occurrence: Oak Grove sand, localities 2646[p], 5632[r].

Subgenus SCACCHIA Philippi

1844. *Scacchia* Philippi, Enumeratio molluscorum siciliae, vol. 2, p. 27.

Type: *Tellina elliptica* Scacchia. (Recent off the coast of Italy.)

Dall[10] described this group in 1900 as follows:

One right and two left cardinals; laminae obsolete; external ligament small but distinct; pallial line simple; foot compressed.

The left anterior tooth may be a concentrated lamina and not a cardinal. In the right valve the dorsal margins are extended, as if to take the place of laminae, functioning, in connection with the dorsal margins of the opposite valve, like the grooves in *Erycina*. *S. tenera* Jeffreys has only one cardinal in each valve. This group appears to be represented by a fragment of a hinge from the Chipola beds.[10]

The daintily sculptured little form described under the name *?Montacuta actinophora* Dall seems rather to have its true affinities with *Erycina*.

Erycina (Scacchia) actinophora (Dall)

Plate XXI, Figure 7

1900. *?Montacuta actinophora* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1172, pl. 44, fig. 2.

Dall described this species as follows:

Shell small, rather compressed, subquadrate, the anterior end much the longer; basal and dorsal margins subparallel, anterior end evenly rounded; posterior end short, sloping above, rounded below; beaks small, low, the nepionic shell conspicuous; outer surface marked with somewhat irregular incremental lines, smooth near the beaks, elsewhere closely, evenly, sharply, radially striate, an obscure ridge extending from the beaks backward and downward; hinge plate narrow, in the right valve with one prominent slender cardinal tooth, directed obliquely forward in front of a narrow elongate sulcus for the resilium obliquely directed backward below the dorsal margin; in the left valve on each side of the sulcus is a rather obscure lamina, the anterior most prominent and longer, the posterior fitting under the posterior dorsal margin of the opposite valve, the anterior into a socket above the right cardinal; interior of the valves smooth or faintly radially striate, the muscular impressions large and rather low down, the pallial line simple and wide. Longitude 11, altitude 7.6, diameter 4.5 millimeters.

This is an elegant shell which has the external aspect of *Scintilla* but a different hinge. The teeth differ from those of typical *Montacuta* in the shortness of the shank of the cardinal "hook" and in the presence of a posterior lamina in the left valve, but traces of the latter may be found in several of the other species. But for the absence of any evidence of an external ligament this species might be referred to *Sportella*.

Type: U. S. Nat. Mus. No. 135874.

[10] Dall, W. H., Contributions to the Tertiary fauna of Florida: Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1142, 1900.

Type locality: No. 2646, Oak Grove, Yellow River, Okaloosa County, Fla.

The cardinal tooth of the right valve is merely a modification of the cardinal portion of the anterior lamella. The dentition of the left valve differs from that of typical *Scacchia* in that the posterior cardinal is obsolete as in *Scacchia tenera* Jeffreys. The dorsal margins are modified to function as laterals.

Occurrence: Oak Grove sand, localities 2646[c], 5632[r], 5631[r], 5633[r], 7054[r].

Genus BORNIA Philippi

1836. *Bornia* Philippi, Enumeratio molluscorum Siciliae, vol. 1, p. 13.

Type: *Bornia corbuloides* Philippi. (Recent on the Sicilian coast.)

Dall [11] described this species as follows:

Shell ovate or subtrigonal, subequilateral, with a more or less flattened disk, the periostracum usually brilliant, the surface smooth or divaricately more or less plicate; an obsolete amphidetic external ligament present, a short, slightly posterior, subumbonal internal resilium without a lithodesma, the pallial line not sinuated, and the pallial area frequently punctate or radially striate; hinge with one moderately long posterior and two shorter anterior laminae in the left valve, and in the right one anterior and one longer, sometimes remote, posterior lamina; one or both the anterior laminae in either valve may have the aspect of cardinals; hinge plate usually excavated.

The genus is known to occur in the Eocene of the Paris Basin and in the Tertiary of eastern North America and the Gulf of Mexico. The Recent species are chiefly confined to the Mediterranean Sea.

Bornia is represented in the Alum Bluff by four species, one to each horizon and the fourth common to the Oak Grove and Shoal River. The Chipola species and that peculiar to the Shoal River develop a radial sculpture, but no analog has yet been reported from the Oak Grove. Most of the shells are small in comparison with the later Tertiary representatives of the group.

Radial sculpture not developed:
- Shell conspicuously trigonal in outline..*Bornia dodona* Dall.
- Shell rounded, transversely ovate in outline. *Bornia floridana* Dall.

Radial sculpture developed toward the lateral margins:
- Radial sculpture absent only upon the medial portion of the disk.....*Bornia fluctusculpturata* Maury.
- Radial sculpture restricted to the lateral keels. *Bornia virgâta* Gardner, n. sp.

Bornia dodona Dall

Plate XXI, Figure 12

1900. *Bornia dodona* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1150, pl. 65, fig. 16.

Dall described this species as follows:

Shell small, thin, compressed, subtrigonal, smooth, brilliantly polished; anterior end slightly shorter, wider, and more rounded, posterior end longer and more pointed; beaks low, the prodissoconch distinguishable, dorsal margins sloping, basal nearly straight; right valve with two lamellae bearing knob-like teeth on the umbonal end in front of the beak, a subumbonal obliquely directed resiliary scar, and a posterior lamella, separated by a groove from the dorsal margin; left valve with two short divaricating lamellae under the beak and a feeble, rather distant posterior lamella; adductor scars small, rather high up, interior of the valves faintly radially striated. Longitude 5.25, altitude 3.7, diameter 1.75 millimeters.

Resembles *B. mactroides* Conrad, but appears to be uniformly of a very much smaller size.

Type: U. S. Nat. Mus. No. 135875.

Type locality: No. 2646, Oak Grove, Yellow River, Okaloosa County, Fla.

Bornia dodona is the only member of the genus in the Alum Bluff which has been reported from more than one horizon.

Occurrence: Oak Grove sand, localities 2646[p], 5632[r]. Shoal River formation, localities 10658[r], 5079[c].

Bornia floridana Dall

Plate XXI, Figure 11

1900. *Bornia floridana* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1150, pl. 45, fig. 2.

Dall described this species as follows:

Shell thin, compressed, smooth, or with faint incremental lines, brilliantly polished, the prodissoconch obvious; teeth short, the anterior left lamella most prominent, the posterior lamella feeble; hinge normal, form as figured. Altitude 5, longitude 6.6, diameter 1.75 millimeters.

This species is more compressed, less trigonal, and more elevated in proportion than *B. dodona*, as the figure shows. The proportional elevation seems to increase with age. All the valves obtained were more or less imperfect.

Type: U. S. Nat. Mus. No. 135876.

Type locality: No. 2646, Oak Grove, Yellow River, Okaloosa County, Fla.

Unfortunately no further material was obtained to supplement the fragments from which this species was described.

Occurrence: Oak Grove sand, locality 2646[r].

Bornia fluctusculpturata Maury

1910. *Bornia fluctusculpturata* Maury, Bull. Am. Paleontology, vol. 4, No. 21, p. 36, pl. 9, fig. 6.

Miss Maury described this species as follows:

Shell oval-trigonal, very thin and fragile, translucent, exquisitely sculptured near either end with many radiating plications like wavelets which are also apparent on the inside of the shell. They do not extend over the center of the valves. Under a lens the lines of growth are seen forming a most delicate concentric ornamentation over the entire shell on the inner as well as the outer side of the valve. Hinge very like that of *Bornia dodona* Dall from Oak Grove and sculpture of the same type as that of *B. scintillata* Dall from the Claiborne Eocene, but the plications are closer in that species and extend over the ventral margin of the shell. Length of largest specimen (imperfect) 9, altitude 6 millimeters; length of younger specimen (complete) drawn 6, altitude 4 millimeters.

Chipola marls, Baileys Ferry, Florida.

Cornell University collection.

[11] Dall, W. H., op. cit., vol. 3, pt. 5, p. 1148, 1900.

No representatives of this interesting species have been observed in the material under study. Apparently it is a larger and less angular shell than *Bornia virgata* Gardner, n. sp., with the very obvious difference that the sculpture in the Shoal River form is restricted to the area of the anterior and posterior keels, whereas in the Chipola species it is present upon the dorsal areas as well.

Occurrence: Chipola formation.

Bornia virgata Gardner, n. sp.

Plate XXI, Figures 9, 10

Shell small, very thin and fragile, approaching in outline an isosceles triangle; moderately convex, obliquely flattened toward the umbones and sharply incurved toward the base. Anterior and posterior areas flattened, the anterior keel the more obscure. Shell quite highly polished and exhibiting a very distinct concentric color banding which is probably directly related to the original pattern. Umbones small, central, proximate and prosogyrate; umbonal angle about 90°. Dorsal margins feebly arcuate, the posterior slope a little steeper than the anterior and the posterior margin rounding a little more abruptly into the horizontal base. Concentric sculpture reduced to exceedingly fine and faint incremental striae and a few rather pronounced resting stages toward the base. Half a dozen or more radial flutings also developed, extending from the anterior and posterior basal angles well up toward the umbones; the inner flutings slightly stronger than those toward the dorsal margins; External ligament very much reduced, seated on minute nymphae. Resilial pit also very small, extending backward from beneath the umbones. Dentition concentrated; anterior and posterior laminae of right valve elevated near the cardinal margin into rather robust laminar hooks, the anterior a little shorter and stouter than the posterior; left valve with a well-developed anterior lamina and behind it a shorter and more delicate posterior process; posterior dorsal margin slightly reinforced and modified to hold the distal portion of the right posterior lamina. Interior of shell somewhat thickened and punctate over the area of the attached mantle surface; radial sculpture of outer surface reflected upon the inner, particularly toward the ventral margin. Adductor muscle scars small, subequal, and subcircular, usually contained within the dorsal half of the shell. Pallial line entire, ragged, remote from the base. Inner margin simple except for the rather sharp crenulations at the extremities of the radials.

Dimensions of right valve: Altitude, 5.0 millimeters; latitude, 6.0 millimeters; semidiameter, 1.5 millimeters. Dimensions of left valve: Altitude, 5.1 millimeters; latitude, 6.7 millimeters; semidiameter, 1.6 millimeters.

Cotypes: U. S. Nat. Mus. No. 352494.

Type locality: No. 3856, 6 miles west-northwest of Mossyhead, Walton County, Fla.

Bornia virgata is the analogue in the Shoal River formation of *Bornia fluctusculpturata* Maury in the Chipola. From the earlier form it is, however, readily separable by the relatively greater altitude, the more angular outline, the absence of any concentric sculpture so pronounced as that indicated by Miss Maury's description, and the restriction of the radial sculpture to the lateral keels. The Shoal River species is remarkable for its bilateral symmetry in form and sculpture, its general angularity, and the horizontal base.

It is by no means uncommon in the environs of the type locality.

Occurrence: Shoal River formation, localities 3856^c, 3742^r.

Family SPORTELLIDAE

Genus SPORTELLA Deshayes

1860. *Sportella* Deshayes, Animaux sans vertèbres découverts dans le bassin de Paris, vol. 1, p. 593.

Type: *Psammotea dubia* Deshayes. (Calcaire grossier of the Paris Basin.)

Shell small, thin, transversely elongate, slightly convex, subequilateral in the majority of species; umbones low and inconspicuous; neither lunule nor escutcheon defined; exterior surface smooth or feebly undulated by incrementals, locally sculptured with a submicroscopic radial striation; external ligament seated on an elongate nymph; internal ligament lodged in an oblique, subumbonal, resilial pit; dentition of right valve consisting of a strong, often recurved, posterior cardinal and a rudimentary anterior cardinal; hinge of left valve with two unequal, divergent cardinals, the anterior of which is the stronger; adductor impressions oval, subequal; pallial line entire, commonly punctate; inner margins smooth.

A genus of small and inconspicuous bivalves inhabiting the near shore waters of Europe and America during Tertiary and Quaternary times.

Sportella is represented in the Alum Bluff by five species, only one of which is at all common. The species in question, *Sportella lioconcha* Dall, occurs not only in the Oak Grove but in the Shoal River as well. A closely allied form is peculiar to the Chipola, whereas the other three species are all restricted to the type locality at Oak Grove.

Shell transversely elliptical or ovate in outline:
- Posterior area not depressed along a sharply defined keel; latitude of adult usually exceeding 7.0 millimeters:
  - Shell relatively solid ..... *Sportella lioconcha* Dall.
  - Shell very thin and delicate. *Sportella leura* Gardner, n. sp.
- Posterior area depressed along a sharply defined keel; latitude of adult not exceeding 7.0 millimeters. *Sportella unicarinata* Dall.

Shell suborbicular or ovate trigonal in outline; latitude of adult not exceeding 7.0 millimeters:
- Shell ovate trigonal in outline ..... *Sportella lubrica* Dall.
- Shell suborbicular in outline ..... *Sportella obolus* Dall.

Sportella lioconcha Dall

Plate XXII, Figure 1

1900. *Sportella lioconcha* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1128, pl. 44, fig. 24.

Dall described this species as follows:

Shell oblong, moderately inflated, evenly rounded, the ends subequal in outline; surface smooth or with some incremental irregularities, sculptured with very fine concentric and obsolete, microscopic, radial striae; interior polished, with faint radial striations; beaks low, inconspicuous, with a minute, brilliantly polished prodissoconch; hinge narrow, cardinals more or less duplex in the young, single, straight and prominent in the adult; pit for the resilium distinct, triangular, short; ridge for the ligament small, short but obvious. Longitude 14, altitude 9.5, diameter 6 millimeters.

This is a very elegant species with somewhat the aspect of a *Scintilla* but the typical hinge of *Sportella*.

Type: U. S. Nat. Mus. No. 135869.

Type locality: No. 2646, Oak Grove, Yellow River, Okaloosa County, Fla.

Sportella lioconcha Dall is by far the most common representative of the genus in the Oak Groove sand and is even more common in the Shoal River. The relatively large dimensions and smoothly rounded, transversely elongated outline readily isolate it from all congenetic species both in the Shoal River and Oak Grove. *Sportella leura* Gardner, n. sp., from the Chipola is very closely allied but is a thinner and more delicate shell, more elongated transversely in proportion to its height.

Occurrence: Oak Grove sand, localities 2646^{p}, 5632^{r} 5631^{r}, 5633^{r}, 7054^{r}. Shoal River formation, localities 3856^{r}, 3742^{p}. 5079^{p}, 3733^{r}.

Sportella whitfieldi Dall

The fragment from Oak Grove referred by Dall [12] to *Sportella whitfieldi* is indeterminate but certainly not referable to the species from New Jersey and Maryland. It is a much larger and thinner shell, with a well-defined escutcheon.

Sportella leura Gardner, n. sp.

Plate XXII, Figure 4

Shell thin and delicate, of moderate dimensions for the genus and moderately inflated, transversely ovate to elliptical in outline. Umbones subcentral, quite full, tipped by the highly polished, rounded, trigonal prodissoconch. Dorsal margins nearly horizontal, the posterior a little higher than the anterior. Anterior extremity a little more produced and a little more smoothly rounded than the posterior. Base line rudely parallel with the dorsal margins. External surface shagreened by the incrementals and, in some individuals, exhibiting a fortuitous, microscopically fine, radial lineation, least feeble posteriorly, together with a crowded but exceedingly fine radial striation toward the ventral margin. Interior highly polished and faintly lineated concentrically and radially. Dorsal margins thickened and beveled. Nymphae short, inconspicuous. Resilial pit small, trigonal, deeply inset. Anterior cardinal of right valve rudimentary, the posterior cardinal rather delicate; anterior cardinal of left valve also rather delicate; posterior left cardinal almost obsolete. Adductor scars distinct by reason of their high polish, almost entirely contained within the dorsal half of the valve; posterior adductor larger than the anterior, both of them irregular and rounded or rudely quadrate in outline. Pallial line entire, obscure. Basal margins smooth and very thin.

Dimensions. Altitude, 6.7 millimeters; latitude, 9.5 millimeters; semidiameter, 2.0 millimeters.

Type: U. S. Nat. Mus. No. 352489.

Type locality: No. 7151, Tenmile Creek, Calhoun County, Fla.

Sportella leura from the Chipola is a decidedly thinner and more delicate shell than its close analogue *S. lioconcha* from the Oak Grove and Shoal River. The outlines are very similar, though the Chipola species is generally smaller and a little lower than that from the higher horizons.

Occurrence: Chipola formation, locality 7151^{p}.

Sportella unicarinata Dall

Plate XXI, Figure 17

1900. *Sportella unicarinata* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1127, pl. 44, fig. 13.

Dall described this species as follows:

Shell small, solid, compressed, ovate, with the anterior part somewhat more produced and attenuated, interior polished, scars distinct; exterior divided into two areas by a single sharply defined small thread extending obliquely from the beak to the posterior part of the base, the area behind the thread depressed, surface smooth or faintly microscopically radially striate, with faint irregularly distributed incremental lines; nepionic shell smooth, conspicuous; hinge normal, the hinge plate thickened in front of the conspicuous right cardinal tooth; left cardinals unequal, the anterior most elevated, the left hinge plate with the posterior dorsal margin slightly inflected. Altitude 4, longitude 5.5, diameter 1.5 millimeters.

This species is notable for its depressed posterior areas, which distinguish it from any of our other species.

Cotypes: U. S. Nat. Mus. No. 135873.

Type locality: No. 2646, Oak Grove, Yellow River, Okaloosa County, Fla.

A remarkably fine valve 8.5 millimeters high and 11.0 millimeters wide was later collected by T. W. Vaughan.

Occurrence: Oak Grove sand, localities 2646^{r}, 5632^{r}, 5633^{r}, 9961^{r}.

[12] Dall, W. H., Contributions to the Tertiary fauna of Florida: Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1128, 1900.

