UNITED STATES DEPARTMENT OF THE INTERIOR

THE MOLLUSCAN FAUNA OF THE ALUM BLUFF GROUP OF FLORIDA

PART VIII. CTENOBRANCHIA (REMAINDER) ASPIDOBRANCHIA, AND SCAPHOPODA

GEOLOGICAL SURVEY PROFESSIONAL PAPER 142–H

UNITED STATES DEPARTMENT OF THE INTERIOR
J. A. Krug, Secretary

GEOLOGICAL SURVEY
W. E. Wrather, Director

Professional Paper 142-H

THE MOLLUSCAN FAUNA OF THE ALUM BLUFF GROUP OF FLORIDA

By
Julia Gardner

PART VIII. CTENOBRANCHIA (REMAINDER) ASPIDOBRANCHIA, AND SCAPHOPODA

Published 1947

(Pages 493 - 656)

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON: 1947

For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.
Price $1.00

CONTENTS

ILLUSTRATIONS

THE MOLLUSCAN FAUNA OF THE ALUM BLUFF GROUP OF FLORIDA

By JULIA GARDNER

PART VIII. CTENOBRANCHIA (Remainder), ASPIDOBRANCHIA, and SCAPHOPODA

INTRODUCTION

The present chapter continues and completes the study of the faunas of the Alum Bluff group in Florida and Georgia.

In 1944 the systematic collections of recent shells in the United States National Museum were rearranged, in order to bring them into line with the results of the later investigations, in large part anatomical. For purposes of convenience, if for nothing more, the general classification of the Tertiary faunas should follow the same pattern as that of the Recent faunas. Most of the changes involved are in the groups formerly under the abandoned suborder Taenioglossa, and in the two presumably degenerate groups, Gymnoglossa, which includes the Pyramidellidae and Melanellidae, and Ptenoglossa, which includes the large and important family Epitoniidae. In the older classifications, the Gymnoglossa and the Ptenoglossa were given rank coordinate with the Taenioglossa and placed either before or after the Taenioglossa. In the current classification, the Gymnoglossa and the Ptenoglossa are treated as superfamilies and introduced between the Amaltheacea and the Cerithiacea.

LIST OF LOCALITIES

The following list shows the localities cited by number in the text and tables (see also map in Part I, p. 2):

2211. Lower bed, Alum Bluff, east bank Apalachicola River, 2 or 3 miles north of Bristol, Liberty County, Fla.

2212. Tenmile Creek, 1 mile west of Baileys Ferry, Chipola River, Calhoun County, Fla.[1]

2213. 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.[2]

2214. Tenmile Creek, 1 mile west of Baileys Ferry, Chipola River, Calhoun County, Fla.[1]

2238. Flournoy's millrace, 2 miles east of Argyle, Walton County, Fla.[3]

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

2564. McClelland farm, 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.[2]

2566. Upper bed, Rock Bluff, SW¼ sec. 17, T. 2 N., R. 7 W., east bank Apalachicola River, Liberty County, Fla.

2615. Log landing, farm of Dr. K. T. McClellan (1895), Shoal River, 5 miles west of Mossyhead, Walton County, Fla.

2645. 1 mile above a log landing on farm of Dr. K. T. McClellan, Shoal River, 5 miles west of Mossyhead, Walton County, Fla.

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

2652. Horse Creek, one-half mile above mouth, 1½ miles south of Oak Grove, Okaloosa 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' field (1900), 7 miles southeast of Bainbridge, Decatur County, Ga.

3419. McClelland farm, 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.[2]

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. Sec. 5, T. 3 N., R. 21 W., three-fourths mile west of Shell Bluff, Shoal River, Walton County, Fla.

3742. Sec. 4, T. 3 N., R. 21 W., 5 miles west of Mossyhead,[4] Shell Bluff, Shoal River, Walton County, Fla.

3748. Summerville millrace, 1 mile east of Argyle, Walton County, Fla.[3]

3856. Sec. 6, T. 3 N., R. 21 W., 6 miles west-northwest of Mossyhead, Walton 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.

[1] Probably at or near the crossing of State Highway 84, 4.7 miles north of Clarksville, on the line between secs. 11 and 12, T. 1 N., R. 10 W.

[2] Type locality of the Chipola formation, SW¼SW¼ sec. 8, T. 1 N., R. 9 W., 2¼ miles east of Carr; west bank of Chipola River.

[3] NE¼ sec. 34, T. 3 N., R. 18 W., on the headwaters of Hog Creek nearly half a mile downstream from the railroad milepost 77, which is nearly a mile southeast of Argyle, Walton County, Fla.

[4] Type locality of the Shoal River formation, Shell Bluff, north bank of Shoal River, E½ sec. 4, T. 3 N., R. 21 W., 3½ miles (airline) N. 25° W. of Mossyhead and three-quarters of a mile east of Godwin Bridge. Base of shell bed, 42 feet above the river and about 135 feet above sea level.

5193. Crowder's Crossing, 1½ miles below Shell Bluff, Shoal River, Walton County, Fla.[5]

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

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

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

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

7055. Old Senterfeit mill, 4½ miles southwest of Laurel Hill, Walton County, Fla.[6]

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

7151. Tenmile Creek, Calhoun County, Fla.[1]

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

7256. Look and Tremble Shoals, Chipola River, Calhoun County, Fla.[7]

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

7261. Upper Alaqua Lethu (?) Bluff, near De Funiak Springs, Walton County, Fla.[7]

7264. De Funiak *Cardium* beds, Alaqua Creek, Walton County, Fla.[7]

7468. Sopchoppy, Wakulla County, Fla.

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

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

9958. Site of Flournoy's old mill, about 1½ 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. Folks 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.

10288. Alum Bluff, Apalachicola River, Liberty County, Fla.

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

10608. Whites Creek, one-half mile below bridge on Eucheeanna-Knox Hill road, 6.7 miles south of Argyle, Walton County, Fla.

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

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

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

10661. Godwin Bridge over Shoal River, 5 to 6 miles northwest 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.

10971. Turtle Lake Bluff, about 150 yards above mouth of Fourmile Creek, Chipola River, Calhoun County, Fla.

14436. Gully south of the road and east of the bridge over Whites Creek on road from Eucheeanna to Knox Hill, 6.7 miles south of Argyle and 1.7 miles southeast of Eucheeanna, Walton County, Fla. Collection made by the Geological Survey of the State of Florida and presented to the United States Geological Survey.

---

[5] C. Wythe Cooke, 1945, identifies Crowder's Crossing with the old ford in Shoal River, one-fourth mile below Godwin Bridge.

[6] C. Wythe Cooke, 1945, identifies the old Senterfelt mill with Tanner's mill and places it in sec. 15, T. 5 N., R. 23 W., 4¾ miles southwest of Laurel Hill, Walton County, Fla.

[7] Cannot be located more exactly.

Distribution of Ctenobranchia (in part), Aspidobranchia, and Scaphopoda in the Alum Bluff group of Florida and Georgia

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

Species	Georgia—Oak Grove sand				Florida—Chipola formation																		Florida—Oak Grove sand											
	3386	3385	7148	3396	10609	7893	2212	2214	7257	2213	2564	3419	7151	7256	10971	2211	7183	2566	3704	2302	10288	7468	Aldrich collection, Johns Hopkins University	Cornell University collections	2646	5632	5631	5630	5633	7054	2652	7055	9961	10659	Aldrich collection, Johns Hopkins University	Cornell University collections
Mitrella pedana Gardner, n. sp.																a																			
Mitrella juncea Gardner, n. sp.																																			
tytha Gardner, n. sp.										p																									
photeina Gardner, n. sp.																																			
mikra Gardner, n. sp.									r	c.	p	p	p												c	p	p			p					
oryzoides Gardner, n. sp.										p																									
nanna Gardner, n. sp.										r																									
stikta Gardner, n. sp.										p	p	c																							
sima Gardner, n. sp.						r																													
belonis Gardner, n. sp.										p	p	p																							
blastos Gardner, n. sp.										r													p												
oxia Gardner, n. sp.						pr				pr		p													c	p	r		r	p			p		
phagon Gardner, n. sp.																								p											
trajectionis (Maury)										r						p																			
alumen Gardner, n. sp.										r																									
dallina Gardner, n. sp.										p														p											
asema Gardner, n. sp.																c									p		pr			c					
dalli (Maury)											r	r																							
perfervida (Dall)										c	p	p																							
megala Gardner, n. subsp.										p	p	r	p																						
ischna Gardner, n. sp.																																			
mitrodita Gardner, n. subsp.										p														p		r									
Strombina waltonia Gardner, n. sp.																																			
aldrichi (Maury)										p		r																							
nemoralis (Maury)																									p	r									p
lissa Gardner, n. sp.																																			
lampra Gardner, n. sp.																																			
ceryx Gardner, n. sp.																																			
Murex (Murex) chipolanus Dall							p			c		r	p																						
(Murex) gilli (Maury)																																		p	
(Murex) dasus Gardner, n. sp.										p	r	r	r																						
(Murex) vaughani Maury																								p											
(Murex) nicholsi Gardner, n. sp.																																			
(Chicoreus) folidodes Gardner, n. sp.										p	r	p							pr																
(Chicoreus) aldrichi Gardner, n. sp.																																			
(Chicoreus?) pyknos Gardner, n. sp.																																			
Paziella (Dallimurex) lychnia Gardner, n. sp.										p	r	r																							
(Dallimurex) fusinoides Gardner, n. sp.											r	r																							
Pteropurpura dryas Gardner, n. sp.																											r							p	
virginiae (Maury)										r														p											
Typhis linguiferus Dall							r																												
(Talityphis) alatus obesus Gabb										p	r		r																						
(Talityphis) pterinus Gardner																									r										
Muricopsis laceopoia Gardner, n. sp.										p	r	r													p										
Urosalpinx phagon Gardner, n. sp.																									p								r		
tribaka Gardner, n. sp.																								p											
xustris Gardner, n. sp.																																			
veatchi (Maury)																								p											
Eupleura pterina Gardner, n. sp.																																			
Personella floridana Gardner, n. sp.																																			
Semicassis (Tylocassis) aldrichi (Dall)							r																												
Sconsia paralaevigata Gardner, n. sp.										r													p												
Morum (Oniscidia) chipolanum (Dall ms) Gardner, n. sp.										r																									
Ficus eopapyratia Gardner, n. sp.							r			p	pr	r											p												
Cypraea (Cypraeorbis) heilprini Dall							r			p																									
(Cypraeorbis) chilona Dall										pr						c			pr																
(Cypraeorbis) tapeina Gardner, n. sp.																																			
Trivia chipolana Maury										r														p											
vaughani Gardner, n. sp.																																			
Erato (Hespererato) chipolana Maury										r														p											

Distribution of Ctenobranchia (in part), Aspidobranchia, and Scaphopoda in the Alum Bluff group of Florida and Georgia—Continued

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

Species	Georgia—Oak Grove sand				Florida—Chipola formation																				Florida—Oak Grove sand										
	3386	3385	7148	3396	10609	7893	2212	2214	7257	2213	2564	3419	7151	7256	10971	2211	7183	2566	3704	2302	10288	7468	Aldrich collection, Johns Hopkins University	Cornell University collections	2646	5632	5631	5630	5633	7054	2652	7055	9961	10659	Aldrich collection, Johns Hopkins University	Cornell University collections
Natica (Natica) alticallosa Dall							c			r	?p	?p				p																	r		
Natica (Naticarius) precursor Gardner, n. sp.					r		c		r	a	a	p	r.												c										
Natica (Stigmaulax) guppiana Toula																																			
(Stigmaulax) guppiana toulana Gardner, n. subsp.																																			
(Tectonatica) mino Gardner, n. sp.																																			
(Tectonatica) semen Gardner, n. sp.					p		a		r	c	p	p				c	r								pr	a	p	r	r	a					
(Tectonatica?) platybasis Gardner, n. sp.					r		c			c	c	c				c	c																		
Polinices judsoni (Maury)																									a	p		r		r	r	r		p		p
Polinices? demicryptus Gardner, n. sp.					r		a					r	p																						
Polinices robustus Gardner, n. sp.																																			
(Neverita) chipolanus Dall					r		pr			pr	p	p	r			a	p								p	r				r		r	r		
(Neverita) eucallosus Gardner, n. sp.	p	c	a																						pr	r	r		r	p				p	
Euspira rotunda Gardner, n. sp.																																			
Sinum chipolanum Dall						r	p			c	c	p	p												c										
waltonense Gardner, n. sp.																																			
dodoneum Gardner, n. sp.																									p	r									
Sigatica euglypta Gardner, n. sp.						r																													
caractica (Dall)										r															c	p			r	r					
Globularia fischeri (Dall)							c			p	r	r	r			?c									r										
Pachycrommium burnsii (Dall)										r	r	p																							
dodonum Gardner, n. sp.																									r					r					
Strombus aldrichi Dall							p			a	c	a	p	r		p								p											
chipolanus Dall						?r	p			p	p	p	?p		r							?r														
dodoneus Gardner, n. sp.																									pr	p		a		c					
Orthaulax gabbi Dall							c			a	r	p		r	r	c	c																		
Xenophora textilina Dall										r																									
Calyptraea centralis (Conrad)		r	r						r	c	r	c	p			p									a	c	p		p	p			r		
crenata Gardner, n. sp.																									r										
Crepidula aculeata costata Morton																																			
fornicata (Linnaeus)		p	r							p	p	c													a	p	p		p						
aesop Dall																									?p	?r	?r								
plana Say							p			c	p	r				p									p	r			r	r					
Crucibulum chipolanum Dall							c			c	r	p	p			r																			
chipolanum dodoneum Gardner, n. subsp.																									a	c	r	p	c	p			p		
waltonense Gardner, n. sp.																																			
constrictum conjuge Gardner, n. subsp.																																			
grande (Say)						?r																			?p										
multilineatum (Conrad)	p	p	a			p																			a	p									
Capulus chipolanus Gardner, n. sp.										r																									
Cheilea dryas (Dall ms) Gardner, n. sp.																																			
Fossarus chipolanus (Dall)							r																												
florius Gardner, n. sp.																									?r										
Iselica psila Gardner, n. sp.											r	p																							
myttonis (Maury)										r		r												p											
Strombiformis scotti (Maury)										r														p											
ischna Gardner, n. sp.																																			
(Polygireulima?) chipolana (Maury)										r														p											
(Polygireulima) defuniak Gardner, n. sp.																																			
(Polygireulima) makista Gardner																																			
Epitonium (Spiniscala) virginiae (Maury)																r								p											
(Clathrus) alaquaënse Mansfield																																			
Gegania acutissima (Dall)																a	p																		
Litiopa palaeosargassina Maury																									r	r								r		p
Alaba chipolana Dall										a	r	p				c																			
dodona Gardner, n. sp.																									r										
Modulus compactus Dall																r																			
biconicus Gardner, n. sp.										r	r	r																							
willcoxii Dall						?r	r																												
Caecum chipolanum Gardner, n. sp.										r		r	p			a	c																		
parareguläre Gardner, n. sp.						r				r																									

Lemintina granifera (Say)																									?a	?r		?p		?p						
papulosa (Guppy)																																				
Petaloconchus sculpturatus H. C. Lea					p		c																		a	p	r		p	r			p			
Architectonica chipolana (Dall)										c	p	p	r			p																				
quadriseriata (Sowerby), subsp.		r	r																						r	r				r						
waltonensis Gardner																																				
alvear Gardner																									c	r			r	r						
verecunda Gardner																																				
(Pseudotorinia) bisulcata (D'Orbigny)										?r																										
Turritella subgrundifera Dall					p	p	c	c		c	c	c	p			c	a	r				p			p	p	r		r				r			
alcida Dall																									a	c	p	p	p	c			p			
bicarinata Gardner, n. subsp.	r	r																		p		p			c	p	r	p	p	p						
gatunensis blountensis Mansfield																																				
segmenta Gardner, n. sp.																																				
(Torcula) dalli Gardner, n. sp.		p				p	p			a	c	c	p			p	p					p														
(Torcula) waltonensis Gardner, n. sp.																																				
(Torcula?) sp.																																				
(Torcula?) mixta Dall							r			r		r																								
(Torcula?) jacula Gardner, n. sp.																																				
(Torcula?) chipolana Dall							r			r																										
"Vitrinella" seminola Gardner, n. sp.					r							r																								
waltonia Gardner, n. sp.																																				
excavata Gardner, n. sp.																																				
"Circulus" mitorraphes Gardner, n. sp.																									r	r										
anthera Gardner, n. sp.																										p				r						
trilix Bush										c																										
Cochliolepis arietina Gardner, n. sp.																									p											
Episcynia mauryi Gardner, n. sp.																									c	p			r	r						p
Syncera microgaza Gardner, n. sp.							r			a	p	p				p																				
Rissoina (Mirarissoina) juncea Gardner, n. sp.										r																										
(Zebinella) chipolana Dall										c	a	a				c																				
(Cibdezebina) browniana D'Orbigny										a	r					p																				
vittata Gardner, n. sp.																r																				
Rissoa phagon Gardner, n. sp.																									r											
litiopaopsis Gardner, n. sp.										r																										
Smaragdia grammica Gardner, n. sp.																																				
chipolana (Dall)							p			c	r	r	r			r																				
Tricolia affinis chipolana Gardner, n. subsp.					r		c			a	a	a				pr	p								?r											
probrevis Gardner, n. sp.							c			c						c									p											
Astraea dalli (Maury)										c														p												
(Lithopoma) chipolana (Dall)																c																				
Gelasinostoma chipolanum (Dall)							r																													
Liotia (Arene) agenea Dall										r																										
Didianema? waltonia Gardner, n. sp.																																				
Teinostoma chipolanum Dall					r		c			c						p																				
nanum eonanum Gardner, n. sp.																																				
phacoton Gardner, n. sp.																	p																			
mekon Gardner, n. sp.																																				
Solariorbis microforatis Dall							r			p		p				r									r	r										
Chlorostoma (Omphalius) exolutum (Conrad)	r					r										p	r								r								r			
(Omphalius) exolutum limatum Dall										p	r	p				p																				
Calliostoma grammaticum Dall										?r	r	r				c	r																			
metrium Dall										r																										
exile Dall											r					r																				
rhombotoide Gardner, n. sp.																																				
ceramicum Dall							r				r																									
flumenvadum Gardner, n. sp.																																				
rugabasis Gardner, n. sp.																																				
Solariella turritella Dall										r																										
laqua Mansfield																																				
Lucapinella limatula (Reeve)										r		r																								
Diodora chipolana (Dall)					r				r	c	r					p									r											
daidala Gardner, n. sp.																																				
pumpellyi Gardner, n. sp.	r	p	r	r																																
Rimula woodringi Gardner, n. sp.																					r		r													
Dentalium (Antalis) chipolanum Gardner, n. sp.					r					a	a	a				p	r																			
(Antalis) diopon Gardner, n. sp.																																				
(Graptacme) eboreum Conrad										p			r												p											
(Episiphon) schumoi Pilsbry					r				r	a	p	p	c																							
(Laevidentalium) santarosanum Maury					r					p	r	r													c										p	
Cadulus (Polyschides) lobion Gardner, n. sp.					r				p	a	c	p	p			c																				
(Gadila) clarae Maury																									pr	a	p		p	c				r		
(Gadila?) volvulus Gardner, n. sp.										c							p																			
(Gadila) spiniformis Gardner, n. sp.																																				

Distribution of Ctenobranchia (in part), Aspidobranchia, and Scaphopoda in the Alum Bluff group of Florida and Georgia—Continued

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

Species	Florida—Shoal River formation																												
	3856	2645	2615	3732	3742	3731	10658	5080	5184	5195	5079	10661	10662	5193	3733	2238	3748	9958	7261	7264	9960	9957	10603	14436	10608	5618	10612	9959	Aldrich collection, Johns Hopkins University
Mitrella pedana Gardner, n. sp.																													
Mitrella juncea Gardner, n. sp.					p																								
tytha Gardner, n. sp.											c				r											?r			
photeina Gardner, n. sp.																													
mikra Gardner, n. sp.																													
oryzoides Gardner, n. sp.																													
nanna Gardner, n. sp.																													
stikta Gardner, n. sp.																													
sima Gardner, n. sp.																													
belonis Gardner, n. sp.																													
blastos Gardner, n. sp.																													
oxia Gardner, n. sp.																													
phagon Gardner, n. sp.																													
trajectionis (Maury)																													
alumen Gardner, n. sp.																													
dallina Gardner, n. sp.																													
asema Gardner, n. sp.																													
dalli (Maury)																													
perfervida (Dall)																													
megala Gardner, n. subsp.																													
ischna Gardner, n. sp.																													
mitrodita Gardner, n. subsp.																													
Strombina waltonia Gardner, n. sp.	a	r		p	a	r		p	c								r				r								
aldrichi (Maury)																													
nemoralis (Maury)																													
lissa Gardner, n. sp.	c			r	a					r							r				r								
lampra Gardner, n. sp.											r							p		p						p		p	
ceryx Gardner, n. sp.	r				p																								
Murex (Murex) chipolanus Dall																													
(Murex) gilli (Maury)																													
(Murex) dasus Gardner, n. sp.																													
(Murex) vaughani Maury																													
(Murex) nicholsi Gardner, n. sp.	p																									r			
(Chicoreus) folidodes Gardner, n. sp.																													
(Chicoreus) aldrichi Gardner, n. sp.					r																								p
(Chicoreus?) pyknos Gardner, n. sp.			r								?c																		
Paziella (Dallimurex) lychnia Gardner, n. sp.																													
(Dallimurex) fusinoides Gardner, n. sp.																													
Pteropurpura dryas Gardner, n. sp.																													
virginiae (Maury)																													
Typhis linguiferus Dall																													
(Talityphis) alatus obesus Gabb																													
(Talityphis) pterinus Gardner	p				p				r																				
Muricopsis laccopoia Gardner, n. sp.																													?p
Urosalpinx phagon Gardner, n. sp.																													
tribaka Gardner, n. sp.	r				r																					r			
xustris Gardner, n. sp.															r														
veatchi (Maury)																													
Eupleura pterina Gardner, n. sp.	r				r																								
Personella floridana Gardner, n. sp.	r				r				r	r													r						
Semicassis (Tylocassis) aldrichi (Dall)																													
Sconsia paralaevigata Gardner, n. sp.																													
Morum (Oniscidia) chipolanum (Dall ms) Gardner, n. sp.																													
Ficus copapyratia Gardner, n. sp.																													
Cypraea (Cypraeorbis) heilprinii Dall																													
(Cypraeorbis) chilona Dall																													
(Cypraeorbis) tapeina Gardner, n. sp.																								r					
Trivia chipolana Maury																													
vaughani Gardner, n. sp.	r				p																								p
Erato (Hespererato) chipolana Maury																													

Natica (Natica) alticallosa Dall																														
Natica (Naticarius) precursor Gardner, n. sp.	r				r					r					r												r			
Natica (Stigmaulax) guppiana Toula	r				c			r	r								r													
(Stigmaulax) guppiana toulana Gardner, n. subsp.					r																									
(Tectonatica) mino Gardner, n. sp.	a				r					r																	r		p	
(Tectonatica) semen Gardner, n. sp.	r			r						c	p						pr	p	r	c	p						r		p	
(Tectonatica?) platabasis Gardner, n. sp.																														
Polinices judsoni (Maury)	pr			p	pr	p	p		c	r	ƥr					ƥr	ƥr			r							r		p	
Polinices? demicryptus Gardner, n. sp.																														
Polinices robustus Gardner, n. sp.									r																					
(Neverita) chipolanus Dall										r	c	r		ƥr															r	
(Neverita) eucallosus Gardner, n. sp.	c				c	c	p		p		c	p			p	c	a	p		r										
Ensipira rotunda Gardner, n. sp.	p				r																								r	
Sinum chipolanum Dall																														
waltonense Gardner, n. sp.	a			r	c	p			p	r					r	p	c								p					
dodoneum Gardner, n. sp.																														
Sigatica euglypta Gardner, n. sp.																														
caractica (Dall)					r																									
Globularia fischeri (Dall)																														
Pachycrommium burnsii (Dall)																														
dodonum Gardner, n. sp.																														
Strombus aldrichi Dall																														
chipolanus Dall																														
dodoneus Gardner, n. sp.																														
Orthaulax gabbi Dall																														
Xenophora textilina Dall					ƥr																									
Calyptraea centralis (Conrad)	p				a		r		r		p				r												r			
crenata Gardner, n. sp.																														
Crepidula aculeata costata Morton																											r			
fornicata (Linnaeus)					c					p					ƥp												ƥr		r	
aesop Dall																														
plana Say	p				r																									
Crucibulum chipolanum Dall																														
chipolanum dodoneum Gardner, n. subsp.								ƥr		p					ƥr															
waltonense Gardner, n. sp.	c				c					ƥr				r																
constrictum conjuge Gardner, n. subsp.	p			r	c			r	r									p			p								p	
grande (Say)																														
multilineatum (Conrad)	r	r		ƥr	p					p				r																
Capulus chipolanus Gardner, n. sp.																														
Cheilea dryas (Dall ms) Gardner, n. sp.					r																									
Fossarus chipolanus (Dall)																														
florius Gardner, n. sp.	r				r					r					r															
Iselica psila Gardner, n. sp.																														
myttonis (Maury)																														
Strombiformis scotti (Maury)																														
ischna Gardner, n. sp.										r																				
(Polygireulima?) chipolana (Maury)																														
(Polygireulima) defuniak Gardner, n. sp.																											r			
(Polygireulima) makista Gardner	p																													
Epitonium (Spiniscala) virginiae (Maury)																														
(Clathrus) alaquaënse Mansfield																						r								
Gegania acutissima (Dall)																														
Litiopa palaeosargassina Maury																														
Alaba chipolana Dall																														
dodona Gardner, n. sp.																														
Modulus compactus Dall																														
biconicus Gardner, n. sp.																														
willcoxii Dall																														
Caecum chipolanum Gardner, n. sp.																														
pararegulare Gardner, n. sp.										r	r				r															
Lemintina granifera (Say)																														
papulosa (Guppy)																									r					
Petaloconchus sculpturatus H. C. Lea					ƥr																									
Architectonica chipolana (Dall)																														
quadriseriata (Sowerby), subsp.																														
waltonensis Gardner	a				a											r											r			
alvear Gardner																														
verecunda Gardner																											r			
(Pseudotorinia) bisulcata (D'Orbigny)																														
Turritella subgrundifera Dall																														
alcida Dall																														
bicarinata Gardner, n. subsp.																														
gatunensis blountensis Mansfield																														
segmenta Gardner, n. sp.					p			r															r				r			
(Torcula) dalli Gardner, n. sp.																														
(Torcula) waltonensis Gardner, n. sp.	pr	p		c	pr	p		a	a	p																			p	
(Torcula?) sp.																							p			p				
(Torcula?) mixta Dall																														
(Torcula?) jacula Gardner, n. sp.																							c			c				
(Torcula?) chipolana Dall																														
"Vitrinella" seminola Gardner, n. sp.																	r													
waltonia Gardner, n. sp.					r																									
excavata Gardner, n. sp.					r																									

Distribution of Ctenobranchia (in part), Aspidobranchia, and Scaphopoda in the Alum Bluff group of Florida and Georgia—Continued

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

Species	Florida—Shoal River formation																													Aldrich collection, Johns Hopkins University
	3856	2645	2615	3732	3742	3731	10658	5080	5184	5195	5079	10661	10662	5193	3733	2238	3748	9958	7261	7264	9960	9957	10603	14436	10608	5618	10612	9959	
"Circulus" mitorraphes Gardner, n. sp.					r																								
anthera Gardner, n. sp.					p																								
trilix Bush											r															r			
Cochliolepis arietina Gardner, n. sp.																													
Episcynia mauryi Gardner, n. sp.																													
Syncera microgaza Gardner, n. sp.																													
Rissoina (Mirarissoina) juncea Gardner, n. sp.																													
(Zebinella) chipolana Dall																													
(Cibdezebina) browniana D'Orbigny																													
vittata Gardner, n. sp.																													
Rissoa phagon Gardner, n. sp.																													
litiopaopsis Gardner, n. sp.																													
Smaragdia grammica Gardner, n. sp.											r																		
chipolana (Dall)																													
Tricolia affinis chipolana Gardner, n. subsp.																													
probrevis Gardner, n. sp.																													
Astraea dalli (Maury)																													
(Lithopoma) chipolana Dall																													
Gelasinostoma chipolanum (Dall)																													
Liotia (Arene) agenea Dall																													
Didianema? waltonia Gardner, n. sp.				r																									
Teinostoma chipolanum Dall																													
nanum eonanum Gardner, n. sp.															r														
phacoton Gardner, n. sp.																													
mekon Gardner, n. sp.																								r					
Solariorbis microforatis Dall																													
Chlorostoma (Omphalius) exolutum (Conrad)																													
(Omphalius) exolutum limatum Dall																													
Calliostoma grammaticum Dall																													
metrium Dall																													
exile Dall																													
rhombotoide Gardner, n. sp.																							r						
ceramicum Dall																													
flumenvadum Gardner, n. sp.	pr				a	r		r	r	r							r												
rugabasis Gardner, n. sp.	r				p					r																			
Solariella turritella Dall																													
laqua Mansfield																								r					
Lucapinella limatula (Reeve)																													
Diodora chipolana (Dall)																													
daidala Gardner, n. sp.																								r					
pumpellyi Gardner, n. sp.																													
Rimula woodringi Gardner, n. sp.																													
Dentalium (Antalis) chipolanum Gardner, n. sp.																													
(Antalis) diopon Gardner, n. sp.	a				c												p												
(Graptacme) eboreum Conrad																													
(Episiphon) schumoi Pilsbry																													
(Laevidentalium) santarosanum Maury																													
Cadulus (Polyschides) lobion Gardner, n. sp.																													
(Gadila) clarae Maury																													
(Gadila?) volvulus Gardner, n. sp.																													
(Gadila) spiniformis Gardner, n. sp.	r	r		r	p						r										r								

SYSTEMATIC DESCRIPTIONS

Phylum MOLLUSCA

Class GASTROPODA

Order CTENOBRANCHIA

Suborder STENOGLOSSA

Family PYRENIDAE

Genus MITRELLA Risso

1826. *Mitrella* Risso, Histoire naturelle des principales productions de l'Europe méridionale, vol. 4, p. 247.

Type by subsequent designation (Cox, Rept. Paleontology Zanzibar, Moll., p. 28, 1927): *Mitrella flaminea* Risso = *Murex scriptus* Linnaeus. Recent in the Mediterranean.

Shell dense, rather small, fusiform. Spire elevated, the whorls evenly tapering. Protoconch small, smooth, blunt, paucispiral. Sculpture restricted to the feeble striae that gird the pillar and the anterior fasciole. Aperture rather narrow. Outer lip thickened a little, feebly emarginate posteriorly; denticulate within. Parietal wash moderately heavy. Pillar feebly rugose. Anterior canal not defined, the fasciole little or not at all expanded. Terminal notch U-shaped, oblique.

The Recent representatives are widely distributed in the warm and shallow waters.

Mitrella pedana Gardner, n. sp.

Plate LII, figure 9

Shell small, fusiform; the maximum diameter falling a little in front of the median horizontal. Aperture nearly half as long as the entire shell. Body smoothly rounded at the base. Spire tapering somewhat irregularly to an obtuse apex; postnuclear whorls trapezoidal, sharp-edged posteriorly. Whorls of conch 4, closely wound, separated by distinctly impressed linear sutures. Protoconch small, smooth, highly polished, twice coiled; initial turn inflated, immersed at the tip; succeeding volution becoming decreasingly convex toward its close. Dividing line between conch and protoconch indicated by a slight axial thickening at the close of the protoconch and by the change in the texture of the shell. Incremental striae microscopically fine, more or less flexuous. Spirals, 4 or 5, low, rounded, closely spaced on the base of the body and the pillar, merging gradually into an equal number of more sharply rounded but finer lirations, which crowd the anterior fasciole. Aperture of moderate width, acutely angulated behind. Outer lip almost vertical from the commissure to the base, feebly emarginate at the posterior siphonal fasciole; a broad and ill-defined axial thickening developed a little behind the thin, sharp margin; inner surface reinforced with about half a dozen elongated denticles that increase in prominence from the anterior to the posterior, which is placed a little in front of the siphonal notch. Inner margin of aperture smoothly and strongly concave. Parietal wash thin. Pillar wash heavier, commonly rugose. Inner margin of pillar sharply keeled, the keel developing within the aperture into a well-defined marginal fold. Anterior canal very short, broad. Terminal notch broad, shallow, obliquely directed.

Dimensions of holotype: Height, 4.7 millimeters; length of aperture, 2.0 millimeters; maximum diameter, 2.0 millimeters.

Holotype: U.S. Nat. Mus. No. 371840.

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

The conch of *M. pedana* is fusiform, with no remarkable characters, but the protoconch includes fewer volutions and is more obtuse than that of any other of the allied Chipola forms. The initial turn of the protoconch, instead of being flattened and almost entirely immersed in the succeeding volution, as in most of the species of *Columbellopsis,* is inflated and immersed only at the tip. The thickening of the labrum of the adult conch is also more slight than in the allied section. The anterior portion of the body whorl in *Mitrella pedana* is so feebly constricted that a reference to the section *Columbellopsis* does not seem justified. In the relatively few whorls and broad conical spire the species recalls *Mitrella lunata* (Say), of the Recent East Coast, and *Mitrella ocellata* (Gmelin), of the Caribbean fauna.

The species is abundant at the type locality.

Occurrence: Chipola formation, locality 2211[a].

Section COLUMBELLOPSIS Bucquoy, Dautzenberg, and Dollfus

1882. *Columbellopsis* Bucquoy, Dautzenberg, and Dollfus, Mollusques marins du Roussillon, vol. 1, p. 77.
=*Atilia* auctores not *Atilia* H. & A. Adams, Genera Recent Mollusca, vol. 1, p. 184, 1853. Type by subsequent designation (Pace, Mal. Soc. London, Proc., vol. 5, p. 42, 1902): *Columbella suffusa* Sowerby. Recent in the Pacific.

Type by original designation: *Columbella minor* Scacchi. Recent, Pleistocene, and Tertiary of the Mediterranean region.

Shell small, slender, with moderately elevated spire and a body abruptly constricted into a short and wide canal. Nucleus small, smooth, blunt, paucispiral. Whorls of spire closely appressed, regularly increasing in height and diameter. Surface smooth except for the lirations girding the pillar. Aperture rather narrow, obtusely angulated posteriorly. Outer lip varicose, sharp-edged but denticulate within, the posterior notch perceptible. Parietal wash thinly spread over a narrow area. Inner margin of pillar oblique, not plicate nor acutely compressed. Anterior siphonal fasciole little or not at all expanded, strongly lirate. Terminal notch narrow, obliquely directed.

Atilia has been used by many workers for the shells here included under *Columbellopsis*. The Adamses selected no type but listed 7 species, arranged alphabetically. The first named species, *C. conspersa* Gaskoin, has been commonly accepted, though there has been apparently no designation. Cossmann in 1901 cited *Mitrella minor* Scacchi as the type of *Atilia,* but *minor* was not included in the original list of the Adams species. Pace in 1902 cited "*C. suffusa,* Sby., selected by Chenu, 1859." Chenu named the species only as an "example," not a type, so the designation must date from Pace's citation in 1902. In case the question of the validity of Pace's unwitting designation should be raised, Grant and Gale, in 1931, made a formal designation of *Columbella suffusa* Sowerby as the type of *Atilia* and placed *Atilia* in the synonymy of *Anachis* H. & A. Adams, 1853.

The differences which separate *Columbellopsis* from *Mitrella*—the constriction of the base of the outer lip to form a defined canal and the stronger tendency toward a terminal varix—are of no more than sectional value. In the large group of Alum Bluff *Mitrella,* indeed, the line drawn seems so arbitrary that even a section separation places an overemphasis on the differences.

Judging from the distribution charts of the Alum Bluff, the section *Columbellopsis* and the genus *Strombina* are in large measure mutually exclusive, for *Columbellopsis* is characteristic of the Chipola fauna and *Strombina* of the Shoal River. The contrast in the make-up of the Chipola and Shoal River faunas is peculiarly striking in the Pyrenidae. In the collections which have been reviewed the number of individuals of *Strombina* in the Shoal River greatly exceeds the number of *Columbellopsis* in the Chipola, and yet the number of species of *Columbellopsis* involved is three times as great as the number of species of *Strombina.* Apparently the Shoal River fauna was one well adapted to a rather unusual environment, while the conditions under which the Chipola species lived must have been more varied and less favorable to any single group. Two out of the twelve species recorded from the Chipola are known only from the lower bed at Alum Bluff, and like so many of the Alum Bluff species they are coarser and more rudely sculptured forms than their Chipola River analogues.

I have been unable to construct a key for *Mitrella* and the section *Columbellopsis* that would simplify the difficulties of their determination.

Mitrella juncea Gardner, n. sp.

Plate LII, figure 17

Shell small, polished, slender, elongate-conic. Aperture decidedly less than half as high as the entire shell. Body rather sharply rounded at the periphery, constricted into the short neck. Sides of spire flattened, evenly converging. Tip broken away in all available material. Conch including probably 5 volutions, although the apex is decorticated and the exact number doubtful. Posterior edge of whorls sharp; sutures distinct. Protoconch imperfectly preserved, of moderate dimensions and including 3 or 4 volutions. Sculpture restricted to 6 or 7 low, flattened lirae that gird the pillar and anterior fasciole. Aperture rather narrow, sinuous, acutely angulated posteriorly. Outer lip feebly emarginate at the posterior fasciole, broadly and smoothly arching in front of the siphonal notch, smoothly but sharply rounding into the base, little or not at all thickened externally, reinforced internally; two rather prominent denticles, the posterior the more elevated, developed in the type a little in front of the notch. Inner margin of the aperture abruptly constricted at the base of the body. Parietal wash thin except directly in front of the commissure, merging into the heavier feebly rugose pillar callus. Pillar short, the inner margin sharply keeled. Anterior canal short, recurved. Terminal notch broad, shallow, obliquely directed.

Dimensions of holotype: Height, 6.0 millimeters; length of aperture, 2.5 millimeters; maximum diameter, 2.1 millimeters.

Holotype: U.S. Nat. Mus. No. 371842.

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

The outer lip is more strongly emarginate at the posterior fasciole than in *Mitrella tytha,* more flaring in front of the fasciole, and less evenly lirate within. *M. stikta* from the Chipola is a close analogue. The general outline and dimensions of the two species are similar, but in the Chipola form, the spirals on the base of the body and pillar are more numerous, more elevated, and more sharply defined than in *Mitrella juncea,* the emargination at the posterior siphon is more shallow, the labrum less expanded anteriorly, and the obscure marginal fold upon the pillar is delimited by a shallow groove. *Mitrella nanna,* also from the Chipola, is smaller than *M. juncea* and even more slender.

Mitrella juncea is not at all common even at the single locality from which it has been collected.

Occurrence: Shoal River formation, locality 3742P.

Mitrella tytha Gardner, n. sp.

Plate LII, figure 24

Shell small, highly polished, slender, elongate-conic. Aperture less than half as long as the entire shell. Body obtusely angulated at the periphery, the posterior portion of the body and the spire evenly and gradually tapering to the subacute apex. Whorls of conch between 4 and 5, sharp-edged posteriorly, separated by feebly impressed sutures. Protoconch moderately large in

comparison with the conch, somewhat turbinate: component whorls 4, the initial turn minute, flattened behind, largely immersed in the succeeding volution; the remaining whorls low, increasing in diameter with a moderate degree of rapidity, rather strongly constricted at the sutures except toward the close of the protoconch. Dividing line between conch and protoconch irregular, the opening of the conch indicated by the flattening of the whorl and by a change in the texture of the shell. A color pattern occasionally retained of rather heavy, brownish lines, rudely parallel to the axis, somewhat broken, and, on the body, sinous like the outer margin of the labrum. Spiral sculpture restricted to 1 or 2 feebly incised lines on the extreme base of the body and 3 to 5 low, subequal threads girding the pillar and anterior fasciole. Aperture rather narrow, sinuous, acutely angulated behind. Outer lip feebly constricted directly in front of the commissure, flaring at the periphery of the body, not thickened externally but reinforced within with 6 or 7 lirations, the anterior very feeble and set at the entrance to the canal; the other denticles increasing in prominence posteriorly up to their abrupt disappearance a little in front of the posterior notch. Inner margin of aperture rather strongly concave. Pillar short. Parietal and pillar wash rather thin, continuous, heaviest directly in front of the commissure and on the pillar, which in the fully adult is minutely denticulate. Inner margin of pillar keeled but not elevated into a distinct fold. Anterior canal not differentiated. Terminal notch broad, shallow, obliquely directed.

Dimensions of holotype: Height, 5.0 millimeters; length of aperture, 2.0 millimeters; maximum diameter, 2.0 millimeters.

Holotype: U. S. Nat. Mus. No. 371843.

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

Mitrella tytha is not so slender nor so highly polished as *M. photeina* from the Chipola and is less evenly rounded and less attenuated anteriorly. The neck is shorter and broader than in *photeina,* and the outer lip is more expanded and more evenly lirate within. *M. juncea* from the Shoal River is more elevated, and the spire is relatively higher. *M. mikra* from the Oak Grove runs smaller and is more slender, but the general characters of the two species are similar and the color patterns close, though that of the Oak Grove form is apparently the more broken and irregular.

Mitrella tytha is common at the type locality but rare elsewhere.

Occurrence: Shoal River formation, localities 5079[c], 3733[r], ?5618[r].

Mitrella photeina Gardner, n. sp.

Plate LII, figure 25

Shell small, lustrous, slender, elongate-conic. Aperture nearly half as high as the entire shell. Body whorl smoothly and evenly rounding into the broad pillar. Whorls 5 in the adult conch, those of the spire closely appressed, trapezoidal, gradually increasing in diameter, sharp-edged posteriorly and separated by sharply defined linear sutures. Protoconch smooth, highly polished, moderately large in proportion to the conch, including between 3½ and 4 volutions; initial turn inflated, immersed at the tip; remaining volutions increasing in diameter and altitude with a moderate degree of rapidity but decreasing in convexity. Dividing line between conch and protoconch irregular, obscure because of the high polish of both the nuclear and postnuclear turns. Surface smooth except for microscopically fine incremental striae, 3 or 4 low, flattened cords upon the extreme base of the body and the pillar, and an equal number of more closely and evenly spaced threadlets upon the anterior fasciole. Aperture narrow, sinuous, obtusely angulated at the commissure. Outer lip broadly emarginate at the posterior fasciole, almost vertical in front of the sinus, rounding abruptly into the anterior fasciole. Labrum thickened a little behind the margin, somewhat produced posteriorly, denticulate within; the denticles evenly spaced, increasing regularly in prominence from the anterior tooth near the entrance to the canal, to the posterior, directly in front of the posterior fasciole. Inner margin of aperture concave, most heavily glazed in front of the commissure and along the short, slightly rugose pillar. Inner margin of pillar keeled and obscurely plicate. Terminal notch broad, rather deep, obliquely directed.

Dimensions of holotype: Height, 5.5 millimeters; length of aperture, 2.5 millimeters; maximum diameter, 2.1 millimeters.

Holotype: U. S. Nat. Mus. No. 371844.

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

Mitrella photeina is remarkable for its high polish and slender, smoothly rounded outline. *M. oryzoides,* the most common of the Chipola Mitrellas, is smaller and not so slender, and the whorls are not so flattened laterally. *Mitrella tytha* from the Shoal River is broader at the anterior extremity and more squarely truncate, and the outer lip is more expanded toward the base of the body. Apparently there was a broad band of a darker color on the posterior portion of the whorl, with possibly darker and rather distant lineations on the lighter anterior portion, but there is no trace of the suture-to-suture lines that apparently furnished the color pattern in *M. tytha.*

Occurrence: Chipola formation, locality 2213[p].

Mitrella mikra Gardner, n. sp.

Plate LII, figure 20

Shell minute, polished, slender, elongate-conic. Aperture almost half as long as the entire shell. Body ob-

tusely angulated, flattened behind the periphery, constricted in front into the broad, ill-differentiated pillar. Sides of spire flattened and evenly tapering to the subacute apex. Whorls of conch 3½, sharp-edged behind, separated by feebly impressed sutures. Protoconch smooth, moderately large relatively, including 4 volutions; initial turn minute, partially immersed in the succeeding turn; remaining whorls increasing regularly in diameter and altitude but decreasing in convexity. Dividing line between conch and protoconch broken; opening of conch indicated by the lower surface polish and the increased flattening of the whorl. Traces of an axial color pattern of irregular brownish bands still retained. Spiral sculpture reduced to 2 or 3 linear grooves girding the base of the pillar and an equal number of ill-defined threads on the anterior fasciole. Aperture moderately wide for so minute a shell, narrow and acutely angulated behind. Outer lip very slightly constricted at the posterior fasciole, thin-edged and inclined to flare a little toward the base, produced and thickened somewhat posteriorly but with no well-defined labral varix; 2 or 3 denticles developed on the posterior medial portion of the inner surface. Labium sharply constricted at the base of the body. Parietal wash very thin except directly in front of the commissure. Pillar short, straight, heavily glazed; inner margin keeled. Anterior canal not differentiated. Anterior extremity obliquely emarginate.

Dimensions of holotype: Height, 3.5 millimeters; length of aperture, 1.6 millimeters; maximum diameter, 1.7 millimeters.

Holotype: U. S. Nat. Mus. No. 371846.

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

Mitrella mikra is a very small and regular little cone—the analog in the Oak Grove fauna of the larger, less slender, but similarly contoured *M. tytha* of the Shoal River. *M. oryzoides,* the common *Mitrella* of the Chipola, runs about the same dimensions, but the whorls are not so much flattened laterally nor so regularly coiled, and there is a canal sufficiently defined to justify its reference to the section *Columbellopsis.* There is also in *oryzoides* a marked flexure in the suture line a little behind the aperture because of the encroachment of the thickened portion of the labrum upon the penultima. In *M. mikra,* on the other hand, the labrum is little or not at all thickened and the suture line little or not at all sinuated.

M. mikra is one of the few representatives of the genus in the Oak Grove fauna, but it is rather abundant and widely distributed at that single horizon.

Occurrence: Oak Grove sand, localities 2646^{c}, 5632^{p}, 5631^{p}, 7054^{p}.

Mitrella oryzoides Gardner, n. sp.

Plate LII, figure 19

Shell minute, elongate-conic, the maximum diameter falling in front of the median horizontal. Aperture less than half as high as the entire shell. Body whorl smoothly rounding into the broad neck. Whorls of conch 4, those of the spire flattened laterally, sharp-edged posteriorly, closely appressed and slowly increasing in diameter, separated by impressed sutures. Protoconch highly polished, rather large relatively, including between 3½ and 4 volutions; initial turn minute, flattened behind, very largely immersed in the succeeding turn; remaining nuclear turns increasing rapidly in diameter and altitude; dividing line between conch and protoconch irregular, rather obscure. Spiral sculpture restricted to 3 or 4 low cords merging into the 2 or 3 more sharply defined lirations upon the anterior fasciole. Aperture narrow, obliquely lobate. Outer lip broadly emarginate posteriorly, flaring slightly in front of the notch; external thickening slight, indicated, however, by the encroachment of the thickened portion on the preceding turn; on the inner surface, about half a dozen short, subequispaced lirations that increase regularly in prominence from the anterior at the mouth of the canal to the posterior directly in front of the siphonal notch. Inner margin of aperture constricted at the base of the body. Parietal and pillar wash rather heavy for so small and thin a shell. Pillar finely denticulate, bearing a marginal fold, which usually flattens out, however, before reaching the aperture. Anterior canal short, broad, not sharply defined. Terminal notch shallow.

Dimensions of holotype: Height, 3.8 millimeters; length of aperture, 1.4 millimeters; maximum diameter, 1.5 millimeters.

Holotype: U. S. Nat. Mus. No. 371845.

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

Mitrella oryzoides is by far the most common representative of the genus in the Chipola. It is smaller than most other *Columbellopsis* but is apparently mature. The whorls are not so flattened nor so regularly coiled as in either the coexistent *photeina* or in *mikra,* the closely allied species of *Mitrella* from the Oak Grove. There is also a characteristic sinousity in the suture on the last quarter turn of *M. oryzoides,* a bending backward around the thickened portion of the labrum, and then a forward turn to the commissure. *Mitrella nanna* is more slender, and the sutures are deeply impressed or even channeled.

Occurrence: Chipola formation, localities 7257^{r}, 2213^{c}, 2564^{p}, 3419^{p}, 7151^{p}.

Mitrella nanna Gardner, n. sp.

Plate LII, figure 22

Shell small and very slender, elongate-conic, the sides of the spire converging slowly toward the subacute apex. Aperture less than half as high as the entire shell. Body sharply rounded at the periphery, constricted rather abruptly into the short, broad neck. Whorls of conch 4½ to 5 in number, flattened laterally, sharp-edged behind, separated by impressed sutures that are often channeled by weathering. Protoconch rather large relatively, including in the type 3 volutions; initial turn low, flattened behind; remaining whorls increasing both in diameter and altitude with a moderate degree of rapidity, broadly inflated except for the final half turn. Dividing line between conch and protoconch irregular, indicated by the increased flattening of the whorl and the lower luster of the conch. Spiral sculpture reduced to about half a dozen rather obscure and irregular lirations on the pillar and anterior fasciole. Aperture sinuous, obtusely angulated posteriorly. Outer lip broadly emarginate at the posterior siphonal fasciole, thin-edged and flaring in front of the fasciole; labrum somewhat heavier behind the margin but not varicose or sufficiently thickened to affect the contour of the whorl; inner surface lirate, the lirae 4 or 5 in number, subequal and equispaced, persisting far within the aperture. Labium sharply excavated at the base of the body. Parietal and pillar wash moderately heavy for so small a shell, especially on the pillar; a small drop of callus deposited on the body wall directly in front of the commissure. Pillar not denticulate, sharply keeled along the inner margin, the keel probably developing within the aperture into a well-defined marginal fold. Anterior canal short, broad, not well differentiated. Terminal notch moderately deep, obliquely directed.

Dimensions of holotype: Height, 4.0 millimeters; length of aperture, 1.6 millimeters; maximum diameter, 1.6 millimeters.

Holotype: U. S. Nat. Mus. No. 371847.

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

Mitrella nanna may be known by its small size, slender outline, and deeply impressed or even channeled sutures. The most closely allied species is *M. oryzoides*, which it approaches so nearly that the end members are with difficulty separable. The typical *nanna* are isolated from typical *oryzoides* by the more slender outline, relatively shorter body, the more evenly tapering spire, and more deeply impressed sutures.

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

Mitrella stikta Gardner, n. sp.

Plate LII, figure 23

Shell small, highly polished, slender, elongate-conic, the spire evenly and gradually tapering to a subacute apex. Aperture less than half as long as the entire shell. Body whorl obtusely angulated at the periphery, flattened behind. Whorls of conch 5, those of the spire trapezoidal, sharp-edged posteriorly, separated by impressed sutures. Protoconch smooth, highly polished, including 4 volutions; initial turn well rounded, partially immersed in the succeeding whorl; remaining nuclear turns increasing more rapidly in diameter than in height, not quite so much flattened laterally as the whorls of the conch. Close of protoconch defined by a distinct but irregular line. Axial sculpture not developed; traces still retained, however, of an axial color pattern of broken and more or less zigzag lines. Spiral sculpture restricted to about 8 subequal, linearly spaced cords on the extreme base of the body and the pillar and 3 or 4 finer lirations on the anterior fasciole. Aperture narrow, slightly oblique, angulated behind. Outer lip smoothly emarginate at the posterior fasciole, flaring slightly in front of the fasciole; lip thin and sharp at the outer edge, thickened a little behind the margin and produced backward on the preceding whorl. Inner surface corrugated with 6 or 7 elongate denticles, the posterior set a little in front of the siphonal fasciole, the anterior at the entrance to the anterior canal; the 2 posterior denticles more prominent than those in front. Labium excavated at the base of the body. Parietal and pillar wash thin and smoothly applied. Pillar short, bearing an obscure marginal fold delimited by the groove behind it. Anterior canal rather narrow, recurved. Terminal notch broad, shallow, obliquely directed.

Dimensions of holotype: Height, 5.5 millimeters; length of aperture, 2.5 millimeters; maximum diameter, 2.1 millimeters.

Holotype: U. S. Nat. Mus. No. 371841.

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

Mitrella stikta is a peripheral species that might be assigned with almost equal propriety to the section *Columbellopsis* or to *Mitrella* s.s. The slight thickening of the outer lip is in some individuals emphasized by exaggerated incrementals, but there is no well-defined varix. The lirations that gird the extreme base of the body and the pillar are more elevated, more sharply defined, and commonly more numerous than in any of the other Alum Bluff species of *Mitrella*.

The type is the only known representative of the species.

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

Mitrella sima Gardner, n. sp.

Plate LII, figure 10

Shell small, slender, elongate-conic, the body abruptly constricted into the narrow neck, which is sharply recurved at the extremity. Aperture approximately half as long as the entire shell. Whorls of conch 4½

to 5 in number, flattened laterally, rather sharp-edged posteriorly, separated by feebly impressed linear sutures. Protoconch rather small, smooth, very highly polished, including about 3 volutions. Initial turn minute, flattened behind, largely submerged in the succeeding whorl; remaining whorls increasing more rapidly in diameter than in height. Dividing line between conch and protoconch distinct, irregular. Spiral sculpture restricted to 4 to 6 rounded, closely spaced threads girding the extreme anterior portion of the body and the pillar and an equal number of finer, more crowded lirae upon the anterior fasciole. Aperture narrow, sinuous, angulated behind. Outer lip emarginate at the posterior fasciole, flaring slightly in front of the fasciole; sharp-edged but reinforced a little behind the margin by a well-defined varical riblet encroaching somewhat upon the preceding whorl, delimited laterally by a shallow, ill-defined depression. Inner surface reinforced with about half a dozen equispaced, elongate denticles that increase regularly in prominence from the anterior—at the entrance to the anterior canal—to the posterior, set a little in front of the posterior siphonal notch. Labium excavated at the base of the body. Parietal wash thin. Pillar glaze also thin but dense and obscurely and very finely denticlate. Inner margin of pillar keeled. Anterior canal short, recurved. Terminal notch rather broad and not very deep.

Dimensions of holotype: Height, 4.2 millimeters; length of aperture, 2.0 millimeters; maximum diameter, 1.8 millimeters.

Holotype: U. S. Nat. Mus. No. 371839.

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

Mitrella sima is readily separable from the two other *Columbellopsis* of comparable dimensions by the well-defined labral varix and recurved anterior canal.

Occurrence: Chipola formation, localities 2213^{p}, 2564^{p}, 3419^{c}.

Mitrella belonis Gardner, n. sp.

Plate LII, figure 11

Shell small, lustrous, slender, acutely tapering. Aperture less than half the length of the shell. Whorls of the spire sharp-edged behind, conspicuously flattened laterally, increasing slowly and regularly in diameter. Body whorl relatively stout, rounding rather sharply into the broad neck. Whorls of the conch closely appressed, probably 6, separated by feebly impressed sutures. Apex somewhat decorticated. Protoconch small, subacute, possibly including as many as 4 volutions; initial turn minute and almost entirely immersed in the succeeding whorl; remaining nuclear turns feebly convex, increasing gradually in diameter and height. Dividing line between conch and protoconch indicated merely by an irregular break and by the reduced polish of the conch. Axial sculpture restricted to microscopically fine incremental striae. Spiral sculpture of half a dozen rather coarse cords on the extreme base of the body and the pillar, becoming less coarse and more closely spaced anteriorly and grading into the 3 linearly spaced threads on the anterior fasciole. Aperture narrow, sinuous, acutely angulated posteriorly. Outer lip little or not at all constricted in front of the commissure, flaring slightly near the base. Labral varix rude, slightly produced posteriorly; margin thin and sharp; denticles on the inner surface most prominent in the medial portion of the lip, very fine anteriorly. Labium sharply contracted at the base of the body. Parietal wash thin except for an irregular deposit directly in front of the commissure. Pillar short, straight, reinforced, finely denticulated just within the outer margin of the wash. Inner margin of pillar keeled and slightly elevated, thus forming a slender marginal fold. Anterior canal short, recurved. Terminal notch broad, moderately deep, obliquely directed.

Dimensions of holotype: Height, 6.3 millimeters; length of aperture, 2.6 millimeters; maximum diameter, 2.5 millimeters.

Holotype: U. S. Nat. Mus. No. 371838.

Type locality: No. 7893, Boynton Landing, Choctawhatchee River, Washington County, Fla.

Mitrella belonis may be recognized by its small size, slender *Strombina*-like outline and acutely tapering multiwhorled spire. *Mitrella dalli* is almost twice as long and has a more attenuated anterior extremity. The young of *dalli* of the same length as *belonis* are sharply carinated at the periphery of the body. *Mitrella dallina* is relatively more slender and the anterior canal is longer than in *M. belonis*.

Mitrella belonis is rare at the single locality from which it has been collected.

Occurrence: Chipola formation, locality 7893^{r}.

Mitrella blastos Gardner, n. sp.

Plate LII, figure 12

Shell small, fusiform, the maximum diameter falling a little in front of the median line. Aperture approximating half the length of the entire shell. Body sharply rounded at the periphery, abruptly constricted into the short, broad neck. Whorls of conch about 4, those of the spire flattened laterally and increasing rapidly in diameter; sutures distinct, slightly impressed. Protoconch rather large relatively, smooth and highly polished, including about 3 volutions; initial turn minute, flattened behind; succeeding whorls increasing more rapidly in diameter than in altitude, broadly inflated except for the last quarter turn. Opening of conch indicated by the lower luster and increased flattening of the whorl. Sculpture restricted to the half

dozen well formed, moderately elevated, subequal, regularly spaced spirals which gird the extreme base of the body and the pillar and an equal number of fine, closely crowded lirae upon the anterior fasciole. Aperture rather narrow, angulated behind. Outer lip broadly emarginate at the siphonal fasciole, flaring in front of the fasciole, thin-edged but somewhat thickened behind the margin; outer limit of the obscure varix defined by a slight depression. Inner wall of aperture sharply constricted along the base of the body. Parietal wash thin. Pillar glaze a little heavier and finely denticulate. Pillar bearing a feeble marginal fold outlined by a shallow linear groove. Anterior canal short, not very broad; emarginate at the extremity.

Dimensions of holotype: Height, 5.0 millimeters; length of aperture, 2.3 millimeters; maximum diameter, 2.5 millimeters.

Holotype: U. S. Nat. Mus. No. 371865.

Type locality. No. 3419, McClelland farm, west bank of Chipola River, 1 mile below Baileys Ferry, Calhoun County, Fla.

Except *M. oryzoides* and *M. sima, Mitrella blastos* is the most common of the smaller *Columbellopsis. Mitrella sima* is similar in general dimensions and outline but is more tapering, and recurved anteriorly.

The varix and rather sharp curvature at the periphery give to *Mitrella blastos* a *Strombina*-like aspect not shared by any other Chipola species of the section except *Mitrella belonis* which like *M. oxia* is larger and more slender than *M. blastos.*

Occurrence: Chipola formation, localities 2213[p], 2564[p], 3419[p].

Mitrella oxia Gardner, n. sp.

Plate LII, figure 18

Shell small, rather slender, and polished. Aperture about half as high as the shell. Whorls of spire very feebly constricted at the sutures, the body smoothly contracted into the rather broad neck; whorls of conch 5, sharp-edged behind, separated by rather feebly impressed sutures. Protoconch relatively rather large, slender, obtusely tapering; nuclear volutions probably 4, the initial turn partly immersed, the succeeding volutions increasing in diameter and height with a moderate degree of rapidity but decreasing in convexity; close of nucleus indicated by a slight break in the shell, the flattening of the whorl, and the lower polish. Spiral sculpture restricted to about 8 lirations on the base of the body and the pillar, less crowded and more elevated anteriorly, and 4 or 5 equal, linearly spaced threadlets on the anterior fasciole. Aperture narrow, angulated behind. Outer lip feebly emarginate posteriorly, flaring slightly in front, varicated a little behind the margin and produced backward upon the preceding volution. Inner surface of labrum threaded with 6 or 7 rather fine, equal, and equispaced lirations, the anterior a little shorter but more elevated than those behind it and marking the entrance to the anterior canal. Inner margin of aperture obliquely constricted at the base of the body. Parietal and pillar wash rather thin except for a small drop of callus directly in front of the commissure and for a series of small denticles on the pillar, corresponding roughly to the spirals. Anterior canal short, broad, recurved. Terminal notch broad, symmetrical, obliquely directed.

Dimensions of holotype: Height, 7.2 millimeters; length of aperture, 3.5 millimeters; maximum diameter, 3.0 millimeters.

Holotype: U. S. Nat. Mus. No. 371835.

Topotype: Johns Hopkins University, Baltimore, Md.

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

Mitrella oxia is shorter and relatively stouter than *M. asema,* and the whorls of the conch are not so flattened laterally and usually fewer by one. The outline and general dimensions of the conch of *M. oxia* suggest those of *Mitrella trajectionis* (Maury) but the whorls of the former are lower and more rounded. The protoconch of *M. trajectionis* is obtuse and includes only 2 volutions, the initial turn well rounded and immersed only at the tip, while that of *M. oxia* is acute and contains about 4 volutions, the initial turn very small and largely submerged in the succeeding whorl. *Mitrella phagon,* the common Oak Grove analog, is larger and relatively stouter.

Occurrence: Chipola formation, locality 2213[r]; Aldrich collection, Johns Hopkins University.

Mitrella phagon Gardner, n. sp.

Plate LII, figure 2

Shell small, highly polished, elongate-conic. Aperture less than half as high as the entire shell. Body obtusely angulated at the periphery, flattened behind, rather sharply constricted in front into the broad neck. Whorls of spire trapezoidal, very narrowly tabulated posteriorly, increasing in diameter with moderate rapidity; whorls of conch 5, closely appressed and separated by sharply defined sutures. Protoconch smooth, rather large relatively, including 4 volutions; initial turn flattened behind, almost entirely immersed; second whorl also low; third and fourth volutions increasing rapidly both in height and diameter. Dividing line between conch and protoconch irregular; opening of conch indicated by a slight change in the texture of the shell and by the increased flattening of the whorl. Axial sculpture not developed, though traces of an axial color pattern of rather crowded, somewhat sinuous and irregular, brownish lines are still retained. Spiral sculpture restricted to about a dozen lirations that gird the extreme base of the body and pillar, becoming increasingly narrower, more rounded, and more closely

695462—47—2

spaced anteriorly and merging gradually into the crowded threadlets of the anterior fasciole. Aperture rather narrow, sinuous, acutely angulated behind. Outer lip feebly constricted directly in front of the commissure, slightly flaring toward the base, sharply rounded at the entrance to the canal. Terminal varix ill-defined, produced backward upon the preceding turn; inner surface lirate except at the siphonal fasciole; lirae usually 5 or 6, most elevated posteriorly, regularly spaced, the feeble anterior liration defining the entrance to the anterior canal. Inner margin of aperture sharply concave. Parietal wash rather thin except for a gob of callus directly in front of the commissure. Pillar short, reinforced, a series of short, irregular denticles developed just within the outer margin of the heavy glaze; inner margin of pillar sharp. Anterior canal very short, broad, recurved. Terminal notch broad, U-shaped, obliquely directed.

Dimensions of holotype: Height, 8.3 millimeters; length of aperture, 3.7 millimeters; maximum diameter, 3.8 millimeters.

Holotype: U. S. Nat. Mus. No. 371836.

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

Mitrella phagon is the probable analog in the Oak Grove fauna of *M. oxia* in the Chipola. The Oak Grove species is larger, and relatively stouter than that from the Chipola; the body is more angular and the anterior part of the shell less tapering. *Mitrella phagon* is fairly common at the single horizon from which it has been collected.

Occurrence: Oak Grove sand, localities 2646^{c}, 5632^{p}, 5631^{r}, 5633^{r}, 7054^{p}, 10659^{p}.

Mitrella trajectionis (Maury)

Plate LII, figure 3

1910. *Astyris trajectionis* Maury, Bull. Am. Paleontology, vol. 4, No. 21, p. 23, pl. 6, fig. 1.

Shell small, smooth and shining, seven-whorled; spiral sculpture consisting only of about ten impressed lines at the base of the shell; outer lip thickened near the margin so as to form a slight varix and with about half a dozen denticulate lirae within; columella with a moderate callus. Length of shell 6; greatest width 2.5 millimeters.

Chipola marls, Baileys Ferry, Florida.

Cornell University collection.—Maury, 1910.

Figured topotype?. U. S. Nat. Mus. No. 371864.

The shell is slender, fusiform, the maximum diameter falling a little in front of the median line. The body is sharply rounded at the periphery. The whorls of the spire are flattened, rather sharp-edged posteriorly and separated by rather deeply impressed sutures. Five of the seven whorls are included in the conch, and two in the smooth, highly polished protoconch. The initial turn of the protoconch is well-rounded and immersed at the tip, the succeeding volution inflated at its beginning but becoming increasingly flattened toward its close. The dividing line between the conch and protoconch is sharply defined. The aperture is rather narrow and angulated posteriorly. There is an obscure emargination at the posterior fasciole. The inner wall of the aperture is obliquely contracted at the base of the body. The pillar is moderately long for the group and bears an obtuse marginal fold delimited by a shallow groove. The terminal notch is broad and very shallow and obliquely directed.