Sportella lubrica Dall

Plate XXI, Figure 8

1900. *?Sportella lubrica* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1127, pl. 44, fig. 9.

Dall described this species as follows:

Shell small, thin, polished, ovate-trigonal, sculptured only by incremental lines, which are feeble generally but at intervals strong; beak low, decurved; hinge plate narrow, right cardinal slender, prominent, with a small prominent callus in front of it on the dorsal margin; shell moderately convex. Altitude 4, longitude 5, diameter 2 millimeters.

A single right valve, somewhat broken, is all that is known of this species. It has not exactly the aspect of *Sportella*, though nearest to that genus, to which until more material is received it is provisionally referred.

Type: U. S. Nat. Mus. No. 135871.

Type locality: No. 2646, Oak Grove, Yellow River, Okaloosa County, Fla.

The type remains unique.

Occurrence: Oak Grove sand, locality 2646[r].

Sportella obolus Dall

Plate XXI, Figures 20–21

1900. *Sportella obolus* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1126, pl. 44, fig. 18.

Dall described this species as follows:

Shell small, solid, subcircular and flattish; interior polished, the cicatrices feeble; exterior smooth or faintly marked with incremental lines, and, in very perfect specimens, microscopic radiating striae; umbones small, polished, conspicuous; dorsal margins of the hinge plate inflected in the right valve; hinge plate strong; right cardinal stout, prominent; left valve with the dorsal margins of the hinge plate slightly beveled, cardinal teeth subequal, small. Altitude 4, longitude 4.5, diameter 1.0 millimeters.

This is a peculiar little shell whose rounded form does not suggest the genus, but it has the typical hinge. The radial striae are extremely fine and visible only under magnification in perfect specimens.

Type: U. S. Nat. Mus. No. 135872.

Type locality: No. 2646, Oak Grove, Yellow River, Okaloosa County, Fla.

This small form is decidedly higher and ruder than any of the congenetic species. It has not been observed in any of the later collections.

Occurrence: Oak Grove sand, locality 2646[p].

Genus HINDSIELLA Stoliczka

1860. =*Hindsia* Deshayes, Description des animaux sans vertebres découverts dans le bassin de Paris, vol. 1, p. 693. Not *Hindsia* H. and A. Adams, 1853.

1871. *Hindsiella* Stoliczka, India Geol. Survey Mem., Palaeontologia Indica, Cretaceous fauna of southern India, vol. 3, p. 266.

Type: *Modiola arcuata* Defrance. (Calcaire grossier of the Paris Basin.)

Stoliczka described this genus in 1871 as follows:

Shell elongately subtriangular, nearly equivalve, with the lower margin insinuated, hinge with one or two (generally one in the right, two in the left) minute cardinal teeth in each valve; ligament external, supported by thin fulcra; muscular impressions narrow, elongated, pallial line rather broad, simple; type *Modiola arcuata* Defrance from the Eocene of the Paris basin.

Dall [13] says:

The peculiar form of the shell with its median constriction, which led to the institution of a genus for the Parisian fossil, is probably due to the commensal habit, and may therefore occur in commensal species of different genetic relations. My attention was first drawn to the explanation by the discovery of the situs of *"Pythina" rugifera* Carpenter of the Alaskan fauna. This little bivalve is byssiferous and has the same median arcuation as the *Hindsiella*. It lives attached by the byssus to one of the abdominal segments of *Gebia pugetensis* Stimpson, a burrowing crustacean of the northwest coast. The mollusk, by means of its arcuate medial sinus, precisely fits the convex surface, to which it is attached by its byssus, and it is difficult, after examining one in situ, to doubt that its location and form have not a certain relation of cause and effect. By fitting closely and thus being able to keep itself hanging symmetrically on the abdomen of the crab the mollusk avoids the shocks which it would receive if it swung to one side, and is able to maintain its position sheltered from the carnivorous gastropods always so ready to drill holes in thin-shelled bivalves. Besides this the fragments of the crab's food in the burrow probably attract many infusoria and other minute organisms which serve as food for the bivalve. Such burrows are known to be frequented by various commensal *Leptonacea*.

This interesting little genus is well represented in the Tertiary of the Paris Basin and of the Gulf and east Atlantic coast. The Recent species is largely confined to the European seas.

Strange to say, *Hindsiella* is known in the Alum Bluff by only a single valve.

Hindsiella nephritica Dall

Plate XXI, Figure 19

1900. *Hindsiella nephritica* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1137, pl. 45, fig. 8.

Dall's description is here quoted.

Shell small, short, inflated, subequilateral, with rather prominent umbones, near which the valves are smooth, elsewhere with irregular, more or less prominent incremental lines; centrally vertically constricted, which produces a shallow insinuation in the basal margin; umbones prosogyrate with the dorsal margin impressed in front of them; hinge narrow, in the right valve a single subumbonal short tooth, behind and below the beak a narrow elongate scar for the resilium, and farther back a slender posterior lamella separated by a groove from the dorsal margin; adductor scars narrow, rather high up; interior of the shell polished with entire margins. Longitude 4.75, altitude 3.5, diameter 3 millimeters.

A single right valve of this species was collected.

Type: U. S. Nat. Mus. No. 114614.

Type locality: No. 2211, lower bed, Alum Bluff, Liberty County, Fla.

[13] Dall, W. H., Contributions to the Tertiary fauna of Florida: Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, pp. 1134–1135, 1900.

The type remains unique and the unique representative of the genus in the Alum Bluff group.

Occurrence: Chipola formation, locality 2211[r].

Family KELLIELLIDAE

Genus ALVEINUS Conrad

1865. *Alveinus* Conrad, Am. Jour. Conchology, vol. 1, pp. 10, 138.

1900. *Alveinus* Conrad, Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, pp. 1165–1167.

Type: *Alveinus minutus* Conrad. (Jackson formation of the Gulf.)

Conrad described this genus as follows:

Equivalved, smooth; anterior, posterior, and ventral margins channeled within; hinge of right valve emarginate under the apex, and having one pyramidal tooth anteriorly; hinge of left valve with a pit under the apex, and two compressed diverging teeth anteriorly; pallial line entire.

Dall gives the following characters:

Hinge with a very feeble nymph only noticeable on the largest and most fully developed specimens, and under the beaks a deep well-marked pit for an internal resilium. Right valve with two teeth, parallel with each other and with the hinge line, proximally elevated and with the upper edges bent over and toward each other. Left valve with a single tooth bent like a figure seven, the proximal arm shorter and with a small projection or angular thickening on the ventral side at about the middle; above this tooth the subumbonal margin is sometimes thickened with a groove between it and the lamina. The posterior shell margin for about a third of the circumference is prominent and is received in a groove in the corresponding margin of the right valve. This grooving is occasionally continued nearly round the shell both in *Lutetia* and *Alveinus;* at other times the margin is flattened or simple.

The known distribution of the genus is restricted to the Eocene and the Alum Bluff Miocene.

This group of minute forms may readily have been overlooked in preparing the collections. At all events only three species have been isolated—the type, *Alveinus minutus* Conrad, from the Eocene; *Alveinus rotundus* Dall, rather common at the type locality on the Chipola River but not recognized outside of the environs; and *Alveinus micculus* Gardner, n. sp., rare even at the single locality on Shoal River at which it has been recognized.

Umbones relatively prominent; anterior end obliquely rounded. *Alveinus rotundus* Dall.

Umbones relatively inconspicuous; anterior end broadly and symmetrically rounded.....*Alveinus micculus* Gardner, n. sp.

Alveinus rotundus Dall

Plate XXI, Figures 13–14

1900. *Alveinus rotundus* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1167, pl. 65, figs. 25, 28.

Dall described this species as follows:

Shell resembling *A. minutus* Conrad, but smaller, more inflated, more elevated, more nearly equilateral, and with a proportionately heavier and more solid shell. No trace of attachment for an external ligament could be found on any of the specimens. Altitude 1.9, longitude 2, diameter 1.2 millimeters.

At first this species was regarded as merely a local race of *A. minutus*, but the comparison of many specimens showed the characters to be constant, and the difference of horizon in the geologic column is quite marked, so I have thought it best to treat it as a species.

Cotypes: U. S. Nat. Mus. No. 114658.

Type locality: No. 2213, 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.

A. rotundus is more angular in its outline than *A. micculus* Gardner, n. sp., from the Shoal River formation, and the anterior dorsal margin as well as the posterior is obliquely truncate, whereas in the Shoal River species the anterior end is symmetrically rounded. The umbones are more prominent in the Chipola form, perhaps by reason of their position at the apex of the angle, and the incremental striae are, as a rule, less faint and more regularly developed than in the Shoal River species.

Occurrence: Chipola formation, localities 10610[r], 2213[c], 3419[p] 7151[p].

Alveinus micculus Gardner, n. sp.

Plate XXI, Figures 15, 16

Shell minute, highly polished, transversely ovate in outline, moderately inflated. Umbones rather low, slightly anterior, acute and prosogyrate at their tips. Posterior dorsal margin obliquely truncated, the lateral margin shorter and obtusely truncate; anterior end of shell rounding smoothly and strongly from the umbones to the basal margin. Base feebly arcuate. External surface lustrous, smooth except for faint incremental striae. External ligament attached along a narrow, corrugated area behind the umbones. Resilifer cuneate, subumbonal. Two dental laminae in the right valve, one of them attached along the inner surface of the anterior dorsal margin directly beneath the umbones, the other heavier but parallel to it; the distal extremity of the first in line with the proximal extremity of the second, the second, however, cut off from the dorsal margin by a shallow groove; left valve with a single subumbonal ⌐-shaped hook, the arm parallel to the dorsal margin longer than that at right angles to it; posterior dorsal margin of right valve and anterior dorsal margin of left deeply grooved to receive the corresponding beveled edge of the opposite valve; grooving commonly continued along the ventral margin. Adductor scars relatively large, distinct, placed rather well up under the dorsal margins. Pallial line obscure, simple, relatively distant from the hinge.

Dimensions of right valve: Altitude, 1.8 millimeters; latitude, 1.8 millimeters.

Dimensions of left valve: Altitude, 2.3 millimeters; latitude, 2.3 millimeters.

Cotypes: U. S. Nat. Mus. No. 352490.

Type locality: No. 3742, Shell Bluff, Shoal River, Walton County, Fla.

Alveinus micculus has more flattened and less prominent umbones than either *A. minutus* or *A. rotundus* Dall. The anterior end is more broadly and symmetrically rounded in the Shoal River species than in the Chipola, and the incremental striae are as a rule less regularly developed.

Occurrence: Shoal River formation, localities 3742[r], 3748[r], 10608[r], 9957[r].

POSITION UNCERTAIN

As the difficulties in the assignment of *Montacuta* and *Aligena* are chiefly anatomical, the problem is referred to the biologists.

Genus MONTACUTA Turton

1822. *Montacuta* Turton, Conchylia insularum Britannicum, Dithyra, p. 58.

Type: *Montacuta substriata* Montagu. (Recent on the British coast.)

Shell small, thin, equivalve, generally inequilateral, trigonal or transversely oblong; umbones incurved, low and inconspicuous, somewhat posterior; external surface smooth except for incrementals, or faintly striated radially; external ligament thin, amphidetic, not attached to nymphs; internal ligament lodged in a fairly deep resilial pit with more or less thickened margins; hinge varying rather widely within the limits of the genus; dentition consisting of two divergent lamellar cardinals in each valve, the posterior of which may be almost or altogether obsolete; anterior laminae also tending to become obsolete, leaving only the delicate subumbonal hooks; anterior adductor impression more elongated than the posterior; pallial line entire.

The genus is represented in the Tertiary deposits of both Europe and North America, and the general distribution of the Recent species is similar to that of the fossil.

The representation of this genus in the Alum Bluff has been reduced to a single species restricted to the Chipola formation. The exquisitely sculptured *actinophora* Dall, dubiously assigned to *Montacuta*, seems more closely allied with *Erycina* (*Scacchia*).

Montacuta chipolana Dall

Plate XXII, Figure 3

1900. *?Montacuta chipolana* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1171, pl. 44, fig. 4.

Dall described this species as follows:

Shell small, very inequilateral, the posterior side very short, dorsal and ventral margins nearly parallel, straight, passing evenly into the bluntly rounded ends; the young have the posterior end proportionately less short and the anterior end narrower; external surface polished, smooth except for faint incremental lines, shell inflated; beaks low, the subtriangular prodissoconch conspicuous; hinge with a stout, conspicuous left cardinal and a more slender prominent right cardinal; thickening of the margin over the resilium feebly developed in both valves, the anterior lamina obsolete in both; scar of the resilium large, short, scars of the adductors and pallial line normal. Longitude of a medium-sized specimen 8.5, altitude 5, diameter 4 millimeters. A broken specimen still measures 10 millimeters in length.

This species forms the next term in a series of which in *M. ferruginosa* the laminae are partially obsolete in front, and in *M. substriata* they are distinctly developed though small. It recalls *Sportella whitfieldi* but has a thinner shell and much more delicate hinge. Species of this type nearly bridge the conchological gap between *Montacuta* and *Sportella*.

Type: U. S. Nat. Mus. No. 114675.

Type locality: No. 2213, 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.

Faint suggestions of nymphae have been observed on some specimens. The species is remarkable for the regularly oblong outline of the adults and the umbones set far back within the posterior quarter. The young are more constricted in front of the umbones than the adults.

Occurrence: Chipola formation, localities 2213[p], 2564[r], 2211[r].

Genus ALIGENA H. C. Lea

1845. *Aligena* H. C. Lea, Am. Philos. Soc. Trans., new ser., vol. 9, p. 238.

Type: *Aligena striata* H. C. Lea = *Amphidesma aequata* Conrad. (Miocene and Pliocene of the east coast.)

Lea described this genus as follows.

Shell equivalve? subequilateral, closed posteriorly and anteriorly; hinge with one cardinal tooth, and a long shallow sulcation under the beaks.

The cardinal tooth is, in general, rather small. The sulcus appears to have received the ligament. It commences at the beak, and runs obliquely past the dorsal margin into the cavity under the beak. As I possess only odd valves of both the following species, I am unable to determine whether the shell is equivalve or not. * * *

I have called the genus *Aligena*, one of the surnames of Venus, from its resemblance to *Erycina*, also an appellation of that goddess.

Dall [14] added the following characters:

The characteristic of this group is the possession of a rounded triangular inflated shell with only a single small anterior tooth under the beaks, separated by a gap from the surface of attachment, under the posterior dorsal margin, of an elongate internal resilium carrying a lithodesma. The pallial line is simple, and the cardinal of the left valve more feeble than the other.

The genus has representatives in the Tertiary deposits of the east coast and of the Paris and Vienna basins and still persists in the cooler waters of the Atlantic.

The Alum Bluff *Aligenae* are a remarkably persistent group of forms. *A. pustulosa* which has been described from the Oak Grove is represented by a

[14] Dall, W. H., Contributions to the Tertiary fauna of Florida: Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1175, 1900.

closely allied or identical species in the Chipola and apparently continues to exist through the Shoal River and into the Calvert of the middle Atlantic slope. *A. lineata* Dall is fairly common both in the Oak Grove and the Shoal River, whereas *Aligena* sp. from the Shoal River certainly has a very intimate genetic relationship with *A. aequata* Conrad of the later Miocene and Pliocene.

Sculpture pustulose----------*Aligena pustulosa* Dall.
Sculpture not pustulose:
Sculpture subdued and irregular------*Aligena lineata* Dall.
Sculpture of sharply elevated laminae regularly spaced with concentrically striated interlaminar areas.
Aligena sp.

Aligena pustulosa Dall

1898. *Aligena pustulosa* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 4, pl. 33, figs. 18, 22 (no description).
1900. *Aligena pustulosa* Dall, idem., pt. 5, p. 1176.

Dall described this species in 1900 as follows:

Shell small, thin, subtrigonal, moderately inflated, subequilateral, with small, pointed, inconspicuous beaks; valves with a well-marked carina extending downward and forward to the anterior angle of the basal margin, in front of which keel the surface is slightly impressed; surface sculptured with feeble incremental lines, along which are irregularly distributed small, pointed pustular elevations; beaks anteriorly twisted with a minute obscure tooth below them on the cardinal margin; ligamentary sulcus long and well marked; scars and pallial line much as in *Diplodonta*; margin entire, inner surface faintly radially striated. Altitude 6, latitude 5.2, diameter 4 millimeters.

The peculiar surface sculpture distinguishes this species at once from the other species. The Chipola specimen is not in very good condition, but shows rather stronger and closer concentric sculpture than the Oak Grove specimens.

Type: U. S. Nat. Mus. No. 135868.

Type locality: No. 2646, Oak Grove, Yellow River, Okaloosa County, Fla.

The Chipola specimen here considered is also less angular and more smoothly ovate in outline than any collected at Oak Grove. It may prove to be distinct, at least subspecifically. A worn valve from the lower Chesapeake at Calvert Cliffs presents no characters by which it can be separated from the Oak Grove species. At all events *A. pustulosa* was present in the Shoal River formation.

Occurrence: Chipola formation, locality ?2213[r]. Oak Grove sand, locality 2646[p]; Shoal River formation, locality 3748[r].

Aligena lineata Dall

Plate XXII, Figure 2

1900. *Aligena lineata* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1176, pl. 44, fig. 23.

Dall described this species as follows:

Shell small, thin, inequilateral, moderately convex, the anterior side longer, rounded, the posterior side higher, shorter, bluntly rounded, the beaks rather elevated, the base evenly arcuate; sculpture of fine, rather irregular elevated lines, not developed into laminae, stronger near the anterior slope and feebler near the posterior slope; hinge and other characters of the interior much as in the last species. Altitude 7, latitude 8, diameter 4 millimeters.

This species is distinguished by its more elongated form and less elevated concentric sculpture from *A. aequata*, to which of all the species it is most nearly allied.