The height of the figured topotype is 6.4 millimeters; the maximum diameter, 2.5 millimeters.

Mitrella trajectionis (Maury) is similar in the characters of the conch to *M. oxia*. The protoconch of *oxia*, however, contains twice as many turns as that of *C. trajectionis* and tapers more acutely because of the more minute initial turn. The conchal whorls of *M. trajectionis* are relatively high and flattened laterally.

Occurrence: Chipola formation, localities ?7893^{r}, ?2213^{r}, 3419^{p}; Cornell University collection.

Mitrella alumen Gardner, n. sp.

Plate LII, figure 5

Shell moderately large for the group, elongate-conic. Aperture a little less than half as high as the entire shell. Whorls of spire flattened laterally, sharp-edged behind, increasing in diameter with a fair degree of rapidity. Body smoothly rounding at the base into the broad neck. Whorls of conch 5, separated by impressed sutures. Protoconch rather small, obtuse, including 3 complete volutions, the initial turn somewhat inflated, immersed at the tip, the two succeeding turns gradually increasing in altitude and diameter but decreasing in convexity. Close of nucleus indicated by a slight break in the shell and the lower luster and greater flattening of the postnuclear whorls. Sculpture reduced to the 4 or 5 spiral lirations that gird the pillar and an equal number of finer, more crowded threadlets upon the anterior fasciole. Aperture narrow, slightly oblique, angulated behind. Outer lip feebly emarginate directly in front of the commissure, flaring slightly toward the base. Terminal varix reduced to an obscure axial fold a little behind the margin, slightly produced posteriorly upon the preceding volution; inner surface lirate except at the posterior fasciole; lirae usually 7 in number, the 2 posterior and the anterior, which defines the entrance to the canal, the most prominent. Labium excavated at the base of the body. Pillar straight and moderately long. Parietal and pillar wash rather thin, heaviest directly in front of the commissure and along the pillar; a few irregular denticles developed on the pillar corresponding in position to the spirals. Canal short, not very broad. Terminal notch U-shaped, rather narrow, obliquely directed.

Dimensions of holotype: Height, 10.1 millimeters; length of aperture, 4.2 millimeters; maximum diameter, 4.2 millimeters.

Holotype: U. S. Nat. Mus. No. 114218.

Type locality: No. 2211, Lower bed at Alum Bluff, Apalachicola River, Liberty Co., Fla.

Mitrella alumen is apparently the analog on the Apalachicola River of *asema* on the Chipola River. As in so many of the analogous species, the Alum Bluff form is ruder, the whorls are less numerous by one, and the spirals upon the pillar are fewer and coarser.

Mitrella alumen has not been recognized except from the type locality.

Occurrence: Chipola formation, locality 2211[p].

Mitrella dallina Gardner, n. sp.

Plate LII, figure 4

Shell very small and very slender, elongate-conic. Aperture less than half as high as the entire shell. Body whorl abruptly constricted at the base, flattened behind the periphery and forming with the whorls of the spire a very smooth and slender obelisk. Whorls of conch probably between 6 and 7 in number, separated by distinct but not conspicuous linear sutures. Protoconch slightly decorticated, apparently rather small, subacute and including about 3 volutions. Initial turn minute, largely immersed in the succeeding turn; remaining whorls increasing more rapidly in diameter than in height, broadly rounded except near the close of the nuclear whorls. Dividing line between the conch and protoconch obscure. Spiral sculpture restricted to 5 to 7 rather strong, well rounded cords that gird the extreme base of the body and the pillar and to 3 to 5 finer lirations that crowd the anterior fasciole. Aperture narrow, acutely angulated behind. Outer lip obscurely emarginate at the posterior fasciole, feebly arcuate, thin-edged, reinforced by a rather broad, axial fold developed a little behind the outer margin and slightly produced posteriorly upon the preceding whorl; denticulations on the inner surface feeble, subequal and equispaced from the siphonal notch to the entrance to the anterior canal. Inner margin of aperture sharply constricted at the base of the body. Parietal wash very thin. Pillar moderately long, rather heavily glazed, feebly rugose. Inner margin of pillar obscurely plicate. Anterior canal rather long for the group, well differentiated, recurved. Terminal notch broad, not very deep, obliquely directed.

Dimensions of holotype: Height, 6.0 millimeters; length of aperture, 2.5 millimeters; maximum diameter, 2.3 millimeters.

Holotype: U. S. Nat. Mus. No. 371837.

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

Mitrella dallina is a slender miniature of *M. dalli* (Maury). It is only about half as large as Miss Maury's species, and the whorls are a little less flattened. *M. belonis,* a coexistent species of comparable dimensions, also has a more flattened, acutely tapering spire, and the posterior margin of the whorls is elevated on the final half turn into an ill-defined fold, which, with the relatively large body, lends a *Strombina*-like outline to the shell.

The type of *M. dallina* is unique.

Occurrence: Chipola formation, locality 2213[r].

Mitrella asema Gardner, n. sp.

Plate LII, figure 6

Shell of moderate dimensions for the genus, the spire elevated and acutely tapering. Aperture decidedly less than half as high as the entire shell. Whorls of conch 6, those of the spire flattened, regularly increasing in diameter, sharp-edged posteriorly. Body broadly rounded. Suture lines distinct, impressed. Protoconch smooth, highly polished, rather small and slender; initial turn immersed at the tip; second and third whorls increasing in diameter and altitude with moderate rapidity but decreasing in inflation. Close of nucleus indicated by a slight thickening of the shell and a somewhat irregular break, followed by the dull-finished, flattened, post-nuclear whorls. Incrementals microscopically fine. Spirals restricted to half a dozen low, rather obscure lirations upon the extreme base of the body and the pillar, more sharply defined and least crowded anteriorly; and to an approximately equal number of fine, equisized, linearly spaced lirations upon the wide anterior fasciole. Aperture narrow, oblique, acutely angulated posteriorly. Outer lip sinuous, feebly constricted directly in front of the commissure and flaring slightly at the periphery of the body, rather sharply folded and slightly thickened a little behind the margin, 6 to 9 subequal and equispaced lirae within. Inner wall of aperture sharply contracted at the base of the body. Pillar rather long for the group and straight. Parietal wall and pillar smoothly glazed, not denticulate or rugose; inner margin of pillar rounded. Anterior canal short, rather broad. Terminal notch broad, moderately deep, obliquely directed.

Dimensions of holotype: Height, 11.0 millimeters; length of aperture, 4.5 millimeters; maximum diameter, 4.0 millimeters.

Holotype: U. S. Nat. Mus. No. 371834.

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

Mitrella asema is shorter and stouter and less attenuated anteriorly than *M. dalli* (Maury) and includes fewer volutions. The whorls are more flattened laterally and more regularly tapering than those of *Mitrella oxia. Mitrella alumen* from the lower bed at Alum Bluff is apparently a close analog of *M. asema,* but it is coarser and not so slender. The protoconch and the character of the early whorls of *M. asema* suggest *Mitrella ischna,* but the posterior tabulation is less

distinct, and there is no trace in *M. asema* of any spiral sculpture except that on the pillar and fasciole.

The species is rather rare even at the single locality at which it is represented.

Occurrence: Chipola formation, locality 2213[r].

Mitrella dalli (Maury)

1910. *Astyris Dalli* Maury, Bull. Am. Paleontology, vol. 4, No. 21, p. 23, pl. 6, fig. 2.

Shell very slender, smooth, acute, nine-whorled, the two nuclear whorls being very smooth and shining; spiral sculpture consisting only of about ten to fifteen impressed lines at the base of the shell; transverse sculpture limited to a varix-like thickening near the edge of the outer lip; margin of outer lip sinuous, with nine or ten denticulate lirae within; columella with a slight callus. Length of shell 12; greatest width 4 millimeters.

Chipola marls, Baileys Ferry, Fla.

Cornell University collection.

Named in honor of Dr. Dall of the Smithsonian.—Maury, 1910.

The length of the aperture is less than half that of the shell, and the body is smoothly constricted into the moderately long, straight pillar. The whorls of the adult conch run as high as 8 in number. The initial protoconchal turn is minute and immersed at the tip, the remaining whorls of the protoconch increasingly elevated and decreasingly inflated. The dividing line between the nuclear and postnuclear whorls is well-defined and is indicated by a slight break in the shell and by the lower polish of the conch. The posterior edges of the whorls of the conch are sharp and the sutures distinct and impressed. The aperture is rather narrow and rudely lobate, the anterior canal of moderate length for the group, not very wide, and broadly emarginate at the extremity. Both *M. asema* from the Chipola River and *M. alumen* from Alum Bluff, species of comparable dimensions, are stouter relatively and include fewer volutions. *Mitrella dallina,* a coexistent form of slender outline and many whorls, is only about half as high as *M. dalli* and has a relatively short body.

Mitrella dalli is not uncommon at the single locality from which it has been collected.

Occurrence: Chipola formation, locality 2213[p], Cornell University collection.

Section TETRASTOMELLA Bellardi in Sacco

1890. *Tetrastomella* Bellardi in Sacco, R. accad. Scienze di Torino Mem., vol. 40, pp. 323, 333.

1890. *Tetrastomella* Bellardi in Sacco, Molluschi dei terreni terziarii del Piemonte e della Liguria, pt. 6, p. 41.

Type herewith designated: *Murex subulatus* Brocchi. Plaisancian of northern Italy.

The subgenus is reserved for relatively large shells of the *Mitrella* group which have in common an elevated, polygyrate spire, the later whorls compressed and narrowly tabulated posteriorly, the body obtusely angulated at the base and constricted into a broad neck of moderate length. The nucleus is similar to that of *Mitrella s. s.* The shell is typically smooth except for the incremental striae and the lirae which gird the pillar and the anterior fasciole. The outer lip is obscurely emarginate at the anal fasciole, varicose and lirate within. At the base it is abruptly constricted into the rather short, recurved canal. The inner margin of the aperture is excavated and heavily callused, the margin of the callus sharp and standing apart from the pillar wall. The pillar rugae are inconspicuous and correspond roughly in position to the spiral lirae. The anterior fasciole is short and slightly bulging. The margin of the rather shallow, asymmetric, terminal notch is bent back a little, giving to the anterior canal a nasute appearance.

Tetrastomella differs from *Columbellopsis* and *Mitrella* s. s. in the more angular outline and narrowly tabulated later whorls. The American representatives of *Tetrastomella* are larger than any of the other members of the *Mitrella* group. The species *ischna* and the subspecies *mitrodita* differ from *Tetrastomella* in the development of a more or less fortuitous spiral sculpture, a decided nick at the base of the outer lip, and a narrower and deeper terminal notch, but they differ from the other described superspecific groups in even more important characters. The resemblance of *Tetrastomella perfervida* of the lower Miocene Floridian fauna to the subgenotype from the Italian Pliocene is rather striking.

Mitrella perfervida (Dall)

Plate LII, figure 1

1900. *Astyris perfervida* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, p. 1197, pl. 41, fig. 10. (No description.)

Shell of average dimensions for the group. Spire elevated, multigyrate, the earlier volutions evenly tapering, increasing slowly in diameter, the later turns increasing more rapidly and sharply but narrowly tabulated posteriorly. Body whorl abruptly constricted into the short pillar. Anterior canal short but well defined. Length of aperture less than half that of the shell. Whorls of conch numerous, separated by impressed suture lines. Protoconch smooth, highly polished, slender, subacute, performing 3½ volutions; initial turn minute, slightly tilted, immersed at the tip; succeeding volutions increasing gradually in diameter and decreasing in convexity, the final half turn with a lateral flattening similar to that of the early whorls of the conch. Dividing line between protoconch and conch obscure, indicated only by an irregular break in the shell. Sculpture of conch restricted to 6 or 8 low, flattened cords on the base of the body and pillar, which become increasingly crowded and elevated anteriorly and pass without any sharp break into the

half dozen crowded lirae on the anterior fasciole. Aperture narrow, angular, sulcate at the commissure. Outer lip thickened externally and slightly produced posteriorly; inner surface sharply lirate medially and anteriorly, the lirae along the medial portion of the labrum more prominent than those in front of them; constriction at the entrance to the canal subangular. Labium obliquely excavated at the base of the body. Parietal wash heaviest directly in front of the commissure and on the pillar, rather thin along the body wall. Pillar obscurely denticulate in harmony with the spirals. Anterior canal short but clearly defined, with parallel, proximate margins; terminal notch broadly U-shaped, obliquely directed.

Dimensions of incomplete holotype: Height, 18.6 millimeters; length of aperture, 8.6 millimeters; maximum diameter, 7.3 millimeters; diameter at right angles to the maximum diameter, 6.5 millimeters.

Holotype: U. S. Nat. Mus. No. 107387.

Type locality: Sta. 2646, Oak Grove, Okaloosa County, Fla.

The specimens from Alum Bluff run a little stouter than those from Oak Grove, and the spirals on the pillar are, as a rule, fewer in number and more prominent.

Occurrence: Chipola formation, locality 2211[c]; Oak Grove sand, localities 2646[p],? 5631[r], 7054[c].

Mitrella perfervida megala Gardner, n. subsp.

Plate LII, figure 21

Shell large and heavy, the aperture about half as high as the entire shell. Apex broken away so that the exact number of whorls is not determinate but possibly about 9 in the conch. Whorls of spire trapezoidal, flattened laterally, somewhat turreted on the medial and anterior portions owing to the narrow posterior tabulation, which becomes less and less narrow toward the aperture. Body compressed and abruptly constricted into the broad pillar. Suture lines distinct, impressed. Protoconch not preserved. Sculpture restricted to a few obscure groovings on the base of the body, 6 to 8 rather prominent lirae on the pillar, and half a dozen lower and more closely spaced lirae on the anterior fasciole. Aperture subquadrate, acutely angulated and sulcated at the posterior commissure. Outer lip slightly produced posteriorly, approximately parallel to the axis as far as the base of the body, where it is abruptly constricted to form the walls of the narrow canal. Labral varix obscurely defined. Lirations on the inner surface rather coarse and irregular, most prominent on the posterior medial portion. Labium sharply excavated at the base of the body. Pillar moderately long and broad. Parietal wash heavy directly in front of the commissure but rather thin elsewhere; pillar glazed, denticulate, the denticles small and obtuse and corresponding in position to the spirals. Anterior canal short, broad, recurved, the margins subparallel. Terminal notch broad, moderately deep, obliquely directed.

Dimensions of holotype: Height, 22.8 millimeters; length of aperture, 11.0 millimeters; maximum diameter, 10.8 millimeters; diameter at right angles to the maximum diameter, 9.5 millimeters.

Holotype: U. S. Nat. Mus. No. 371881.

Type locality: No. 2564, 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.

Mitrella (Tetrastomella) perfervida megala suggests a large *M. perfervida* (Dall). The subspecies is relatively broader, the tabulation on the later whorls is not so narrow as in *perfervida*, the body is more angular, and the spirals on the pillar are more prominent and more numerous.

Occurrence: Chipola formation, localities 2564[r], 3419[r].

Mitrella ischna Gardner, n. sp.

Plate LII, figure 7

Shell rather high and very slender. Aperture less than half as long as the entire shell. Whorls 7½ in the conch, those of the spire trapezoidal, increasing slowly in diameter; the later volutions minutely tabulated posteriorly. Body whorl smoothly but rather abruptly constricted at the base. Suture lines distinct but not impressed. Protoconch small, smooth, highly polished, subacutely tapering, coiled 3 times; initial turn minute, immersed at the tip; two remaining volutions increasing slowly in height and diameter but decreasing in convexity. Dividing line between conch and protoconch indicated by a slight break in the texture of the shell; spire in the young forms and in some of the adults entirely smooth; in other adults, as in the type, lineated on the anterior half of the conch by two subequal, obscure grooves, the anterior a little in front of the median horizontal, the posterior midway between the anterior sulcus and the suture line; base of body and pillar girded with about half a dozen unequal cords, those on the pillar the most prominent and the most distantly spaced. Anterior fasciole closely threaded with half a dozen lower, more crowded lirations. Aperture narrow, obliquely lobate, acutely angulated posteriorly. Outer lip varicated a little behind the thin, sharp margin, pushed backward a little, on the preceding turn; inner surface of varix set with 9 or 10 short, lirate ridges, subequispaced, but slightly more elevated medially; labral margin notched at the base of the body of the adult, possibly for the extension of the eye stalks. Inner wall of aperture strongly concave. Parietal wash heavy directly in front of the commissure but thin on the base of the body. Pillar thickly glazed, obscurely denticulated; margin of pillar well rounded. Anterior canal short, recurved, narrowly and deeply emarginate.

Dimensions of holotype: Height, 15.5 millimeters; length of aperture, 6.3 millimeters; maximum diameter, 5.6 millimeters; diameter at right angles to the maximum diameter, 5.0 millimeters.

Holotype: U.S. Nat. Mus. No. 371832.

Type locality: Sta. 2213, 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.

The members of the species in which the spiral sculpture is prominent have been segregated under the subspecies *mitrodita.* The nick near the base of the labrum is not always perceptible, but it is much too commonly developed and too uniform in its character to be a pathologic phenomenon.

The smooth individuals suggest *M. perfervida* and *M. dalli* in the elevated multispiral conch. *M. perfervida* is a little larger and stouter, and the tabulation of the later whorls is well-defined; *M. dalli,* on the other hand, is smaller than *M. ischna,* more slender, and less abruptly constricted at the base of the body.

Occurrence: Chipola formation, localities 2213^{c}, 2564^{p}, 3419^{p}.

Mitrella ischna mitrodita Gardner, n. subsp.

Plate LII, figure 8

Shell rather small, solid, elevated. Aperture less than half the height of the entire shell. Whorls of conch 7 in the type, those of the spire trapezoidal; the later volutions narrowly tabulated; the body whorl smoothly constricted at the base. Suture lines distinct but not impressed. Protoconch small, smooth, highly polished, obtusely tapering, including 3 volutions; initial turn minute, immersed at the tip; two succeeding whorls increasing slowly in diameter and height but decreasing in convexity. Line between conch and protoconch broken, indicated chiefly by a slight change in the texture of the shell. Later adult whorls spirally lirate in the type; spirals initiated on the fourth turn of the conch in the form of two feeble grooves similar to those on the body and the final whorl of the spire of *M. ischna* s.s.; sculpture on the later volutions elevated rather than depressed, the two initial sulci deepening so that the area between the grooves and that between the posterior groove and the posterior suture stand up as heavy cords; other grooves and cords developed in the same manner, so that on the penultima of the type, there are 3 and on the body 4 subequal cords, with 1 or 2 linear grooves in front of them; anterior medial portion of the body girded with an unsculptured band about double the width of one of the spirals; base of body and pillar coarsely lirate. Fasciole feebly threaded. Aperture narrow, obliquely lobate, acutely angulated posteriorly. Outer lip obscurely varicated a little behind the thin, sharp margin, lirate within. Edge of labrum emarginate, as a rule, at the periphery. Inner wall of aperture constricted along the base of the body. Pillar straight. Parietal wash heaviest directly in front of the commissure and dense along the pillar, the margin of the glaze sharply defined and standing apart a little from the pillar wall. Anterior canal short, recurved. Terminal notch narrow, deep, obliquely directed.

Dimensions of holotype: Height, 16.0 millimeters; length of aperture, 7.0 millimeters; maximum diameter, 6.3 millimeters; diameter at right angles to the maximum diameter, 5.7 millimeters.

Holotype: U. S. Nat. Mus. No. 371833.

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

M. ischna mitrodita is readily separated from *M. ischna* s.s. as well as from all other coexistent members of the genus by the development of a spiral sculpture. The type is a peripheral member, however; the spiral sculpture in most of the individuals is more restricted and less prominent, and the labral notch may be wanting.

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

Genus STROMBINA Mörch

1852. *Strombina* Mörch, Catalogus Conchyliorum quae reliquit D. Alphonso d'Aguirra & Gadea, Comes de Yoldi, p. 85.

1901. *Strombocolumbus* Cossmann, Essais de paléoconchologie comparée, vol. 4, p. 241.

Type by subsequent designation: Cossmann, Essais de paléoconchologie comparée, pt. 4, p. 241, 1901: *Columbella lanceolata* Sowerby = *Columbella recurva* Sowerby. Recent on the Pacific side of Panama.

Bronn in 1849[8] used *Strombina* as a major group name to include *Chenopus, Rostellaria, Pteroceras, Strombus,* and *Pterodonta.* The name did not have nor was it intended to have a generic significance, and it has no generic standing. Nevertheless, Bucquoy, Dautzenberg, and Dollfus substituted the name *Columbellopsis* for *Strombina,* on the ground that *Strombina* was already preoccupied by Bronn; but included under it a number of other forms of the genus *Atilia* H. and A. Adams 1853, typified by *Mitrella minor* Scacchi. Cossmann considered the *Columbellopsis* of Bucquoy, Dautzenberg, and Dollfus as an exact synonym of *Atilia* and for that reason no longer available for the group of *C. lanceolata* Sowerby. Assuming, as did the authors of Les Mollusques marins du Roussillon, that *Strombina* had been preoccupied by Bronn, he substituted for *Strombina* the name *Strombocolumbus.*

Woodring in 1928 observed that *Strombina* was probably susceptible to division. None of the east American Tertiary species exhibit the noded sculpture that characterizes the genotype.

Strombina as it is commonly used for the east coast shells includes those species characterized by an ele-

[8] Bronn, H. G., Index palaeontologicus, vol. 3, p. 440, 1849.

vated, commonly turreted spire, a heavily varicose outer lip, in some species, as in the *S. gradata* group, a tricornute cross section of the body due to a flattening of the apertural face, an oblique compression behind the labral varix, a sculpture which, if present, is usually axial and inclined to evanesce toward the aperture and a canal more sharply constricted than that of the genotype.

The group is best developed toward the close of Alum Bluff time, in the Shoal River, the period during which the fauna was apparently most freely in communication with the faunas of the mid-Americas.

The species has been reported from the Tertiaries of Europe and the Antillean and Floridian region, but the Recent representatives are confined to the warm waters of the Pacific side of Middle and South America.

There are six species reported from the Alum Bluff, three of them allied to the *Strombina gradata* (Guppy) group from the mid-Americas, though smaller and more delicate. The genus occurs very much more abundantly in the Shoal River than in either of the other horizons, for not only is *Strombina waltonia* much more prolific than either *S. aldrichi* from the Chipola or the subspecies *nemoralis* from the Oak Grove, but the three smaller unsculptured species of *Strombina* are all of them restricted to the Shoal River horizon.

Axial sculpture restricted to the last 4 or 5 whorls, pillar smooth ..... *Strombina waltonia* Gardner, n. sp.
Axial sculpture restricted to the last 1, 2, or 3 whorls, pillar denticulate ..... *Strombina aldrichi* (Maury) s. l.
  Altitude of adult usually exceeding 12.0 millimeters ..... *Strombina aldrichi* (Maury) s. s.
  Altitude of adult rarely exceeding 12.0 millimeters ..... *Strombina aldrichi nemoralis* (Maury)
Axial sculpture restricted to incremental striae and the labral varix:
  Inner margin of pillar rounded or subacute:
    Spire not very slender either in absolute dimensions or relative to the diameter of the body ..... *Strombina lissa* Gardner, n. sp.
    Spire very slender both in absolute dimensions and relative to the diameter of the body ..... *Strombina lampra* Gardner, n. sp.
  Inner margin of pillar acutely keeled ..... *Strombina ceryx* Gardner, n. sp.

Strombina waltonia Gardner, n. sp.

Plate LII, figures 26-28

Shell rather thick, crumbly, tall for the genus but very slender, the spire even more slender relatively than the body and acutely tapering. Whorls 12 to 14 in all, the early volutions flattened laterally and increasing gradually in diameter, commonly flattened on the apertural face and the later turns narrowly tabulated. Body so compressed behind the terminal varix that it appears somewhat distorted; gently constricted at the base into the rather broad, recurved pillar. Suture lines distinct, feebly impressed. Protoconch small, slender, subacute, smooth, and rather highly polished; component volutions 3; initial turn minutely bulbous, immersed in the succeeding turn; two remaining turns feebly inflated. Dividing line between conch and protoconch indicated by a slight change in the texture of the shell and by the flattening of the whorls. On the posterior half of the later volutions, an axial sculpture of sharp little puckers normally equal, and equispaced, running about 16 to the whorl except on the body, where they are irregular, and on the last half turn, where they may be obsolete; incremental striae microscopically fine. Spiral sculpture restricted to a coarse irregular cording on the extreme base of the body and the pillar and to an obscure striation on the anterior fasciole. Aperture narrow, sinuous, channeled posteriorly. Outer lip thin-edged but varicose behind the margin and pushed backward on the preceding whorl; commonly a slight depression directly behind the varix. Lirations on the inner surface of the varix short, 9 in the type, decreasing in elevation anteriorly, the posterior liration usually opposite the extremity of the posterior of the pillar spirals. Inner margin of aperture sinuous. Parietal wall and pillar rather heavily glazed, the pillar callus commonly standing apart a little from the body wall, not plicate nor denticulate. Inner margin of pillar well rounded. Anterior canal rather narrow, short, twisted, flaring a little and deeply and obliquely emarginate at the anterior extremity.

Dimensions of incomplete holotype: Height, 23 millimeters; length of aperture, 12.5 millimeters; maximum diameter, 8.5 millimeters; diameter at right angles to the maximum diameter, 6.7 millimeters. Dimensions of immature paratype: Height, 14.3 millimeters; maximum diameter, 4.7. millimeters.

Holotype and paratype: U. S. Nat. Mus. No. 371848.

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

Strombina waltonia is more elevated and more slender than *S. aldrichi* (Maury), the later volutions are more turreted and the body larger, relative to the size of the spire. The axials are also more numerous by 2 or 3 to the whorl and are developed on the later 4 or 5 volutions instead of being restricted to the body and the latest whorl of the spire.

Strombina waltonia is the Floridian representative of a group widely distributed in the mid-Americas. The species share the diagnostic characters of an elevated turreted spire, a body obliquely flattened behind the terminal varix and presenting a more or less ob-

scure tricornute cross section and a sculpture of short, pinched axials confined in many species to the posterior part of the whorl. Among the species are *Strombina gradata* (Guppy), 1866, described presumably from the Bowden beds of Jamaica, *S. cyphonotus* Pilsbry and Johnson, 1911, and *S. prisma* Pilsbry and Johnson, 1911, both from the Dominican Republic, *Strombina lessepsiana* Brown and Pilsbry, 1911, from the Gatun of the Canal Zone and Costa Rica, and *Strombina gradata humboldti* Rutsch from the Punta Gavilan beds in northern Venezuela. *Strombina dorsata* Sowerby from the Recent Panamanian fauna on the Pacific side has much the general aspect of the group although no trace remains of the axial sculpture.

Occurrence: Shoal River formation, localities, 3856[a], 2645[r], 3732[p], 3742[a], 3731[r], 5080[p], 5184[c], 3748[r], 9960[r].

Strombina aldrichi (Maury)

Plate LII, figure 29

1910. *Astyris Aldrichi* Maury, Bull. Am. Paleontology, vol. 4, No. 21, p. 24, pl. 6, fig. 3.

Shell of moderate size, polished, with the general shape of *A. perfervida* Dall, but characterized by the presence of ten or more vertical riblets on the body whorl just below the suture. Earlier whorls eroded, remaining whorls five, outer lip with about eight lirae within and a slight external varix near the margin, canal reflexed; columella with five weak denticles and a moderate callus on the anterior part. Length of decollate shell 14 [millimeters]; greatest width 6 millimeters.

Chipola marls, Baileys Ferry, Fla.

Cornell University collection.

Dedicated to Mr. T. H. Aldrich of Washington.—Maury, 1910.

Dimensions of figured specimen: Height, 16.5 millimeters; maximum diameter, 5.7 millimeters.

Figured specimen: U.S. Nat. Mus. No. 371883, from No. 3419, Baileys Ferry, Chipola River, Fla.

The shell is rather small for the group and not very thick. The aperture is less than half as high as the entire shell, and the spire correspondingly elevated and acutely tapering. The earlier volutions increase more slowly in diameter, however, than the later and are not so sharp-edged posteriorly. There are as many as 9 whorls in the adult conch, while the protoconch includes 3 volutions, the earliest partially submerged, the 2 later turns feebly inflated. The dividing line between the conch and protoconch is clearly marked by a slight break in the shell and by the flattening of the whorl. The axial riblets are sharp little puckers, restricted entirely to the posterior half of the whorl and commonly obsolete on the final half turn; usually as many as 14 if developed around the entire circumference of the whorl, sometimes restricted to the body and more rarely developed on the final whorls of the spire. The spirals at the base of the body and on the pillar are remarkably strong and sharp. The aperture is narrow and acutely angulated at the posterior commissure. The prominence of the denticles on the inner surface of the labrum opposite the constriction at the base of the body make the aperture look almost as narrow behind as in front. The terminal notch is broadly U-shaped and obliquely directed.

Strombina aldrichi in the broad sense is readily isolated from *S. waltonia* by its smaller size, relatively stouter outline, rather less numerous whorls, less uniformly tapering spire but relatively more slender body, more restricted and less numerous axials, and denticulate pillar.

Occurrence: Chipola formation, localities 2213[p], 3419[r], Cornell University collection.

Strombina aldrichi nemoralis (Maury)

Plate LII, figure 30

1903. *Strombina tetrica* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 6, p. 1590 (name only).

1910. *Astyris aldrichi* var. *nemoralis* Maury, Bull. Am. Paleontology, vol. 4, No. 21, p. 24, pl. 6, fig. 4.

Shell resembling the typical form from Bailey's Ferry but smaller, and with riblets on the next to the last as well as on the last whorl. Earlier whorls eroded, remaining whorls three; spiral sculpture of a varying number of impressed lines extending from the base of the shell to about midway or less up on the body whorl; transverse sculpture of (on the last whorl ten to eleven) narrow, nearly straight, rounded riblets best developed at and near the sutures and becoming obsolete a short distance below them. These riblets are present only on the last whorl and a half and do not appear on the earlier whorls. Outer lip with a varix near the margin and with about eight sharply-cut lirae within; aperture narrow; canal reflexed; columella with about six denticles and a thin callus. Length of decollate shell 10; greatest width 5 mm.

Oak Grove, Fla.

Cornell University collection.—Maury, 1910.

Dimensions of topotype: Height, 12.5 millimeters; maximum diameter, 4.6 millimeters.

Topotype: U.S. Nat. Mus. No. 371868. From No. 2646, Oak Grove, Yellow River, Okaloosa County, Fla.

Topotype: Aldrich collection, Johns Hopkins University.

The subspecies is consistently smaller and usually a little stouter than the species s.s., although like it there are 9 whorls included in the adult conch. The protoconch judged by the small scar is probably similar to that of *aldrichi* s.s. The axial sculpture offers approximately the same range of variation in number of ribs and degree of development as that of the species s.s., but the spiral sculpture is sharper relatively, and fortuitous linear grooves occasionally occur well up upon the body and even on the whorls of the spire.

Occurrence: Oak Grove sand, localities 2646[p], 5632[r]; Cornell University Collection.

Strombina lissa Gardner, n. sp.

Plate LII, figures 14, 15

Shell small for the genus, stout, conical, acutely tapering. Aperture nearly half as high as the entire

shell. Volutions 11 in all, only 6 of these included in the conch. Whorls of spire trapezoidal, increasing rather rapidly in diameter, very narrowly but sharply tabulated behind. Body whorl rather smoothly constricted into the short, broad pillar. Sutures distinct, impressed. Protoconch large for the genus, smooth, highly polished when perfectly preserved, somewhat pupiform; initial turn flattened, almost entirely immersed in the succeeding volution; 4 remaining volutions increasing rather slowly in diameter and height but decreasing in convexity so that the final half or three-quarters turn is separable from the compressed initial turn of the conch only by a very slight and irregular break and an almost imperceptible change of texture. Sculpture restricted to a few, shallow grooves or flattened cords on the extreme base of the body, the pillar and the short anterior fasciole. Aperture narrow, angulated and feebly sulcate behind; outer lip beveled to a thin, sharp margin, feebly varicose, slightly produced posteriorly on the preceding turn; inner varical surface sharply lirate. Inner wall of aperture sharply constricted at the base of the body. Pillar rather short and straight, well-rounded at the margin; parietal wash heavy, a gob of callus deposited on the parietal wall directly in front of the commissure and irregular denticles along the heavy pillar glaze. Anterior canal short. Terminal notch narrow, deep, obliquely directed.

Dimensions of holotype: Height, 10.8 millimeters; length of aperture, 5 millimeters; maximum diameter, 5 millimeters; diameter at right angles to maximum diameter, 4.7 millimeters.

Holotype and juvenile paratype: U. S. Nat. Mus. No. 371869.