Type: U. S. Nat. Mus., No. 135867.

Type locality: No. 2646, Oak Grove, Yellow River, Okaloosa County, Fla.

The figured type is decidedly larger than the normal individual and more trigonal in outline. The usual form is transversely ovate, the umbones only slightly posterior, and the posterior lateral margin obtusely truncate. The Oak Grove individuals are on the whole more strongly sculptured than those from the Shoal River, but the degree of variation in both groups is so large that systematic value can not be attached to the differences.

Occurrence: Oak Grove sand, localities 2646[c], 5632[r], 5633[r], 7054[r]. Shoal River formation, localities 3742[r], 5079[p], 10661[r], 3748[r], 10603[r].

Aligena sp.

A single valve from Somerville Mill Race, not fully mature and somewhat imperfect, indicates a new species or subspecies differing from *Aligena aequata* Conrad in the transversely elongated outline. The concentric sculpture of sharply elevated laminae with concentrically striated interlaminar areas is strong and regular and quite distinct from the subdued and irregular sculpture of *A. lineata* Dall.

Occurrence: Shoal River formation, locality 3748[r].

Superfamily CARDIACEA

Family CARDIIDAE

Genus CARDIUM Linnaeus

1758. *Cardium* Linnaeus, Systema naturae, 10th ed., p. 678.

Type: *Cardium costatum* Linnaeus; designated by Children, 1822. (Recent in the Indo-Pacific.)

Shell usually subequilateral, closed or slightly gaping, globose, the united valves subcordate laterally. Umbones prominent, almost straight or with a slight anterior twist. True lunule and escutcheon absent. Sculpture dominantly radial. Ribs commonly granulose, spinose or imbricated. Ornamentation of lateral areas, particularly of the posterior, commonly differing from that of the disk. Ligament external, ophisthodetic. Hinge characterized, with a few exceptions, by two cardinals, of which the ventral is the stronger, and one or two posterior and one or two anterior lateral lamellae in each valve; cardinals more or less twisted. Muscle impressions subequal. Pallial line simple or slightly sinuous posteriorly. Internal basal margins serrate.

The Cardiums form a conspicuous element in the faunas from the Mesozoic onward. They are gener-

ally rather fragile, and not well adapted to preservation. The external sculpture is commonly formed from a superficial shelly layer, which readily breaks away, leaving no scar upon the polished surface beneath. For this reason it is difficult to tell a perfectly fresh specimen. The recent representatives, the so-called cockles, number about 200 species and are most abundant in the warmer waters.

Cardium is represented in the Alum Bluff by 24 species. Fourteen, or more than 55 per cent, of these species are present in the Chipola, although none of the 14 is so prolific in individuals as either *Cerastoderma taphria* of the Oak Grove or *C. waltoniana* of the Shoal River. Curiously enough 13 of the 14 have not been recognized at any other horizon. The single species *Laevicardium compressum* occurs in the Oak Grove as well. There is apparently no *Cardium* common to the Chipola and the Shoal River. Two out of the three *Acanthocardia* are peculiar to the Chipola and three out of the four *Fragum*. The single species of *Papyridea*, *Trachycardium*, and *Cerastoderma* are also well represented. The most widely distributed and characteristic of the Chipola species are *Trachycardium cestum*, *Cerastoderma chipolana*, and *Fragum simrothi*. *Trachycardium parile*, *Cerastoderma chipolana alumen*, and *Fragum aliculum* are most closely associated with the fauna from the section at Alum Bluff.

The Oak Grove Cardiums include 8 species, at least 6 of which are peculiar to that formation. By far the most conspicuous feature is the extraordinary abundance and wide distribution of *Cerastoderma taphria* Dall. Four of the 8 species are referable to *Trachycardium*, one to *Acanthocardia*, one to *Cerastoderma*, one to *Fragum*, and one to *Levicardium*.

The Shoal River fauna is remarkable for the paucity of species, only 4 in all, and for the abundance of the individuals. Of these *Cerastoderma waltoniana* is the best represented, although *Trachycardium plectopleura* is also common. The other forms are minor elements. *Acanthocardia*, *Fragum*, *Papyridea*, and *Laevicardium* have none of them been recorded.

The most interesting feature in the representation of the subgenera of the Alum Bluff as a whole is the meager number of species and individuals referable to *Acanthocardia*, *Papyridea*, and *Laevicardium*. *Trachycardium* includes the largest number of species. *Cerastoderma* is represented by a characteristic and more or less prolific species at each horizon, whereas *Fragum* is present in great abundance in the Chipola but is reduced in the Oak Grove and extremely rare in the Shoal River.

Shell generally heavy, more or less strongly costate radially:
- Shell generally rather heavy, rotund-trigonal or ovate-cordate in outline, not conspicuously elongated transversely, usually inflated:
  - Posterior area rounded, or, if truncated, flattened and angulated only in adult shells exceeding 15 millimeters in altitude:
    - Costals more or less nodulated, spinose, or sharply serrate:
      - Outline rotund or slightly elongated transversely in the adults:
        - Costals not exceeding 28:
          - Costals broadly V-shaped, crowned by a nodulated cord; intercostals transversely striated. *Cardium* (*Acanthocardia*) *propeciliare* Dall.
          - Costals obtusely V-shaped, the minute spines rising directly from the summits of the ribs; intercostals sculptured only with microscopically fine incrementals. *Cardium* (*Trachycardium*) *parile* Dall.
        - Costals exceeding 28:
          - Costals exceeding 40; alternating costals on medial area bearing tubular spines. *Cardium* (*Acanthocardia*) *acrocome* Dall.
          - Costals rarely exceeding 40:
            - Costals usually exceeding 35, studded on the anterior area with lobate or clavate processes. *Cardium* (*Trachycardium*) *virile* Dall.
            - Costals rarely exceeding 35, studded on the anterior area with cuplike processes. *Cardium* (*Trachycardium*) *malacum* Dall.
      - Outline ovate-cordate in the adults, inflated; medial costals acutely ridged or crowned with a narrow T rail:
        - Medial costals acute, attenuated, crowned with a narrow T rail, which is usually broken away; sides of costals granulose. *Cardium* (*Trachycardium*) *cestum* Dall.
        - Medial costals sharply serrate; sides of costals not granulose:
          - Normal number of costals 32, those on the anterior area quite evenly nodulated. *Cardium* (*Trachycardium*) *lingualeonis* Guppy.
          - Normal number of costals 33 or 34, those on the anterior area irregularly corrugated or set with flattened, medially sulcate, lobate processes. *Cardium* (*Trachycardium*) *plectopleura* Gardner, n. sp.
          - Normal number of costals 35; those on the anterior area heavily studded with cuplike processes. *Cardium* (*Trachycardium*) *ustrix* Gardner, n. sp.
        - Medial costals crowned with V-shaped spines dorsally directed. *Cardium* (*Trachycardium*) *delphicum* Dall.
      - Outline broadly ovate in the adults, not greatly inflated; costals flattened or obtusely V-shaped:
        - Costals rarely exceeding 35:
          - Shell not oblique, 6 or 7 costals upon the anterior area. *Cardium* (*Traychycardium*) *delphicum* Dall.
          - Shell slightly oblique, normally 12 costals upon the anterior area. *Cardium* (*Trachycardium*) *malacum* Dall.

Costals generally exceeding 35:
Spinose or nodose processes developed in perfect individuals upon all the primary costals.
Cardium (*Trachycardium*) *virile* Dall.
Processes developed only upon the secondaries intercalated in the posterior area.
Cardium (*Trachycardium*) *inconspicuum* Guppy.

Costals simple or concentrically imbricated:
Posterior keel not acutely angulated; posterior area rounded or somewhat flattened, sculptured with more or less elevated costals:
Costals not exceeding 25:
Costals normally 18, very broad, concentrically striated but not imbricated, separated by broad, flattened intercostals ..... *Cardium* (*Acanthocardia*) *ctenolium* Dall.
Costals normally 21, moderately broad, heavily imbricated, separated by rather narrow, concave intercostals ..... *Cardium* (*Cerastoderma*) *panastrum* Dall.
Costals exceeding 25:
Shell compressed; costals broad and low ..... *Cardium* (*Trachycardium*) *inconspicuum* Guppy.
Shell inflated; costals narrow and elevated ..... *Cardium* (*Cerastoderma*) *waltonianum* Dall.
Posterior keel more or less acutely angulated; posterior area flattened, sculptured with exceedingly low costals or impressed sulci:
Shell transversely elongated, subtrigonal in outline ..... *Cardium* (*Cerastoderma*) *druidicum* Dall.
Shell ovate-cordate in outline:
Anterior area differentiated by the evanescence of the concentric striations:
Costals upon the anterior and medial areas not exceeding 25.
Cardium (*Cerastoderma*) *chipolanum* Dall, s. l.
Costals averaging 24, relatively narrow and rounded upon their summits.
Cardium (*Cerastoderma*) *chipolanum* Dall, s. s.
Costals averaging 21, relatively broad and flattened upon their summits.
Cardium (*Cerastoderma*) *chipolanum alumen* Gardner, n. subsp.
Costals upon the anterior and medial areas exceeding 25 .. *Cardium* (*Cerastoderma*) *taphrium* Dall.
Anterior area not differentiated by the evanescence of the concentric striations.
Cardium (*Cerastoderma*) *waltonianum* Dall.
Posterior area truncated, abruptly flattened, and more or less acutely angulated:
Costals exceeding 28; outline subquadrate ..... *Cardium* (*Fragum*) *burnsii* Dall.
Costals not exceeding 28:
Outline trigonal, the costae defining the posterior keel, conspicuously produced and prominent; nodules usually decorticated, rather large and not very numerous; intercostal channels normally very finely cross striated.
Cardium (*Fragum*) *aliculum* Dall.
Outline subquadrate; intercostal channels quite coarsely cross striated:
Costals normally 22 to 25; concentric sculpture persistent across the costals.
Cardium (*Fragum*) *sellardsi* Gardner, n. sp.
Costals normally 18 or 19, usually retaining upon the summits traces of rather small and numerous nodules, the two costals in front of the keel perceptibly narrower than those anterior to them.
Cardium (*Fragum*) *simrothi* Dall.
Costals normally 22, rarely retaining upon the summits any trace of nodules, the two costals in front of the keel not perceptibly narrower than those anterior to them ..... *Cardium* (*Fragum*) *apateticum* Dall.
Shell thin, compressed, transversely elongated ..... *Cardium* (*Papyridea*) *bulbosum* Dall.
Shell thin, radially lineated but not costate ..... *Cardium* (*Laevicardium*) *compressum* Dall.

Subgenus ACANTHOCARDIA Gray [15]

1851. *Acanthocardia* Gray, List of British animals in collection of British Museum, pt. 7, p. 23.

Type: *Cardium aculeatum* Linnaeus. (Recent in European waters.)

Shell of medium size, rotund or rhomboid, slightly gaping, ribs spinose, interspaces striate or granulose; two cardinals and anterior and posterior laterals developed in each valve.

Cardium (Acanthocardia) propeciliare Dall

Plate XXII, Figure 5

1900. *Cardium propeciliare* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1080, pl. 48, fig. 12.

Not *Cardium* (*Trachycardium*) *propeciliare* Dall, U. S. Nat. Mus. Bull 90, p. 142, pl. 18, fig. 7, 1900.

Dall described this species as follows:

Shell small, thin, inflated, slightly oblique and inequilateral, with high, well-rounded beaks, anterior end slightly shorter, general outline suborbicular; sculptured with 19 elevated ribs of triangular section separated by narrow, cross-striated channeled interspaces, each rib surmounted by a low keel the edge of which is periodically produced into short spines each ending in a knob, sides of the ribs finely concentrically striate; near the posterior end the whole surface shows a microscopic granulation; internal margins deeply fluted; hinge normal, delicate. Altitude 20, longitude 20, diameter 15.5 millimeters.

This elegant little shell is close to the young of the *C. echinatum* Linnaeus of Europe, in which, however, the ribs are lower, the interspaces wider and less sharply cross striated, the keel less elevated and continuous, and the spines long and sharp. The European shell is more equilateral, with a longer hinge line and not oblique. However, they are so similar as to be very interesting According to Turton and Hanley, the young *C. echinatum* is probably the *C. ciliare* of Linné.

[15] *Cardium* s. s. of those authors who consider *C. aculeatum* Linnaeus the type of the genus.

Type: U. S. Nat. Mus. No. 114768.

Type locality: No. 2213, 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.

The angle between the smooth-sided trigonal costals and the concentrically striated, almost imbricated intercostals is very sharp and very clearly defined.

The low number of ribs, their regular outline, and the cordate tuberculate keel which crowns their summits renders this one of the best characterized members of the genus.

Occurrence: Chipola formation, localities 2213[r], 3419[r], 7183[r].

Cardium (Acanthocardia) ctenolium Dall

Plate XXII, Figure 6

1900. *Cardium ctenolium* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1081, pl. 40, fig. 13.

Dall described this species as follows:

Shell rounded, a little produced behind, with inflated beaks, subequilateral; sculptured with 18 broad, rounded ribs separated by narrower flat interspaces sharply defined; there are posteriorly some fine radial striations and over the whole shell fine concentric sculpture which seems stronger where it passes over the ribs, especially distally, and in some places approaches imbrication; there is a small smooth area above the outermost anterior rib, but none behind the beaks; internal margins deeply fluted and radially striate; hinge normal. Longitude 19.5, altitude 18.5, diameter 14 millimeters.

Although not spiny I have placed this species in the typical section, as in all other characters this seems closely related to the true Cardia, and the latest representative of that group known from our Tertiaries.

Type: U. S. Nat. Mus. No. 107393.

Type locality: No. 2646, Oak Grove, Yellow River, Okaloosa County, Fla.

Cardium ctenolium Dall is remarkable for the rotund outline, slightly elongated transversely, and the sharp definition of the angle between the costals and the intercostal channels. The costals suggest broad, inverted V's of which the apex has been evenly rounded off.

Occurrence: Oak Grove sand, locality 2646[r].

Cardium (Acanthocardia) acrocome Dall

Plate XXII, Figure 7

1900. *Cardium acrocome* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1081, pl. 48, fig. 2.

Dall described this species as follows:

Shell small, rotund, plump, nearly equilateral, with moderately full umbones; sculpture of about 45 close-set, low, nearly flat radial ribs separated by very narrow channeled interspaces; the alternate ribs anteriorly surmounted with prominent hollow spines usually truncate at the ends, their alternates showing low Λ-shaped spines; behind the middle of the shell the long-spined ribs are less numerous and on the posterior area nearly all the ribs have low spines; there is no smooth area near the hinge margin; internally the margins are fluted or serrate minutely, and the shell radially sulcate near the margin; hinge normal, delicate. Altitude 7.5, longitude 7.5, diameter 6 millimeters.

Only a single valve of this very distinct little species was obtained. Owing to the alternation in the sculpture it has somewhat the aspect of *Criocardium*.

Type: U. S. Nat. Mus. No. 114759.

Type locality: No. 2213, 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.

The type is unique.

Occurrence: Chipola formation, locality 2213[r].

Subgenus TRACHYCARDIUM Mörch

1853. *Trachycardium* Mörch, Catalogus conchyliorum quae reliquit D. Alphonso d'Aguirra and Gadea Comes de Yoldi, fasc. 2, p. 34, =*Granocardium* Gabb, 1868, Paleontology of California, vol. 2, p. 266; type *G. sabulosum* Gabb.

Type: *Cardium isocardia* Linnaeus. (Recent on the east coast from Hatteras to Trinidad; fossil in the late Tertiary and Pleistocene.)

Valves closed, rotund or ovate-cordate in outline; ribs concentrically sculptured or granulose, many of them elaborately imbricated or tuberculate; left cardinals anterior when interlocked.

Cardium (Trachycardium) cestum Dall

Plate XXII, Figure 8

1900. *Cardium (Trachycardium) cestum* Dall, Wagner Free Inst. Sci. Trans., vol. 3 pt. 5, p. 1083, pl. 48, fig. 14.

1915. (?) *Cardium (Trachycardium) cestum* Dall, U. S Nat. Mus. Bull. 90, p. 142, pl. 4, fig. 13.

Dall described this species as follows:

Shell moderately large, solid, inflated, slightly oblique, subequilateral; beaks high and rounded; sculpture of 34 triangular radial ribs, on the summit of which is developed a thin elevated keel of which the summit is somewhat like the top of a T rail, overhanging at the sides, when intact, and flattened and smooth on top; the sides of the keels and ribs, up to the twenty-second, are vertically striated and sparsely sprinkled with minute granules; the posterior 12 ribs are asymmetrical, the keels being placed behind the summits of their sustaining ribs and crenulate or surmounted by obliquely set transverse nodules; the first 9 ribs are somewhat similarly imbricate or nodulous, and ventrally in adults near the margin are often pressed over backward and strongly transversely wrinkled with their interspaces flat and rather wide, while over the disk the interspaces are chiefly narrow and V-shaped; different individuals show minor modifications of these details of ornament; interior with the margins fluted, the posterior margin deeply serrate, the internal face with shallow grooves extending upward from the flutings; hinge normal. Altitude 50, longitude 40, diameter 36 millimeters.

Cotypes: U. S. Nat. Mus. No. 114757.

Type locality: No. 2213, 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.

The T rail summit of the 8 or 9 medial ribs is ornamented with a single series of minute tubercles, most commonly visible in the young; the keels on both the anterior and the posterior ribs are asymmetric and posterior in position, and the number of ribs in some specimens falls as low as 30. In *Trachycardium lin-*

gualeonis, *T. plectopleura*, and *T. ustrix*, forms which have a somewhat similar outline, the costals are crowned with a sharply serrate keel.

The specimens from Ballast Point are young and very imperfect but quite certainly distinct from the *T. cestum* of the Chipola.

Occurrence: Chipola formation, localities 2212[P], 2213[C], 3419[P], 9994[P].

Cardium (Trachycardium) lingualeonis Guppy

1866. *Cardium lingualeonis* Guppy, Geol. Soc. London Quart. Jour., vol. 22, p. 293, pl. 18, fig. 7.
1873. *Cardium subelongatum* Gabb, Am. Philos. Soc. Trans., vol. 15, p. 250.
Not *Cardium subelongatum* Sowerby, Zool. Soc. London Proc., 1840, p. 108.
1900. *Cardium* (*Trachycardium*) *lingualeonis* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1084.

Guppy described this species as follows:

Shell elongate, subquadrate; valves deep, ornamented with numerous (32) nodosely muricate ribs, which are lower and more distant toward the anterior and posterior margins; margins coarsely crenulate, the posterior one strongly serrate; hinge with three large and stout teeth.

The nearest ally of this shell is *C. rubicundum* of Madagascar. It is distinguished both from that species and from *C. elongatum* by its deeper valves and by the ribs on the disk being somewhat muricate. It is also rather narrower than those species.

Type: British Museum, Natural History, Geological Department, No. 64090.

Type locality: "Miocene" of Jamaica.

The 13 or 14 medial ribs are low with broad, flattened tops separated from one another by narrowly V-shaped intercostal channels which are more or less granular and transversely striated. The summits of the ribs are crowned by a fluted, laminar keel, placed upon the posterior margin. The nine or ten anterior ribs are asymmetric and more or less inclined backward. The fluted keel of the medial costae is thickened and modified on the seventh, eighth, and ninth ribs into one that suggests twisted candy. On the second to the sixth rib it is further modified into a series of low, shapeless protuberances set upon the anterior margin and side of the costal. The extreme anterior rib is submarginal and ill-defined. The eight or ten posterior costae are also asymmetric but inclined forward. The keel becomes gradually twisted and heavier and toward the dorsal margin is modified into a series of thickened, rudely trigonal plates obliquely disposed. The posterior cardinal of the right valve and the anterior cardinal of the left are vigorous, but the anterior cardinal of the right and the posterior cardinal of the left are very small and insignificant. The laterals are also strong and placed high up, near the umbones. Traces of the marginal flutings persist far within the interior of the shell.

The imperfect fragment from Walton County which has been referred to this species is *C. plectopleura*. There is no other evidence for its existence in the Alum Bluff of Florida.

Cardium (Trachycardium) plectopleura Gardner, n. sp.

Plate XXII, Figures 10–11

Shell rather thick and heavy, ovate in external outline, broadly elliptical in the internal, inflated cordate in the double valves. Umbones very prominent, tumid, subcentral in position, orthogyrate, incurved, the apices concealed by the reverted hinge plate. Lunule and escutcheon not defined. External sculpture ornate; 34 costals in the right valve of the type, 33 in the left, commonly one more or less; anterior, medial, and posterior areas each including about 11 ribs, not, however, sharply differentiated in character; medial ribs narrowly tabulated upon their summits, crowned in the young and in the umbonal region of the adults by a flattened cord posterior in position, which is finely striated transversely; away from the umbones on the medial portion of the disk the cord is very much compressed and so closely twisted that it is cut up into a series of sharply crested laminar wavelets with a slight posterior flexure, headed toward the umbones; cords crowning the posterior ribs twisted but not compressed nor sharply indented, becoming gradually thinner and more serrate toward the medial portion of the disk; sculpture of posterior area characterized by the vertical compression of the wavelets, so that they assume the form of a series of elongated, medially sulcate lobes, the broader end directed toward the umbones; in the fully adult specimens the lobate sculpture degenerates toward the ventral margin into a heavy corrugation; intercostal areas smoothly concave and regularly striated concentrically on the medial portion, shallower and smooth or fortuitously striated distally; ribs more closely spaced upon the medial portion than upon the anterior, less closely than upon the posterior, with the exception of the two nearest the dorsal margin; area directly in front of the umbones smooth. Ligament external, opisthodetic; ligament nymph heavy. Hinge armature rather concentrated, a feeble anterior cardinal and a strong upcurved posterior cardinal springing from beneath the umbone of the right valve; a vigorous anterior and a short compressed posterior cardinal in the left valve; laterals in the right valve compressed, prominent, with deep sockets dorsal to them for the reception of the less prominent cardinals of the left valve, rather small, rounded pits developed just ventral to the left laterals for the reception of the laterals of the right valve. Muscle impressions large but rather obscure, the posterior the larger and the more sharply defined. Inner margins deeply serrate, most deeply along the posterior margin, least deeply along the anterior; interior striated in harmony with the external sculpture almost halfway from the ventral margin to the umbone.

Dimensions: Altitude of right valve, 45.6 millimeters; latitude of right valve, 35.8 millimeters; diameter of right valve, 20.6 millimeters; altitude of left valve of another individual, 47.2 millimeters; latitude of left valve, 37.5 millimeters; diameter of left valve, 22.0 millimeters.

Cotypes: U. S. Nat. Mus. No. 352495.

Type locality: No. 3742, Shell Bluff, Shoal River, 5 miles west of Mossyhead, Walton County, Fla.

Trachycardium plectopleura Gardner, n. sp., suggests *T. lingualeonis* Guppy from the Bowden. It is a little larger and heavier, however, somewhat broader relatively, and more smoothly rounded. The costals are more numerous and the intercostals on the medial portion broader, more symmetrical, and more conspicuously striated concentrically The keel which crowns the summits of the ribs is heavier and more variously modified than that in the Bowden species, and the sculpture, though vaguely suggesting that of *T. lingualeonis* medially, is quite dissimilar upon the anterior and posterior areas.

Trachycardium plectopleura Gardner, n. sp., is with the exception of the prolific *Cerastoderma waltonianum* the most common and characteristic *Cardium* of the Shoal River.

Occurrence: Shoal River formation, localities 3856^{r}, 2645^{r}, 3732^{r}, 3742^{a}, 5080^{r}, 5184^{p}, 9957^{c}, 10603^{c}.

Cardium (Trachycardium) ustrix Gardner, n. sp.

Plate XXII, Figure 12

Shell moderately large and heavy, inflated, ovate-cordate in external outline, slightly prolate in the internal. Umbones set a little in front of the median line, gibbous, incurved, orthogyrate, the tips concealed by the upturned hinge plate. Lunule not defined, although there is a very narrow, smooth area in front of the beaks. Dorsal margins short and almost straight. Anterior lateral margin very broadly rounded, the posterior obscurely truncate vertically. External sculpture ornate; 35 costae, asymmetrically Λ-shaped upon the medial and anterior portions of the shell, the posterior slope almost vertical, the anterior not so steep; spines upon the posterior portion of the shell borne directly from the surface; anterior costals, probably the first 13, ornamented with strung-convolvulus cups, which toward the dorsal margin and the umbones tend to close and become modified into lobate nodes; cups most crowded upon the third to the seventh ribs, becoming more distant toward the medial portion of the disk, modified on about the fourteenth costal into triangular laminar plates which overlap one another and are disposed along the ridge of the rib in the manner of the plates in *Stegosaurus;* toward the posterior third the plates are inclined to be sinuated and discrete and on the two or three extreme posterior ribs they are modified into thickened petaloid processes set obliquely to the axis of the rib; simple lirate intercalaries introduced on all the interspaces behind the twenty-second costa, the three or four earliest lirae placed upon the posterior slope of the channel rather than in the bottom of it, the remaining lirae intermediate in position between the ribs; intercostal areas narrow, Λ-shaped grooves, microscopically striated by the incrementals except posteriorly, where they are extremely narrow and almost completely filled by the intercalated cord. Ligament external, opisthodetic, mounted on a short, robust nymph delimited by a deeply incised sulcus. Hinge rather concentrated; posterior cardinal of the right valve and the anterior cardinal of the left vigorous, upcurved, acutely pointed; receiving pits correspondingly deep; anterior cardinal of the right valve and the posterior cardinal of the left incipient. Laterals very strong, compressed, cuneate, those of the right valve cut off from the dorsal margins by deep grooves in which the left laterals are received, the right laterals held in small pits just ventral to the laminae. Muscle scars large but obscure, the anterior irregular in outline, the posterior semielliptical, both of them placed well up toward the hinge. Marginal flutings gradually increasing in strength along the anterior lateral and the ventral margins, sharply serrate posteriorly; radial sulci persistent halfway to the umbones.

Dimensions: Altitude, 42.0 millimeters; latitude, 35.0 millimeters; semidiameter, 15.4 millimeters.

Type: U. S. Nat. Mus. No. 352492.

Type locality: No. 3856, 5 to 6 miles west-northwest of Mossyhead, Walton County, Fla.

Trachycardium ustrix is perhaps most closely related to *T. plectopleura*, a larger, relatively higher, and much more inflated shell. The sculpture of *plectopleura* is more dense, and the differences in details of sculpture between the two species are so obvious that it is not necessary to emphasize them by enumerating them. The ornamentations upon the anterior areas are more dissimilar than elsewhere on the shell.

Occurrence: Shoal River formation, localities 3856^{p}, 3742^{r}.

Cardium (Trachycardium) delphicum Dall

Plate XXII, Figure 9

1900. *Cardium* (*Trachycardium*) *delphicum* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1084, pl. 48, fig. 18.

1915. *Cardium* (*Trachycardium*) *delphicum* Dall, U. S. Nat. Mus. Bull. 90, p. 142, pl. 25, fig. 12 (ex parte).

Dall described this species as follows:

Shell small, solid, thick, subovate, with high beaks, nearly equilateral; sculptured with 28 to 31 strong, high, triangular ribs, with much narrower, hardly channeled interspaces, both longitudinally and concentrically feebly striated; the first six or seven ribs are furnished with the usual cuplike projections, but succeeding ones show the cups narrowing and compressed above so as to form strong Λ-shaped imbrications; at about

the nineteenth rib the anterior wing of the ∧ seems to become obsolete and the posterior wing, persisting on the posterior side of the ribs, more and more oblique and nodulous; interior margin with rather small flutings continued as sulci nearly to the middle of the shell; posterior margin feebly serrate; hinge short, strong. Altitude 33, longitude 28, diameter 24 millimeters.

This represents in the Oak Grove fauna the *C. isocardia* type. The Ballast Point specimens have only 28 ribs and may belong to another species; as they are rather poor siliceous pseudomorphs I have preferred to class them here, at least temporarily.

Type: U. S. Nat. Mus. No. 157525.

Type locality: No. 2646, Oak Grove, Yellow River, Okaloosa County, Fla.

T. delphicum commonly presents a superficial resemblance to *T. malacum* Dall. It does not exhibit, however, anything of the obliquity which characterizes *T. malacum* and differs further in that the costals upon the anterior area number only 6 or 7 instead of 12.

Occurrence: Oak Grove sand, locality 2646[r].

Cardium (Trachycardium) virile Dall

Plate XXIII, Figure 1

1900. *Cardium (Trachycardium) virile* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1086, pl. 48, fig. 1.

Dall described this species as follows:

Shell small, solid, strong, rounded, subovate, with about 38 rather close-set ribs, with narrower channeled interspaces; the anterior ribs to the number of about 14 exhibit the strung and flattened cup imbrication like *Cardium consors* in miniature; the posterior 14 are asymmetrical, with an undulate or irregularly twisted serrate keel on the anterior side of the rib; those in the middle of the disk have a similar keel on the posterior side of the rib; the outer posterior ribs are more or less muricate or spinulose, and the posterior margin is serrate, the rest merely fluted internally; exceptionally perfect small specimens show small and extremely delicate spines on the medial ribs. Altitude 27, longitude 25.5, diameter 18 millimeters.

The delicacy and fragility of the ornamentation of this little shell are such that not a single specimen of many preserved its sculpture intact.

Type: U. S. Nat. Mus. No. 114764.

Type locality: No. 2212, Tenmile Creek, 1 mile west of Baileys Ferry, Calhoun County, Fla.

The massing of the lobate imbrications along the anterior portion of the shell is very characteristic. The umbonal region and the medial portion of the entire shell are relatively free from sculpture, and the ornamentation upon the posterior area is sharper and less crowded than upon the anterior. The small spines upon the medial ribs are posterior in position and posteriorly inclined. The distant processes upon the summits of the ribs in the anterior area in the young gives them quite a different aspect from the adults. The deep serration of the posterior margin is a constant character both in the mature and the immature forms.

Occurrence: Chipola formation, localities 7893[r], 2212[c], 2213[c], 2564[p], 3419[c], 7151[r].

Cardium (Trachycardium) parile Dall

Plate XXIII, Figure 2

1900. *Cardium (Trachycardium) parile* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1086, pl. 48, fig. 17.

1915. *?Cardium (Trachycardium) parile* Dall, U. S. Nat. Mus. Bull. 90, p. 143, pl. 4, fig. 6.

Dall described this species in 1900 as follows:

Shell small, suborbicular, inflated, nearly equilateral, the posterior end slightly more attenuated and produced; beaks full but not high; sculptured with 25 ribs having in section the form of a truncated pyramid, separated by narrower channeled interspaces, elegantly concentrically closely striated; the anterior ten ribs bear ∧-shaped projections, the anterior wing of the ∧ being broad and produced, the posterior narrow and appressed; the four ribs next posterior have on their tops slender arcuate transverse rather sparse imbrications; behind these the projections shift to the posterior side of the summits of the ribs, gradually becoming more oblique, losing the anterior wing of the arch, and finally appearing as delicate spinules nearly parallel with the ribs; interior margin behind strongly serrate, below and in front fluted, the flutings continued to the umbonal cavity as shallow sulci; hinge normal, delicate; a narrow, smooth area between the most anterior rib and the hinge margin. Altitude 15, longitude 15.5, diameter 10 millimeters.

This little species appears to be rather abundant in the sands.

Type: U. S. Nat. Mus. No. 114647.

Type locality: No. 2211, lower bed, Alum Bluff, Liberty County, Fla.

Trachycardium parile Dall is known by its small size, rather distant costals, and subdued ornamentation upon the summits of the costae. Although the umbones are quite full the shell flattens both toward the ventral and the lateral margins, so that the species appears to be less inflated than most of its congeners.

It is abundant at the type locality but is not very common elsewhere.

The specimens from Ballast Point seem a little higher relatively and the costals upon them somewhat narrower and more rounded.

Occurrence: Chipola formation, localities 2213[p], 3419[r], 2211[a], 7183[c], 10660[c], ?6175[r], ?6776[r].

Cardium (Trachycardium) malacum Dall

Plate XXIII, Figure 3

1900. *Cardium (Trachycardium) malacum* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1087, pl. 48, fig. 4.

Dall described this species as follows:

Shell small, solid, somewhat oblique, the upper anterior and lower posterior margins produced, beaks small and low; sculpture of 32 rounded-triangular rather high ribs with very narrow channeled interspaces, which, with the sides of the ribs, are concentrically striated; the first 12 ribs have cuplike imbrications of the strung-convolvulus type, behind which they change by the modification of the anterior part to 7-shaped, and finally to the usual transverse oblique nodulous

type; interior margin sharply and deeply fluted, the channels continued halfway up the disk, the upper posterior margin with seven or eight serrations. Altitude 24, longitude 24, diameter 16 millimeters.

This species has a peculiar obliquity that I have not elsewhere noticed, otherwise its characters are not striking.

Type: U. S. Nat. Mus. No. 135881.

Type locality: No. 2646, Oak Grove, Yellow River, Okaloosa County, Fla.

In the general aspect of the sculpture *Trachycardium malacum* suggests *T. virile* of the Chipola fauna. It is, however, relatively broader and less inflated, the umbones are less prominent and the ribs less numerous. The cups upon the anterior costae are not so dense, the spines upon the medial costae are less delicate, and those upon the posterior more produced. The number of costae upon the anterior area is almost double that of *T. delphicum*, a coexistent species to which *T. malacum* commonly bears a superficial resemblance, and the obliquity which characterizes *T. malacum* is not shared by *T. delphicum*.

Occurrence: Oak Grove sand, localities 2646^{p}, 5630^{r}, 5633^{r}, 7055^{r}, 10659^{r}.

Cardium (Trachycardium) inconspicuum Guppy

1866. *Cardium inconspicuum* Guppy, Geol. Soc. London Quart. Jour., vol. 22, p. 293, pl. 18, fig. 12.

1900. *Cardium* (*Trachycardium*) *inconspicuum* Guppy. Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1082.

Guppy described this species as follows:

Shell elongate, subtrigonal, ovate, ornamented with numerous (38) imbricate radiating ribs broader than their regularly squamose interstices; umbones scarcely prominent; margins strongly dentate; hinge small, with three teeth.

Type: British Museum, Natural History, Geological Department, No. 64091.

Type locality: "Miocene" of Jamaica.

Dall described this species as follows:

The present species has from 36 to 42 ribs, which, when they preserve their outer coat, have a beautiful close concentric threading over the whole shell, except the ribs of the posterior area, which are smooth and polished; the loops of the threads as they pass over the body ribs (as usual in *Cardium*) are convex toward the umbones. When this coating is removed by wear, the tops of the ribs will be flat and polished while their sides show fringing wrinkles. If erosion attack the second surface, the structure of the shell will reproduce pretty faithfully the reversed loops of the original outer coat.

C. inconspicuum Guppy is rather narrow and pointed in the dorsal region, broadening and flattening toward the ventral margin. The costae are unusually low, broad, and flattened. None of the primaries are nodulated, but threads are introduced in the 8 or 9 posterior intercostal channels, which bear minute knobs at rather short intervals.

Occurrence: Chipola formation, localities 2212^{r}, 2213^{r}.

Subgenus CERASTODERMA Mörch

1853. *Cerastoderma* Mörch, Catalogus conchyliorum quae reliquit D. Alphonso d'Aguirra and Gadea Comes de Yoldi, fasc. 2, p. 34.

Type: *Cardium edule* Linnaeus. (Recent along the European shores from the North Atlantic to the Mediterranean.)