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

Strombina lissa, though by no means so abundant nor so widely distributed as the much taller, axially sculptured, coexistent *S. waltonia,* is very common at the type locality and fairly well represented at other Shoal River outcrops. *S. lampra* from the environs of Laurel Hill is smaller, more slender, and more acutely tapering. *Strombina mira* Dall from Gatun is a species of comparable dimensions though a little smaller and more slender. The spiral sculpture, furthermore, is developed over the entire base of the body in front of the periphery, the lirae numbering about twice as many as those on the base and pillar of *S. lissa.*

The species varies rather widely in relative dimensions.

Occurrence: Shoal River formation, localities 3856^{c}, 3732^{r}, 3742^{a}, 5195^{r}, 3748^{r}, 9960^{r}.

Strombina lampra Gardner, n. sp.

Plate LII, figure 13

Shell small for the group, highly polished, acutely tapering. Aperture about half as high as the entire shell. Spire slender, the body whorl relatively large, flattened behind the labrum, abruptly contracted at the base; later volutions narrowly tabulated, trapezoidal in lateral outline. Whorls 9 in all, but only 5 included in the conch. Sutures distinct, feebly impressed. Protoconch moderately tall but slender; initial turn minute, almost entirely immersed; 3 remaining nuclear whorls moderately inflated, increasing gradually in diameter and height, flattening toward the close. Dividing line between conch and protoconch distinct; well-preserved specimens marked by an abrupt change from the white of the protoconch to the shining gray of the conch and by a further lateral flattening of the whorl. Axial sculpture restricted to microscopically fine incremental striae. Base of body and pillar girded with a few well-defined spiral threads, the posterior flattened on their summits but becoming increasingly narrower and more elevated anteriorly and merging into the 5 or 6 spirals that crowd the anterior fasciole. Aperture narrow, slightly oblique, acutely angulated and obscurely sulcate posteriorly. Outer lip thickened and pushed backward, the margin, however, thin and sharp; lirations on the inner surface feeble, except the posterior ridge directly opposite the constriction at the base of the body. Labium strongly concave. Parietal wash heavy, especially in front of the commissure; outer margin of glaze sharply defined. Pillar smooth except for a series of minute denticles developed in some adults and corresponding in position to the spirals on the anterior fasciole; inner margin of pillar subacute. Anterior canal short. Terminal notch broad, deep, obliquely directed.

Dimensions of holotype: Height, 8.7 millimeters; length of aperture, 4.4 millimeters; maximum diameter, 4.0 millimeters; diameter at right angles to the maximum diameter, 3.5 millimeters.

Holotype: U. S. Nat. Mus. No. 371849.

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

Strombina lampra is the smallest member of the genus known to occur in the Shoal River and the most slender. *Strombina lissa* resembles it in absence of sculpture except on the base and pillar, but *A. lissa* is much less shining and has a stouter spire both in absolute dimensions and relative to the size of the body. *S. lampra* is for the most part restricted to the environs of De Funiak Springs.

Occurrence: Shoal River formation, localities 5079^{r}, 9958^{r}, 7264^{p}, 5618^{p}, 9959^{p}.

Strombina ceryx Gardner, n. sp.

Plate LII, figure 16

Shell small for the genus, ovate-conic, fairly heavy and rude. Aperture about half as high as the entire shell. Whorls 6 to 7 in all, the earlier turns of the conch flattened laterally, the later volutions broadly

rounded, narrowly tabulated; the body abruptly constricted at the base. Suture lines impressed. Apex usually decorticated. Protoconch rather small, obtuse, probably including 3 volutions; initial turn minute and almost entirely immersed; second and third whorls broadly inflated, gradually flattening toward the close of the nucleus. Dividing line between conch and protoconch obscure, indicated by a slight and irregular break. Incremental striations feeble; other axial sculpture not developed. Spirals restricted to the base of the body, pillar and anterior fasciole; base of the body commonly outlined by a faintly incised linear sulcus; 3 or 4 sharply elevated, narrow, uncrowded spirals developed between this sulcus and the anterior fasciole. Fasciole coarsely but obscurely lirate. Aperture broadly lenticular; acutely angulated and sulcated posteriorly but sulcus too shallow to cut off the terminal varix as it does in *Bifurcium*. Outer lip thickened slightly behind, and at the margin; feebly lirate within. Inner wall of aperture strongly concave, heavily glazed, the wash spread in a broad arc from the commissure to the canal, heaviest directly in front of the commissure; 2 or 3 obscure and irregular denticles occasionally developed on the base of the pillar. Pillar smooth except for these denticles and for the narrow but acute marginal fold. Anterior canal incipient; the entrance indicated by the anterior liration on the inner surface of the labrum and directly opposite, the marginal fold of the labium. Terminal notch narrow, deep, obliquely directed.

Dimensions of holotype: Height, 8.5 millimeters; length of aperture, 4.2 millimeters; maximum diameter, 4.3 millimeters.

Holotype: U. S. Nat. Mus. No. 371850.

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

Strombina ceryx is the only member of the genus exhibiting the marginal keel and the strongly sulcated posterior commissure, which in a much exaggerated form characterize the subgenus *Bifurcium*. Both of these diagnostic characters are too feebly developed in *S. ceryx* to justify the reference of the species to *Bifurcium*. Furthermore, *Bifurcium* is a thinner shell and the varix is confined to the extreme margin of the lip; the lirae, characteristically well developed on the inner labral surface of *Strombina* are reduced in *Bifurcium* to feeble denticles developed only on the inner surface of the marginal varix; and the parietal wash in *Strombina*, including *S. ceryx*, is thick; in *Bifurcium* it is very thin or absent.

Strombina walli Mansfield (pl. LII, fig. 38) from the Brasso beds of Trinidad is a smaller, more delicate shell. The oral armature, though similar in a general way, is heavier and the gutter at the posterior commissure much better defined.

Occurrence: Shoal River formation, localities 3856[r], 3742[p].

Family MURICIDAE

Genus MUREX Linnaeus

1758. *Murex* Linnaeus, Systema naturae, ed. 10, p. 746.

Type by subsequent designation (Montfort, Conchyliologie systématique, vol. 2, p. 619, 1810): *Murex pecten* Montfort=*Murex tribulus* Linnaeus. Recent in the South Pacific and Indian Oceans.

Shell oblong, oval, pyriform or fusiform in outline. Spire usually elevated, acutely tapering. Protoconch rather small, smooth, paucispiral. Ornamentation of conch elaborate; axial varices 3 in the restricted *Murex*, usually continuous, commonly spinose at the intersection with the spirals, less commonly foliaceous; simple costals may be reduced on the later whorls to peripheral tubercles; spiral sculpture developed, as a rule, over the entire conch, overriding the axials; primary spirals modified into spinose processes. Aperture subcircular, elliptical or ovate. Labrum varicated, lirate or denticulate within. Labium nonplicate, heavily glazed, often rugose or denticulate in front of the commissure and along the pillar. Anterior canal long and straight or short and recurved, generally roofed over in the adult.

Murex has a limited representation in the Cretaceous. In the succeeding Tertiary and later faunas the genus becomes increasingly abundant, and the recent species number well over 200, the most of them tropical and subtropical from between tides to a depth of 50 fathoms.

Seven species have been isolated from the Alum Bluff, and the number would be materially increased if the imperfect specimens were named. Three out of the four species of *Murex* s.s. have been described from the Chipola. Though none has been named from the Oak Grove there are at least 3 species represented at that horizon, all of them allied to the Chipola forms. The single known *Murex* s.s. from the Shoal River is distinct. In the subgenus *Chicoreus*, *M. folidodes* from the Chipola is the close analog of *M. aldrichi* from the Shoal River. *M. pyknos* from the Shoal River is a form with no near relatives and of doubtful affinities. *Chicoreus* is not recorded in the Oak Grove.

The relationship of the Alum Bluff Murices to those from the Tampa silex beds is not so close as Dall supposed. The species are certainly allied, but the differences between the earlier and later representatives are constant and specific. The resemblance to the West Indian fauna is also strong, especially among the *Murex* s.s.

Varices more or less spinose; anterior canal commonly very long, straight, and slender ..... *Murex* s. s.
Axial varices only moderately elevated; primary spirals in front of the periphery on the body, not including the pillar, more than 8 in number:
Shoulder defined both by the obscure angulation of the whorl and by the difference in character of the spiral sculpture; anterior canal conspicuously long and slender ..... *Murex (Murex) chipolanus* Dall.
Shoulder little or not at all defined; spirals alternately fine and coarse from the anterior to the posterior suture; anterior canal moderately long and slender ..... *Murex (Murex) dasus* Gardner, n. sp.
Axial varices conspicuously elevated; primary spirals in front of the periphery on the body, not including the pillar, not more than 8 in number ..... *Murex (Murex) nicholsi* Gardner, n. sp.
Varices usually more or less foliaceous but not spinose; anterior canal not very long, rather broad, and recurved ..... *Chicoreus* Montfort.
Height of shell exceeding 40.0 mm.; varices foliaceous:
Intervarical tubercles only 1 on the later whorls ..... *Murex (Chicoreus) folidodes* Gardner, n. sp.
Intervarical tubercles 2 on the later whorls ..... *Murex (Chicoreus) aldrichi* Gardner, n. sp.
Height of shell not exceeding 40.0 mm.; varices simple, not conspicuous ..... *Murex (Chicoreus?) pyknos* Gardner, n. sp.

Subgenus MUREX s. s.

Type by subsequent designation (Montfort, Conchyliologie systématique, vol. 2, p. 619, 1810): *Murex pecten* Montfort=*Murex tribulus* Linnaeus. Recent in the South Pacific and Indian Oceans.

The subgenus is characterized by the rather short spire, the 3 axial varices either simple or spinose, and the long, straight, slender closed canal.

Murex (Murex) chipolanus Dall

Plate LIII, figures 1, 2

1890. *Murex chrysostoma* Gray var. *chipolana* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 1, p. 139.

The specimens from the Chipola River differ from the Recent *M. chrysostoma* in being smaller than the average adult Recent specimens, with a slightly shorter canal, from which the antecedent canal tends to divaricate, while in the typical *chrysostoma* it is usually continuous.

The anterior margin of the varices in the fossil also tends to be more spinose or to have the projecting points more produced than in the recent shell, though similarly situated and similar in number.—Dall, 1890.

Shell rather small for the group and not very heavy. Spire moderately elevated, acutely tapering. Body, like the later whorls of the spire, inflated, rounding abruptly at the base into the slender pillar. Aperture including anterior canal approximately two-thirds as high as the entire shell. Whorls of adult conch 6 or 7, increasing regularly and rather rapidly in diameter, moderately convex, the maximum convexity of the whorl falling near the median horizontal. Whorls closely appressed, separated by inconspicuous sutures feebly crenulated by the costals of the preceding whorl. Protoconch small, smooth, elevated, turbinate, including 4 volutions; initial turn bulbous, immersed at the tip; succeeding whorls feebly convex, turbinate; close of protoconch indicated by a narrow, arcuate riblet. Axial sculpture of 3 primary varices, including the terminal varix, spinose at the periphery of the later whorls and the body, the spines slender, sickle-shaped, laminar, closely folded, one of the primary spirals forming the midrib, the free edges proximate and facing the aperture; spines not developed behind the periphery; commonly secondary spines in front of the periphery at the intersection with the primary spirals, especially on the base of the body and the posterior portion of the pillar; primary varices on the medial whorls standing up like heavy, well-rounded cords; 2 or 3 more or less irregular secondary axial ribs usually developed between each pair of primary ribs on the spire; on the body commonly reduced to peripheral tubercles; on the early whorls usually 8 to 10 equisized and equispaced, well-rounded and somewhat undulatory axials crossed by 3 or 4 rather prominent spiral cords. Spirals subequal and equispaced, the posterior and medial of the early primaries outlining the periphery of the later whorls and a little more prominent than the other spirals; posterior peripheral spiral forming the axis of the prominent varical spines; 3 or 4 slightly less prominent lirae intercalated between the posterior peripheral primary and the posterior suture with or without additional secondary threadlets; 2 to 4 threadlets also intercalated between the 2 peripheral spirals; 10 primaries in front of the periphery on the body, subequal and regularly spaced, the wider interspaces threaded with 1 or 2 fine lirae; sculpture on the pillar less regular, about half a dozen primaries, as a rule, with intercalated secondaries. Anterior fasciole crowded with about a dozen very fine, wavy threadlets. Aperture exclusive of the anterior canal broadly oval, feebly notched posteriorly. Outer lip obscurely angulated at the periphery, the margin finely crenate in harmony with the spiral sculpture. Inner wall of aperture excavated at the base of the body; labium reflected, forming a heavy callus, its thin, sharp margin discrete from the body wall; corrugations within the margin rather heavy on the posterior half. Anterior canal long and very slightly flexed toward its extremity, the former canals, one for each varix, slightly divergent. Final canal roofed over and almost entirely closed by a thin, laminar plate of callus, the continuation of the callus which reinforces the inner wall of the aperture; a linear opening in the figured specimen but doubtless closed in the perfect adult.

Dimensions of lectotype: Height, 49 millimeters; length of aperture, 34 millimeters; diameter, including varices, 26 millimeters; diameter at right angles to maximum diameter, 19 millimeters.

Lectotype and juvenile topotype: U. S. Nat. Mus. No. 371885.

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

Murex chipolanus though small compared with many of the Recent representatives of the group is taller than any other *Murex* known from the Chipola. Almost half its length, however, is included in the very slender, tubular pillar. Worn and imperfect specimens may approach rather closely to *M. dasus,* a more compact form with a lower, broader spire, a relatively broader body, and a shorter, less slender canal. The tendency toward the development of spines is much stronger in *M. chipolanus,* but the spiral sculpture is not so close nor so regular. Even in the young shells the sculptural differences are sufficiently marked to permit the separation of the two species.

Murex (Murex) recurvirostris Broderip, widespread in the mid-Americas from the lower Miocene to the Recent, is a similar species but has a shorter canal and is less slender and less spinose.

The closely allied *domingensis* Sowerby from the Gurabo formation of the Dominican Republic is even broader relatively than *recurvirostris,* and spines are little or not at all developed.

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

Murex (Murex) gilli (Maury)

1910. *Fusus Gilli* Maury, Bull. Am. Paleontology, vol. 4, No. 21, p. 19, pl. 5, fig. 3.

Shell with six convex whorls of which the first three are smooth and the remainder sculptured. Spiral sculpture of well-defined threads alternating in size. Longitudinal sculpture of rounded riblets (ten on the last whorl). Suture waved; pillar nearly straight; aperture and canal keyhole-shaped. Length of shell 9 millimeters; greatest width 4 millimeters.

Named in honor of Professor Gill of Cornell University.

Oak Grove, Fla.

Mr. Aldrich's collection.—Maury, 1910.

This is the tip of a species closely allied to *Murex chipolanus* Dall and of approximately the same dimensions.

Occurrence: Oak Grove sand, Aldrich collection, Johns Hopkins University.

Murex (Murex) dasus Gardner, n. sp.

Plate LIII, figure 4

1890. "*Murex mississippiensis*" Conrad. Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 1, p. 139 (in part). Not *Murex mississippiensis* Conrad 1848, Acad. Nat. Sci. Philadelphia Jour., 2d ser., vol. 1, p. 116. pl. 11, fig. 30. (Type locality, Vicksburg, Miss.)

1915. "*Murex mississippiensis*" Conrad. Dall, U. S. Nat. Mus. Bull. 90, p. 73 (in part), figure excluded.

Shell rather small for the group, moderately heavy, stout fusiform, the maximum diameter falling behind the median horizontal. Whorls of conch 6½ to 7, broadly convex, rapidly increasing in diameter. Body whorl inflated, abruptly constricted into the moderately long and slender pillar; suture line inconspicuous, irregularly crenulated by the axial ribbing of the preceding whorl. Protoconch small, smooth, conic, flattened behind, coiled 3½ times; initial turn immersed, the succeeding volutions feebly convex; the close of the protoconch indicated by a narrow, elevated, arcuate riblet. Axial sculpture on the earliest whorls of the conch of about 8 sharply rounded, well-elevated costae, separated by narrower intercostals; 10 or 11 conspicuously inequal axials on the medial portion of the shell; reduced on the final whorls of the spire and the body to 3 varices with 1 to 3 irregular riblets or peripheral nodes in the intervarical spaces; body varices and the final varix on the spire usually produced into short, sharp spines, the primary spirals forming the midribs of the spines, the fine edges proximate and open toward the aperture; 1 or 2 series of varical spines also developed on the pillar. Spiral sculpture close, sharp, and regular; primary spirals on the early whorls usually 4, the anterior scarcely emergent behind the suture line, the posterior less elevated than those in front of it; filamentary secondaries intercalated except on the very earliest whorls; number of primaries increasing, by the strengthening of the secondaries and the introduction of further intercalaries, to about 7 on the final whorl of the spire, and 20 on the body and pillar; interprimary areas crowded with secondaries and tertiaries; threading on the pillar coarser and less regular, but very fine and crowded on the ill-differentiated anterior fasciole. Aperture rather large, oblique, broadly rounded behind, smoothly contracted into the little more than linear opening of the anterior canal; posterior canal obscurely indicated. Labrum broadly and asymmetrically arcuate, varicated behind the margin; the margin in the holotype thin and finely crenulated in harmony with the spirals; inner surface of varix elevated and heavily denticulated from the commissure to the entrance to the anterior canal, the denticles approximately 15 and corresponding roughly in position to the spaces between the primary spirals; a similar denticle also developed on the posterior portion of the body wall and with the posterior denticle of the labrum defining the siphonal channel. Labium smoothly excavated, heavily glazed, the wash thinning on the base of the body so that the spiral sculpture shows through it. Pillar straight, reinforced, the margin of the wash standing apart from the wall of the pillar, corrugated within the margin by 4 to 6 rugose denticles. Anterior canal moderately long and straight with parallel proximate margins, obliquely truncate at its extremity.

Dimensions of slightly imperfect holotype: Height, 33.4 millimeters; length of aperture, 22 millimeters;

diameter including spines, 20.5 millimeters; diameter at right angles to maximum diameter, 15 millimeters.

Holotype: U. S. Nat. Mus. No. 112057.

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

Murex dasus is a shorter, stouter species than *M. chipolanus* Dall. The pillar, which is incomplete in the type, is not so attenuated as in *M. chipolanus,* the tendency toward the development of spines is not so strong, and the spiral sculpture is more crowded and more regular. The sculpture behind the periphery in *M. dasus* is similar in character to that in front of it, while in *M. chipolanus* it differs both in the prominence of the spirals and in the spacing. *Murex mississippiensis* from the Vicksurg is a smaller but heavier species, with more numerous axials on the earlier whorls and more prominent varices on the later. There is apparently no tendency toward the development of spines either in the Vicksburg form or in *Murex tritonopsis* Heilprin, the Tampa analog. The spirals, too, are more numerous on the early volutions and more even in *M. mississippiensis* than they are in the Chipola species. *M. dasus* is apparently the Floridian analog of *M. domingensis* Sowerby, a larger and less slender species with a less abruptly constricted body, a shorter, broader canal, coarser and less crowded spirals, and more prominent varices.

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

Murex (Murex) vaughani Maury

1910. *Murex vaughani* Maury, Bull. Am. Paleontology, vol. 4, No. 21, p. 25, pl. 6, fig. 6.

Shell small, pyriform, compact, resembling in shape young specimens of *M. messorius* Sowerby of the Pliocene and recent faunas. Whorls about six, the nuclear nearly smooth, the three later whorls bearing each seven varices. On the body whorl the varices are prominent, rounded, somewhat broader than the interspaces. The varices of the shell form nearly continuous, sinuous lines from near the apex to the base of the canal. Spiral sculpture of raised lines, of which groups of two or three are much stronger and stand out prominently from among alternating feebler spirals. Outer lip with about ten strong internal lirae; aperture oval; canal not quite half the length of the shell. Length of the shell 22.5; greatest width 14 mm.

Chipola marls, Baileys Ferry, Fla.

Cornell University collection.

Named in honor of Mr. T. W. Vaughan of the United States Geological Survey.—Maury, 1910.

This is apparently a young form allied to *Murex dasus.* Nothing quite like it has been found in the collections available for study.

Murex (Murex) nicholsi Gardner, n. sp.

Plate LIII, figure 3

Shell rather small, though probably reaching dimensions greater than those of the type; rudely biconic, the maximum diameter falling a little behind the median horizontal. Whorls probably 6 or 7 in the perfect adult, broadly convex, increasing rapidly in diameter. Body well-rounded medially, abruptly constricted into the rather slender pillar. Whorls closely appressed, the posterior margin creeping up a little upon the preceding volution, the sutures inconspicuous and sinuated by the axials. Protoconch imperfectly preserved, apparently rather large; final turn smooth, polished. Dividing line between conch and protoconch marked by a narrow axial riblet. Axials on the earliest turns narrowly rounded, sharply elevated, equal and equispaced; 3 narrow, rounded varices developed on the medial portion of the shell; spinose only at the intersection with the primary spiral which outlines the periphery and forms the midrib of the short, open spine. Spiral sculpture rather sharp; 3 narrow, angular primaries on the early whorls, the posterior outlining the shoulder, the other 2 symmetrically disposed between it and the anterior suture; a fourth introduced on the later whorls of the spire directly behind the anterior suture; sculpture behind the periphery usually finer and more irregular than that in front of it; 2 or 3 secondary lirations may be developed, 1 of them approximating the primaries; spiral sculpture on the body of the type regular; 6 subequal and subequispaced primaries on the medial portion and the base, a secondary threadlet intercalated midway between each pair; 3 less fine secondaries developed between the posterior primary and the suture line, the medial secondary a little coarser than those on either side; pillar girded with 6 or 7 secondaries, more widely spaced anteriorly; anterior fasciole probably closely threaded. Aperture imperfectly preserved, obliquely lobate, broadly rounded behind, obscurely sulcate posteriorly. Outer lip broadly arcuate; margin crenulated; inner surface of terminal varix dentate; posterior labral and parietal denticles indicating the margins of the posterior canal. Inner wall of aperture more strongly convex than the outer, heavily glazed, rugose along the pillar; inner margin of pillar sharply rounded. Anterior canal imperfectly preserved, probably long and straight and obliquely truncate at its extremity.

Dimensions of holotype: Height, 25 millimeters; length of aperture, 16± millimeters; diameter including varices, 14.5 millimeters; diameter at right angles to the maximum diameter, 10.0 millimeters.

Holotype: U. S. Nat. Mus. No. 371851.

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

Murex nicholsi n. sp. is possibly the analog in the Shoal River fauna of *M. dasus* in the Chipola. The varices are more elevated than in the Chipola species, the spirals more flattened, fewer in number, and more distantly spaced. *Murex nicholsi* also approaches rather closely to *M. domingensis* Sowerby, but the Shoal River species is less slender, with a shorter, broader canal, more elevated axials and less prominent primary spi-

rals. These generalizations are made tentatively, however, for *domingensis* is the most prolific species in the muricoid fauna of the Gurabo formation and the *nicholsi* material is imperfect and much of it juvenile. The species is named in honor of G. W. Nichols, of Walton County, Fla., who collected the material.

Occurrence: Shoal River formation, localities 3856[p], 5618[r].

Subgenus CHICOREUS Montfort

1810. *Chicoreus* Montfort, Conchyliologie systématique, vol. 2, p. 610.

Type by monotypy: *Murex ramosus* Linnaeus= *Murex ramosus* Rumphius, 1741. Recent in the Indo-Pacific.

The subgenus is characterized by the 3 foliaceous or digitated varices, and the recurved canal, usually shorter and broader than in *Murex* s.s., and almost or completely closed.

Murex (Chicoreus) folidodes Gardner, n. sp.

Plate LIII, figure 5

1890. *Murex trophoniformis* Heilprin. Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 1, p. 140 (in part). Not *Murex trophoniformis* Heilprin, Wagner Free Inst. Sci. Trans., vol. 1, p. 107, pl. 15, fig. 40, 1887. (Type locality, Ballast Point, Hillsboro County, Fla.)

Shell of moderate dimensions, rather heavy, stout fusiform, the maximum diameter falling in front of the median horizontal. Aperture little more than half as high as the entire shell. Whorls of conch probably 7, the early volutions broadly convex, the body increasing less rapidly in diameter than the whorls of the spire; the posterior margin of the closely appressed later volutions creeping up a little on the preceding whorl. Protoconch imperfectly preserved; final whorl small and smooth, somewhat flattened laterally. Axials on the early volutions narrow, well rounded, retractive, arranged in series slightly off set at the suture and performing about half a turn, increasing in prominence toward the anterior suture, equal and separated by concave interspaces of approximately their own width, commonly 9. Varices developed by the strengthening of every third rib, the costal to the right of the varix becoming increasingly feeble and finally obsolete, the costal to the left of the varix, gradually transformed into a rather prominent peripheral node; varices on the later whorls foliaceous, the free edges sharply fluted in a series of short, serrate processes, open toward the aperture; the primary spirals forming the axes of the spines; spines tending to lengthen anteriorly, most produced on the pillar. Entire surface except the apical region macroscopically shagreened by the sharp laminar incrementals, numbering about 4 to the millimeter over the greater part of the adult shell; the free edges worn down in the type but probably in fresh specimens finely fluted by the spirals, even by the secondaries and tertiaries. Spiral sculpture well developed. Primary spirals 5 on the whorls of the spire, 13 or 14 on the body and pillar, rather angular and separated on the posterior portion of the shell by angular interspaces, equally prominent on the costals and intercostals, but more elevated toward the anterior suture; linear secondaries intercalated between each pair of primaries on the third or fourth whorl of the conch, the number of intercalated secondaries increased on the fifth whorl to 2, on the final whorl of the spire to 3 or 4, and on the periphery of the body to 4 or 5, the medial secondary usually stronger than those on either side. Anterior fasciole not well differentiated, threaded with 9 or 10 subequal lirae. Aperture exclusive of the canal obliquely elliptical, emarginate posteriorly. Curvature of outer lip a little broader than that of the inner; margin of outer lip sharply crenate in harmony with the spiral sculpture, the interspiral channels showing up on the inner surface as low ridges and produced for some little distance within the mouth of the aperture. Labium smoothly excavated at the base of the body, heavily glazed. Pillar margin sharply rounded at the entrance to the canal. Anterior canal broad, compressed dorsoventrally, curved backward, obliquely truncate at its extremity, probably closed in the perfect adult; former canals, one to each varix, quite sharply divergent from the final canal.

Dimensions of imperfect holotype: Height, 43.3 millimeters; length of aperture and canal, 26.5 millimeters; diameter including varices, 25 millimeters; diameter at right angles to the maximum diameter, 20.8 millimeters.

Holotype: U. S. Nat. Mus. No. 371852.

Type locality: No. 3419, 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.

A weathered individual with the characteristic surface almost entirely lost but probably referable to this species appears in the check list as *Murex trophoniformis* Heilprin, described from the Tampa silex beds. In Heilprin's species, however, the varices are more numerous and simple, while in the Chipola form faint but indubitable traces remain of foliated varices, subspinose at the intersection with the spirals. *Murex aldrichi* from the Shoal River is extremely close and may, with the collection of further material, prove to be identical. Apparently, however, the Chipola species is smaller and stouter. The number of whorls in the spire seems to be the same in both species, but the apical angle is larger in the Chipola form. The axial varices are apparently more prominent in *M. aldrichi* and more nearly continuous. The axial to the right of the varix is almost or entirely obsolete upon the later whorls of *M. folidodes,* and the axial to the left of the varix appears as a prominent peripheral node. In *M. aldrichi,* on the other hand, the two axials persist even on the later whorls, although the axial directly to the

right of the terminal varix is relatively feeble. The intercalated spirals are more numerous in *M. folidodes* and the fine cancellation by the incrementals sharper, but the surface is not so well preserved in *M. aldrichi*, and differences based on the very fine details of the sculpture should not be emphasized. *Murex folidodes* may be the analog in the Chipola fauna of the ornate *M. cornurectus* Guppy of the West Indian fauna.

A few individuals of puzzling affinities occur with *M. folidodes*, and are possibly identical with it. They differ in having only 3 primaries instead of 5 on the early whorls, and in the earlier appearance of primaries. The protoconch of these forms is small, highly polished, and smooth and includes 2 volutions, the initial turn inflated, high and immersed at the tip so that it has the appearance of being slightly tilted. The second whorl is also high, inflated at its beginning but flattening toward its close. The dividing line between the conch and protoconch is conspicuously defined by the change in texture and by the abrupt initiation of the sculpture, both axial and spiral.

Occurrence: Chipola formation, localities 2213^{p}, 2564^{r}, 3419^{p}, ?3704^{r}.

Murex (Chicoreus) aldrichi Gardner, n. sp.

Plate LIII, figure 11

Shell large, heavy, not very stout, the aperture more than half as long as the entire shell. Apex broken away so that the exact number of whorls is not determinable but probably about 7; whorls increasing regularly in diameter and with a moderate degree of rapidity, convex, the maximum inflation falling a little in front of the median horizontal. Body whorl rather abruptly constricted into the broad pillar. Volutions closely appressed, the posterior margin in front of the varices creeping up on the preceding whorl; suture lines inconspicuous, irregular; protoconch not preserved. Axials on the early whorls narrow, rounded, equisized and equispaced, uniform in elevation between the sutures, 9 in number. Varices developed by the strengthening of every third rib, the intermediate costals gradually becoming obsolete toward the sutures and appearing on the later whorls as peripheral tubercles, that to the left of the varix usually more elevated than that on the right; varices 3 in number, abruptly elevated, sharply rounded on their summits, finely laminated on the side toward the aperture, quite strongly retractive and continuous, so that each of the three series performs approximately half a revolution around the axis of the shell. Spiral sculpture regular; primaries 5 in number on the whorls of the spire and 13 or 14 on the body; rather narrow, prominently elevated lirations, equally strong on the varical and intervarical areas separated from one another by slightly wider areas, the spacings equal on the spire and medial portion of the body but widening slightly on the base of the body and the pillar; secondaries not intercalated on the early whorls of the spire, a single threadlet introduced along toward the close of the spire, while on the penultima and ultima 2 or even 3 lirations are intercalated between each pair of primaries; secondaries on the pillar similar to those on the medial portion of the body; threading on the anterior fasciole very fine and close. Aperture exclusive of the canal ovate, obscurely sulcate posteriorly. Curvature of outer lip higher than that of the inner; outer lip symmetrically arcuate, varicated behind the margin, thin, sharp, and finely crenate at the margin in harmony with the spiral sculpture; lirate within, the lirae persisting to the outer edge of the labrum and corresponding in position to the interprimary areas. Labium strongly but smoothly excavated at the base of the body, evenly and heavily glazed from the commissure to the entrance to the canal. Inner margin of pillar well-rounded. Anterior canal broad, probably of moderate width and possibly closed in the perfect adult. Anterior fasciole sharply rounded, diverging from the canal at an angle of approximately 45 degrees; space between the fasciole and the linear canal opening occupied by a cuneate, shelly lamina; anterior extremity of canal broken away.

Dimensions of worn and imperfect holotype: Height, 53.5 millimeters; length of aperture, 30 millimeters; maximum diameter, 31.5 millimeters.

Holotype: Aldrich collection, Paleontological Laboratory, Johns Hopkins University.

Type locality: Shell Bluff, Shoal River, Walton County, Fla.

This is apparently a larger but more slender species than *Murex folidodes* from the Chipola formation. The whorls of the spire do not increase in diameter so rapidly as in *M. folidodes*, the varices seem to be more prominent and more nearly continuous, the intervarical ribs retain their original character for a greater distance, the incrementals are not so sharp, and there are not so many intercalations between the primary spirals. The two species run very close, however, and it is unfortunate that they should both have such meager representation. Some of the larger individuals of *M. domingensis* Sowerby from the Gurabo formation of the Dominican Republic are very close to *M. aldrichi*. In the Gurabo forms, however, the peripheral spiral and the shoulder ramp on the later whorls are more evident than they are in the Shoal River species.

The holotype of *Murex aldrichi* is from the collections obtained from Mr. Aldrich by the Johns Hopkins University, Baltimore, Md.

Occurrence: Shoal River formation, locality 3742^{r}, Aldrich collection, Paleontological Laboratory, Johns Hopkins University.

Murex (Chicoreus?) pyknos Gardner, n. sp.