Valves closed, rotund, transversely or obliquely ovate, cordate in outline; anterior and posterior areas not defined; radial costae numerous, elevated, smooth or obscurely granulated or imbricated; intercostal areas simple; left cardinals anterior when interlocked.

Cardium (Cerastoderma) panastrum Dall

Plate XXIII, Figure 5

1900. *Cardium* (*Cerastoderma*) *panastrum* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1093, pl. 40, fig. 14.

Dall described this species as follows:

Shell small, solid, plump, slightly oblique and inequilateral, suborbicular, with moderately prominent beaks; sculptured with 21 strong, rounded ribs (of which six are smaller and on the posterior area) separated by narrower, sharply channeled interspaces; concentric sculpture irregular but rather marked, cross-striating the channels and forming thickened loops over the backs of the ribs; surface polished, a small, smooth, pseudolunule in front of the beaks, hinge normal, strong for the size of the shell, the internal margins deeply channeled, the sulci reaching well up on the disk. Altitude 11, longitude 11, diameter 9 millimeters.

Type: U. S. Nat. Mus. No. 107390.

Type locality: No. 2646, Oak Grove, Yellow River, Okaloosa County, Fla.

This species has much the external aspect of a plump *Venericardia*. Its closest likeness is possibly to *C. ctenolium* of the Chipola, a larger, more sparsely costate shell that lacks the concentric corrugation developed upon the anterior half of *C. panastrum*.

The specimen referred to *panastrum* from Walton County is merely a worn fragment of *C. waltonianum* Dall.

Occurrence: Oak Grove sand, localities 2646^{r}, 9961^{r}, 7055^{r}, 10659^{p}, 3749^{r}. Shoal River formation localities 10603^{p}, 10608^{p}.

Cardium (Cerastoderma) druidicum Dall

Plate XXIII, Figure 4

1900. *Cardium* (*Cerastoderma*) *druidicum* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1094, pl. 40, fig. 7.

Dall described this species as follows:

Shell small, rather thin, with moderately high beaks; produced and pointed behind, rounded below and in front; sculptured with about 16 strong, rounded ribs with narrower channeled interspaces; on the posterior area are five flattened, smooth ribs separated by narrow sulci; the anterior ribs, especially toward the margin, show low transverse ridges rather regularly and distantly arranged, as in *Dinocardium*, the ante-

rior four or five ribs, however, are smaller and smooth; transverse sculpture, except that just mentioned, only of incremental lines; a small, smooth pseudolunule; hinge small, delicate, normal; anterior and basal margins fluted, the sulci ascending as high as the lower edges of the adductor scars. Longitude 25, altitude 22.5, diameter 15 millimeters.

This is an elegant little shell foreshadowing the characters of *Dinocardium*, but also related intimately to *Cerastoderma*.

Type: U. S. Nat. Mus. No. 107383.

Type locality: No. 2646, Oak Grove, Yellow River, Okaloosa County, Fla.

The anterior and posterior areas are strongly differentiated in the adults, more so than in the young. The 4 or 5 anterior costae are smooth and very low and rounded, the 5 or 6 posterior costae are smooth and very low and flattened, whereas the 16 or 18 costae upon the disk are prominently elevated and more or less strongly imbricated or striated concentrically. The posterior portion of the shell is more flattened and angulated in *C. druidicum* than in any other of the Alum Bluff representatives of the subgenus.

Occurrence: Oak Grove sand, localities 2646[c], 5632[r], 5633[p], 7054[r].

Cardium (Cerastoderma) chipolanum Dall

Plate XXIII, Figure 9

1900. *Cardium (Cerastoderma) chipolanum* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1098, pl. 40, fig. 8.

Dall described this species as follows:

Shell thin, polished, with large, full beaks; subequilateral, rounded in front and below, obliquely subtruncate behind; sculptured with about 24 strong ribs, of which the anterior five or six are smooth, thence to the middle of the shell with thickened adherent scalelike ornaments (which I call lepidote for short) especially near the margin, the remainder of the ribs smooth, except on their sides, where they are cross-striated, as are the narrow channeled interspaces; posterior area smooth with obsolete radial grooves, one or two near the hinge stronger; no pseudolunule; hinge normal, strong; internal margins sharply fluted, sulci reaching well up on the disk. Longitude 34, altitude 36, diameter 24 millimeters.

This shell in its general characters is a miniature *Cardium robustum*, and is especially characteristic of the Chipola horizon.

Type: U. S. Nat. Mus. No. 114765.

Type locality: No. 2212, Tenmile Creek, 1 mile west of Baileys Ferry, Chipola River, Calhoun County, Fla.

The young are much lower relatively than the adults and more conspicuously flattened and truncated behind, suggesting at first glance a multicostate *C. druidicum*.

Occurrence: Chipola formation, localities 10596[a], 10609[r], 10610[a], 7893[p], 2212[a], 7257[r], 2213[c], 3419[p], 9994[p], 7151[p], 10660[p], 2653[c].

Cardium (Cerastoderma) chipolanum alumen Gardner, n. subsp.

Plate XXIII, Figure 6

Shell rounded, trigonal, inflated in the umbonal region, flattened posteriorly. Anterior lateral margin rounding broadly and smoothly into the base; posterior lateral margin truncated a little obliquely; posterior keel acute. A smooth ill-defined area in front of the beaks. External sculpture simple for the genus; anterior and medial portion of the type sculptured with 16 costae, the 5 anterior very low, smooth, and obliquely inclined, the 7 or 8 succeeding costae adorned, at least toward the ventral margins, with regular concentric imbrications, abruptly initiated anteriorly but evanescing gradually posteriorly, persisting longer upon the sides of the ribs than upon the summits; costae just behind the median line more strongly tabulated than those in front of them or than the one or two in front of the posterior keel; intercostal channels microscopically striated, becoming increasingly wider posteriorly until in very large individuals they are equal in width to the costals; sculpture upon the posterior area reduced to about half a dozen linear grooves, more distant and more deeply impressed toward the dorsal margin. Ligament opisthodetic. Nymph narrow, delimited by a deep groove. Hinge normal, the posterior cardinal in the right valve and the anterior cardinal in the left acute, up-curved, subumbonal, separated by deep trigonal pits, the one from the incipient anterior cardinal in the right valve, the other from the incipient posterior cardinal of the left; laterals acutely compressed; laminae symmetrically spaced with respect to the umbone, those of the right valve separated from the dorsal margins by deep grooves which receive the laminae of the left; the right laterals received in small pits ventral to the laterals of the left valve. Muscle impressions obscured, the anterior higher than the left. Pallial line indistinct. Inner margins deeply fluted, the sulci persisting as faint radiations almost to the umbones.

Dimensions of right valve: Altitude, 32.6 millimeters; latitude, 30.7 millimeters; semidiameter, 11.7 millimeters.

Type: U. S. Nat. Mus. No. 352500.

Type locality: No. 2211, Alum Bluff, Liberty County, Fla.

Cerastoderma chipolanum alumen is more produced and more acutely angulated posteriorly than the typical *chipolanum* and is relatively narrower through the umbonal region. Furthermore, in the Alum Bluff subspecies the costae run a little lower in number and are more strongly tabulated and more widely separated upon the posterior half. A fragment of a very imperfect individual implies dimensions double those of the figured specimen. The subspecies is abundant at the type locality and probably occurs at Boyntons Landing on the Choctawhatchee River. None of the specimens from Boyntons Landing are fully mature, but they differ from the subspecies developed at Alum Bluff in the less marked tabulation of the radials behind the posterior keel. Casts of forms apparently identical with the Alum Bluff species occur in considerable abundance at Sopchoppy in Wakulla County.

Occurrence: Chipola formation, localities 10609[r], 10610[c], ?7893[p], 2211[c], 7183[p], 10660[p], ?7468[c].

Cardium (Cerastoderma) taphrium Dall

Plate XXIII, Figure 7

1900. *Cardium (Cerastoderma) taphrium* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1098, pl. 40, fig. 9.
1900. *Cardium (Cerastoderma) taphrium* Dall, U. S. Nat. Mus. Bull. 90, p. 144, pl. 19, fig. 3 (part).

Dall described this species as follows:

This at first sight might be taken for the preceding species, but an examination shows that the ribs are one-third more numerous, being usually 33 or 34; there is a rather large pseudolunule, the shell is proportionately more produced behind and below and actually larger when mature. The specimen figured is 35 millimeters long, but a full-grown one, obtained later, measures longitude 48, altitude 47, diameter 34 millimeters.

The radial grooves on the posterior area are usually sharper and stronger than in the preceding species. The types come from Oak Grove, where the shell seems characteristic of that horizon. * * *

Type: U. S. Nat. Mus. No. 354046.

Type locality: No. 2646, Oak Grove, Yellow River, Okaloosa County, Fla.

The shell is rather thin and broadly ovate-cordate in outline. The posterior area is well differentiated both by the obtuse carina and the abrupt disappearance of the elevated costae, but it is less flattened and less sharply angulated than in *C. chipolanum*. The costals are low and tabulated but narrower than those of the analogous Chipola species. A count of the ribs on 199 right valves and 178 left valves from Oak Grove has yielded the following figures:

Number of ribs on right and left valves of Cardium (Cerastoderma) taphrium (posterior area excluded)

Ribs	Right valves	Left valves	Ribs	Right valves	Left valves
27	1	0	33	39	40
28	3	1	34	26	23
29	8	10	35	16	11
30	18	12	36	10	9
31	29	30	37	1	6
32	47	35	38	1	1

This count gives an average of 32¼ ribs on the anterior and medial portions of the right valve and a little more than 32½ ribs in the left valve. Of this number 6 or 7 are generally anterior, though they may run as low as 4 or as high as 8. The average number of ribs upon the posterior area, a number not included in the figures given above, is 7 or 8. The intercostal areas are narrow and quite sharply chiseled and free from any sculpture except faint incremental striae. The ligament nymph is rather heavy and cut off by a deep sulcus. The hinge is normal and a little less concentrated than in *C. chipolanum*. The young are relatively broader and more nearly elliptical in transverse outline than the adults. In them the anterior and posterior areas are less differentiated and the anterior portion of the umbonal region is quite bald.

The specimens referred to *C. taphrium* from Ballast Point are finely spinose posteriorly. Some of the very young specimens of *C. taphrium* from Oak Grove retain traces of minute spines, but these are completely obliterated before the individuals attain anything like the dimensions of the forms from Ballast Point. The Shoal River representatives exhibit more than the usual number of ribs but not more than the extreme end members from Oak Grove. Certain very large and imperfect individuals have been tentatively placed near this species, although they are surely distinct, at least subspecifically.

Cerastoderma taphrium Dall is perhaps the most conspicuous element in the bivalve fauna of Oak Grove.

Occurrence: Oak Grove sand, localities 2646[pr], 5632[p], 5631[r], 5630[c], 5633[c], 7054[c], 2652[r], 9961[r], 7055[r], 10659[c]. Shoal River formation, localities 3856[r], ?5080[r], ?5184[r], ?5195[r], 5079[c], 5193[p], ?9960[r], 10603[p], 9959[r].

Cardium (Cerastoderma) waltonianum Dall

Plate XXIII, Figure 8

1900. *Cardium (Cerastoderma) waltonianum* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1093, pl. 48, fig. 19.

Dall described this species as follows:

Shell solid, coarse, strong, elevated, short, with about 40 narrow, flat-topped radial ribs separated by subequal channeled interspaces crossed by lines of growth; a narrow, smooth area on the hinge margin on each side of the high, rather pointed beaks; hinge very strong; internal basal and anterior margins with short flutings. Longitude 45, altitude 45, diameter 28 millimeters.

This shell is more trigonal than *C. craticuloide* and has less elevated ribs; it is not so produced at the ends as *C. leptopleura* Conrad, has narrower and more crowded ribs and a different outline.

Cotypes: U. S. Nat. Mus. No. 113819.

Type locality: No. 2238, Flournoy's mill race at Somerville, 2 miles east of Argyle, Walton County, Fla.

Cerastoderma waltonianum Dall is possibly the analog in the Shoal River fauna of *C. chipolanum* of the Chipola fauna and *C. taphrium* of the Oak Grove. At least it is in so far that it is much the most abundant member of the subgenus at the horizon at which it occurs. It is a larger and heavier shell than either of the other two, the anterior area is not at all differentiated, and the posterior area is relatively ill defined. The costae are decidedly more numerous, narrower, and more elevated and are separated by wider and more squarely channeled intercostals than in either *C. chipolanum* or *C. taphrium*. The young have something of the aspect of a *Protocardia*, as they are bald

in the umbonal and medial regions but radially lirate laterally. Though slightly less abundant at any single locality than *C. taphrium* this species is more commonly present throughout the formation, but unlike either its Chipola or its Oak Grove analog it is peculiarly susceptible to decortication.

Occurrence: Shoal River formation, localities 3856[a], 3742[a], 3731[r], 10658[p], 5080[p], 5184[c], 5195[p], 5194[r], 3733[r], 2238[c], 9958[p], 3748[a], 3747[r], 7261[r], 7264[p], 5618[a], 9959[c].

Subgenus FRAGUM Bolten

1798. *Fragum* Bolten, Museum Boltenianum, pt. 2, p. 189.

Type: *Fragum fragum* Linnaeus = *Fragum flavum* Bolten; not *Fragum flavum* Linnaeus. (Recent in the Indo-Pacific.)

Shell cordate, inflated, truncated posteriorly; lunule and escutcheon not defined; radial costae prominent, variously scupltured; intercostal areas usually simple; left cardinals anterior when interlocked; pallial line relatively near the ventral margin.

The subgenus has a very meager representation in the Shoal River fauna but is common in the rest of the Alum Bluff group.

Section FRAGUM s. s.

Type: *Fragum fragum* Linnaeus = *Fragum flavum* Bolten; not *Fragum flavum* Linnaeus. (Recent in the Indo-Pacific.)

Dall [16] characterized this group as follows:

Valves obtusely angular in front of the truncation, ribs numerous, strong, pustular, or imbricate throughout.

Cardium (Fragum) burnsii Dall

Plate XXIII, Figure 13

1900. *Cardium* (*Fragum*) *burnsii* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1101, pl. 48, fig. 15.

Dall described this species as follows:

Shell small, subquadrate, moderately inflated, truncate behind, rounded in front, with rather low beaks; sculpture of on the body 22 to 24 subequal rounded ribs with narrower channeled interspaces, sharply cross striated between the ribs; on the posterior truncation 12 to 14 similar but smaller ribs, a few near the hinge margin wider than the rest with no marked smooth area between them and the margin either in front of or behind the umbones; an easily detachable outer layer covers the ribs with fine concentric threading, rising at intervals into semilunar small nodules, all of which is frequently worn off when the ribs appear polished; internally, the margin is strongly fluted; hinge normal, strong. Longitude 6.5, altitude 7.0, diameter 6.0 millimeters. A single broken valve reaches 10 millimeters in height.

This little shell stands almost midway between typical *Fragum* and *Trigoniocardia*, having the striated interspaces of the latter and the numerous similar subequal ribs of the former. It seems abundant in the marls.

Type: U. S. Nat. Mus. No. 114770.

Type locality: No. 2213, 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.

[16] Dall, W. H., Contributions to the Tertiary fauna of Florida: Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1075, 1900.

Fragum burnsii is the least inflated and by far the most closely sculptured of the Alum Bluff representatives of the subgenus.

Occurrence: Chipola formation, localities 7257[r], 2213[c], 2564[p], 3419[p], 7151[r], 7183[p], 10660[c].

Section TRIGONIOCARDIA Dall

1900. *Trigoniocardia* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1075.

Type: *Cardium graniferum* Broderip and Sowerby. (Recent from the Gulf of California to Panama.)

Dall characterized this group as follows:

Shell small, few ribbed, medial ribs very strong; posterior end subtruncate with smaller closer ribs; channels strongly concentrically sculptured; shell colorless, periostracum smooth.

Cardium [Fragum (Trigoniocardia)] aliculum Dall

Plate XXIII, Figure 15

1900. *Cardium* (*Trigoniocardia*) *alicula* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1103, pl. 48, fig. 5; not pl. 40, fig. 12.

Not *Cardium* (*Trigoniocardia*) *alicula* Dall, U. S. Nat. Mus. Bull. 90, p. 144, pl. 25, fig. 8, 1915.

Dall described this species as follows:

Shell obliquely subtriangular, elevated, narrow, truncate behind the beaks, rounded above in front and pointed below; beaks high, carinated behind the keel defining the posterior area; posterior area with eight low, flat ribs, the upper ones broader; body with twelve similar but larger ribs separated by narrow cross-striated channels deeper near the keel and almost obsolete in front; on top of the ribs when perfect are rounded pustules, sparse, very fragile, and usually worn off; the pustules on the ribs of the posterior area are more elongate, oblique, and rarely arcuate; margin fluted internally, hinge strong. Altitude when fully mature 19, longitude 14, diameter 14 millimeters.

Cotypes: U. S. Nat. Mus. No. 157550.

Type locality: No. 2213, 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.

Fragum aliculum is well characterized by the conspicuously trigonal outline. The costal which defines the posterior keel is the most prominent of all and is strongly arcuated. There is usually a broad and more or less strongly marked depression of the medial part of the posterior area and, in the young ones, commonly a very feeble constriction in front of the keel.

The Ballast Point specimens are relatively higher and much narrower dorsally, with no trace of a constriction either behind or in front of the posterior keel and with fewer and even lower costals.

Occurrence: Chipola formation, localities 10610[p], 2213[c], 2211[a], 7183[a], 10660[a].

Cardium [Fragum (Trigoniocardia)] sellardsi Gardner, n. sp.

Plate XXIII, Figures 11–12

Shell small, heavy, highly inflated, the interior subquadrate in outline. Umbones flattened toward their tips, incurved, prosogyrate. Anterior margin round-

ing smoothly into the base; basal margin truncate in front of the posterior keel; posterior area flattened, well differentiated; posterior margin truncate, the posterior basal angle approximating 90°. Radial sculpture vigorous; radials elevated, somewhat flattened upon their summits, separated by broad U-shaped interradials of about the same width though a little narrower relatively in the adults and upon the posterior area of individuals of all ages; from 13 to 16 radials on the anterior and medial portions of the valve and generally 9 on the posterior area; both radials and interradials crossed by crowded, concentric, imbricating lamellae, most prominent upon the summits, nearly obsolete upon the sides of the costals, and rather feeble in the intercostal channels; every third or fourth lamella relatively strong and developed into a lobate process upon the summits of the ribs. Ligament opisthodetic. Dentition normal, the posterior cardinal in the right valve and the anterior cardinal in the left robust, acute, upcurved, subumbonal, separated by deep trigonal pits, the one from the incipient anterior cardinal in the right valve, the other from the incipient posterior cardinal of the left. Laterals obtuse, the posterior the more remote from the umbones, those of the right valve separated from the dorsal margins by deep grooves which receive the laminae of the left; the right laterals received in small pits ventral to the laterals of the left valve. Muscle impressions large and distinct for the genus, set high up near the hinge plate and close to the lateral margins. Inner margins deeply fluted.

Dimensions of right valve: Altitude, 8.3 millimeters; latitude, 8.3 millimeters; semidiameter, 4.0 millimeters. Dimensions of left valve: Altitude, 7.6 millimeters; latitude. 7.5 millimeters · semidiameter, 4.0 millimeters.

Cotypes: U. S. Nat. Mus. No. 352493.

Type locality: No. 7893, Boynton Landing, Choctawhatchee River, Washington County, Fla.

I have the pleasure of naming this interesting species in honor of the collector, Dr. E. H. Sellards, formerly State geologist of Florida, now acting director of the Bureau of Economic Geology of Texas.

Fragum sellardsi Gardner, n. sp., resembles in general outline and character of ornamentation *F. simrothi*, also from the Chipola, but the posterior basal angle is not produced, the costals are more numerous, more uniform, and not so coarse upon the medial portion of the disk. The concentric lamellae have not been observed upon the costals of *F. simrothi*, although the nodules developed from them have persisted. As in most of the Cardiums the secondary sculpture decorticates readily, leaving the radials smooth and shining and exhibiting no trace of mutilation.

Occurrence: Chipola formation, localities, 7893^{p}, 7183^{r}.

Cardium [Fragum (Trigoniocardia)] simrothi Dall

Plate XXIII, Figure 10

1900. *Cardium (Trigoniocardia) simrothi* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1104, pl. 48, fig. 8.

Dall described this species as follows:

Shell small, oblique quadrate, plump, rounded in front and especially on the anterior basal margin, truncate and slightly alate behind; beaks high, involute and prosogyrate; body with 11 broad, flat, rapidly widening low ribs separated by narrow interspaces in which the cross grooves are so wide that their interspaces appear as narrow, elevated, concentric threads; ribs on the truncation seven or eight, smaller and more crowded; when perfect the ribs are surmounted by small pustules, oblong in a transverse sense on the body and droplike in a vertical sense on the truncation; internal margin fluted, hinge normal, strong, with very deep sockets and conical teeth. Altitude 13, longitude 9.5, diameter 10 millimeters.

In measuring these oblique species the altitude is taken from the point of the valve below to the top of the umbo. This shell much resembles the Caloosahatchie species but is squarer, with the hinge margin more produced behind and with pustules of a more transverse and different shape.

Cotypes: U. S. Nat. Mus. No. 114767.

Type locality: No. 2213, 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.

The two ribs directly in front of the posterior keel are commonly a little narrower than those anterior to them and seem to lose their ornamentation more readily, thus lending to the costal which defines the posterior keel a prominence which it would not otherwise possess. In *F. sellardsi* Gardner, n. sp., the posterior basal angle is not produced and the costals upon the medial portion of the disk are approximately uniform in prominence and spacing.

Occurrence: Chipola formation, localities 10596^{c}, 2213^{c}, 2564^{pr}, 3419^{pr}, 9994^{c}, 10660^{r}.

Cardium [Fragum (Trigoniocardia)] apateticum Dall

Plate XXIII, Figure 14

1900. *Cardium (Trigoniocardia) apateticum* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1105, pl. 48, fig. 6.

Dall described this species as follows:

Shell small, oblique, produced behind at the hinge line, obliquely truncate, evenly rounded from in front into the base; beaks rather high, carinate behind, and prosogyrate; truncation with nine and body with 13 ribs, low, flat, wide on the body and rapidly broadening with very narrow interspaces squarely channeled; on the truncation the ribs, as usual, are smaller and more crowded and decrease in size from within outward; the channels are crossed by fine, sharp, evenly spaced elevated lamellae which have a punctate appearance in the narrower interspaces; these threads rise on the sides of the ribs and pass over them as fine concentric threads; internal margin fluted, hinge strong, with a small, smooth space on each side of the umbones simulating lunule and escutcheon. Altitude 11.5, longitude 8, diameter 7 millimeters.

This is the only species which when perfectly intact is without nodules.

Type: U. S. Nat. Mus. No. 107384.

Type locality: No. 2646, Oak Grove, Yellow River, Okaloosa County, Fla.

Even this species is nodulated when intact. No absolutely perfect individual was found, but a few

specimens have been observed in which small rounded nodes are retained on the posterior sides of the ribs of the body and similar but rather more prominent nodes upon the rib which outlines the keel and upon the truncated posterior area. When decorticated they leave a fresh polished surface with no trace of a scar.

Fragum apateticum Dall is rather suggestive of *F. simrothi* in general outline though somewhat less inflated and not so heavy, especially in the hinge area. Aside from the fact that in *F. simrothi* the nodular sculpture is almost invariably retained in a greater or less degree and in *F. apateticum* almost never, the species may be differentiated by the more uniform ribbing of *F. apateticum*. In *F. simrothi* the two costae in front of the posterior keel are perceptibly narrower than those anterior to them, but this irregularity if present in *apateticum* is much less marked.

The species is characteristic of the Oak Grove and abundant in it.

Occurrence: Oak Grove sand, localities 2646[a], 5632[a], 5631[p], 5633[r], 7054[c], 9961[p]. Shoal River formation, locality 5079[p].

Subgenus PAPYRIDEA Swainson

1840. *Papyridea* Swainson, Treatise on malacology, p. 374.

Type: *Cardium soleniforme* Bruguière = *Cardium spinosum* Meuschen. (Recent from Cape Hatteras to Santa Marta, Brazil.)

Swainson characterized this group as follows:

Shell heart-shaped or transversely oval; inequilateral; the anterior side almost always gaping.

The radial costae are numerous and more or less nodular or spinose.

Cardium (Papyridea) bulbosum Dall

Plate XXIII, Figure 17

1900. *Cardium* (*Papyridea*) *bulbosum* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1109, pl. 48, fig. 20.

Dall described this species as follows:

Shell ovate, moderately inflated, with about 38 ribs, 9 anterior with minute spines on the anterior side of each rib near the margin; 16 medial, low and rounded, with narrower chaneled interspaces; 13 posterior, low and obliquely flattened, with their highest part on the posterior side, the last 3 or 4 bearing minute spiny pustules; beaks low, pointed, smooth, margin crenulate, serrate above behind; hinge normal. Longitude 27, altitude 23.5, diameter 10 millimeters.

This species is * * * especially notable for the small number of anterior ribs and the very sparse muricate sculpture.

Type: U. S. Nat. Mus. No. 114762.

Type locality: No. 2213, 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.

The type is unique and the only member of the subgenus which has yet been detected in the Alum Bluff.

Occurrence: Chipola formation, locality 2213[r].

Subgenus LAEVICARDIUM Swainson

1840. *Laevicardium* Swainson, Treatise on malacology, p. 373.

Type: *Cardium europaeum* Wood. (Recent on the west coast of Europe and in the Mediterranean.)

Swainson characterized this group as follows:

Shell longitudinally oval, inequilateral, the surface neither ribbed nor spired.

Dall [17] described this subgenus as follows:

Shell thin, oval, closed, middle of the valves smooth or feebly radially sculptured, ends with a smooth area, hinge normal, but with the anterior laterals springing from the umbonal cavity; periostracum smooth.

Cardium (Laevicardium) compressum Dall

Plate XXIII, Figure 16

1900. *Cardium* (*Laevicardium*) *compressum* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1109, pl. 48, fig. 21.

Dall described this subgenus as follows:

Shell small, plump, inequilateral, with convex beaks nearer the anterior end; surface smooth over a small anterior area, and over the posterior area which is compressed so that the pinch gives to the lower posterior margin a distinct insinuation; between these the disk is covered by minute radii which, though conspicuous in eroded shells, hardly interrupt the smoothness of the surface when perfect; the outline is rounded in front and below and slightly oblique; interior polished, with the adductor scars impressed; the margin, except of the anterior and posterior areas, finely serrate. Longitude 24, altitude 26, diameter 14 millimeters.

All the species of *Laevicardium* are very similar shells especially when they have lost color by fossilization, but this species is readily recognizable by the small size of the smooth areas and the peculiar pinching of the posterior areas.

Type: U. S. Nat. Mus. No. 114769.

Type locality: No. 2213, 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.

The young are very thin, almost papyraceous, and relatively broader than the adults. They show no trace whatever of any radial lineation upon the larval shell, which is much more commonly retained than in most species. The hinge is unusually delicate.

Occurrence: Chipola formation, localities 7893[p], 2212[p], 7257[p], 2213[c], 3419[r], 7151[p], 2211[c]. Oak Grove sand, locality 2646[c].

Genus PROTOCARDIA Beyrich

1845. *Protocardia*. Beyrich, Zeitschrift für Malacologie, p. 17.

Type: *Cardium hillanum* Sowerby. (Cenomanian of Europe.)

The characters which separate *Protocardia* from *Cardium* are the sharply differentiated radial sculpture on the posterior portion of the shell, the large posterior muscle scar, and the incipient pallial sinus.

The genus is represented in the Shoal River by two imperfect individuals, both of them apparently distinct from any described species and neither of them sufficiently well preserved to be named. One of them is very small, smaller even than *P. jamaicensis*, and very similar to that form in general outline and in the aspect of the radial sculpture but wanting the concentric threading which characterizes the Jamaican species. The other vaguely suggests *C. nicoleti* of the upper Eocene but differs conspicuously in the rather fine and somewhat irregular concentric undulation of the anterior portion of the shell.

[17] Dall, W. H., Contributions to the Tertiary fauna of Florida: Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1076, 1900.

PLATES XVIII–XXIII

PLATE XVIII

[The specimen figured is the type unless otherwise stated]

FIGURE 1. *Codakia (Jagonia) erosa* Dall (p. 103). Exterior of left valve; altitude, 6.5 millimeters; latitude, 6.7 millimeters. (After Dall.)

FIGURE 2. *Codakia (Jagonia) chipolana* Dall (pp. 103–104). Exterior of left valve; altitude, 7.5 millimeters; latitude, 8.0 millimeters. (After Dall.)

FIGURES 3–4. *Lucina corpulenta* Dall (p. 105).

3. Apical view of double valves; altitude, 38.5 millimeters; latitude, 42.5 millimeters; diameter, 32.0 millimeters. (After Dall.)
4. Exterior of left valve of same individual; altitude, 38.5 millimeters; latitude, 42.5 millimeters. (After Dall.)

FIGURE 5. *Lucina janus* Dall (p. 105). Exterior of right valve; altitude, 30.0 millimeters; latitude, 33.5 millimeters; diameter, 19.0 millimeters. (After Dall.)

FIGURE 6. *Lucina santarosana* Dall (p. 105). Exterior of right valve; altitude, 33.0 millimeters; latitude, 39.0 millimeters. (After Dall.)

FIGURES 7–9. *Myrtaea waltonensis* Gardner, n. sp. (p. 106).

7. Exterior of right valve; altitude, 7.1 millimeters; latitude, 8.2 millimeters.
8. Hinge area of right valve of another individual (not the type).
9. Interior of right valve; altitude, 7.1 millimeters; latitude, 8.2 millimeters.

FIGURE 10. *Phacoides (Linga) glenni* Dall (pp. 107–108). Exterior of right valve; altitude, 32.0 millimeters; latitude, 30.0 millimeters. (After Dall.)

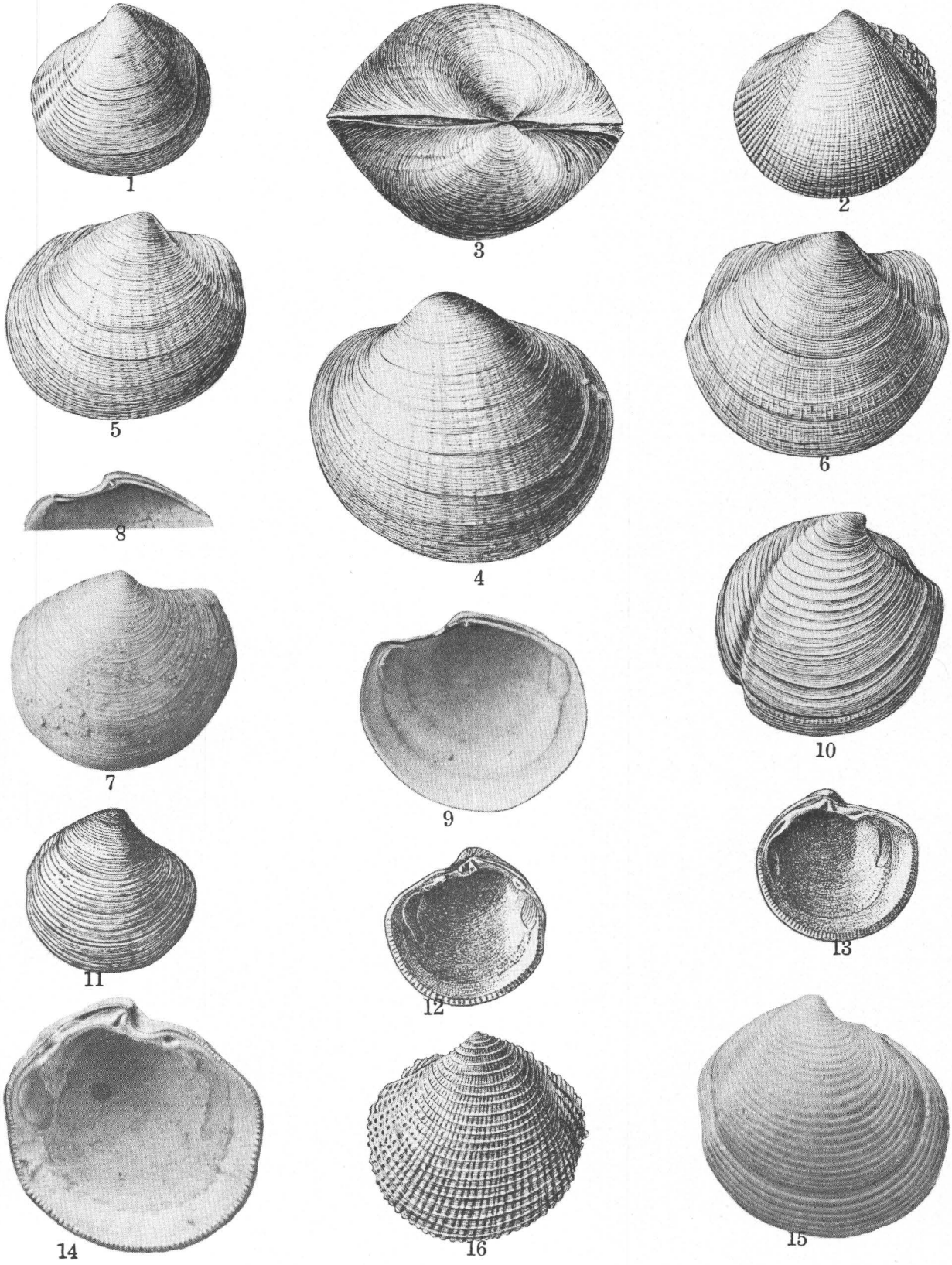
FIGURES 11–13. *Phacoides (Cardiolucina) trisulcatus* (Conrad) Dall (pp. 108–109).

11. Exterior of right valve (not the type); altitude, 8.0 millimeters; latitude, 8.5 millimeters. (After Glenn.)
12. Interior of right valve (not the type); altitude, 8.0 millimeters; latitude, 8.5 millimeters. (After Glenn.)
13. Interior of left valve (not the type); altitude, 8.0 millimeters; latitude, 8.5 millimeters. (After Glenn.)

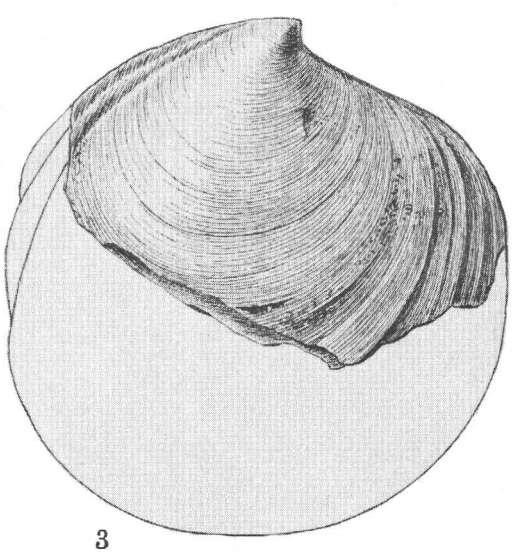
FIGURES 14–15. *Phacoides (Cardiolucina) parawhitfieldi* Gardner, n. sp. (pp. 109–110).