Plate LIII, figure 10

Shell rather low but thick and stout. Aperture more than half as long as the entire shell. Whorls closely appressed, broadly convex, increasing somewhat irregularly in diameter, probably about 7 in the conch. Body rather abruptly constricted into the short, broad pillar. Protoconch not preserved. Axials on the early whorls 9, rather low, rounded, separated by equal interspaces. Rather low broad varices developed by the strengthening of every third rib, the terminal varix, however, decidedly more prominent than those behind it; axial to the right of the varix becoming increasingly feeble and finally obsolete, the axial to the left of the varix forming a moderately prominent peripheral node. Spiral sculpture regular; 4 or 5 lirations on the early whorls equal and equispaced and uniformly elevated on the costal and intercostal areas; 5 primaries on the final whorl of the spire, 9 or 10 on the body and 2 on the pillar; secondaries intercalated on the next to the last whorl of the spire, 1 between each pair of primaries; 2 or 3 secondaries usually developed between each pair on the last whorl of the spire and the body and as many as 4 between the primaries on the pillar. Anterior fasciole decorticated but probably finely lirate. Aperture wide, obliquely elliptical. Outer lip broadly arcuate, varicose a little behind the margin; the margin crenulated by the spirals; on the inner labral surface, about 8 low, short lirae. Inner wall of aperture strongly concave, heavily glazed; inner margin of pillar sharply rounded. Anterior canal rather short, oblique, sinistrally directed; margins parallel, rather close together. Anterior fasciole well-defined, not parallel to the canal opening but changing its direction with each resting stage; the resultant fasciole, asymmetrically arcuate; space between the fasciole and the canal opening filled by a thin lamina unsculptured except for incrementals.

Dimensions of imperfect holotype: Height, 32 millimeters; length of aperture, 20 millimeters; diameter, including varices, 20.8 millimeters; diameter at right angles to maximum diameter, 16.5 millimeters.

Holotype: U. S. Nat. Mus. No. 115771.

Type locality: No. 2615, 5 miles west of Mossyhead, Walton County, Fla.

Murex pyknos is an anomolous and ill-preserved species of doubtful affinities. The sculpture is much more subdued than is normal for *Chicoreus,* but there are free edges on the apertural side of the body varices which suggest that group. The varices are, however, very low and broadly rounded and do not persist beyond the final whorl of the spire. The character of the intervarical axials and the ill-preserved pillar and anterior canal also suggest that subgenus to which it has been tentatively assigned. A species occurring in very considerable abundance half a mile below Shell Bluff is closely related to *M. pyknos* but possibly not identical with it. The spire seems to be a little lower relatively in the doubtful form, and the adult characters seem to be assumed earlier in the growth of the shell. It is not, however, possible to determine with any assurance the relation of these forms to the type, as they are all young or very imperfectly preserved while the type is an adult with a decorticated apex, and the only other individual collected at the type locality is also an adult in which all traces of the juvenile characters have been lost.

Occurrence: Shoal River formation, localities 2615^{r}, ?5079^{c}.

Incertae sedis

Plate LIII, figure 7

Shell small, solid, stout, fusiform, the maximum diameter falling near the median horizontal. Aperture approximately half the length of the entire shell. Whorls 5 in the conch, those of the spire buccinoid, increasing rapidly in diameter, the body inflated medially, abruptly constricted into the short pillar. Sutures inconspicuous, finely crenulated by the axials of the preceding whorl. Protoconch small, smooth, twice-coiled, the initial turn flattened behind, immersed at the tip, the second whorl broadly convex. Opening of conch indicated by the abrupt appearance of the conchal sculpture, both axial and spiral. Axials on the early whorls very narrow, sharply rounded, closely crowded, probably as many as 15 on the posterior portion of the conch and 10 on the medial portion, equal and equispaced, smoothly rounded, uniform in prominence between the sutures, wider than the intercostals, every fourth rib on the last whorl of the spire and the body strengthening into a simple varix; axials persisting well down on the pillar, the rib directly behind the terminal varix, however, more or less obsolete. Spiral sculpture sharply threading the conch from the nucleus to the anterior fasciole, overriding the axials and equally prominent on the costal and intercostal areas; primaries 4 on the whorls of the spire, increasing slightly in elevation from the posterior to the anterior suture, approximately 12 on the body and pillar, sharply rounded, abruptly elevated, regularly spaced; a filamentary secondary intercalated between each pair of primaries on the later whorls, and a slightly stronger secondary between the posterior primary and the suture line. Anterior fasciole threaded with half a dozen closely spaced, linear lirae. Aperture sinuous, minutely gourd-shaped in outline, obtusely angulated at the posterior commissure. Labrum arcuate, varicated a little behind the margin, the varix abutting against the preceding volution and posteriorly produced upon it; labral margin thin, sharp, and finely crenate in harmony with the spirals; inner surface of varix denticulate, the denticles normally 8 and elongated at right angles to the margin, except the denticle at the entrance

to the anterior canal, which is rudely parallel to the canal. Labium excavated at the base of the body, heavily glazed from the commissure to the entrance to the canal; a rather obscure parietal tooth developed directly in front of the commissure. Pillar wash rugose. Anterior canal imperfect in the figured specimen, short, flexuous, bent backward slightly and arched to the right; possibly closed in perfect adults. Anterior fasciole diverging only slightly from the canal, emarginate at its extremity.

Dimensions of figured specimen: Height, 14.5 millimeters; length of aperture, 9.5 millimeters; diameter including varices, 8.3 millimeters.

Figured specimen: U. S. Nat. Mus. No. 371878.

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

This small and possibly immature form is probably a muricoid. Three of the varices including the terminal varix seem relatively stronger than the rest and suggest the muricoid sculpture pattern. The anterior canal is imperfect and may have been closed in perfect adults. Somewhat similar forms in the collections have been referred to *Favartia,* but the rasping incrementals characteristic of *Favartia* are not developed. No defined group covering these few forms has been found.

Occurrence: Chipola formation, locality 2211[p].

Genus PAZIELLA Jousseaume

1879. *Paziella* Jousseaume, Revue et Magasin de Zoologie, 1879, p. 325.

Type by original designation, monotypy and tautonomy: *Murex pazi* Crosse. Recent in waters from 200 to 338 fathoms deep, from the Bahamas south through the lesser Antilles (Clench).

Subgenus DALLIMUREX Rehder

1946. *Dallimurex* Rehder, Nautilus, vol. 59, p. 142.

Type by original designation: *Murex nuttingi* Dall. Recent off Sand Key, Fla.

Dallimurex differs from typical *Paziella* in having stronger, laminated varices, shorter and stouter spines on the shoulder and numerous shorter spines below the shoulder. The whorls below the shoulder have strong, irregular spiral ridges, which culminate in the varical spines.

Paziella (Dallimurex) lychnia Gardner, n. sp.

Plate LIII, figures 12, 13

1890. *Muricidea spinulosa* Heilprin. Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 1, p. 149 (in part). Not *Murex spinulosa* Heilprin, Wagner Free Inst. Sci. Trans., vol. 1, p. 108, pl. 15, fig. 41, 1887. (Type locality, Ballast Point, Hillsboro County, Fla.)

1903. *Muricopsis heilprini* Cossmann, Essais de paléoconchologie comparée, vol. 5, p. 34 (in part).

Shell of moderate dimensions for the group, rather slender, fusiform, hexagonal. Aperture decidedly more than half as long as the entire shell. Spire elevated, scalar; the rapidly tapering whorls acutely angulated at the periphery; the broad shoulder ramp not far from horizontal, undulated by the varices and slightly concave at the varical spines; the sides of the whorls nearly vertical. Body whorl rounded medially, obliquely constricted into the rather slender pillar. Number of whorls at least 6 and possibly 7 in the perfect adult; coiling very close, the posterior margin creeping up a little on the preceding whorl. Sutures inconspicuous, irregular. Protoconch small, smooth, polished, twice coiled, the initial turn inflated, immersed at the tip, the succeeding volution also well-rounded though flattening somewhat toward its close. Dividing line between conch and protoconch indicated by a slight thickening of the shell and by the abrupt initiation of the axial sculpture. Varices 6, equisized and equispaced, terminating at the peripheral angle in a slender spine curved upward and backward; a single row of spines also girding the pillar; free edges of varical lamellae on the body fluted by the primaries; intervarical areas smoothly concave; varices obsolete on the shoulder except for the closely appressed, overlapping, retractive laminae. Spiral sculpture restricted to low, rounded, equisized and equispaced lirations, 2 or 3 on the whorls of the spire, the posterior liration outlining the periphery, the anterior almost or entirely concealed by the suture, the medial midway between the suture and the periphery; spirals 6 to 8 on the body, even and regular from the periphery to the base; secondaries not intercalated; sculpture on the pillar restricted to the single row of varical spines, without a connecting spiral, girding the pillar midway between the base of the body and the anterior fasciole. Fasciole corrugated by heavy, overlapping lamellae, one to each varix. Aperture narrowly elliptical, exclusive of the canal, which is a little less than half as long as the entire opening; aperture obscurely sulcated at the commissure, emarginate at the periphery. Labrum broadly arcuate in front of the periphery, varicated a little behind the margin, finely crenate at the margin in harmony with the spiral sculpture, lirate within; the lirae corresponding roughly in position to the interspiral areas, tending to alternate in length, the longer of the lirations produced far within the aperture. Labium concave, smoothly and heavily glazed, the margin detached from the pillar wall. Anterior canal compressed, with narrow, proximate margins. Anterior fasciole well differentiated, emarginate at its extremity, flaring away from the labial margin, leaving a narrow, cuneate umbilical opening.

Dimensions of imperfect holotype: Height, 25.5 millimeters; length of aperture, 17.0± millimeters; diameter, including varices, 15 millimeters.

Dimensions of paratype: Height 16.9 millimeters; diameter including varices 9.6 millimeters.

Holotype and paratype: U. S. Nat. Mus. No. 371853.

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

The spire of *Paziella (Dallimurex),* with its smooth shoulder almost at right angles to the sides and crowned at the periphery by the upcurved spines, is suggestive of a candelabrum. The species may be the descendant of the smaller and more slender *"Muricopsis" heilprini* Cossmann, from the Tampa silex beds. There is no very closely allied coexistent species. *Muricopsis laccopoia* to which it bears a superficial resemblance, is rather conspicuously biconic. The axial varices are continuous and strongly retractive forming a series of small pockets on the shoulder ramp directly in front of the suture and to the right of the varix, and one or two spiral lirations are intercalated between the periphery and the posterior suture. The shoulder of *M. lychnia* is devoid of spiral sculpture and the axials are for the most part obsolete.

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

Paziella (Dallimurex) fusinoides Gardner, n. sp.

Plate LII, figures 39, 42

Shell large and heavy, for the group; fusiform. Aperture about half as long as the entire shell. Whorls of conch probably 8 or 9, regularly increasing in diameter, the early volutions obscurely shouldered, the outline of the later volutions largely determined by the broad and prominent costals. Body whorl inflated, very abruptly constricted into the slender pillar. Sutures inconspicuous, evenly undulated by the costals of the preceding volution. Protoconch like that of *Paziella (Dallimurex) lychnia,* small, smooth, twice-coiled, the initial turn inflated, immersed at the tip, the succeeding whorl well-rounded, flattening toward its close; dividing line between conch and protoconch indicated by a narrow riblike thickening of the shell and by the initiation of the sculpture. Axials on the early volutions narrow but smoothly rounded, feebly retractive, 6 or 7 in number, equisized and equispaced, uniform in elevation from the periphery to the anterior suture but dying out on the ill-defined shoulder; outer margin of the shoulder coronated with short, sharp spines formed by the intersection of the axials with the peripheral spiral. Axials on the later volutions prominent, broadly rounded, varicose but undulatory in character, disappearing rather abruptly a little in front of the posterior suture, thus forming an obscure shoulder; axials persisting, however, to the anterior suture and well down to the base of the body and appearing on the pillar as closely appressed, overlapping folds; component laminae of the varices occasionally free, visible only on the apertural side of the varix and only on the later volutions; sharply frilled by the spirals but not produced into spines except on the shoulder and the medial portion of the pillar; intervarical areas concave and of approximately the same width as the varices. Spiral threading sharp; lirae narrow, elevated, angular, the primaries 3 in number on the early whorls, 4 or 5 on the penultima and antepenultima, and 7 to 9 on the body exclusive of the pillar, separated by flattened interspaces approximately double the width of the spirals; posterior primary outlining the periphery and forming the midrib of the short, varical spines; 1 or, on the later whorls, 2 threadlets intercalated between the periphery and the suture line and undulated in harmony with the suture; a secondary regularly intercalated between the peripheral spiral and the spiral next in front of it; 1 or 2 finer spirals at the extreme base of the body; pillar girded with 3 simple primaries, a series of short spines—one to each varix—parallel to the primaries, and 1 or 2 irregular spirals in front of the spines. Anterior fasciole sharply rounded, laminated by the extremities of the varices, not spirally threaded. Aperture spatulate, oblique, broadest posteriorly, not sulcated at the posterior commissure. Outer lip arcuate, varicated behind the margin, thin and sharply crenate at the margin in harmony with the spirals, lirate within, the lirae usually short and corresponding in position to the interprimary areas. Inner wall of aperture excavated at the base of the body, smoothly and heavily glazed. Pillar moderately long and straight, corrugated just behind the entrance to the canal, with 3 to 6 lirations at right angles to the axis. Anterior canal long and slender, the margins proximate and parallel. Anterior fasciole diverging slightly, leaving a narrow, umbilical chink between the fasciole and the inner margin of the canal.

Dimensions of incomplete holotype: Height, 36.7 millimeters; length of aperture, 20 millimeters; maximum diameter, 16.5 millimeters. Dimensions of paratype: Height, 14 millimeters; maximum diameter, 7.5 millimeters.

Holotype and paratype: U. S. Nat. Mus. No. 371854.

Type locality: No. 2564, 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.

Paziella (Dallimurex) fusinoides is well characterized by its conspicuously fusiform outline. The costals are as broad as the intercostals and broadly rounded on their summits, though their muricoid character is indicated in the free edges, which are crenulate in harmony with the spiral sculpture and are visible only on the apertural face of the varix.

Occurrence: Chipola formation, localities 2564^{r}, 3419^{r}.

Genus PTEROPURPURA Jousseaume

1879. *Pteropurpura* Jousseaume, Revue et Magasin de Zoologie, ser. 3, vol. 7, p. 334.

=*Pteronotus* Swainson, 1833, Zool. Illustrations, ser. 2, vol. 3, pl. 122 (type by monotypy: *Murex pinnatus* Swainson, Recent in the China Sea)=*Pteronotus*

pinnatus Swainson, 1840, Malacology, p. 296. Not "*Pteronotus*" Rafinesque, 1815.

Type by original designation: *Murex macropteron* Deshayes. Eocene, Calcaire grossier of the Paris Basin.

The adult whorls are trivaricate, the varices set at angles of 120°. The peripheral node in the intervarical space on the later volutions corresponds to a rib on the earlier volutions. The free edges of the lamellae that make up the varix are exposed on the face toward the aperture and, in spirally sculptured forms, are more or less crepey. The aperture is obliquely pyriform, not angulated nor channeled posteriorly. The outer lip is arcuate, dentate within, and the margin crenulated in harmony with the spirals. The peristome is continuous around the commissure. Both the parietal glaze and the pillar are smooth. The pillar margin is rounded and flexed at the entrance to the canal. The canal is flattened dorsoventrally, flexed, and recurved. The margins above the canal are parallel and closely proximate but do not meet.

Pteropurpura is allied with *Thais* rather than with *Murex,* because of the lateral nucleus of the operculum, but it lacks a diagnostic character of *Thais,* the spur on the margin of the labrum a little behind the entrance to the anterior canal. The recent representatives are, as a rule, deeper water forms than *Thais,* and the shell devices of their shallow-water relatives may be unnecessary in their less troubled environment.

a. Spiral sculpture behind the periphery of the whorl usually restricted to a single more or less obscure liration..... *Pteropurpura dryas* Gardner, n. sp.

b. Spiral sculpture behind the periphery of the whorl not restricted to a single liration. *Pteropurpura virginiae* (Maury)

Pteropurpura dryas Gardner, n. sp.

Plate LIII, figures 9

Shell rather small for the group, stout, trivaricate, the maximum diameter falling behind the median horizontal. Aperture decidedly more than half as long as the entire shell. Whorls of spire inflated, obtusely angulated at the periphery, rapidly increasing in diameter. Body whorl relatively large, constricted at the base, rendered somewhat cuneate by the axial varices. Whorls of conch probably 6, closely appressed, separated by impressed linear sutures, undulated by the varices of both the whorl in front of the suture and that behind it. Protoconch not preserved but certainly small. Earliest whorl of conch sculptured with 9 subequal and equispaced axial ribs, the number gradually diminishing with the growth of the shell and the character changing; final whorl of spire and body triangulated by 3 rather broad, foliated flanges, the terminal flange the broadest of the 3, the dozen or more component laminae visible on the front of the varix; varix crenulated by the spiral scultpure and produced backward on the preceding whorl almost or quite to the periphery; intervarical rib on the later whorls reduced to a rather prominent peripheral tubercle. Spirals obscure and irregular, increasing in number and prominence with the growth of the shell; early whorls usually sculptured with 2 low, rounded lirations, the anterior the more prominent and outlining the obscure peripheral angle; posterior spiral on the later whorls of the type indicated chiefly by the outline of the margin of the varices; a third spiral introduced directly behind the suture on the last whorl of the spire becoming on the body, almost but not quite so prominent as the peripheral spiral; 2 or 3 less prominent lirations on the base of the body and irregular secondaries intercalated in the much wider interspaces. Lirae on the anterior fasciole obscure. Aperture oblique, pyriform, broadly rounded behind. Outer lip varicated, the edge of the labral portion of the peristome broadly rounded and crenulated in harmony with the primary spirals; half a dozen obtuse denticles developed a short distance within the margin. Labium feebly convex, reinforced. Pillar sharply rounded and flexed at the entrance to the canal. Anterior canal less than half as long as the aperture including the canal, very narrow, with a backward twist, the margins parallel and proximate but not in contact. Anterior fasciole sharply differentiated, truncate at its extremity, the former fascioles, one to each varix, diverging slightly from the final fasciole.

Dimensions of holotype: Height, 29 millimeters; length of aperture, 18.3 millimeters; diameter including varices, 20 millimeters; diameter at right angles to the maximum diameter, 11.5 millimeters.

Holotype: U. S. Nat. Mus. No. 371855.

Type locality: No. 5630, 100 yards below Oak Grove Bridge, Yellow River, Okaloosa County, Fla.

Pteropurpura dryas is the analog in the Oak Grove fauna of *P. virginiae* (Maury) in the Chipola. The general character of the sculpture is the same in both, but the Oak Grove species is larger than the Chipola and decidedly stouter. The spirals are not so numerous nor so evenly developed, especially behind the periphery and upon the spire; the aperture is more oblique and the anterior canal more twisted than in Miss Maury's species. Both species are doubtless related genetically to the more slender *P. postii* Dall from the Tampa silex beds, but the similarity between the Tampa and Chipola forms is much more striking than that between the Tampa and the later Oak Grove forms.

Occurrence: Oak Grove sand, locality 5630r; Aldrich collection, Johns Hopkins University.

Pteropurpura virginiae (Maury)

1910. *Murex Virginiae* Maury, Bull. Am. Paleontology, vol. 4, no. 21, p. 25, pl. 6, fig. 5.

Shell small with some resemblance to *Typhis,* trigonal, biconic; whorls six; the two later being sharply carinated at

the shoulders. Varices six, the alternate three being much more pronounced and giving the shell its triangular form. Spiral sculpture of raised threads which on the last whorl alternate with one or two finer, intercalated lines. Fainter, longitudinal threads form with the spirals a fine cancellation on the last whorl. Aperture oval, slightly more than half the length of the shell; canal narrow, reflexed. Length of shell 15; greatest width 8 millimeters.

This shell recalls *M. shilohensis* Heilprin from the Miocene of Shiloh, New Jersey, but that species has eight subequal varices. The variety *burnsi* of *M. shilohensis* has six varices like the Chipola shell, but they are very much more prominent.

Chipola marls, Baileys Ferry, Fla.

Cornell University collection.—Maury, 1910.

The conch of an apparently mature specimen in the collection of the United States National Museum includes 5 volutions, while the rather small, smooth, subcylindrical protoconch is coiled 2½ times. The protoconch is somewhat flattened behind owing to the partial immersion of the initial half turn. The two remaining whorls increase more rapidly in height than in diameter. The first of these is highly inflated, but the final turn is flattened toward its close. The axials upon the earliest whorls run as high as 9 in number and are subequal and sharply rounded on their summits but not acute nor varicated. On the latest volution, however, there are 3 more or less foliaceous varices, the component laminae discrete in the terminal varix but more or less fused on the periphery of the whorl in the earlier varices. The intervarical ribs become decreasingly prominent and on the body are reduced to obtuse tubercles. The spirals are not prominent, but they are distinct and regular, the cord that outlines the periphery, the broadest and most elevated of all. Behind the periphery, on the earlier whorls, there are usually 3 approximately equal spirals and in front of it 1 or 2 narrower threadlets. The spirals behind the periphery on the body are relatively low and flat, and a secondary is usually intercalated. The spirals in front of the periphery of the body, both the primaries and the secondaries, are rather sharp relatively. The primaries run probably about 10, with 1 or 2 secondaries intercalated between each pair. The spirals persist across the apertural surface of the terminal varix and crenulate the component laminae and the margin of the peristome. The labrum is rather sharply emarginate about halfway between the periphery and the suture, and its inner surface is reinforced by half a dozen obtuse denticles. The pillar is sharply rounded and twisted in line with the former canal. The final canal is rather wide with proximate, parallel margins. The anterior fasciole is not sharply differentiated and is obliquely truncate at its extremity.

The Oak Grove analogue, *Pteropurpura dryas,* is larger and stouter. The axial ribs become varicose earlier than in *P. virginiae,* and the spiral sculpture is more obscure and less regular, especially on the spire and behind the periphery. The primary spirals on the body number only a few, though the shell in many specimens is twice as large. The aperture is more oblique in *P. dryas,* the anterior canal more twisted, and the anterior fasciole more sharply differentiated. *P. postii* from the Tampa silex beds, a possible ancestor, is more than twice as large as *P. virginiae* but has the same general outline. The primary varices, furthermore, are more sharply defined on the spire, and the spirals on the body are not so wide but more numerous. Both species are rare.

Occurrence: Chipola formation, locality 2213[2], Cornell University collection.

Genus TYPHIS Montfort

1810. *Typhis* Montfort, Conchyliologie systématique, vol. 2, p. 615.

1944. *Typhis* Montfort. Keen, Jour. Paleontology, vol. 18, p. 53.

Type by monotypy: *Murex tubifer* Roissy=*Purpura tubifer* Bruguière. Eocene of the Paris Basin.

The shells of *Typhis* are muricoid in outline but run much smaller and are usually more delicate than those of *Murex.* The characteristic ornaments of the restricted genus are the 4 hollow, tubular spines, perforated at their extremities, superimposed in some species on the varices, in others ascending from the intervarical areas. The latest of the tubular spines is occupied by the excurrent siphon. The anterior canal is short, recurved, and entirely closed in the adult forms.

An excellent and exhaustive monograph of the family by Myra Keen has recently been published.

The genus is fairly well represented in the Tertiaries of the Paris Basin from the Thanetien upward. Its presence in most of the other well-known fossil localities in the central and southern European Tertiaries and in the Tertiaries of this country has been established, but it is nowhere abundant either in species or in individuals. The Recent forms are included under less than 30 described species and live, for the most part, in the relatively deep tropical and subtropical waters of the Mediterranean and the west Atlantic and South Pacific Oceans.

The number of individuals of this rare little genus represented in the material covered does credit to the collector. They have been included under three species —*Typhis linguiferus* Dall, common to the Chipola and Oak Grove, and two closely allied representatives of the subgenus *Talityphis* Jousseaume, *Typhis (Talityphis) alatus obesus* Gabb, common to the Chipola, Santo Dominican, Panamanian, and Bowden Miocene, and *Typhis (Talityphis) pterinus* from the Shoal River.

Varices rounded.....*Typhis linguiferus* Dall.
Varices acutely angulated, the terminal varix alate:
Maximum diameter approximately two-sevenths of the height; spiral lirations obscure on the body.....
Typhis (Talityphis) alatus obesus Gabb.

Maximum diameter approximately three-sevenths of the height; spiral lirations distinct on the body..... *Typhis (Talityphis) pterinus* Gardner, n. sp.

Typhis linguiferus Dall

Plate LIII, figure 17

1890. *Typhis linguiferus* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 1, p. 152, pl. 12, fig. 7.
1917. *Typhis linguiferus* Dall?, Pilsbry and Brown, Acad. Nat. Sci. Philadelphia Proc., vol. 69, p. 34.
1925. *Typhis linguiferus* Gabb. Maury, Bull. Am. Paleontology, vol. 10, no. 42, p. 214, pl. 36, figs. 4, 5.

Shell with two laxly coiled, polished, peripherally-keeled nuclear whorls and six subsequent whorls; surface polished; transverse sculpture of (on each whorl four) strong, thick, rounded varices, which gradually increase from in front backward, each being largest at the shoulder, where it is produced axially into a linguiform, rather pointed spine, between which and the suture the varix is depressed, then rises against the preceding whorl, where it is expanded and appressed; the spines are bent inward and to some extent backward, the varix is strongly marked by the incremental lines and is linked to the tube, which precedes it by a little elevated ridge, but there is no similar connection with the succeeding tube; the ends of these spines are generally broken and they then appear hollow for a short distance, but the spines are not pervious and have no connection with the interior of the shell; the tubes are moderately large and, instead of conforming to the curves of the varices, they curve upward, outward, a little backward and a little downward at last, though often broken; from the base of each tube a narrow ridge extends forward in harmony with the incremental lines, and behind this ridge is perceptible the mark of an old resting-stage; suture appressed and undulated by the sculpture; between the suture and the shoulder the whorl is somewhat excavated; other spiral sculpture only of a few irregular lines near the periphery, which give the surface a malleated appearance but are not elevated enough to be termed threads or form continuous ridges; the roundness of the varices is not interrupted by them; as there are four varices to a whorl, there are usually three old canals discernible beside the one in use; there is no umbilical chink; the canal is wholly closed, slender and attenuated; the aperture small, subovate and simple, with an elevated rim. Max. lon. of shell 15.0; diameter 7.2 millimeters.

This species most nearly approaches *T. curvirostratus* of the Upper Eocene, but is much more slender, smaller, and more elegant, while the Eocene form has at the shoulder only a short, obtuse spine, and the tube is much closer to its succeeding varix than to the preceding one; while in the present form the tube is midway or, if anything, a little more distant from the succeeding varix.—Dall, 1890.

Holotype: U. S. Nat. Mus. No. 112183.

Type locality: No. 2212, Tenmile Creek near the Chipola River, Calhoun County, Fla.

A related specimen from Oak Grove is more than 20 millimeters high.

Typhis linguiferus Dall is the only described species from the Alum Bluff that is characterized by rounded varices.

Pilsbry and Brown, 1917, report a similar species from the Miocene of Cartagena, Colombia.

Occurrence: Chipola formation, locality 2212r.

Subgenus TALITYPHIS Jousseaume

1879. *Talityphis* Jousseaume, Revue et Magasin de Zoologie, ser. 3, vol. 7, p. 338.

Type by original designation: *Typhis expansus* Sowerby. Recent; locality not known.

The characteristic feature of the subgenus is the alate terminal varix. The four primary varices are compressed and lamellar and produced posteriorly into spinose processes. The intermediate tubercle is closer to the varix behind it than to the varix in front of it. The aperture is symmetrically ovate, the rim of the peristome continuous, acute and elevated. The anterior canal is short, compressed, curved backward and closed. The subgenus differs from *Typhinellus* Jousseaume in the expanded flange of the terminal varix.

Typhis (Talityphis) alatus obesus Gabb

Plate LIII, figures 15, 16

1873. *Typhis obesus* Gabb, Am. Philos. Soc. Trans., vol. 15, p. 203.
1890. *Typhis alatus* Sowerby var. *obesus* Gabb. Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 1, p. 151.
1922 (January). *Typhis obesus* Gabb. Pilsbry, Acad. Nat. Sci. Philadelphia Proc., p. 354, pl. 28, figs. 5, 6.
1922 (April). *Typhis alatus* Sowerby. Olsson, Bull. Am. Paleontology, vol. 9, no. 39, pt. 1, p. 132, pl. 10, fig. 15.
1928. *Typhis (Talityphis) alatus obesus* Gabb. Woodring, Carnegie Inst. Washington Pub. 385, p. 294, pl. 18, figs. 3, 4.
Not *Typhis alatus* var. *obesus* Gabb. Maury, Bull. Am. Paleontology, vol. 10, no. 42, p. 214, pl. 36, figs. 6, 9. 1925=*Typhis sawkinsi* Mansfield, 1925.

Shell short, broad; spire very low; whorls eight, sharply angulated; concave above the suture, sloping convexly below; varices four to each whorl, acute-angular on their margins, and ending in a blunt process on the upper angle of the whorl; tubes moderate, pointed laterally, below each tube the surface of the shell is greatly swollen, and two lines pass anteriorly, one being the margin of the old mouth, the other, in advance of the tube, being similar in character and indicating another arrest in growth. Surface polished, marked by faint lines of growth, and crossed below the angle by a few irregular transverse lines, not ribs. Aperture small, oval, bordered by a prominent, acute raised margin; canal closed, short, recurved; front face of terminal varix marked by five small ribs radiating from the outer lip. Length 1.0 inch, width 0.75 inch.

With the same general surface ornaments and the same number of whorls and varices, the shell has a very much lower spire and the body whorl is a third wider than Sowerby's species. The great variety [rarity] of both species prevents a comparison of a series, but I can hardly believe, despite their similarity in some respects, that two shells of such different form can be specifically related. *T. alatus* is a long, slender fusiform shell, with a long straight canal and a slender spire. At the same time the resemblance in the ornaments, number of the varices, and of the whorls, and in size render it possible that they are only varieties of one species. My only specimen of *T. alatus* has not the aperture perfect, so in that respect I am compelled to use Sowerby's figure for comparison. The mouth of my *obesus* is much more elongated than Sowerby makes it, and it is sub-angulated instead of being round in advance.—Gabb, 1873.

Type locality: Santo Domingo.

Shell of moderate dimensions for the genus, kite-shaped in profile, acutely angulated by the 4 axial varices. Aperture and canal about two-thirds as long as the entire shell. Spire broad, acutely tapering, scalariform. Whorls of conch 5, acutely angulated at the periphery, the posterior tabulation interrupted by the varices, the sides of the whorls flattened and feebly inclined toward the axis. Body obliquely flattened in front of the periphery, somewhat concave toward the base. Whorls closely appressed, the posterior margin creeping up a little on the preceding whorl. Sutures linear, inconspicuous, irregular. Protoconch smooth, polished, twice-coiled; initial turn highly inflated, immersed only at the tip, the succeeding volution well-rounded, less convex and obscurely tabulated toward its close. Opening of conch indicated by a slight change in the texture of the shell and by the first appearance of the axial sculpture. Axials on the earliest whorls restricted to the 4 intervarical tubes which radiate from the narrow, obtuse shoulder at right angles to the axis of the shell; varices on the later whorls 4 in number, compressed and acutely angulated at their summits, the terminal varix much expanded and flattened upon the apertural face, produced along the peripheral angle, recurved and acutely pointed; incrementals fine, strongly retractive on the shoulder, flexuous on the anterior canal. Spirals obscure and commonly obsolete, reduced to a few faint and irregular lirations, least feeble on the terminal varix. Aperture rather small, smoothly rounded posteriorly, obtusely angulated in front. Peristome continuous, the rim elevated. Inner surface smoothly and heavily glazed. Labral varix flattened on its apertural face; area between the spinose peripheral angle and the corresponding varix on the penultima occupied by a rather heavy trigonal plate which is the upcurved lateral margin of one of the shoulder plates. Anterior canal entirely closed in the adult form, compressed and slightly twisted backward and to the right; line of the former opening indicated by a free edge overlapping the labral varix; former canals, one for each varix, superimposed on the true canal, their anterior extremities slightly divergent.

Dimensions of figured specimen: Height, 21 millimeters; diameter including varices, 14 millimeters; diameter at right angles to the maximum diameter, 10 millimeters.

Figured specimen: U. S. Nat. Mus. No. 371859, from locality 2564, 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.

The species has a meager representation in the Chipola formation, and the material is rather imperfect, but there are no characters preserved by which it may be separated from the Bowden and Santo Dominican forms. *Typhis (Talityphis) pterinus,* the Shoal River analog, is constantly lower and broader in the body but with a more slender spire and a much sharper and more regular spiral sculpture.

Occurrence: Chipola formation, localities 2213^{p}, 2564^{r}, 7151^{r}; Miocene of the Dominican Republic (Pilsbry, 1922), of the Canal Zone (Olsson, 1922), and of the Bowden beds, Jamaica (Woodring, 1928).

Typhis (Talityphis) pterinus Gardner

Plate LIII, figure 14

1936. *Typhis pterinus* Gardner, Florida State Dept. Cons. Geol. Bull. 14, p. 52, pl. 10, fig. 10.

Shell polished, of moderate dimensions for the genus, rather thin and slender except for the flangelike varices; spire scalariform; body including the varices cuneate; maximum diameter falling a little in front of the median horizontal. Whorls of conch probably 6 in the adult; closely appressed, the posterior margin creeping up a little on the preceding whorl, acutely angulated at the periphery. Shoulder slightly concave, rippled by the intervarical tubes; sides of whorls flattened, slightly inclined toward the axis; body somewhat rounded medially, gently concave anteriorly. Sutures linear, inconspicuous, zigzagging around the varices. Protoconch known only from the final whorl but apparently small, smooth, and highly polished. Opening of conch indicated by a change in the texture of the shell and by the initiation of the axial sculpture in the form of obtuse tubercles. Primary varices 4, the terminal varix a rather broad, laminar flange, the other 3 body varices compressed, acutely angulated ridges, terminating at the shoulder in compressed, posteriorly directed tubes; short circular tubes also developed in the intervarical areas, directed at right angles to the axis of the shell, perforate at their outer extremities, but only the last tube in direct communication with the body cavity. Spiral sculpture restricted to very fine, feeble, rather widely spaced, irregular lirations, commonly obsolete on the spire, strengthening toward the aperture, usually 3 to 5 on the terminal wing, absent on the anterior canal. Incrementals macroscopic, retractive and somewhat arcuate on the shoulder, flexuous on the anterior canal, and relatively prominent on the apertural surface of the terminal varix, where they are crenulated and puckered by the fine, sharp spiral lirae. Apertural opening rather small, oval, widening a little posteriorly, the margin elevated slightly above the body surface; peristome continuous, smoothly rounded; inner surface glazed; area between the labral varix and that directly behind it occupied by a rather thin, trigonal plate. Anterior canal short, compressed, feebly inclined toward the right, the former canals, one to each varix, superimposed but diverging very slightly at their anterior extremities.

Dimensions of holotype: Height, 20 millimeters; maximum diameter including varices, 13 millimeters;

diameter at right angles to maximum diameter, 8 millimeters.

Holotype: U. S. Nat. Mus. No. 371860.

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

Typhis (Talityphis) pterinus is allied to *Typhis (Talityphis) alatus obesus* Gabb, but the spire is more elevated in proportion to the body, and the spiral sculpture is sharper and more regular than in either the Bowden or the Chipola individuals referred to *T. alatus obesus* or in *T. harrisi* Olsson and the subspecies *T. harrisi waltonensis* Mansfield. The slender spire and the sharper spirals suggest *T. alatus* s. s., but if Sowerby's figure is correct the aperture in the Santo Dominican species is less ovate than in the species from Shoal River.

Occurrence: Shoal River formation, localities 3856[p], 3742[p], 5184[r].

Genus MURICOPSIS Bucquoy and Dautzenberg

1882. *Muricopsis* Bucquoy and Dautzenberg, Mollusques marins du Roussillon, vol. 1, p. 19.

Type by monotypy: *Murex blainvillei* Payraudeau. Recent in the Mediterranean.

Shell of moderate dimensions, commonly heavy. Spire elevated, usually more or less scalariform. Axials numerous, equispaced, and equal or nearly so. Spirals usually coarse and regularly spaced, equal or alternating in strength. Aperture oblique, broadest posteriorly. Labrum varicose, lirate within. Labium excavated at the base of the body, heavily glazed, smooth. Anterior canal moderately long, open, with parallel, proximate margins. Umbilicus narrowly perforate or closed.

The nucleus of the operculum, unlike that of *Murex* and *Urosalpinx,* is apical or nearly so. *Muricopsis* differs further from *Murex* in the normally smaller and more fusiform outline, the less ornate axial sculpture, and the open, anterior canal.

Muricopsis has a wide distribution from the early Tertiary on to the Recent. The Recent species are for the most part denizens of the warm and shallow waters.

Muricopsis laccopoia Gardner, n. sp.

Plate LII, figures 40, 41

Shell rather small, biconic. Aperture more than half as long as the entire shell. Spire obscurely scalariform, the posterior ramp broken by the axial sculpture; whorls probably 7 in number in the perfect adult, regularly and rapidly increasing in diameter. Body relatively large, inflated medially, abruptly constricted into the rather slender pillar. Volutions closely appressed, the posterior margin transgressing at the varices upon the preceding whorl. Sutures inconspicuous and irregular. Protoconch rather small, smooth, highly polished, subcylindrical; initial whorl strongly inflated medially, immersed at the tip; succeeding volution also convex, though flattening on the last quarter turn; close of protoconch indicated by a slight thickening of the shell. Axials 6, narrow, elevated, sharply rounded on their summits, equal and equispaced, retractive, the varices continuous, each series performing about half a revolution around the axis of the shell, persistent from the earliest whorl of the conch to the anterior fasciole; intervarical areas broadly concave, wider than the varices excepting on the base of the body whorl, where they wedge out; intervarical depressions deepest toward the posterior suture and to the right of the varix, where a curious little pocket is formed—a character perceptible on the third whorl of the conch and strengthening with the growth of the shell. Spirals coarsely threading the entire conch and equally prominent on the axials and the interaxials; primaries 3 on the whorls of the spire and the medial portion of the body, 3 on the base of the body, and 3 or 4 on the pillar, regular in size and spacing, elevated, obtusely Λ-shaped except on the base of the body and the pillar, where they are less elevated and more rounded; separated for the most part by narrower V-shaped channels, though on the base of the body and the pillar the interspaces are flattened and of approximately the same width as the spirals; one and, on the later whorls, 2 secondaries intercalated between the posterior primary and the suture; secondary spirals may also be intercalated on the base of the body and the pillar; the primary outlining the shoulder and one or more body spirals spinose at the intersection with the axials. Pillar formed by the closely appressed, overlapping varices, the anterior fasciole also bearing the record of successive canals, 1 to each varix. Aperture rather narrow, spatulate, obtusely angulated posteriorly. Labrum varicated a little behind the thin crenate margin, lirate within. Labium excavated at the base of the body, heavily glazed, smooth except for a few rugae on the pillar near the entrance to the canal. Anterior canal of approximately the same length as the wider opening behind it; narrow, with parallel, proximate margins. Anterior fasciole arcuate, built up from the extremities of the successive terminal varices.

Dimensions of holotype: Height, 18 millimeters; length of aperture, 11.2 millimeters; maximum diameter, 9.8 millimeters. Dimensions of paratype: Height, 9.8 millimeters; maximum diameter, 5.3 millimeters.

Holotype and paratype: U. S. Nat. Mus. No. 371880.

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

In *Muricopsis laccopoia,* the varices are arranged in a continuous series which break down the shoulder ramp into small intercostal depressions, usually threaded with 2 secondaries. A single individual collected from

the Oak Grove is a juvenile, but it is aparently identical with the Chipola individuals. The individual from the Shoal River is also a juvenile and probably referable to an analogous but not identical species.

Occurrence: Chipola formation, localities 2213[p], 2564[r], 3419[r]; Oak Grove sand, locality 2646[r]; Shoal River formation, ?Aldrich collection, Johns Hopkins University.

Genus UROSALPINX Stimpson

1865. *Urosalpinx* Stimpson, Am. Jour. Conchology, vol. 1, p. 58.

Type by original designation: *Fusus cinereus* Say. Recent from Prince Edward Island, to St. Augustine, Fla.

Shell elongated oval, or short fusiform, longitudinally ribbed or undulated and spirally striated; aperture with a short canal. Operculum somewhat like that of *Purpura*, semicordate, with the nucleus at the outer edge a little below the middle. Lingual dentition nearly like that of *Trophon*, the lateral teeth having an elongate base of attachment; but the rhachidian tooth has numerous minute denticles between the principal ones, corresponding to ridges on the surface of the tooth, as in the Murices. Ova-capsules oblong, shouldered, widest near the summit, compressed, carinated on either side, peduncle short; base of attachment very small; aperture median at the summit.[9]

It differs from *Trophon* in its operculum and from *Ocinebra* in its smoother shell, want of varices, and open canal.—Stimpson, 1865.

Urosalpinx is essentially a muricid in which the varices have been subdued into costals of varying degrees of prominence. Evidence of the family relationship is, however, still retained even in the ornamentation, for the surface is rasped as a rule by fine, sharp incremental laminae.

Urosalpinx and *Muricopsis* may be difficult to separate in the fossil state, for the opercula, not ordinarily available to the paleontologist, are in these genera more definitely characterized than the conchs.

Urosalpinx was probably initiated as early as the Eocene. Both the fossil and the Recent species are best represented along the east coast of North America and the Gulf of Mexico. The most prolific of the Recent species is the type, *Urosalpinx cinerea* (Say), the common oyster drill that has caused such havoc among the oyster beds of the Middle Atlantic slope.

Urosalpinx phagon Gardner, n. sp.

Plate LII, figures 36, 37

Shell rather small, solid, fusiform in outline, the maximum diameter falling not far from the median horizontal. Spire turreted, the whorls increasing regularly and rather rapidly in diameter. Whorls of conch 5 in number, closely appressed, the posterior margin creeping up a little upon the preceding volution. Shoulder very broad and rather steeply sloping, the periphery of the whorls of the spire falling in front of the median horizontal. Sides of whorls approximately parallel to the axis. Body obliquely constricted at the base into the moderately long and slender pillar. Sutures inconspicuous, undulated by the costals of the preceding whorl. Protoconch small, smooth, twice-coiled, the initial turn moderately inflated but flattened behind and immersed at the tip; final whorl convex, flattening on the last half turn; close of protoconch indicated by a slight riblike thickening of the shell. Axials prominently elevated, running in the holotype 8 to the whorl from the initial turn of the conch to the body, very narrow and sharply rounded upon the posterior volutions, broad and somewhat undulatory in character upon the anterior, uniform in prominence from the periphery to the anterior suture but weakening upon the shoulder; body axials most prominent upon the periphery, more or less obsolete upon the base; intercostal areas concave and usually a little narrower than the costals. Entire surface shagreened with fine incremental laminae, most prominent upon the shoulder, where the fine, sharp edges rasp the surface almost as strongly as in *Coralliophaga*. Spiral sculpture subdued; primaries low, rounded, equal and regularly spaced, 2 or 3 in number upon the whorls of the spire, 6 upon the medial portion of the body, 3 upon the base of the body, and 4 or 5 upon the pillar; posterior spiral outlining the periphery; shoulder free from threading; secondaries fortuitously introduced between the primaries, most frequently upon the body. Anterior fasciole arched and corrugated by the axials but not spirally lirate. Aperture moderately wide, oblique, acutely angulated at the posterior commissure. Outer lip obtusely angulated at the shoulder, obliquely constricted at the base of the body, varicated a little behind the margin, lirate within, the lirae produced far within the aperture and corresponding in position to the spaces between the primaries. Labium excavated at the base of the body. rather heavily and very smoothly glazed, the pillar feebly rugose in the adult; inner margin of pillar sharply rounded at the entrance to the anterior canal. Canal moderately long, bent backward slightly, the margins parallel and proximate. Anterior extremity broadly emarginate. Umbilicus imperforate in the young, the fasciole flaring in the adult so that a narrow chink is left between the fasciole and the inner wall of the canal.

Dimensions of holotype: Height, 16.5 millimeters; length of aperture, 10.5 millimeters; maximum diameter, 9.2 millimeters. Dimensions of paratype: Height, 7.4 millimeters; maximum diameter, 4.6 millimeters.

Holotype and paratype: U. S. Nat. Mus. No. 371856.

[9] Stimpson adds the following footnote: In the form of the ovacapsules we find an important difference between the Muricidae and the Buccinidae. In the former group they are more or less pedunculated and erect, while in the latter they are flattened, discoidal, adhering by the broad flat base, and generally occur piled upon one another in masses.

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

Urosalpinx phagon has much the aspect of *Muricopsis,* but it is rather small for that genus, the spire is relatively low, and the character of the surface is more typical of *Urosalpinx.* The species may be readily separated from all of the coexistent members of the genus by the absence of spiral sculpture upon the shoulder.

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

Urosalpinx tribaka Gardner, n. sp.

Plate LII, figures 35, 45

Shell of moderate dimensions, rather heavy and rude, stout, fusiform in outline, the maximum diameter falling near the median horizontal. Aperture more than half as high as the entire shell. Number of whorls of conch indeterminate but probably about 5; whorls of spire rather steeply sloping to the periphery, which is about two-thirds of the way from the posterior to the anterior suture; sides approximately vertical. Body large relatively, inflated medially, rather abruptly constricted into the broad pillar. Whorls closely appressed, separated by inconspicuous sutures. Protoconch not preserved but doubtless small. Both the axial and spiral sculpture subdued and rather irregular. Early whorls quite sharply rippled by a dozen narrow, obtuse riblets, most prominent at the periphery and inclined to become obsolete toward the posterior suture; axials broadening upon the later whorls, becoming irregular in size and only about 7 in number on the body of the adult, restricted almost entirely to the peripheral region; incrementals sufficiently strong to rasp the entire surface and toward the posterior sutures appearing as very fine, retractive laminae. Spiral sculpture crowding the entire shell; spirals low, rounded, not sharply defined, tending to alternate in size; peripheral spiral usually a little more prominent than any of the others; spirals least elevated upon the shoulder; primaries about 3 in number on and in front of the periphery and 3 or 4 behind it, with an approximately equal number upon the shoulder and medial portion of the body and half a dozen subequal and equispaced lirae girding the pillar; secondaries usually intercalated between each pair of primaries and even tertiaries developed upon the medial portion of the body. Anterior fasciole raised, sculptured only with heavy incrementals. Aperture spatulate, obtusely angulated and obscurely channeled at the posterior commissure. Outer lip broadly arcuate, thickened behind the margin, thin and finely crenulated in harmony with the spiral sculpture at the margin, lirate within; lirae corresponding in position to the interprimary areas, most prominent a little behind the medial portion of the lip. Inner wall of aperture smooth, excavated at the base of the body. Parietal wash heaviest directly in front of the commissure. Pillar rounded, slightly flexed at the entrance to the anterior canal. Canal moderately long for the genus, nearly vertical, the margins parallel and proximate. Anterior fasciole well differentiated, corrugated, not parallel to the anterior canal; emarginate at the extremity. Umbilical chink not entirely closed.

Dimensions of incomplete holotype: Height, 22.5 millimeters; length of aperture, 15± millimeters; diameter including varices, 13.5 millimeters; diameter at right angles to maximum diameter, 11.5 millimeters. Dimensions of paratype: Height, 10.9 millimeters; maximum diameter, 6.2 millimeters.

Holotype and paratype: U. S. Nat. Mus. No. 371857.

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

Urosalpinx tribaka exhibits the peculiar worn and weathered aspect common to so many of the members of this genus. Both the axial and the spiral sculpture are subdued, and the outline of the shell is fairly regular. There is no closely related species. The Oak Grove form, *U. xustris,* is of an entirely different type—many more whorls, more strongly inflated at the periphery, vigorous axials reduced on the body to prominent peripheral nodes, and fine, sharp, and crowded spirals dissected by the incrementals. In *Urosalpinx phagon,* also from the Oak Grove, the well-defined shoulder is free from spiral threading.

Occurrence: Shoal River formation, localities 3856[r], 3742[r], 5618[r].

Urosalpinx xustris Gardner, n. sp.

Plate LII, figure 44

Shell of moderate dimensions for the group, stout, fusiform, the maximum diameter falling near the median horizontal. Whorls of conch probably 6 in number, increasing rapidly in diameter; an ill-defined and obliquely sloping shoulder; but the outline of the peripheral and anterior portion of the whorl obscured by the heavy axial ribbing. Body obliquely constricted at the base into the broad, recurved pillar. Whorls closely appressed, the sutures inconspicuous and crenulated by the costals of the preceding volution; apical region decorticated in all the material available so that the nuclear characters are obscured. Protoconch small, smooth, twice-coiled, the initial turn inflated and immersed at the tip, the remaining volution rather high, broadly convex, flattening toward the close of the protoconch, which is apparently indicated by a slight thickening of the shell substance and the initiation of the conchal sculpture. Axials on the earliest whorls narrow, sharply rounded, subequal and equispaced, uniform in elevation between the sutures, 11 or 12 in number, much broader on the later volutions and more distantly spaced, inclined to be nodose on the periphery, and more or less obsolete upon the shoulder, 7 or 8 in number on the later whorls. Spiral sculpture

crowding the entire conch; 3 or 4 primaries on the medial and anterior portion of the whorl and the 5 or 6 on the base of the body usually a little stronger than the approximately equal number of primaries on the shoulder; secondaries and tertiaries crowded between the primaries, all of them separated from one another by linear interspaces and macroscopically roughened by the close axial striation; spirals on the pillar lower, broader, more flattened, and more irregular in arrangement than the spirals on the rest of the conch; lirations on the anterior fasciole very close and approximately a dozen in number. Aperture obliquely spatulate in outline, obscurely sulcated and angulated at the posterior commissure. Outer lip rather strongly arcuate, not varicose in the holotype, thin at the margin and finely crenate in harmony with the spiral sculpture; dentate within, the denticles, approximately 7 in number, most prominent within the peripheral portion, quite evenly disposed from the anterior canal to a little in front of the posterior commissure. Labium excavated at the base of the body but not very strongly. Parietal wash dense, smoothly applied. Inner margin of pillar sharply rounded. Anterior canal rather long, feebly recurved, almost vertical, the margins parallel and proximate. Anterior fasciole well rounded, arcuate, not parallel to the inner wall of the canal, obliquely emarginate at its extremity. Umbilical chink indicated by the deep linear depression to the right of the fasciole.

Dimensions of holotype: Height, 25 millimeters; length of aperture, 17.0 millimeters; maximum diameter, 14.5 millimeters.

Holotype: U. S. Nat. Mus. No. 371858.

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

Urosalpinx xustris is remarkable for the elaborate ornamentation. The Shoal River species, *U. tribaka,* has been so named because of the worn and rubbed appearance of the external surface. Both the axial and the spiral sculpture are much subdued, and even the outline of the shell exhibits no sharp angles or curves. In *U. xustris,* on the other hand, the whorls are inflated at the periphery, the axials are strongly inclined to be nodose, and the spirals are close and sharp and finely dissected by the incrementals. *Murex veatchi* Maury is apparently a closely related species differing from *U. xustris* in the more persistent axials upon the body, less crowded spiral sculpture, and more oblique anterior canal. The coexistent species, *U. phagon,* develops no spiral sculpture upon the shoulder and, as a rule, not more than 3 primaries and no secondaries upon the whorls of the spire.

Occurrence: Oak Grove sand, locality 2646[p]; 10659[r]; Shoal River formation, locality 3733[r].

Urosalpinx veatchi (Maury)

1910. *Murex veatchi* Maury, Bull. Am. Paleontology, vol. 4, no. 21, p. 26, pl. 6, fig. 7.

Shell pyriform, small, with five somewhat convex whorls, transverse sculpture of numerous, prominent raised lines which show some tendency to alternate but in general are subequal, longitudinal sculpture of subequal varices (six on the last whorl) and of fine longitudinal raised lines which form with the spirals a very fine network, or honeycomb ornamentation. Aperture oval; canal open; outer lip lirate within. Length of shell 21; of aperture and canal 13; greatest width 12 millimeters.

Named in honor of Mr. Arthur Veatch of the United States Geological Survey, who collected the shells.

Chipola marls, Baileys Ferry, Fla.

Cornell University collection.—Maury, 1910.

Murex veatchi is apparently a *Urosalpinx* of the group of *U. xustris,* but stouter, with more persistent axials, a coarser and less crowded spiral sculpture and a more oblique anterior canal. The species has not been recognized in the material under observation.

Occurrence: Chipola formation, Cornell University collection.

Genus EUPLEURA H. and A. Adams

1853. *Eupleura* H. and A. Adams, Genera Recent Mollusca, vol. 1, p. 107.

Type by subsequent designation (F. C. Baker, Chicago Acad. Sci. Bull., vol. 2, p. 176, 1895): *Ranella (Eupleura) caudata* Say. Recent from Massachusetts to Florida in 1 to 8 fathoms (fide C. W. Johnson).

Shell solid, ranelliform, carrying two continuous primary and several intermediate secondary varices. Aperture oval. Labrum dentate within. Labium smooth. Anterior canal long, narrow, partially closed.

Eupleura was considered by Tryon to be intermediate between *Murex* and *Ranella.* It may be separated from *Murex* by the presence of the two ranelliform varices and from *Ranella,* by the smooth columella and the muricoid ornamentation.

The genus was not initiated, apparently, until the Tertiary. The Recent representatives are confined to the east coast of North America, ranging from New England south to Panama and thence to the West Indies.

Eupleura pterina Gardner, n. sp.

Plate LIII, figure 6

Shell small, thin, friable, the dense and polished outer layer more or less decorticated in most specimens. Body whorl alate, the short spire somewhat scalariform. Aperture almost three-fourths the length of the entire shell. Number of whorls in conch indeterminate but probably about 5. Whorls of spire broadly convex, obscurely shouldered, increasing rapidly in diameter. Body rudely hexagonal, the 6 intervarical areas feebly concave, attenuated anteriorly, the varices

crenulated by the spiral sculpture. Protoconch not preserved. Axials on the early volutions narrow, subacute, possibly 12, separated by wider, concave interaxials; laminar varices developed from the costals relatively early in the growth of the shell, the ribs becoming increasingly prominent, fewer in number, and consequently more distantly spaced; costals on the body whorl normally 6 including the peripheral node halfway between the terminal varix and the laminar varix behind it; varix opposite the terminal varix a little more prominent than the intermediate varices; laminae thin and translucent, flaring at the edges and emphasizing by their outline the shoulder of the whorl; a single lamina, or at most 2 or 3, visible in any but the terminal varix, which usually shows about a dozen. Spiral sculpture meager; 3 well-rounded primary spirals, the posterior outlining the obscure shoulder, the medial girding the ill-defined periphery, the anterior directly behind the suture line and partially or even wholly concealed by it; base of body and pillar corded with 9 subequal and equispaced less prominent spirals of similar character, and the anterior fasciole obscurely threaded with half a dozen finer lirae; secondaries rare and fortuitous. Aperture lobate, slightly oblique, broadest posteriorly. Outer lip obtusely angulated at the posterior spiral, the terminal varix flaring away from the aperture, giving a cross section of the component laminae. Inner margin of labrum from the shoulder to the entrance to the canal broadly arcuate, reinforced by half a dozen denticles elongated at right angles to the margin, the next to the posterior the most prominent; a slight thickening of the inner margin between the suture and the shoulder angle in the adult, indicating with the posterior labral denticle, an obscure channel for the excurrent siphon. Inner wall of aperture gently concave, smoothly and heavily glazed. Pillar rounded and slightly flexed at the entrance to the anterior canal. Canal long, rather broad, sinistrally inclined, the lips parallel and proximate. Anterior fasciole well-rounded, broadly arcuate, not parallel to the canal opening, cut off from it by a thin lamina, the continuation of the parietal callus. Anterior extremity obliquely truncate.

Dimensions of imperfect holotype: Height, 15.3 millimeters; length of aperture, 11.0 millimeters; diameter including varices, 9.6 millimeters; diameter at right angles to the maximum diameter, 7.0 millimeters.

Holotype: U. S. Nat. Mus. 371882.

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

The ranelliform character of the varices is not obvious, but the general aspect of the shell is that of *Eupleura,* and it may be that the two individuals which represent the species are not fully mature. *Eupleura pterina* is the first species to be reported from the Alum Bluff. The similarity to the later species, such as *E. caudata* Say, is generic only.

Occurrence: Shoal River formation, localities 3856[r], 3742[r].

Suborder MESOGASTROPODA
Superfamily DOLIACEA
Family CYMATIIDAE
Genus CYMATIUM "Bolten" Roeding

1792. *Cymatium* "Bolten" Roeding, Museum Boltenianum, pt. 2, p. 129.

Type by subsequent designation (Dall, Smithsonian Misc. Coll., vol. 47, p. 133, 1904): *Murex femorale* Linnaeus. Recent off southern Florida and the West Indies.

Shell fusoid or buccinoid in outline, commonly large and heavy. Spire more or less elevated. Whorls nodulated and varicose, the varices irregular and discontinuous. Aperture oval. Outer lip thickened and usually varicated, dentate or lirate within. Inner lip smooth, corrugated or plicated. Anterior canal more or less produced and recurved.

The genus is first cited in the Cretaceous and is moderately abundant in the Tertiaries. The Recent species are confined largely to the warmer waters and are particularly characteristic of the Asiatic seas.

This genus is so essentially a warm-water group and so well-developed in the Antillean Tertiaries that its presence in the Alum Bluff is not without significance.

Subgenus LAMPUSIA Schumacher

1817. *Lampusia* Schumacher, Essai d'un nouveau système des vers testacés, p. 250.

Type by subsequent designation (Herrmannsen, Indicis generum malacozoorum, vol. 1, p. 575, 1847): *Murex pileare* Linnaeus. Recent in the Indo-Pacific and possibly the Mediterranean.

The subgenus is characterized by the relatively long anterior canal.

Fragments of a single individual rather distantly related to the type of *Lampusia* occur in the Chipola.

Cymatium (Lampusia) sp.

The single individual that establishes the presence of this group in the Alum Bluff is moderately slender and probably attained a height of 65 or 70 millimeters. Only the body and a part of the last whorl of the spire have been preserved. The terminal varix is prominent, but some of the other half dozen axials are reduced to rather acute peripheral nodes. On the last whorl of the spire there are 3 equal and equispaced, prominent primary fillets, the posterior outlining the shoulder, the anterior directly in front of the suture and sometimes concealed. Four or five secondaries are developed on the shoulder and one between each pair of primaries on the final whorl of the spire. On the body the primaries are increased to 6, with 2 secondaries intercalated be-

tween each pair on the medial portion of the shell. Three lower and narrower primaries with intercalated secondaries gird the pillar and in front of them four equal and more closely spaced lirations. The anterior fasciole is obscurely threaded with 4 inconspicuous lirae. The aperture is pyriform, the curvature of the outer margin higher than that of the inner. The labral varix is heavy, the labral margin rather sharply crenate, and the inner surface rugose, the ridges corresponding in position to the secondary spirals. The inner wall of the aperture is concave, thickly glazed, and corrugated from the posterior commissure to well down toward the extremity of the anterior canal. The anterior canal is rather long and decidedly recurved, with parallel, proximate margins.

There is an undescribed Costa Rican species, smaller than this individual, with a shorter anterior canal and a more prominent but less acute axial sculpture, which nevertheless strongly resembles the Florida species in general aspect.

Occurrence: Chipola formation, locality 2213r.

Genus COLUBRARIA Schumacher

1817. *Colubraria* Schumacher, Essai d'un nouveau système des vers testacés, p. 251.

Type by subsequent designation (Dall, Smithsonian Misc. Coll., vol. 47, p. 135, 1904): *Buccinum maculosum* Chemnitz. Recent in the Indian Ocean.

Herrmannsen in 1847 designated *Tritonium maculosum* of Gmelin, 1792, but, judging from the Chemnitz figures, Gmelin's species may be distinct from that of Chemnitz.

Shell of moderate dimensions, rather thick and solid, more or less fusiform. Spire elevated, the axis commonly arcuate. Whorls broadly convex, as a rule, increasing slowly in diameter. Sculpture reticulate or granular with occasional axial varices. Aperture shorter than the spire, narrow, obliquely lenticular. Outer lip varicose, dentate within. Inner lip concave. Parietal and pillar wash heavy. Anterior canal short, recurved with parallel, proximate margins.

The distribution of *Colubraria* is similar to that of the closely allied *Cymatium*. It appears early in the Tertiaries both in this country and in Europe and persists to the present day. Like *Cymatium*, too, the Recent representatives of the genus are peculiarly characteristic of the South Pacific and Polynesian waters. The Polynesian group is addicted to self-decapitation. In the normal adult of some of the species the entire posterior fourth of the shell is decollated.

Only a single individual, obviously an early member of the series of *Colubraria lanceolata* Menke, is present in the available collection of Alum Bluff material.

Colubraria sp. cf. C. lanceolata Menke

A fragment consisting of 3 or 4 of the later whorls of the spire is almost identical with Menke's West Indian species. The outline and obscure posterior tabulation of the whorls and the axial riblets and varices are similar in the Chipola and Recent individuals. The spirals seem, however, to be a little lower, broader, and more flattened in the Recent form. It is to be hoped that material may be collected shortly that will establish the relationship between the Alum Bluff and Recent representatives of this persistent race.

The group is represented in the Costa Rican Tertiaries of Port Limon by a smaller, more angular, less finely reticulate species. There is also a closely allied form in the Miocene of Duplin County. The Caloosahatchee species has been considered identical with the Recent form, though the whorls are constantly more rounded. Whether the differences be specific or individual, the line of descent of the *C. lanceolata* group is certainly remarkably clear from the Chipola forms to the Recent.

Occurrence: Chipola formation, locality 2213r.

Genus PERSONELLA Conrad

1865. *Personella* Conrad, Am. Jour. Conchology, vol. 1, p. 21.

Type by monotypy: *Distortio (Personella) septemdentata* Gabb. Cook Mountain formation (middle Eocene) of Texas.

Shell rather small for the group, moderately heavy, lacking uniformity of outline and winding in the adult stages. Protoconch smooth, naticoid, performing 3 complete volutions. Beginning of conch indicated by the appearance of 3 primary spirals, which become increasingly prominent, the medial spiral outlining the obscure shoulder on the later whorls. Higher orders of spirals netted by the incrementals introduced on the interprimary areas of the adult. Axial sculpture not uniform; the ribs of the laterally compressed early whorls numerous and equisized, equispaced and nodulated by the primary spirals, which override them; the regular reticulate sculpture in some individuals exhibited on less than 2 whorls, in others on at least 4 whorls. Breakdown in the regularity of the sculpture coincident with irregularities in the outline of the whorls and of their coiling. Later volutions irregularly convex and axially sculptured with inequal and inequispaced costals with occasional resting stages and varices. Aperture obliquely lenticular, the outer lip feebly arched, varicose and strongly dentate within, the denticles usually 7 and conforming in number and position to the interspirals. Aperture expanded by the abrupt contraction of the body. Parietal wash too thin to obscure the sculpture, but callus much heavier on the pillar and rugose. Pillar short, twisted, and bearing, posteriorly, a pinched fold, which at the aper-

ture is almost normal to the axis and which on breaking the shell is visible as far as the apical region together with an intermittent series of denticles. Canal short, girded with a few strong spirals, recurved and truncate at its extremity.

Dall[10] in 1904 granted generic rank to *Personella,* although he considered *Sassia* Bellardi, 1873 (I Molluschi dei terreni terziarii del Piemonte e della Liguria, pt. 1, p. 249), type *Triton apenninicum* Sassi from the Miocene of Italy, as synonomous. Few of the European authors have had comparative material for critical observation. The material, however, on which Arthur Wrigley's study of *Sassia* is based included both European and American species. He recognized the importance of the characters that separate *Personella* from *Distorsio* on the one hand and from *Sassia* on the other. The type of *Distorsio* is the recent *Murex anus* Linnaeus, an Indo-Pacific shell of more than double the dimensions of the type of *Personella,* and with a *Cassis*-like spread of callus upon the parietal wall and a heavily rugose lobe of callus at the base of the pillar. The conch of *Sassia* is very similar to that of *Personella,* though less distorted, and the final whorl of the protoconch is reticulately sculptured. There has been some speculation on the origin and the routes of distribution followed by the frog shells and their allies. The group which includes *Sassia* and *Personella* is recorded in the Danian in the form of *Tritonium (Sassia) faxense* Ravn, a surprising record inasmuch as the figured specimen shows the apertural characters of typical *Sassia* and *Personella,* groups which in the Tertiary are characteristic of warm water biotas. The group seems also to be present in the Montian, although on the western side of the Atlantic *Triton tuomeyi* Aldrich, from the Woods Bluff, is the earliest recognized member, and this species lacks the irregularities in outline and sculpture that characterize the later forms. The absence of any common species among the fairly numerous representatives in the Paris Basin and that of the south of England indicates a sensitive group. The evidence assembled points to the development of the group in north European waters in the late Cretaceous and its later establishment upon American shores. *Distorsio,* on the other hand, is first recorded in the Oligocene of the Gulf Province. Conrad's *Triton crassidens,* though smaller than the genotype, exhibits the characteristic irregularity and oral armature, and may, as Wrigley suggests, have developed from *Personella.* In the European Tertiaries, *Distorsio* is not recorded before the Miocene. Like so many other of the warm water Tertiary genera, *Distorsio* has sought refuge in the Indo-Pacific. There is no record in the western Tertiaries of *Personella, Sassia,* or *Distorsio.* In a group so well characterized, and existent over so long a period, the inference that it did not reach the western shores seems justified.

[10] Dall, W. H., An historical and systematic review of the frog shells and Tritons: Smithsonian Misc. Coll., vol. 47, No. 1475, pp. 130, 140, 1904.