14. Interior of left valve (cotype); altitude, 8.2 millimeters; latitude, 8.7 millimeters.
15. Exterior of right valve (cotype); altitude, 8.0 millimeters; latitude, 8.2 millimeters.

FIGURE 16. *Phacoides (Lucinisca) calhounensis* Dall (p. 110). Exterior of left valve; altitude, 9.5 millimeters; latitude, 10.0 millimeters. (After Dall.)



LUCINACEA OF THE ALUM BLUFF GROUP



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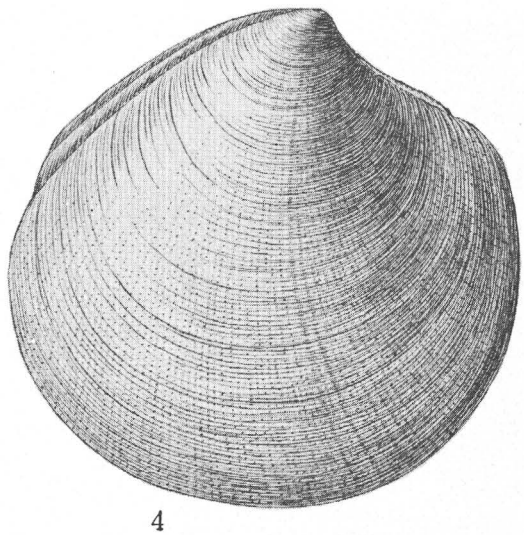

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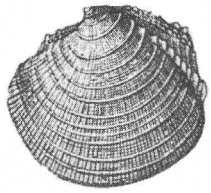

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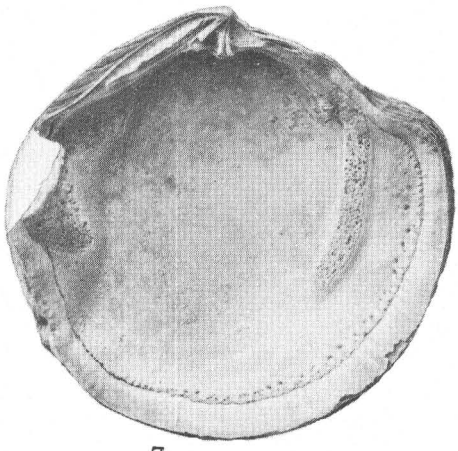

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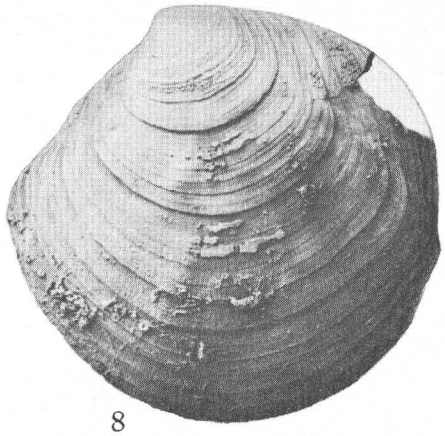

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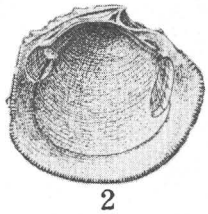

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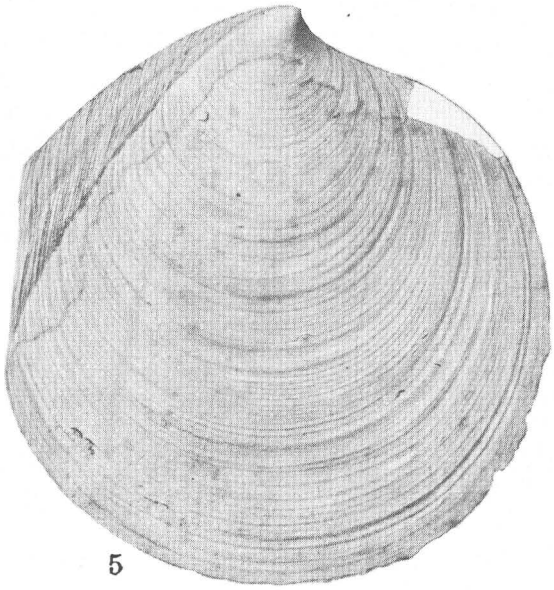

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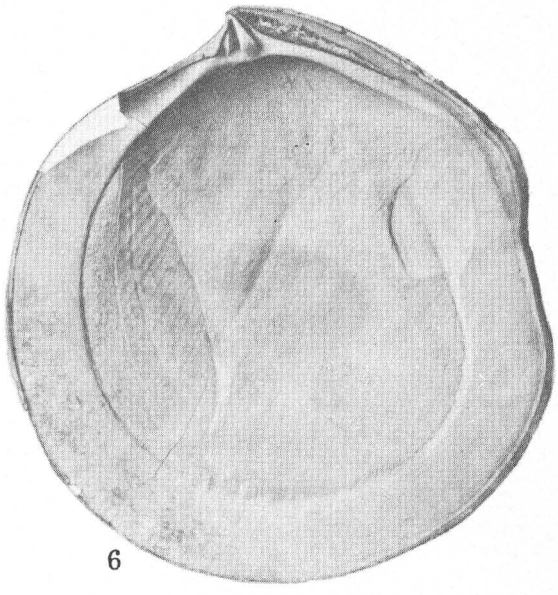

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LUCINACEA OF THE ALUM BLUFF GROUP

PLATE XIX

FIGURES 1–2. *Phacoides* (*Lucinisca*) *plesiolophus* Dall (pp. 110–111).

1. Exterior of left valve; altitude, 15.0 millimeters; latitude, 15.5 millimeters. (After Dall.)
2. Interior of left valve; altitude, 15.0 millimeters; latitude, 15.5 millimeters. (After Dall.)

FIGURES 3–6. *Phacoides* (*Miltha*) *chipolanus* Dall (p. 111).

3. Exterior of fragment of right valve. (After Dall.)
4. Exterior of right valve of type of *Phacoides* (*Miltha*) *heracleus* Dall; altitude, 80.0± millimeters; latitude, 80.0±millimeters. (After Dall.)
5. Exterior of right valve (not the type); altitude, 74.0 millimeters; latitude, 68.0 millimeters.
6. Interior of right valve (not the type); altitude, 74.0 millimeters; latitude, 68.0 millimeters.

FIGURES 7–8. *Phacoides* (*Miltha*) *heilprini* Gardner, n. sp. (p. 112).

7. Interior of left valve; altitude, 56.5 millimeters; latitude, 57.5 millimeters.
8. Exterior of left valve; altitude, 56.5 millimeters; latitude, 57.5 millimeters.

PLATE XX

FIGURES 1–2. *Phacoides* (*Miltha*) *xustris* Gardner, n. sp. (p. 112).

1. Interior of left valve; altitude, 37.0 millimeters; latitude, 36.5 millimeters.
2. Exterior of right valve of same individual; altitude, 37.0 millimeters; latitude, 36.5 millimeters.

FIGURES 3–5. *Phacoides* (*Pseudomiltha*) *paranodonta* Gardner, n. sp. (p. 113).

3. Interior of left valve; altitude, 26.0 millimeters; latitude, 27.0 millimeters.
4. Exterior of left valve; altitude, 26.0 millimeters; latitude, 27.0 millimeters.
5. Anterior view of double valves; diameter, 10.0 millimeters.

FIGURE 6. *Phacoides* (*Parvilucina*) *sphaeriolus* Dall (p. 113). Exterior of left valve; altitude, 4.0 millimeters; latitude, 4.5 millimeters. (After Dall.)

FIGURE 7. *Phacoides* (*Parvilucina*) *sphaeriolus* subsp. *angaleus* Gardner, n. subsp. (pp. 113–114). Exterior of right valve; altitude, 3.2 millimeters; latitude, 3.2 millimeters.

FIGURES 8–9. *Phacoides* (*Parvilucina*) *vaughani* Gardner, n. sp. (p. 114).

8. Exterior of right valve; altitude, 4.0 millimeters; latitude, 4.0 millimeters.
9. Interior of right valve; altitude, 4.0 millimeters; latitude, 4.0 millimeters.

FIGURE 10. *Phacoides* (*Parvilucina*) *piluliformis* Dall (pp. 114–115). Exterior of left valve; altitude, 5.0 millimeters; latitude, 4.7 millimeters. (After Dall.)

FIGURE 11. *Phacoides* (*Parvilucina*) *flumenvadosa* Gardner, n. sp. (p. 115). Exterior of left valve; altitude, 3.0 millimeters; latitude, 3.0 millimeters.

FIGURE 12. *Phacoides* [*Parvilucina* (*Bellucina*)] *eupheus* Gardner, n. sp. (pp. 115–116). Exterior of left valve; altitude, 3.0 millimeters; latitude, 3.2 millimeters.

FIGURES 13–14. *Divaricella waltonia* Gardner, n. sp. (p. 117).

13. Exterior of left valve; altitude, 11.0 millimeters; latitude, 11.5 millimeters.
14. Interior of right valve; altitude, 11.0 millimeters; latitude, 11.5 millimeters.

FIGURE 15. *Divaricella chipolana* Dall (p. 117). Exterior of left valve; altitude, 17.0 millimeters; latitude, 18.5 millimeters. (After Dall.)

FIGURES 16–19. *Diplodonta nucleiformis* (Wagner) (p. 118).

16. Exterior of left valve (not the type); altitude, 6.0 millimeters; latitude, 6.3 millimeters.
17. Interior of left valve (not the type); altitude, 6.0 millimeters; latitude, 6.3 millimeters.
18. Exterior of left valve (not the type); altitude, 5.3 millimeters; latitude, 5.5 millimeters.
19. Interior of left valve (not the type); altitude, 5.3 millimeters; latitude, 5.5 millimeters.

FIGURES 20–21. *Diplodonta* (*nucleiformis* subsp.?) *sphaeromorpha* Gardner, n. sp. (p. 118).

20. Interior of right valve; altitude, 4.7 millimeters; latitude, 4.6 millimeters.
21. Horizontal profile of right valve; latitude, 4.6 millimeters; semidiameter, 1.5 millimeters.

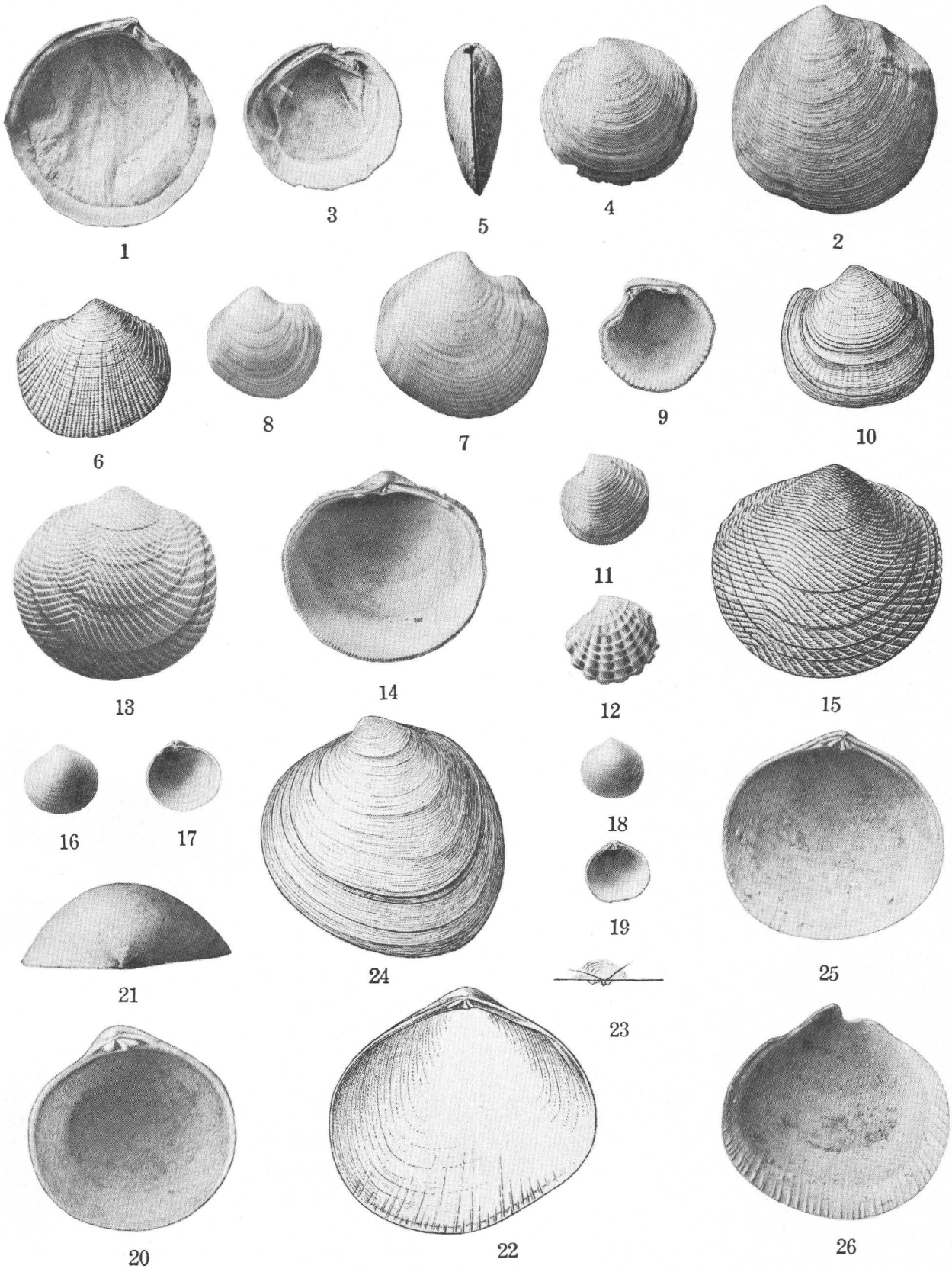
FIGURES 22–23. *Diplodonta radiata* Dall (p. 119).

22. Interior of left valve; altitude, 18.0 millimeters; latitude, 19.0 millimeters. (After Dall.)
23. Profile of hinge of left valve. (After Dall.)

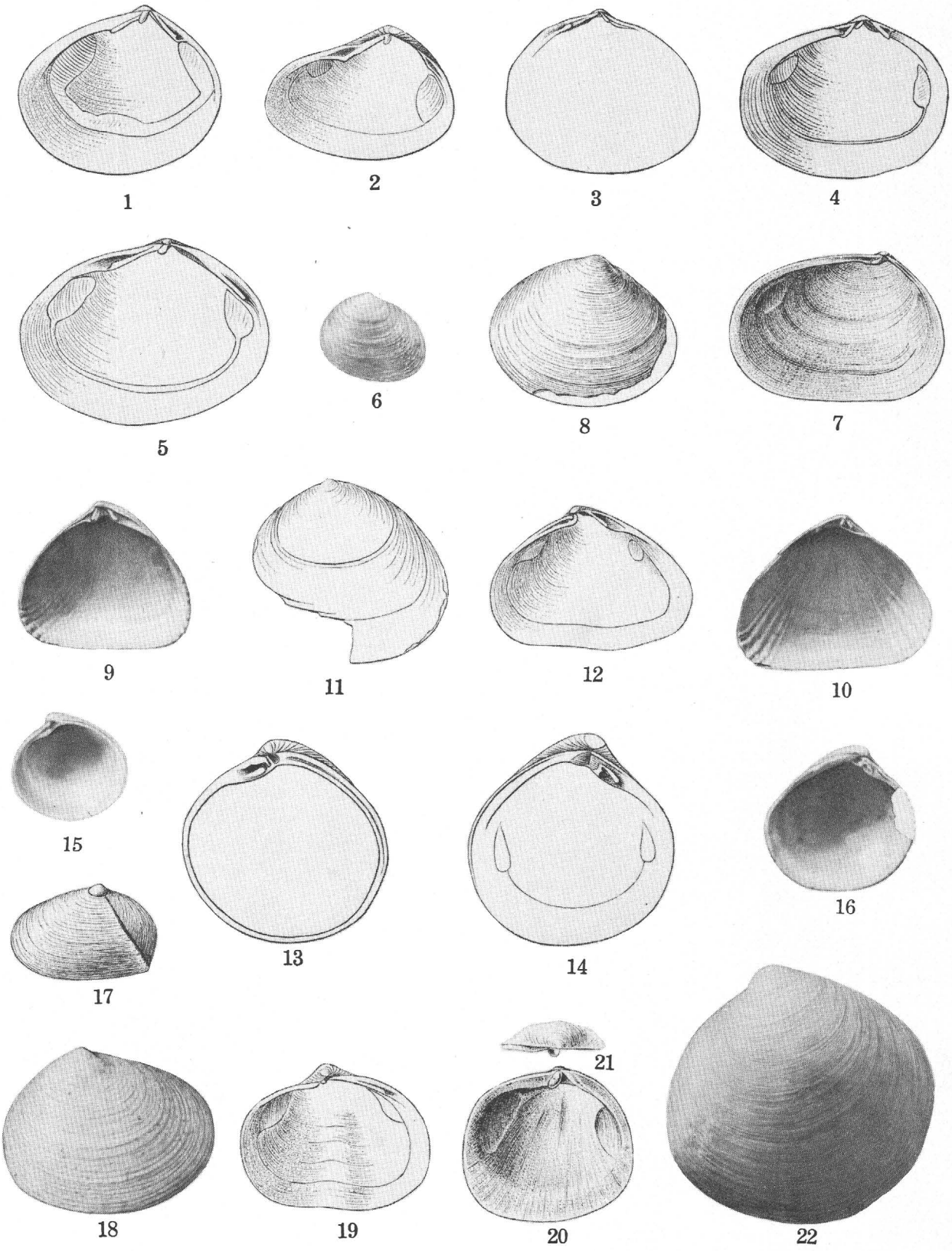
FIGURE 24. *Diplodonta paralta* Gardner, n. sp. (p. 119). Exterior of left valve; altitude, 27.0 millimeters; latitude, 26.0 millimeters. (After Dall.)