Personella floridana Gardner, n. sp.

Plate LIII, figure 8

Shell of moderate dimensions for the genus, rather thin, and friable. Aperture a little less than two-thirds the height of the entire shell. Whorls of conch 6 in number. Spire elevated, the posterior portion evenly turriculate; early whorls obliquely and rather obscurely shouldered, obtusely angulated at the periphery which falls near the median horizontal; final whorls of spire bulging in front of the periphery, the suture line falling in front of the normal plan of coiling, so that the whorl is abnormally high and inflated. Body whorl so inflated medially and so constricted anteriorly into the short, broad pillar that the shell has a peculiar, hunchback aspect; adult outer lip produced backward on the last half turn so that the margin reaches the periphery of the preceding whorl. Sutures inconspicuous and finely crenulated. Protoconch rather large, smooth, polished, naticoid, the tip broken away so that the exact number of whorls is not determinable but probably between 3 and 4; initial turn minute, largely immersed in the succeeding whorl; remaining nuclear turns broadly and symmetrically rounded, increasing rapidly both in height and in diameter. Dividing line between conch and protoconch very sharp, marked by a change in the texture of the shell and by the abrupt appearance of the axial and spiral sculpture. External surface rather evenly cancellated. Axials low, narrow, obtuse, retractive, subnodose at the intersection with the spirals which override them, persistent from suture to suture and well down to the base of the body, separated from one another by wider interspaces, approximately 20 in number on the early whorls, increasing to 25 or more on the body; obscure and irregular varices developed at irregular intervals on the later whorls. Spirals more sharply defined than the axials, the primaries consisting of rather narrow fillets, 3 or 4 in number on the whorls of the spire, 6 on the posterior and medial portion of the body, 3 on the base of the body, and 3 or 4 on the pillar; posterior fillet revolving directly in front of the suture, the medial fillet on the whorls of the spire outlining the periphery, the anterior narrower than those behind it and intermediate in position between the periphery and the anterior suture; a fourth primary may be visible in whole or in part directly behind the anterior suture; 1 or 2 fine secondary threadlets intercalated between the posterior spiral and the suture and between the posterior and peripheral spirals; interspace between the posterior and peripheral spirals the widest; areas included between the axials and spirals rec-

tangular and except on the shoulder and on the base of the body laterally elongated; spirals on the base of the body narrower and more elevated than on the medial portion. Pillar and anterior fasciole corded with rather closely spaced spirals, commonly beaded by the axials. Aperture rather narrow, very irregular, abruptly expanding at the base of the body. Outer lip posteriorly produced, varicated a little behind the margin, the margin expanded and flaring, sharply crenulated in harmony with the spiral sculpture. A series of short denticles just within the margin corresponding to the interspiral areas; a heavy rib developed a little further within the aperture and cut up into short, sharp, toothlike ridges, the one directly opposite the base of the body much the most prominent; 2 or 3 finer denticles developed behind it; internal rib becoming increasingly narrow anteriorly but persisting to the extremity of the canal, the serrations usually 7 or 8 in front of the prominent tooth, increasingly fine and more closely spaced toward the anterior extremity. Inner wall of aperture obliquely and abruptly constricted at the base of the body. A heavy parietal tooth developed a little in front of the commissure and a little behind the prominent labral tooth. Pillar reinforced by a narrow, attenuated rib superimposed upon it directly opposite the rib on the inner wall of the labrum and like the labral rib dissected into a series of sharp ridges 9 to 12 in number. Parietal and pillar glaze washing the body wall almost or quite to the posterior suture, the glaze only varnishing the sculpture, however, and scarcely obscuring it; outer margin of the wash distinct, standing apart from the body wall, parallel to the varices, persistent to the anterior extremity, heavily rugose on the pillar. Columellar folds 2, the posterior at the base of the body, the anterior proximate and parallel to it but more prominent, its outer extremity abutting against the posterior extremity of the pillar rib. Anterior canal short, twisted slightly backward and to the left, partially choked by the labral and labial ribs, obliquely truncate at its extremity.

Dimensions of holotype: Height, 24 millimeters; length of aperture, 15 millimeters; maximum diameter, 17 millimeters; diameter at right angles to maximum diameter, 12.6 millimeters.

Holotype: U. S. Nat. Mus. No. 371879.

Type locality: Sta. 3742, Shell Bluff, Shoal River, Walton County, Fla.

Personella floridana is the first of the genus to be reported from the Alum Bluff. *Personella* occurs in the Eocene and Lower Oligocene of the Gulf Province and in the Miocene of the West Indies and Panama, but it has not been previously collected from the Miocene of the Gulf. The Florida species is smaller than the West Indian and Panamanian forms and not quite so sharply sculptured spirally. The forms are, however, so close that the differences may well be due to place rather than time.

Occurrence: Shoal River formation, localities 3856^{r}, 3742^{r}, 5184^{r}, 5195^{r}, 10603^{r}.

Family CASSIDIDAE

Genus SEMICASSIS Mörch

1852. *Semicassis* Mörch, Catalogus conchyliorum quae reliquit D. Alphonso d'Aguirra et Gadea, Comes de Yoldi, pt. 1, p. 112.

Type by subsequent designation (Harris, 1897, Cat. Tert. Mollusca British Mus., pt. 1, Australasian, p. 198): *Cassis japonica* Reeve. Recent in Japanese waters.

Semicassis differs from *Phalium* Link in the absence of marginal spines near the base of the outer lip.

Subgenus TYLOCASSIS Woodring

1928. *Tylocassis* Woodring, Miocene Mollusks from Bowden, Jamaica, pt. 2, Carnegie Inst. Washington Pub. 385, p. 306.

Type by original designation: *Buccinum inflatum* Shaw. Recent in the West Indies and the southeast coast of the United States.

Shell reaching a large size, greatly inflated, spire low. Most shells have only a terminal varix, but some have two or more varices. Nucleus naticoid, consisting of about three and a half whorls. Aperture long, wide, deeply emarginate at base, forming a short canal. Siphonal fasciole greatly inflated. Edge of inner lip detached at base, fused to body whorl above base. Columella bearing a basal twist. Basal part of inner lip bearing many denticles, replaced on middle part of columella by ridges. Parietal wall bearing several ridges. Outer lip greatly thickened, its inner edge bearing long lirations. Sculpture consisting of low spiral bands, modified by axial wrinkles.

All the later Tertiary species from eastern America, and also *inflata* (Shaw) and *abbreviata* (Lamarck), the latter living on the Pacific coast of Mexico and Central America, represent *Tylocassis*, which differs from *Semicassis* s. s. principally in having wart-like denticles instead of long ridges on the basal part of the inner lip.—Woodring, 1928.

Semicassis (Tylocassis) aldrichi (Dall)

Plate LIV, figure 6

1890. *Phalium aldrichi* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 1, p. 162.

1892. *Cassis (Phalium) aldrichi* Dall, idem, pt. 2, p. 263, pl. 21, fig. 2.

Shell small, stout, solid, subglobose, with three smooth nuclear and four subsequent whorls; spiral sculpture on the last whorl in front of the shoulder of fourteen primary, strong, flattish, wide, elevated ridges, with much narrower interspaces; a single fine, intercalary thread is sometimes present in most of the channels; the peripheral spiral is larger than the others, but not so large as that at the shoulder; on the shoulder are three primary, more or less rippled spirals. the first at the suture, which is not appressed; in the channel in front of it is a single secondary thread, the second channel has two, and between the third primary and the shoulder are three fine threads close

together, forming a sort of band behind the tuberculous shoulder; the tubercles here are squarish and about fifteen on the last whorl; transverse sculpture of rather regularly spaced, impressed lines, which cut the primary spirals in a way to recall by the result the ends of shingles on a roof, as the irregularities are not nodules, and have their long slope toward the aperture; the shell now described has two past varices; outer lip much thickened, with a deep groove behind it; inside it has about eighteen strong lirae, unpaired and with wider interspaces; inner lip heavily callous, reflected, strongly pustular, lirate at the base of the pillar and on the body; canal narrow, short, strongly recurved; axis pervious; siphonal notch very deeply cut; siphonal fasciole strong, with a deep channel behind it; the callus of the aperture reaches to the shoulder. Max. long. of shell 26.0; of aperture 21.0; max. lat. 19.0 millimeters.

The specimen described came from Ten-Mile Creek, Chipola River, collected by Mr. Burns. Its nearest relative seems to be *C. caelatura*, which is quite differently sculptured and proportioned. It is named in honor of Mr. T. H. Aldrich, who is doing so much to increase our knowledge of the Southern Eocene fauna of the United States.—Dall, 1890.

Holotype: U. S. Nat. Mus. No. 112207.

The type remains unique.

Occurrence: Chipola formation, locality 2212[r].

Genus SCONSIA Gray

1847. *Sconsia* Gray, Zool. Soc. London Proc., pt. 15, p. 137.

Type by original designation: *Cassidaria striata* Lamarck. Recent in the West Indies.

Shell of medium or rather large size, ovoid, the spire low and broad, the body broadly inflated. Protoconch horny, small, paucispiral, smooth, the initial turn immersed at the tip. Whorls of spire trapezoidal, increasing rapidly in diameter. Body broadly inflated, relatively large, the aperture more than two-thirds the height of the shell. Sutures impressed. Entire surface spirally lirate, the lirae crowded and flattened except on the earlier whorls of the spire and the fasciole. No axial sculpture except strong incrementals, a terminal varix, and usually, though not in every individual, a body varix, so placed that its sharply defined margin intercepts the reverted pillar callus at the extreme base of the body. Terminal varix heavy, defined exteriorly by a shallow groove, lirate within. Parietal wash thin but widely spread, thickening toward the base of the body, corrugated at the base of the body, and lirate at right angles to the margin of the pillar. Anterior canal short, broad; the margins proximate; nasute and emarginate at its extremity.

The genus has been discussed by Dall,[11] Pilsbry,[12] Woodring,[13] Wrigley,[14] and a number of authors.

[11] Dall, W. H., Contributions to the Tertiary paleontology of the Pacific Coast, I, The Miocene of Astoria and Coos Bay, Oregon: U. S. Geol. Survey Prof. Paper 59, p. 66, 1909.

[12] Pilsbry, H. A., Revision of W. M. Gabb's Tertiary Mollusca of Santo Domingo: Acad. Nat. Sci. Philadephia Proc., vol. 73, pp. 361, 362, 1922.

[13] Woodring, W. P., Miocene mollusks from Bowden, Jamaica, pt. 2: Carnegie Inst. Washington Pub. 385, pp. 308, 309, 1928.

[14] Wrigley, Arthur, English Eocene and Oligocene Cassididae, with notes on the nomenclature and morphology of the family: Mal. Soc. London Proc., vol. 21, pp. 114-116, 1934.

The inflated anterior fasciole and deep, obliquely directed terminal notch that characterize *Cassis* and *Semicassis* are not developed in *Sconsia*, and both the labral and the parietal callus are relatively thin for the family. *"Cassis" nuperus* Conrad from the Gosport sand was cited by both Dall and Pilsbry as an ancestral form of *S. lintea* Conrad of the Vicksburg fauna and *S. hodgii* Conrad of the Duplin fauna, but Woodring excluded it from *Sconsia* because of its prominent anterior fasciole. Dall treated *Sconsia* as a subgenus of *Galeodea*, but Wrigley considered *Sconsia* to be more closely related to *Semicassis*.

Sconsia paralaevigata Gardner, n. sp.

Plate LIV, figure 11

Shell of moderate dimensions for the group, rather thin and easily decorticated. Aperture approximately three-fourths the length of the entire shell. Spire very short and acutely tapering, the component volutions narrow but feebly inflated and very narrowly tabulated like the whorls of *Buccinum*. Body strongly globose, smoothly constricted into the short, broad pillar. Whorls 7 in all, separated by slightly impressed sutures. Apical region decorticated so that the dividing line between the conch and protoconch is lost. Protoconch rather large, papillate, paucispiral, the initial turn well-rounded and immersed at the tip, the succeeding whorl or whorls contoured like the early whorls of the conch. Axial sculpture restricted to incremental striae that strengthen toward the aperture and to occasional traces of former terminal varices. Spiral sculpture also buccinoid; spirals very low and flat, somewhat unequal and irregular, a little stronger posteriorly than medially; about 9 in number on the final whorl of the spire, almost four times as many on the body and pillar; interspaces shallow and of approximately the same width as the spirals. Anterior fasciole threaded with half a dozen more sharply defined lirations, equal and equispaced. Aperture moderately wide, somewhat auriculate, obtusely angulated but not sulcate posteriorly. Outer lip broadly arcuate, somewhat produced posteriorly on the preceding whorl; much thickened along the margin, lirate along the inner surface of the varix; lirae from 15 to 20 in number, some of them longer than the others, all of them normal to the margin except the anterior, which outlines the entrance to the canal. Inner margin of aperture flexuous, well-rounded along the body, feebly excavated at the base of the body. Parietal wash thin but spread over a broadly arcuate area. Pillar heavily reinforced, the outer margin of the callus thick and laminated; surface of callus toward the aperture wrinkled posteriorly, rather heavily corrugated toward the canal. Anterior canal short, rather narrow with well-defined parallel lips; recurved and obliquely truncate at its extremity.

Dimensions of holotype: Height, 36 millimeters; length of aperture, 28 millimeters; maximum diameter, 25 millimeters.

Holotype: U. S. Nat. Mus. No. 371888.

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

Sconsia paralaevigata is close to *S. laevigata* Sowerby from Santo Domingo, but it is decidedly less elegant. The inflation both of the whorls of the spire and of the body is a little higher in the Chipola form, and the constriction at the base of the body consequently more abrupt. The spiral sculpture in the Santo Dominican form is finer, and so high is the polish of the shell that the lirae seem to be subcutaneous. The Chipola individuals though fairly well-preserved are not polished, and the spiral sculpture has a normal aspect.

Occurrence: Chipola formation, locality 2213^{r}, Aldrich collection, Johns Hopkins University.

Genus MORUM "Bolten" Roeding

1798. *Morum* "Bolten" Roeding, Mus. Boltenianum, pt. 2, p. 53.

Type by monotypy: *Morum purpureum* Roeding= *Strombus oniscus* Gmelin. Recent in the West Indies.

Shell rather small for the group but heavy and solid, subcylindrical or ovate trigonal. Spire short, the body large and inflated. Sculpture dominantly spiral and more or less tuberculated or sharply reticulate. Aperture long and narrow. Outer lip thickened and plicate within. Labium widely expanded over the body; the surface of the callus usually granular or papillated. Anterior canal very short, recurved, obliquely emarginate.

The genus was foreshadowed if not actually present in the upper Cretaceous of India and has a meager representation in the Tertiaries of Europe and of this country. The known Recent species are less than a dozen in number, but they have a world-wide distribution in the tropical and subtropical seas. Only a single species is known in the Alum Bluff group, *Morum (Oniscidia) chipolanum* (Dall ms.).

Subgenus ONISCIDIA Swainson

1840. Swainson, Malacology, p. 299. *Oniscidia* evidently an error for *Oniscia* Sowerby (=*Morum* Roeding), which is correctly cited elsewhere in the text and index; *O. oniscus* Chemnitz [=*Strombus oniscus* Linnaeus] and *O. cancellata* Sowerby listed.

1852. *Oniscidia* (Swainson) Mörch, Catalogus conchyliorum Comes de Yoldi, pt. 1, p. 111.

Type by monotypy: *Morum cancellatum* Sowerby. Recent in the China Sea.

Oniscia Sowerby, 1824, is an exact synonym of *Morum* Roeding, and the type is the same for both. If *Oniscidia* is credited to Swainson then *Oniscia cancellata* Sowerby becomes the type by elimination.

The subgenus is characterized by the cancellate sculpture and the absence of a well-defined sulcus at the posterior extremity of the aperture.

Oniscidia has been reported from the Miocene and later Tertiary beds of both Europe and North America. The Recent representatives are, for the most part, confined to the South Pacific. A single, mid-American species has been reported, *Oniscia dennisoni* Reeve, described from an unknown habitat and listed from the Gulf of Mexico by both Dall and Johnson.

Morum (Oniscidia) chipolanum (Dall ms.) Gardner, n. sp.

Plate LIV, figure 18

Shell of moderate dimensions for the group, rather thick and heavy, ovate trigonal. Aperture nearly as long as the entire shell. Spire broad, scalariform. Whorls of conch probably 5, closely appressed, increasing rapidly in diameter. Posterior tabulation wide, almost at right angles to the axis; sides of whorls of spire shorter than the width of the shoulder and approximately vertical. Body somewhat obliquely constricted into the short, broad, ill-differentiated pillar. Sutures inconspicuous, finely crenulated in harmony with the axial sculpture, the later whorls so closely appressed that the posterior margin creeps up a little on the preceding whorl. Protoconch not preserved but doubtless very small. Axials very sharp and narrow and in the later whorls distinctly laminated, and the free edges fluted by the spirals; the number increasing from 7 on the first whorl of the spire to 15 on the body. Incrementals appearing as thin, papery, overlapping plates, from 4 to 6 between each of the axials on the body. Both the incrementals and the costals persistent from suture to suture on the whorls of the spire and, on the body to the anterior fasciole; approximately vertical on the sides of the whorl but distinctly retractive on the shoulder. Intercostal areas broadly concave, about twice the width of the costals. Primary spirals strong, well-rounded cords, subequal and regularly spaced over the entire conch, 1 or 2 on the whorls of the spire and 11 on the body not including the lower, narrower spirals on the pillar; spirals separated by concave interspaces of approximately their own width though slightly wider at the extreme base of the body; posterior primary outlining the periphery; secondaries not developed except for a couple of ill-defined threadlets on the shoulder. Anterior fasciole laminated by the axials but not spirally sculptured. Aperture narrow, obtusely angulated and obscurely sulcated posteriorly. Outer lip very feebly arcuate, thickened, somewhat reflected, and lirate along the inner margin, the lirae corresponding in position to the spaces between the spirals. Inner lip widely reflected over the body wall and pillar. Outer margin of callus discrete, parallel to the axis through the greater part of its extent, broadly arcuate behind; sur-

face of callus coarsely granulated, the granules for the most part irregular but tending to be elongated and oriented normal to the axis along the oblique inner margin of the aperture. Anterior canal very short and broad, its entrance indicated on the labral side by a short, oblique liration. Anterior extremity narrowly and deeply emarginate.

Dimensions of holotype: Height, 32 millimeters; length of aperture, 28 millimeters; maximum diameter, 20 millimeters.

Holotype: U. S. Nat. Mus. No. 114095.

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

Mansfield, 1937, described a subspecies, *M. chipolanum tampanum,* and reported a closely related, unnamed form. The spire of the Tampa species is more obliquely shouldered, the ornamentation is less ornate, both the axials and the spirals less sharply defined, the transverse lirae upon the outer lip less numerous, and the pustules upon the parietal wall fewer and less elevated than in topotypes of *M. chipolanum.* The unnamed form differs from the Chipola species in the more inflated body, the relatively higher spire, and the more numerous axials.

Morum chipolanum also suggests *M. domingense* Sowerby in the sculpture but lacks the narrow, well-defined sulcus at the posterior commissure, which characterizes not only the species but the subgenus *Herculea* to which *domingense* has been referred. Like most of the members of this group, the form is very rare.

Occurrence: Chipola formation, locality 2213[r].

Family FICIDAE

Genus FICUS "Bolten" Roeding

1798. *Ficus* "Bolten" Roeding, Mus. Boltenianum, pt. 2, p. 148.
1799. *Pyrula* Lamarck, Prodrome d'une nouvelle classification des coquilles: Soc. hist. nat. Paris Mém., p. 73 (type by monotypy: *Bulla ficus* Linnaeus).
1810. *Pirula* Montfort, Conchyliologie systématique, vol. 2, p. 486 (type by monotypy: *Murex ficus* Linnaeus).

Type by monotypy: *Ficus communis* "Bolten" Roeding= *Ficus variegata* "Bolten" Roeding=*Bulla ficus* Gmelin=*Murex ficus* Linnaeus. Recent in the East Indies. The only other species cited by Roeding is *Ficus picta,* a nomen nudum.

Shell rather large, thin, almost papyraceus, inflated, fig-shaped, imperforate. Spire low, rounded rather than angulated. Protoconch smooth, obtuse, few whorled. Sculpture of conch spiral or delicately reticulate. Aperture wide, pyriform, terminating anteriorly in a long, open canal; outer lip thin, simple, arcuate; columellar lip sinuous, destitute of plications.

Ficus was initiated in the Cretaceous and culminated in the Tertiary. The representation in the Recent waters is meager and confined to the tropical and subtropical regions, notably the Antilles, the Indian Ocean, and the Philippine Islands. Clench, in No. 2 of Johnsonia, 1942, reported 18 Recent species and subspecies, 3 of them from the western Atlantic. Only *Ficus payratia* is found in coastal waters and is common only along the Florida coast.

Ficus eopapyratia Gardner, n. sp.

Plate LIV, figures 1-3

Shell rather small for the group, very thin, pyriform in outline. Aperture almost as long as the entire shell. Spire very short, broad, obtusely tapering. Whorls of conch a trifle more than 3, rapidly increasing, obscurely tabulated behind, broadly rounded medially, the body smoothly constricted into the somewhat flattened pillar. Sutures inconspicuous and on the later turns intermittently glazed. Protoconch rather large, obtuse, naticoid, smooth and polished, including two volutions; initial turn minute, flattened behind, almost entirely immersed in the succeeding whorl; second whorl increasing rapidly in diameter and altitude. Opening of conch marked by a slight and irregular break and by the appearance of 4 or 5 microscopically fine spirals. Axials appearing within the first quarter turn of the conch uniform in elevation from suture to suture, fine and sharp on the early whorls and numbering 3 or 4 to the centimeter, less narrow, more flattened and less regular in size and spacing on the body but running about 2 to the centimeter in the peripheral region, thickly crowded on the pillar and persistent even across the anterior fasciole. Spiral sculpture, like the axial, sharper on the spire, broader, and more flattened on the body; primaries 2 or 3 on the whorls of the spire and not far from 18 on the body and pillar; secondaries intercalated on the later portion of the spire between each pair of primaries and between the posterior primary and the suture; secondaries and tertiaries regularly developed on the medial portion of the body and the pillar. Anterior fasciole threaded with about a dozen fine wavy lirae tending to alternate in size. Aperture pyriform; interspaces between the spirals and axials rectangular, elongated parallel to the axis on the spire, square or elongated at right angles to the axis on the medial portion of the body. Outer lip very thin and sharp, obscurely shouldered posteriorly, broadly arcuate in front of the shoulder, feebly constricted anteriorly into the pillar. Inner margin of aperture flexuous, convex along the periphery of the body, broadly concave along its base, the slender columella bent slightly backward toward its anterior extremity. Parietal and pillar walls free from glaze or plications. Anterior canal approximately half the length of the aperture, rather broad and somewhat flattened dorsoventrally, feebly recurved; labral margin flaring, the labial expanding slightly toward the truncate anterior extremity.

Dimensions of holotype: Height, 46.5 millimeters; length of aperture, 44 millimeters; maximum diameter, 22.5 millimeters.

695462—47—4

Holotype: U. S. Nat. Mus. No. 114097.

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

The conch of the Chipola species is so close to that of *Ficus papyratia* (Say) of the Recent Floridian fauna that the differences might almost be covered by individual variations. The protoconchs, however, are distinct.

A special study of the protoconch of *Pyrula* has been made by Burnett Smith, *A Contribution to the morphology of Pyrula,* Acad. Nat. Sci. Philadelphia, Proc., pp. 208-219, 1907. He concluded that while the grosser morphological features of the conchs vary little, the protoconchs indicate the degree of development of the genus; and that with the decrease in the number of whorls as the group advances through the Tertiary and into the Recent there is an increase in the size of the initial whorl.

The nucleus of *Ficus papyratia* is more inflated than that of *eopapyratia,* and though the whorls are relatively larger they are fewer by half a turn. There is also a slight tilt to the Recent protoconch that has been acquired since the Chipola. If the number of whorls be an index to the degree of evolution, *Ficus eopapyratia* represents a stage of development equivalent to that of *F. pilsbryi* (Burnett Smith) from the Bowden. However, though the number of whorls is the same in both forms, the nucleus is decidedly lower in the Bowden species than in the Chipola. The surface cancellation is sharper, too, in the Bowden form, and the pillar is less slender.

Occurrence: Chipola formation, localities 2212^{r}, 2213^{p}, ?2564^{r}, 3419^{r}, Aldrich collection, Johns Hopkins University.

Superfamily CYPRAEACEA

Family CYPRAEIDAE

An enormous amount of monographic work was done on the family by F. A. Schilder during the decades of the 1920's and the 1930's. Most of his papers were published in the *Archiv fur Naturgeschichte* (Berlin) and the *Proceedings of the Malacological Society of London.*

Genus CYPRAEA Linnaeus

1758. *Cypraea* Linnaeus, Systema naturae, 10th ed., p. 718.

Type by subsequent designation (Montfort, Conchyliologie systématique, vol. 2, p. 631, 1810): *Cypraea tigris* Linnaeus. Recent in the Indo-Pacific.

Shell solid, ovoid, ventricose. Spire slightly elevated in the young, involved in the adult forms. Surface highly polished, smooth, lirate or tuberculate. Aperture long, narrow, canaliculate at each extremity; both outer and columellar lips crenulated within.

Cypraea-like forms have been detected by Stefani in strata as old as the Jurassic. The Cretaceous and Tertiary representatives are increasingly abundant, while the Recent species, best known as the cowry shells, constitute a conspicuous element in the tropical and subtropical molluscan faunas. They are also a prominent factor in the political economy of many of the uncivilized tribes of the regions in which they are found. Along the west coast of Africa and inland from that Coast, where the cowries are the accepted currency, the rate of exchange for one dollar of American coinage is 2,000 to 6,000 cowries.

Cypraea s.s. has not been recognized in the Alum Bluff group.

Subgenus CYPRAEORBIS Conrad

1865. *Cypraeorbis* Conrad, Am. Jour. Conchology, vol. 1, p. 31.

Type by monotypy: *Cypraeorbis sphaeroides* Conrad. Vicksburg Oligocene of Mississippi.

Medium size turtle-shaped shells flattened on the apertural face, asymmetrically arched dorsally, the posterior inflation greater than the anterior. Surface smooth, enameled. Aperture narrow, the margins subparallel and following the curvature of the body dorsally. Fossula shallow. Dentition rather fine (between 20 and 25 in both the labral and the labial series in the subgenotype), restricted to the apertural margins. Posterior notch U-shaped, with the sides flattened and parallel. Anterior notch narrow, sinistrally inclined, the inner margin pinched, and a sulcus behind it; the base of the outer lip also pinched and flattened.

Cypraeorbis includes a small, compact group of species from the middle Tertiary of the Gulf Province. Many other species ranging in age from the Jurassic to the Recent, through all the warm seas, have been referred to it. It is probable that the majority of these should be excluded, if *Cypraeorbis* is to have any value as a subgenus. For example, *Bernaya* Jousseaume (subgenotype, *Cypraea media* Deshayes from the Eocene of the Paris Basin) is considered synonymous by Morley Davies. The few representatives of the group in our collections differ in the constriction of the inner lip toward the anterior extremity. *Cypraea lurida* Linnaeus, cited as a Recent Mediterranean representative, is a subcylindrical shell that displays an apparent spire.

All three of the Alum Bluff cypraeids, however, have been included under *Cypraeorbis.*

Cypraea (Cypraeorbis) heilprinii Dall

Plate LIV, figures 12, 13

1890. *Cypraea Heilprinii* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 1, p. 166, pl. 11, figs. 2, 2a.

1915. *Cypraea heilprinii* Dall, U. S. Nat. Mus. Bull. 90, p. 85, pl. 3, figs. 2, 14 (in part).

1939. *Cypraea heilprini* Dall. Ingram, Bull. Am. Paleontology, vol. 24, No. 84, p. 3, pl. 1, figs. 1, 2.

Holotype: U. S. Nat. Mus. No. 114103.

Ingram, 1939, called attention to certain inaccuracies in Dall's figures.

By some misfortune, the figured type of this species comes not from Ballast Point, the locality cited by Dall, but from locality 2212, Tenmile Creek, 1 mile west of Baileys Ferry, Chipola River, Fla. There is an error, too, in the dimensions: the length of the type is 29 millimeters, not 26.5 millimeters. It is by no means, however, the largest specimen in the Chipola; one individual attains a length of 45 millimeters. Immature forms, such as the figured type, are more cylindrical than the fully mature forms. The adult outline is asymmetrically ovate, and the maximum diameter falls behind the median horizontal. The posterior extremity of the aperture is inclined toward the left, the posterior notch obliquely U-shaped. The anterior extremity is truncated, the anterior notch asymmetric and inclined to the left. The Ballast Point forms that have been referred to this species are higher relatively and the aperture less strongly flexed at the posterior extremity. *Cypraea chilona,* described from Alum Bluff, is lower relatively and almost as broad as it is long.

Cypraea ballista Dall, 1915, is considered by Mansfield, 1937, to be nothing more than a subspecies of *C. tumulus* Heilprin, 1887 (=*Cypraea pinguis* Dall, 1890). The Ballast Point species is a shorter, higher form than that from Chipola River, and the slope both posterior and anterior is more abrupt. It differs further from *C. heilprinii* Dall in the somewhat finer serration of the apertural margins.

Occurrence: Chipola formation, localities 2212[r], 2213[p].

Cypraea (Cypraeorbis) chilona Dall

Plate LIV, figures 4, 5

1900. *Cypraea chilona* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, pl. 39, figs. 1, 3 (no description).
1939. *Cypraea chilona* Dall, Ingram, Bull. Am. Pal., vol. 24, No. 84, p. 4, pl. 1, figs. 3, 4.

Shell large, heavy, turtle-shaped, the greatest height falling a little behind the median line, so that the posterior slope is a little, but not much, steeper than the anterior. Apertural surface flattened, almost as wide as it is long, asymmetric, the curvature of the left margin much stronger than that of the right, the aperture, however, only a little nearer the right margin than the left. Protoconch concealed. External surface smooth and peculiarly susceptible to decortication. Aperture narrow, sinuous, flexed to the left posteriorly. Armature rather coarse. Serrations on the outer lip 20 to 23, a little shorter and less closely spaced posteriorly. Serrations on the inner lip only about 17, a little heavier and less closely spaced anteriorly. Posterior extremity of the aperture narrowly and deeply emarginate. Anterior portion of the shell drawn out into a very short canal, the margins parallel and proximate. Fossula shallow, obscure. Terminal notch rather narrow, deep, somewhat oblique, widening slightly just within the entrance. Shell thickened somewhat around the notch, thus simulating a feeble flexure of the canal.

Dimensions of lectotype: Length of shell along the axis, 45 millimeters; lateral diameter, 36.5 millimeters; dorsoventral diameter, 25 millimeters. Dimensions of incomplete paratype: Length of shell along the axis, 51 millimeters.

Lectotype: U. S. Nat. Mus. No. 498388.

Paratype: U. S. Nat. Mus. No. 497120.

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

Cypraea chilona Dall, which is common only in the environs of the type locality, is larger, relatively lower and broader than the Chipola River species *C. heilprinii.* Half-grown *C. chilona* were early referred by Dall to *C. willcoxii* Dall, which he had described from White Beach. *C. willcoxii* attains even larger dimensions than *C. chilona,* but it is not nearly so broad relatively and much higher. The serrations on the margins of the aperture are also much coarser.

Occurrence: Chipola formation, localities ?2213[r], 2211[c], ?3704[r].

Cypraea (Cypraeorbis) tapeina Gardner, n. sp.

Plate LIV, figures 7, 8

Shell broad, flattened on the apertural surface, highly inflated on the posterodorsal surface, narrowing both laterally and dorsoventrally toward the anterior extremity; outline as viewed toward the posterior end very high and full but broader than it is high. Surface glaze probably heavy in the fresh specimen. Aperture as long as the shell; narrow, subparallel margins flexed slightly with the dorsal curvature of the body. Inner wall of aperture flattened. Fossula shallow. Labial teeth rather coarse and somewhat irregular, 14 in the holotype, 18 in the paratype, restricted to the margin of the aperture. Teeth along outer lip shorter than those on the inner lip and in the holotype more numerous by 4. Margins of anterior notch sharply pinched, particularly the inner margin, which is set off by the sulcus behind it. Base of outer lip scooped slightly. Terminal notch deep and narrow, with parallel sides.

Dimensions of holotype: Length, 33 millimeters; lateral diameter, 24 millimeters; dorsoventral diameter, 19 millimeters. Dimensions of imperfect paratype: Length, 49 millimeters; lateral diameter, 35.5 millimeters; dorsoventral diameter, 28 millimeters.

Holotype and paratype: U. S. Nat. Mus. No. 497854. Collected by the Florida State Geological Survey and presented to the United States Geological Survey.