FIGURES 25–26. *Diplodonta leptodoma* Gardner, n. sp. (p. 119).

25. Interior of left valve (cotype); altitude, 7.5 millimeters; latitude, 8.0 millimeters.
26. Interior of right valve (cotype); altitude 12.0± millimeters; latitude, 12.5 millimeters.



LUCINACEA OF THE ALUM BLUFF GROUP



LUCINACEA AND LEPTONACEA OF THE ALUM BLUFF GROUP

PLATE XXI

FIGURE 1. *Erycina undosa* Dall (p. 122). Interior of right valve; altitude, 2.8 millimeters; latitude, 3.5 millimeters. (After Dall.)

FIGURE 2. *Erycina chipolana* Dall (p. 122). Interior of right valve; altitude, 3.0 millimeters; latitude, 4.1 millimeters. (After Dall.)

FIGURES 3–4. *Erycina curtidens* Dall (p. 123).

3. Interior of left valve (cotype); altitude, 2.9 millimeters; latitude, 3.5 millimeters. (After Dall.)
4. Interior of right valve (cotype); altitude, 2.7 millimeters; latitude, 3.4 millimeters. (After Dall.)

FIGURES 5–6. *Erycina fabulina* Dall (p. 123).

5. Interior of right valve (cotype); altitude, 3.6 millimeters; latitude, 5.0 millimeters.
6. Exterior of right valve (cotype); altitude, 2.9 milimeters; latitude, 3.6 millimeters. (After Dall.)

FIGURE 7. *Erycina (Scacchia) actinophora* (Dall) (pp. 123–124). Interior of right valve; altitude, 6.2 millimeters; latitude, 8.6 millimeters. (After Dall.)

FIGURE 8. *Sportella lubrica* Dall (p. 127). Exterior of right valve; altitude, 4.5 millimeters; latitude, 5.2 millimeters. (After Dall.)

FIGURES 9–10. *Bornia virgata* Gardner, n. sp. (p. 125).

9. Interior of right valve (cotype); altitude, 5.0 millimeters; latitude, 6.0 millimeters.
10. Interior of left valve of another individual (cotype); altitude, 5.1 millimeters; latitude, 6.7 millimeters.

FIGURE 11. *Bornia floridana* Dall (p. 124). Exterior of left valve; altitude, 6.8 millimeters; latitude, 7.5 millimeters. (After Dall.)

FIGURE 12. *Bornia dodona* Dall (p. 124). Interior of right valve; altitude, 3.7 millimeters; latitude, 5.25 millimeters. (After Dall.)

FIGURES 13–14. *Alveinus rotundus* Dall (p. 128).

13. Interior of right valve (cotype); altitude, 1.9 millimeters; latitude, 1.9 millimeters. (After Dall.)
14. Interior of left valve (cotype); altitude, 1.9 millimeters; latitude, 2.0 millimeters. (After Dall.)

FIGURES 15–16. *Alveinus micculus* Gardner, n. sp. (pp. 128–129).

15. Interior of right valve (cotype); altitude, 1.8 millimeters; latitude, 1.8 millimeters.
16. Interior of left valve (cotype); altitude, 2.3 millimeters; latitude, 2.3 millimeters.

FIGURE 17. *Sportella unicarinata* Dall (p. 126). Exterior of left valve (cotype); altitude, 2.5 millimeters; latitude, 3.7 millimeters. (After Dall.)

FIGURE 18. *Erycina scaptera* Gardner, n. sp. (pp. 122–123). Exterior of right valve; altitude, 5.5 millimeters; latitude, 7.0 millimeters.

FIGURE 19. *Hindsiella nephritica* Dall (pp. 127–128). Interior of right valve; altitude, 3.5 millimeters; latitude, 4.75 millimeters. (After Dall.)

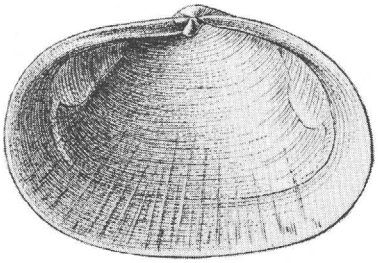
FIGURES 20–21. *Sportella obolus* Dall (p. 127).

20. Interior of right valve; altitude, 4.0 millimeters; latitude, 4.5 millimeters. (After Dall.)
21. Profile of hinge of right valve. (After Dall.)

FIGURE 22. *Diplodonta (Phlyctiderma) glos* Gardner, n. sp. (pp. 120–121). Exterior of left valve; altitude, 15.0 millimeters; latitude, 16.0 millimeters.

PLATE XXII

FIGURE 1. *Sportella lioconcha* Dall (p. 126). Interior of right valve; altitude, 8.3 millimeters; latitude, 12.5millimeters. (After Dall.)
FIGURE 2. *Aligena lineata* Dall (p. 130). Exterior of left valve; altitude, 7.0 millimeters; latitude, 8.0 millimeters. (After Dall.)
FIGURE 3. *Montacuta chipolana* Dall (p. 129). Interior of left valve; altitude, 3.7 millimeters; latitude, 6.5 millimeters. (After Dall.)
FIGURE 4. *Sportella leura* Gardner, n. sp. (p. 126). Interior of right valve; altitude, 6.7 millimeters; latitude, 9.5 millimeters.
FIGURE 5. *Cardium* (*Acanthocardia*) *propeciliare* Dall (pp. 132–133). Exterior of left valve; altitude, 20.0 millimeters; latitude, 20.0 millimeters. (After Dall.)
FIGURE 6. *Cardium* (*Acanthocardia*) *ctenolium* Dall (p. 133). Exterior of left valve; altitude, 18.5 millimeters; latitude, 19.5 millimeters. (After Dall.)
FIGURE 7. *Cardium* (*Acanthocardia*) *acrocome* Dall (p. 133). Exterior of right valve; altitude, 7.5 millimeters; latitude, 7.5 millimeters. (After Dall.)
FIGURE 8. *Cardium* (*Trachycardium*) *cestum* Dall (pp. 133–134). Exterior of right valve (cotype); altitude, 32.0 millimeters; latitude, 27.0 millimeters. (After Dall.)
FIGURE 9. *Cardium* (*Trachycardium*) *delphicum* Dall (pp. 135–136). Exterior of left valve; altitude, 34.0 millimeters; latitude, 29.0 millimeters. (After Dall.)
FIGURES 10–11. *Cardium* (*Trachycardium*) *plectopleura* Gardner, n. sp. (pp. 134–135).
10. Exterior of left valve (cotype); altitude, 47.2 millimeters; latitude, 37.5 millimeters.
11. Interior of right valve of another individual (cotype); altitude, 45.6 millimeters; latitude, 35.8 millimeters.
FIGURE 12. *Cardium* (*Trachycardium*) *ustrix* Gardner, n. sp. (p. 135). Exterior of right valve; altitude, 42.0 millimeters; latitude, 35.0 millimeters.



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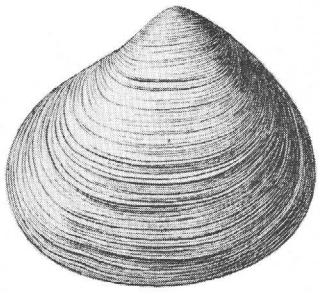

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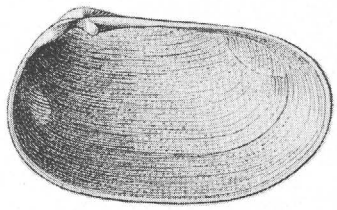

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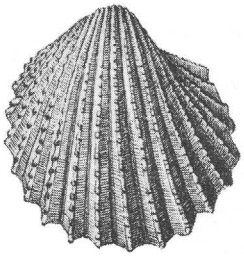

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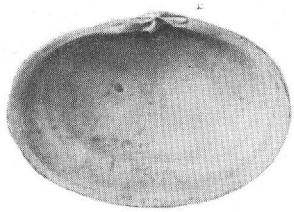

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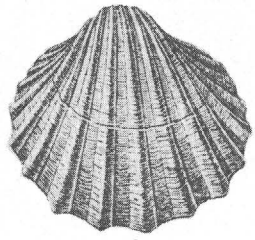

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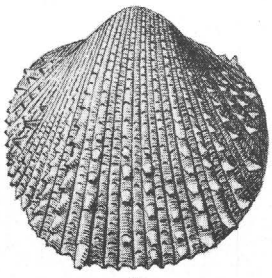

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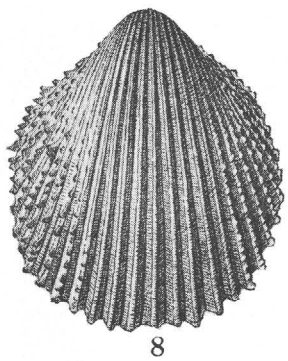

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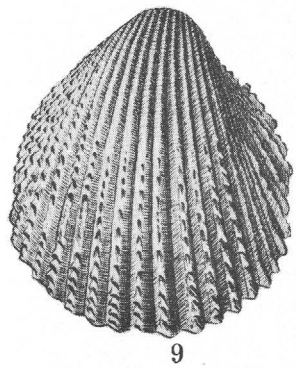

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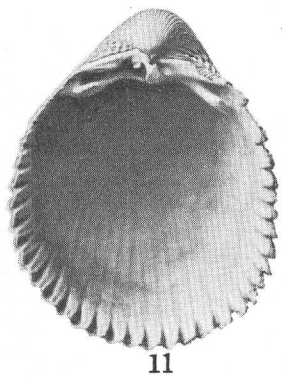

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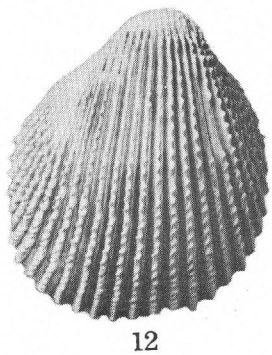

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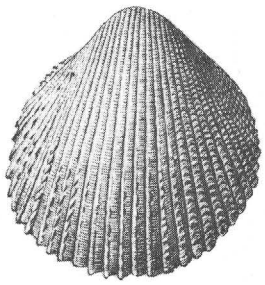
LEPTONACEA AND CARDIACEA OF THE ALUM BLUFF GROUP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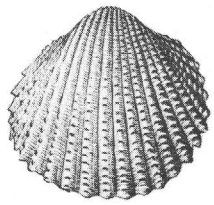
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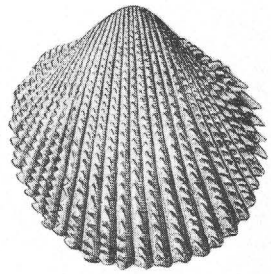
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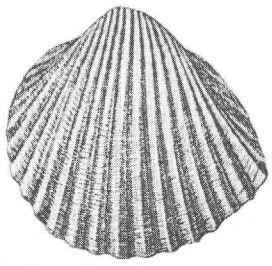
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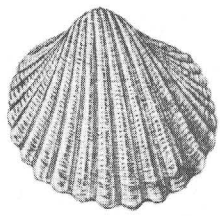
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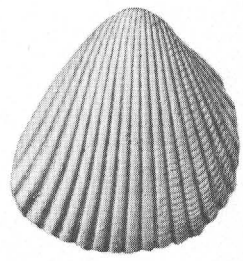
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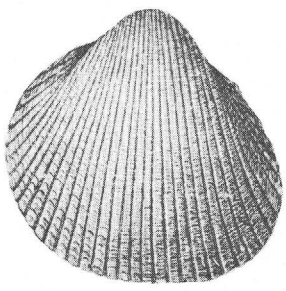
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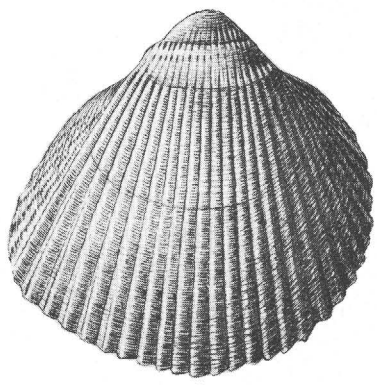
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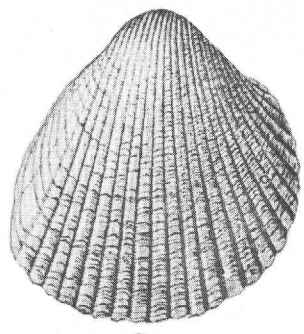
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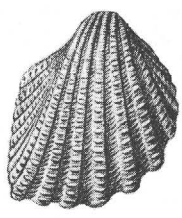
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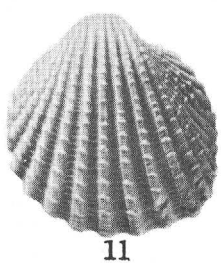
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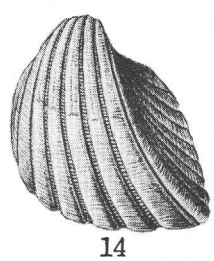
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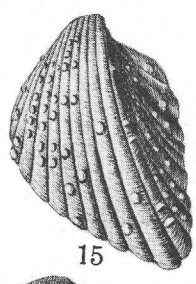
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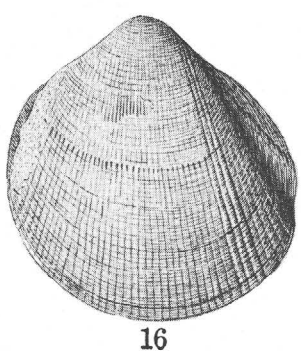
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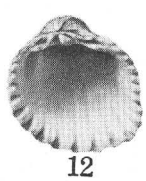
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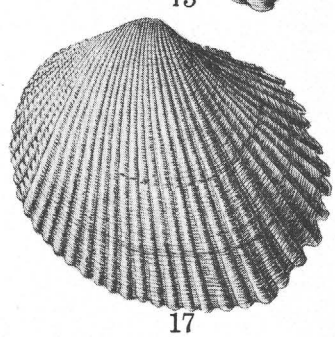
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CARDIACEA OF THE ALUM BLUFF GROUP

PLATE XXIII

FIGURE 1. *Cardium* (*Trachycardium*) *virile* Dall (p. 136). Exterior of right valve; altitude, 27.0 millimeters; latitude, 25.5 millimeters.

FIGURE 2. *Cardium* (*Trachycardium*) *parile* Dall (p. 136). Exterior of right valve; altitude, 15.0 millimeters; latitude, 15.5 millimeters.

FIGURE 3. *Cardium* (*Trachycardium*) *malacum* Dall (pp. 136–137). Exterior of left valve; altitude, 24.0 millimeters; latitude, 24.0 millimeters. (After Dall.)

FIGURE 4. *Cardium* (*Cerastoderma*) *druidicum* Dall (pp.137–138). Exterior of left valve; altitude, 22.5 millimeters; latitude, 25.0 millimeters. (After Dall.)

FIGURE 5. *Cardium* (*Cerastoderma*) *panastrum* Dall (p. 137). Exterior of left valve; altitude, 12.0 millimeters; latitude, 12.0 millimeters. (After Dall.)

FIGURE 6. *Cardium* (*Cerastoderma*) *chipolanum* subsp. *alumen* Gardner, n. subsp. (pp. 138–139). Exterior of right valve; altitude, 32.6 millimeters; latitude, 30.7 millimeters.

FIGURE 7. *Cardium* (*Cerastoderma*) *taphrium* Dall (p. 139). Exterior of left valve; altitude, 34.0 millimeters; latitude, 35.0 millimeters. (After Dall.)

FIGURE 8. *Cardium* (*Cerastoderma*) *waltonianum* Dall (pp. 139–140). Exterior of right valve (cotype); altitude, 39.0 millimeters; latitude, 40.0 millimeters. (After Dall.)

FIGURE 9. *Cardium* (*Cerastoderma*) *chipolanum* Dall (p. 138). Exterior of right valve; altitude, 36.0 millimeters; latitude, 34.0 millimeters. (After Dall.)

FIGURE 10. *Cardium* [*Fragum* (*Trigoniocardia*)] *simrothi* Dall (p. 141). Exterior of right valve (cotype); altitude, 8.5 millimeters; latitude, 7.5 millimeters. (After Dall.)

FIGURES 11–12. *Cardium* [*Fragum* (*Trigoniocardia*)] *sellardsi* Gardner, n. sp. (pp. 140–141).

11. Exterior of left valve (cotype); altitude, 7.6 millimeters; latitude, 7.5 millimeters.
12. Interior of right valve (cotype); altitude, 8.3 millimeters; latitude, 8.3 millimeters.

FIGURE 13. *Cardium* (*Fragum*) *burnsii* Dall (p. 140). Exterior of right valve; altitude, 7.0 millimeters; latitude, 6.5 millimeters. (After Dall.)

FIGURE 14. *Cardium* [*Fragum* (*Trigoniocardia*)] *apateticum* Dall (pp. 141–142). Exterior of left valve; altitude, 11.5 millimeters; latitude, 8.0 millimeters. (After Dall.)

FIGURE 15. *Cardium* [*Fragum* (*Trigoniocardia*) *aliculum* Dall (p. 140). Exterior of left valve (cotype); altitude, 12.5 millimeters; latitude, 8.5 millimeters. (After Dall.)

FIGURE 16. *Cardium* (*Laevicardium*) *compressum* Dall (p. 142). Exterior of left valve; altitude, 26.0 millimeters; latitude, 24.0 millimeters. (After Dall.)

FIGURE 17. *Cardium* (*Papyridea*) *bulbosum* Dall (p. 142). Exterior of left valve; altitude, 23.5 millimeters; latitude, 27.0 millimeters. (After Dall.)

NOTE.—The types of formerly described species have been remeasured, and the dimensions are not all identical with those given in the original descriptions.

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