Type locality: No. 14436, gully south of the road and east of the bridge over Whites Creek, on road from Eucheeanna to Knox Hill, 6.7 miles south of Argyle, 1.7 miles southeast of Eucheeanna, Walton County, Fla.

Cypraea tapeina is the most highly inflated of any of the three Alum Bluff species. *Cypraea chilona* Dall

from the Chipola approaches most closely to it, but the Chipola species is less evenly inflated and the maximum inflation less posterior.

The species is known only from the type locality and from the type material.

Occurrence: Shoal River formation, locality 14436r.

Genus TRIVIA "Gray" Broderip

1837. *Trivia* "Gray" Broderip, Penny Cyclopoedia, vol. 8, p. 256.

Type by subsequent designation (Gray, Zool. Soc. London Proc., pt. 15, p. 142, 1847): *Cypraea europ[a]ea* Montagu = *Voluta Jonensis* Pennant. Reported off the coast of Europe from Trondhjeim Fjord to the Mediterranean and Aegean Seas; reported also from the Pleistocene of western Europe, from the Pliocene Crag of England, and from the Vienna Basin.

Trivia has been commonly attributed to J. E. Gray, who described it in 1832 in his "Descriptive catalogue of shells." Mr. C. D. Sherborn, of the British Museum, however, unearthed the information that only proof sheets of the "Descriptive Catalogue" were printed in 1832 and that the paper had no standing. Shaw[15] and Iredale[16] have also commented on this fact.

Shell small, ovoid or subspherical. Spire involute. Sculpture vigorous; a medial anteroposterior dorsal depression marking the line of union of the recurved mantle lobes. Transverse sulcations deep, simple or ramose, continuous with the apertural teeth. Aperture narrow, conforming in outline to the shape of the body whorl. Fossula shallow, the dentition continued across it. Columellar lip crenulated. Labrum thickened, inflected, transversely sulcated within, the thickening continued around the extremities of the aperture. Anterior extremity truncate or obscurely emarginate.

The genus is first recognized at the beginning of the Tertiary. The Recent species are, for the most part, confined to the warmer waters.

Sculpture regular, ridges more than 20 in number along the labium of the adult ..... *Trivia chipolana* Maury.
Sculpture irregular, ridges not more than 20 in number along the labium of the adult ..... *Trivia vaughani* Gardner, n. sp.

Trivia chipolana Maury

1910. *Trivia chipolana* Maury, Bull. Am. Paleontology, vol. 4, no. 21, p. 26, pl. 6, fig. 8.

Shell globose, inflated, rather thin, ribs fine, numerous, about twenty-five on the lip, where they form a line of fine but sharply-defined teeth. The ribs extend uninterruptedly over the dorsal area of the shell and occasionally divaricate towards the lateral margins. The shell shows a very faint medial dorsal ridge with barely visible grooves on either side. Length of shell 7.5; greatest width 5; height 5 millimeters.

It is interesting to note that this species from the Florida Oligocene is very like small specimens of *T. Europaea* Montagu, from which it differs only in the faint dorsal groovings which are absent in the Europaean species. *T. Europaea* (*T. sphaericulata* Lam.) is found in the Miocene abroad, being common in the Red Crag. Its present distribution is from the Mediterranean north along the continent to Norway. This species appears to be the nearest ally of the Chipola shell.

Chipola marls, Bailey's Ferry, Fla.

Cornell University collection.—Maury, 1910.

This is apparently a rare species, since only a single individual is present in the National Museum collections. The species attains, however, a length of 10.5 millimeters, a width of 8.0 millimeters, and a height of 7.5 millimeters. The increase in the number of ridges both in the figure of the type and in the Museum specimen seems to be brought about by the intercalation of new ridges rather than by the ramification of the old. The transition from the sculpture on the medial portion of the shell to that of the extremities is unbroken.

Occurrence: Chipola formation, locality 2213r. Cornell University collection.

Trivia vaughani Gardner, n. sp.

Plate LIV, figures 9, 10

Shell small, solid, ovoid, broader behind than in front, highly inflated dorsally, somewhat flattened ventrally though upcurved both at the sides and at the ends. Maximum inflation a little behind the median line, posterior slope consequently steeper than the anterior. Spire involved even in comparatively young forms, its presence occasionally indicated by a slight bulge near the posterior extremity of the aperture. Protoconchal characters not known. Axial furrow rather obscurely defined medially, obsolete at the extremities. Medial portion sculptured with 5 to 8 narrow, flat-topped, well-elevated ridges normal to the axis, continuous across the dorsal furrow, or interlocking along it. Ridges on the posterior and anterior slopes gradually converging till they are almost parallel to the axis; number of ridges increased toward the margins by intercalation but not by the ramification of the original lirae; intercalaries irregular in number and arrangement but so introduced that the interspaces are about double the width of the ridges over both the dorsal and the ventral portions of the shell; ridges continuous from the dorsal to the basal surface without change in elevation. Entire surface microscopically granulated, the granules very sparse over the greater part of the disk but crowded along the dorsal surface of the thickened labrum and around the extremities of the aperture, particularly the posterior extremity. Aperture but little more than linear, feebly arcuate, curved more sharply behind than in front; margins parallel. Outer lip thickened, its dorsal margin clearly but not conspicuously defined. Inner margin of labrum sharply rounded and serrated with

[15] Shaw, H. O. N., Notes on the genera *Cypraea* and *Trivia:* Malacol. Soc. London Proc., vol. 8, p. 289, 1909.

[16] Iredale, Tom, On some new and old molluscan generic names: Malac. Soc. London Proc., vol. 12, pp. 34–35.

about 20 ridges, which continue unchanged across the labrum but disappear just within the aperture; ridges on the inner lip only 12 to 15 in number but more persistent. Extremities of aperture emarginate, the posterior notch narrow and oblique, the anterior broader and symmetrical with respect to the axis.

Dimensions of holotype: Length along the axis, 8.0 millimeters; lateral diameter, 6.5 millimeters; dorsoventral diameter, 5.5 millimeters.

Holotype: U. S. Nat. Mus. No. 371861.

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

Trivia vaughani is a heavier, more coarsely and less regularly sculptured species than *T. chipolana* Maury from the Chipola River. It is apparently a forerunner of the group represented in the Recent Florida seas by *T. globosa* Gray and *T. candidula* Gaskoin.

Occurrence: Shoal River formation, localities 3856^{r}, 3742^{p}, Aldrich collection, Johns Hopkins University.

Genus ERATO Risso

1826. *Erato* Risso, Histoire naturelle de l'Europe méridionale, vol. 4, p. 240.

Type by monotypy: *Erato cypraeola* Risso=*Voluta laevis* Donovan (in part). Miocene and Pliocene of Italy.

The name of *Erato,* one of the Muses, was given to this genus, perhaps, because of its close relationship with *Cypraea,* which is derived from Cypris, one of the many names of Venus.

Shell smooth, polished, subpyriform or obovate. Spire short but distinct; conical. Apex submamillate. Final whorl large, inflated. Aperture linear or sublinear. Columellar lip feebly denticulate anteriorly. Outer lip thickened in the adult, inflected and crenulated within. Basal notch rather shallow.

The genus was initiated, apparently, in the Cretaceous and has been represented, though rather meagerly, in all the subsequent formations. The Recent species, some 15 in number, are, for the most part, inhabitants of the tropical and subtropical seas.

Subgenus HESPERERATO Schilder

1932. *Hespererato* Schilder, Fossilium Catalogus, pt. 55, p. 83.

Type by original designation: *Erato vitellina* Hinds. Recent on the California coast from the Farallone Islands to San Diego.

The subgenus is characterized by the absence of a distinct fossula, the name given to the hollow depression near the anterior end of the inner lip and parallel to the columella. One or more terminal ridges border the anterior canal.

The subgenus is best developed in the Tertiary of the southern United States and the mid-Americas and in the Recent faunas of North America and northern South America.

Erato (Hespererato) chipolana Maury

1910. *Erato chipolana* Maury, Bull. Am. Paleontology, vol. 4, no. 21, p. 27, pl. 6, fig. 9.

Shell small, pear-shaped, highly polished; aperture very narrow; outer lip finely crenulate within; columella with a slight fold at the base in adult shells.

Length of shell 4; of aperture 3.5; greatest width 3 mm.

Chipola Oligocene, Baileys Ferry, Florida.

Cornell University collection.—Maury, 1910.

Shell small, rather heavy, ovate-conic. Spire short, broad, obtusely tapering. Body obtusely angulated at the periphery, somewhat obliquely constricted in front of the periphery, inclined to flare slightly at the anterior extremity. Conch and protoconch each including 2½ volutions, the suture glazed, however, so that in unmutilated specimens it is entirely obscured. Protoconch revealed only by removing the surface enamel; smooth and very highly polished, somewhat naticoid; initial turn minute, inflated, partially immersed; remaining turn and a half increasing more rapidly in altitude than in diameter, flattening toward the close of the nucleus. Opening of conch marked by an abrupt change from the vitreous to the procellanous texture. Surface smooth except for microscopically fine, irregular, blistered lines radiating from the apex to a little in front of the shoulder. Aperture sublinear, oblique. Outer lip sharply angulated at the shoulder, feebly contracted medially, much thickened and serrated along the inner margin by about 15 short, lirate ridges, longest medially and very short and heavy anteriorly, the foremost outlining the entrance to the incipient canal. Inner wall of aperture flattened; a series of irregular denticles developed along the inner margin of the aperture, the three in front produced into oblique and somewhat irregular ridges that simulate columellar folds. Fossula obsolete. Body constricted anteriorly into an ill-defined canal, squarely truncate or obscurely emarginate at its extremity.

Erato chipolana Maury is not so broad nor so globose as *Erato maugeriae* Gray and has a higher, less obtusely tapering spire. The ornamentation on the spire recalls the radial sculpture of some of the *Corbula,* such as *C. barratiana.* The character of the sculpture suggests a pathologic condition possibly induced by a parasite, but if this is true the parasite was coextensive with the host.

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

Superfamily NATICACEA

Family NATICIDAE

Represented in the Alum Bluff group are 3 subfamilies, 13 genera, subgenera, and sections, and 21 species and subspecies of the family Naticidae.

The Shoal River fauna is notable for the abundance of individuals. Ten species have been reported, 50 per-

cent of them peculiar. *Natica (Tectonatica) mino* is the only restricted form that is prolific. The other two most abundant species are *Polinices judsoni* Maury, present also in the Oak Grove, and *Natica (Tectonatica) semen,* occurring in both the Oak Grove and the Chipola. *Natica (Stigmaulax) guppiana* and *Polinices robustus* are both restricted to the Shoal River, but the subspecies *N. guppiana toulana* is rare, and *Polinices robustus* is known only from the unique type.

The Chipola fauna includes 9 members of the group, 5 of them restricted. Only *N. platabasis* is prolific but *N. alticallosa* is fairly common at certain localities. The other two restricted forms—*Pachycrommium burnsii* and *P. dodonum*—are rare at the few localities from which they have been reported.

The Oak Grove naticoid fauna is relatively meager; it includes 6 species and only one—*Pachycrommium dodonum*—is peculiar. The most conspicuous forms are *Polinices (Neverita) eucallosus,* n. sp., which is also rather common in the Shoal River fauna, and *Natica (Tectonatica) semen,* which is fairly well represented in both the Chipola and the Shoal River faunas. *Polinices judsoni* Maury, prolific in the Shoal River formation, is abundant at one locality in the Oak Grove sand and is present at three others. *N. precursor* and *P. chipolanus,* both characteristic Chipola forms, occur in the Oak Grove sand but are not abundant. The evidence, so far as it goes, indicates rather local faunas, the Chipola and Shoal River faunas well characterized and the Oak Grove a composite, possibly more closely allied to the Shoal River than to the Chipola.

The group has an unusually wide latitudinal and bathymetric range, and it is unsafe to draw any deductions from the occurrence of genera alone.

Natica (Naticarius) canrena, the possible descendant of *N. precursor,* n. sp., and *Natica (Stigmaulax) sulcata* (Born), in the line of descent from *N. guppiana,* are characteristic species of the Recent shallow-water tropical faunas of the West Indies.

Genus NATICA (Adanson) Scopoli

1777. *Natica* (Adanson) Scopoli, Introductio ad historiam naturalem, p. 392.

Type by subsequent designation (Anton, Verzeichniss der Conchylien, p. 31, 1839): *Nerita Vitellus* Linnaeus. Recent in the west Pacific.

Shell porcellaneous, solid, ovate or globular, generally umbilicate, the umbilicus commonly furnished with internal ridges and in one subgenus plugged with callus. Surface of the majority of forms smooth and polished. Aperture holostomous, semicircular or ovate. Outer lip sharp, smooth within. Columellar lip subvertical, calloused, nonplicate. Parietal wash heavy. Operculum calcareous.

The genus has been prominent since the mid-Mesozoic and is abundantly represented in the temperate and tropical seas of today.

The Naticas and the closely related Polinices show an unusual sex variation owing to the size of the egg sac. In consequence, the whorls of the shell of the female are more inflated in front of the suture and the general outline more turreted. The subgeneric determination of the fossil species is far from satisfactory.

Surface sculptured with oblique sulci radiating from the posterior suture:

- Umbilical rib not depressed anteriorly ..... *Natica (Naticarius) precursor* Gardner, n. sp.
- Umbilical rib depressed anteriorly:
  - Sulci persistent across the whorl ..... *Natica (Stigmaulax) guppiana Toula.*
  - Sulci evanescent on the medial portion of the whorl ..... *Natica (Stigmaulax) guppiana toulana* Gardner, n. subsp.

Sculpture feeble or altogether absent:

- Umbilicus only partially closed by a funicular rib:
  - Shoulder of body whorl not obliquely sulcated ..... *Natica (Natica) alticallosa* Dall.
  - Shoulder of body whorl obliquely sulcated ..... *Natica (Tectonica) mino* Gardner, n. sp.
- Umbilicus almost or entirely filled with callus:
  - Height of adult shell exceeding 5 millimeters:
    - Body whorl smoothly rounded ..... *Natica (Natica) alticallosa* Dall.
    - Body whorl obtusely angulated at the periphery ..... *Natica (Tectonatica?) platabasis* Gardner, n. sp.
  - Height of adult shall not exceeding 5 millimeters; body whorl smoothly rounded ..... *Natica (Tectonatica) semen* Gardner, n. sp.

Subgenus NATICA sensu stricto

The subgenus, as restricted by Dall, is characterized by a multisulcate operculum.

Natica (Natica) alticallosa Dall

Plate LIX, figure 3; plate LXII, figure 10

1892. *Natica alticallosa* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 365, pl. 22, fig. 28.

Shell of four well-rounded whorls, with the suture well-marked and the surface smooth except for lines of growth which are sometimes slightly elevated near the suture; male with the suture less impressed and the spire more evenly sloping than in the other sex; spire slightly less elevated than in *N. permunda;* aperture with a thick body callus continuous with the umbilical callus; the latter in *N. permunda* is coiled on the middle of the umbilical wall, with a space between it and the antecedent whorl; in *N. alticallosa* the callus fills the upper two-thirds of the umbilicus completely, and sometimes nearly reaches the umbilical carina, which last is less sharply defined than in *N. permunda,* and consequently the aperture at the base of the pillar is somewhat less angular and effuse than in that species. Altitude of shell 18; maximum diameter 18 millimeters.

The subsutural callus in this species is generally separated from the outer lip at the body by an obscure groove, and the callus here projects forward on the body beyond the lip. The operculum is unknown.—Dall, 1892.

Holotype: U. S. Nat. Mus. No. 112841.

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

The original figure of *Natica alticallosa* creates a false impression of the umbilical characters, and therefore a corrected figure has been inserted. As Woodring,[17] remarked in 1928, the shell "has a thick pad of callus filling the umbilicus." In the juveniles the pad occupies a smaller area relatively, but the first drawing corresponds in outline and dimensions to the adult among the specimens indicated in Dall's handwriting as the types.

The species apparently varies to an unusual degree in the elevation and contour of the spire and in the relative size of the umbilicus and the umblical rib. The forms which have been doubtfully referred to it are all immature.

Occurrence: Chipola formation, localities 2212^{c}, 2213^{r}, ?2564^{p}, ?3419^{p}, 2211^{p}.

Subgenus NATICARIUS Duméril

1806. *Naticarius* Duméril, Zoologie Analytique, p. 164.
1928. *Naticarius* Duméril, Woodring, Carnegie Inst. Washington Pub. 385, p. 378.

Type by monotypy: *Nerita canrena* Linnaeus. Recent in the West Indies.

The subgenus includes rather large, inflated, low-spired shells. The aperture is semielliptical, the umbilicus rather wide and partially filled by a heavy funicular rib, which, however, is free from the umbilical wall except along the apertural face. The sculpture is highly characteristic, a retractive wrinkling of the shell directly in front of the posterior suture.

Natica (Naticarius) precursor Gardner, n. sp.

Plate LIX, figures 1, 2, 6

1892. *Natica canrena* var. *plicatella* Conrad. Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 364 (in part).
Not *N. plicatella* Conrad, 1863.

Conrad proposed for the Miocene fossil the name of *N. plicatella,* which may be used in a varietal sense to cover the older Miocene forms, in which, though the shells are absolutely identical, the operculum differs slightly from that of the newer Miocene, Pliocene, and Recent shells. The latter has about ten channeled, deep grooves, separating as many flattened, subequal ribs, which become narrower and more keeled toward the outer margin of the operculum. The central portion of the latter has an irregular, little-elevated callous area. In the operculum of the variety *plicatella,* as here restricted, the central callus is more elevated, with its margin limited by a conspicuous groove, while another similar groove separate the outermost rib from those inside from it. This character may not be constant, but until this is shown it would seem advisable to retain the varietal name, notwithstanding the shells offer no differential characters. We have a somewhat similar case in the recent *Fasciolaria princeps* of California and *F. gigantea* Kiener of Florida. The shells cannot be differentiated, but the opercula are markedly unlike.—Dall, 1892.

Dimensions of holotype: Height, 11.5 millimeters; maximum diameter, 10 millimeters.

Figured holotype: U. S. Nat. Mus. No. 329061.

Operculum figured: U. S. Nat. Mus. No. 329062. From locality 3419, McClelland farm, 1 mile below Baileys Ferry, Calhoun County, Fla.

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

Conrad's species was founded on the shells figured by Emmons and Tuomey and Holmes under the name *N. canrena* Lamarck. The form developed in the Miocene of the Carolinas is identical with the Recent *N. canrena* both in the characters of the shell and of the operculum, and for that reason Conrad's *N. plicatella* must be considered as the exact synonym of *N. canrena.*

Natica precursor is consistently smaller than *N. canrena* and differs in the character of the operculum. In individuals of the same size there are 4 component volutions in *N. precursor* and only 3¼ in *N. canrena.* The nucleus is more depressed in the former, and the umbilical rib more widely separated anteriorly from the umbilical wall. These constant disparities in the shells of *N. precursor* and *N. canrena* together with the unlike opercula seem to warrant the specific separation of the two forms, although there is no doubt of their intimate genetic relationship.

Occurrence: Chipola formation, localities 10609^{r}, 2212^{c}, 7257^{r}, 2213^{a}, 2564^{a}, 3419^{p}, 7151^{r}; Oak Grove sand, locality 2646^{c}, 9961^{r}; Shoal River formation, localities 3856^{r}, 3742^{r}, 5079^{r}, 3733^{r}, 5618^{r}.

[17] Woodring, W. P., Miocene mollusks from Bowden, Jamaica, pt. 2: Carnegie Inst. Wash. Pub. 385, p. 378.

The group of *Natica canrena* is widespread in the middle and upper Miocene and Pliocene of the southern United States and the mid-Americas. It is recorded in the Duplin marl and the Waccamaw formation of both North and South Carolina; in the *Cancellaria* zone of the Choctawhatchee formation and in the Caloosahatchee marl of Florida; in the Miocene beds of Zululum, Mexico, (Engerrand and Urbina, 1910) and of Tehuantepec, Mexico (Böse, 1906 and 1910); in the Gatun formation of Costa Rica (Olsson, 1922) and of the Canal Zone (Brown and Pilsbry, 1912, and Olsson, 1922); in the Cercado and Gurabo formations of the Dominican Republic (Maury, 1917, and Pilsbry, 1922); in Trinidad (Maury, 1925, and Mansfield, 1925); in the Bowden beds of Jamaica (Woodring, 1928); and in recent deposits from North Carolina to the West Indies and the Gulf of Mexico.

Subgenus STIGMAULAX Mörch

1852. *Stigmaulax* Mörch, Catalogus conchyliorum quae reliquit D. Alphonso d'Aguirra et Gadea, Comes de Yoldi, fasc. 1, p. 133.

Type by subsequent designation (Harris, Catalogue of Tertiary Mollusca, British Museum, pt. 1, Australasian, p. 262, 1897): *Natica [Nerita] sulcata* Born. Recent in the West Indies.

The diagnostic features of the subgenus are the high inflation of the whorls; the retractive axial trenching; the wide umbilicus, the anterior portion occupied by a funicular rib separated by a groove from the umbilical wall; and the wide rough and heavy central rib of the semicordate operculum.

The group seems to be peculiarly characteristic of the West Indian Cenozoic faunas.

Natica (Stigmaulax) guppiana Toula

Plate LIX, figure 9

1909. *Natica guppiana* Toula, K.-k geol. Reichsanstalt Jahrb., Band 58, Heft 4, p. 696 [24], pl. 25 (I), fig. 6.
1910. *Natica guppiana* Toula?. Engerrand and Urbina, Bol. Soc. Geol., vol. 6, pt. 2, p. 130, pl. 60, figs. 53, 54, 55.
1911. *Natica guppyana* Toula. Brown and Pilsbry, Acad. Nat. Sci. Philadelphia Proc., p. 360.
1917. *Natica (Stigmaulax) sulcata* Born? Maury, Bull. Am. Paleontology, vol. 5, No. 29, p. 135 (part).
1922. *Natica guppyana* Toula. Olsson, Bull. Am. Paleontology, vol. 9, No. 39, p. 156, pl. 13, figs. 13, 14, 15.
1934. *Natica sulcata guppyana* Toula. Rutsch, Schweizer. paleont. Gesell. Abh., vol. 54, pp. 51, 52.

Shell of moderate size and weight, conspicuously inflated, of a little more than 5 volutions, including the small and ill-differentiated nuclear turns. Whorls of spire evenly convex, increasing in size with moderate rapidity. Body whorl strongly and evenly rounded from the suture to the umbilicus. Surface sculptured with prominent subequal and subequispaced, rounded, retractive sulci, 30 to 40 in number on the body, persistent from suture to suture on the spire, most prominent on the shoulder and tending to evanesce on the final half turn. Suture lines distinct, even a little channeled. Aperture holostomous, semielliptical. Outer lip strongly arcuate, slightly patulous in front. Inner lip feebly oblique. Parietal wall heavily callused from the posterior commissure almost to the umbilicus. Umbilicus open posteriorly, closed anteriorly by a semifunicular rib, which is cut off from the umbilical wall by a narrow sulcus. Rib irregularly depressed or dimpled in front. Anterior portion of umbilical wall and base of columella reinforced. Operculum not known.

Dimensions of specimen figured by Toula (fide Toula): Height, 18 millimeters; diameter, 18 millimeters.

Type: Depository not known.

Type locality: Cut at Gatun Locks, Panama Canal.

The Engerrand and Urbina figures indicate a shell similar in outline and general sculpture pattern to that figured by Toula, but the axial groovings seem stronger and more persistent on the Zululum specimen. It is possible that this difference may be due to immaturity.

Olsson, 1922, observed that *N. guppyana* was confined to the mainland of southern Mexico, Costa Rica, and the Canal Zone. He included under *N. sulcata* the Dominican, Jamaican and Venezuelan races. The Jamaican species is the *N. vererugosum* of Cossmann, 1924, the Dominican form, the *N. sulcata gurabensis* Rutsch, 1934, and the Venezuelan race, the *N. sulcata beaumonti,* also of Rutsch, 1934. The Rutsch separations were made on the character of the axial sculpture, the presence or absence of spiral sculpture and the character of the operculum. Specimens from the Dominican Republic are, however, similar in sculpture pattern to topotypes of *N. guppiana.* Both the Gatun and Dominican forms are larger than those from Shoal River, the groove behind the funicular rib seems broader, and the dimple on the apertural face of the rib less pronounced. These differences do not, however, seem sufficiently great to demand recognition in the taxonomy. The illustrations of the Venezuelan subspecies reveal no characters by which they may be separated from *N. guppiana.* The Bowden species, *N. vererugosum* Cossmann, exhibits a slightly lower spire than that of *N. guppiana,* the axial grooves are deeper and more numerous, and there is a more or less obvious spiral sculpture.

The presence of *Natica guppiana* in the Shoal River is another link between that fauna and the Gatun. *Natica guppiana* like *Natica canrena* represents a group widely distributed in the mid-Americas in the middle Miocene and persistent within that area to the present time.

Occurrence: Shoal River formation, localities 3856^{r}, 3742^{c}, 5080^{r}, 5184^{r}, 3748^{r}.

Natica (Stigmaulax) guppiana toulana Gardner, n. subsp.

Plate LIX, figures 7, 8

Shell rather heavy. Whorls 4 or 5, increasing rapidly in size; those of the low spire broadly rounded, the body whorl obscurely flattened in front of the suture line, the maximum diameter falling in front of the median horizontal. Surface sculptured with 30 to 35 retractive sulci radiating from the suture, subequal in size and spacing, persistent with diminished strength to the anterior suture on the spire and on the body almost but not quite to the periphery. Spiral sculpture not developed. Suture lines distinct, even a little channeled. Aperture semielliptical. Outer lip thin, sharp, and somewhat asymmetrically arcuate, patulous anteriorly, separated posteriorly from the parietal callus by a shallow groove. Columellar margin slightly oblique, thickened. Body wash heavy from the posterior commissure almost to the umbilicus. Umbilicus semilunate, open behind, closed in front by a heavy, funicular rib which is cut off anteriorly from the body wall by a narrow sulcus and is irregularly depressed on the anterior portion of its apertural face. Umbilical wall reinforced. Operculum unknown.

Dimensions of holotype: Height, 20 millimeters; maximum diameter, 20 millimeters.

Holotype: U. S. Nat. Mus. No. 351564.

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

N. guppiana toulana is represented by two individuals only. Though obviously of near kin to the true *N. guppiana,* they differ in the evanescence of the radial sculpture on the medial portion of the body, the slightly lower spire, and the less strongly and evenly inflated whorls. *N. precursor* is smaller and the axial sculci less numerous, more feeble and less persistent.

Occurrence: Shoal River formation, locality 3742r.

Subgenus TECTONATICA Sacco

1890. *Tectonatica* Sacco, I molluschi dei terreni terziarii del Piemonte e della Liguria, Boll. mus. zool. ed. Anat. comp., vol. 5, no. 86, p. 33.

1892. *Cryptonatica* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 362.

Type by subsequent designation (Cossmann, Essais de paléoconchologie comparée, vol. 13, p. 119, 1924): *Natica tectula* Bonelli, Miocene and Pliocene of northern Italy.

The subgenus is characterized by its small size, moderately heavy parietal wash, an umbilicus almost or completely closed by a callus pad, and the smooth calcareous operculum.

The majority of the Recent species referred to *Tectonatica* inhabit the cooler waters, but the subgenotype is a Mediterranean species.

Natica (Tectonatica) mino Gardner, n. sp.

Plate LIX, figures 10, 11

Shell small, obliquely ovate, moderately heavy, of approximately four complete volutions. Conch and protoconch not well differentiated. Initial half turn depressed and largely immersed, the succeeding whorls of the spire well-rounded at the shoulder and increasing in size with moderate rapidity. Shoulder of body obliquely flattened near the aperture. Base strongly and evenly rounded. Surface smooth and polished except for rather faint sulcations radiating across the shoulder from the posterior suture of the later whorls and fading away toward the periphery into normal incremental sculpture. Aperture holostomous, a little more than two-thirds the altitude of the entire shell; inner margin dividing the ellipse of the shell into two subequal parts, the apertural part, a little the smaller of the two; outer lip slightly patulous, thin, sharp, and strongly arcuate, separated posteriorly from the parietal callus by a shallow groove. Inner lip slightly oblique, reinforced anteriorly. Body wall heavily calloused. Outer margin of the wash subparallel to the labium as far as the umbilicus; deposit heaviest at the posterior commissure and the umbilicus. Umbilicus small, filled for the most part with a semifunicular rib separated from the umbilical wall by a chink that increases in width and depth posteriorly and from the parietal wash by a broad but shallow sulcus. Operculum not known.

Dimensions of holotype: Height, 6.4 millimeters; maximum diameter, 6 millimeters.

Holotype: U. S. Nat. Mus. No. 351571.

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

Natica mino suggests *N. pusilla* Say in size, but the umbilicus of the latter is almost completely closed and the external surface of the shell devoid of sculpture.

The incomplete closure of the umbilicus challenges the propriety of referring *N. mino* to the subgenus *Tectonatica,* but even in *N. pusilla* the funicle does not occupy the entire umbilical cavity, and in this character the two species differ in degree rather than kind.

Occurrence: Shoal River formation, localities 3856a, 3742r, 5079r, 5618r, 9959p.

Natica (Tectonatica) semen Gardner, n. sp.

Plate LIX, figures 17-19

Shell very small, polished, subglobose to stout conical. Whorls approximately 5, the protoconch small, highly polished, much depressed, the two component volutions lying in nearly the same plane. Volutions of conch moderately elevated and increasing rather rapidly in size. Body whorl broadly rounded, the maximum diameter falling in front of the median horizontal. Surface smooth except for rather faint incremental

striae. Suture lines closely appressed, not very distinct. Aperture auriculate, broadening anteriorly. Outer lip thin, sharp, arcuate. Columella slightly oblique. Parietal wall heavily washed, the callus separated from the lip by a shallow, ill-defined groove. Umbilicus small, for the most part filled with a semilunar rib of callus which fits closely into the umbilical pit, leaving only a narrow but occasionally deep depression on the convex margin. Umbilical keel evenly rounded, reinforced near its anterior extremity. Operculum small, flat, auriculate, the external surface somewhat thickened along the columellar margin and further strengthened by a deposit of calcite on the anterior portion of the exterior surface near the columella; inner surface of operculum not known.

Dimensions of holotype: Height, 2.6 millimeters; maximum diameter, 2.4 millimeters.

Holotype: U. S. Nat. Mus. No. 371876.

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

A larger, less perfect individual measures 4.6 millimeters in height and 4.1 millimeters in maximum diameter.

Natica semen is one of the most widely distributed of the naticoids in the Alum Bluff fauna. There is no form with which it may be confused. Most of the young of the associated species are stouter with relatively lower spires and have a more or less open umbilicus. The young of *N. platabasis* are relatively stouter, with lower spires, less numerous whorls, and either smaller umbilical chinks or none at all. *Natica semilineata* Lea from the Eocene is a much larger shell and the young are relatively stouter than the adult *N. semen* and the whorls of the spire more rounded and more elevated.

Though the species is common at a number of localities, the holotype is the only individual retaining the operculum.

Occurrence: Chipola formation, localities 10609^{p}, 2212^{a}, 7257^{r}, 2213^{c}, 2564^{p}, 3419^{p}, 2211^{c}, 7183^{r}; Oak Grove sand, localities 2646^{pr}, 5632^{a}, 5631^{p}, 5630^{r}, 5633^{r}, 7054^{a}; Shoal River formation, localities 3856^{r}, 3732^{r}, 5079^{c}, 10661^{p}, 3748^{pr}, 9958^{p}, 7261^{r}, 7264^{c}, 9960^{p}, 5618^{r}, 9959^{p}.

Natica (Tectonatica?) platabasis Gardner, n. sp.

Plate LIX, figures 23, 24

1892. *Natica (Cryptonatica) floridana* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 366 (in part).

1915. *Natica (Cryptonatica) floridana* Dall, U. S. Nat. Mus. Bull. 90, p. 106 (part).

Shell large for the subgenus, rather heavy, subconical. Whorls approximately 4 in number, 3¾ in the holotype. Protoconch of 1½ turns, smooth, highly polished, and immersed except for the flattened posterior surface. Initiation of conch marked by the more porcellanous texture and the development of incremental striations. Whorls of conch increasing rapidly in size, somewhat obliquely coiled so that toward the aperture a progressively larger part of the whorl is exposed; whorls obliquely flattened in front of the posterior suture; the body obtusely carinated at the periphery. Base more or less flattened between the peripheral and umbilical keels. Surface incrementally striated. Aperture auriculate, broader anteriorly. Outer lip asymmetrically rounded, expanding in front. Columellar margin slightly oblique. Parietal wash very heavy, cut off from the labrum by a shallow sulcus, thickening toward the umbilicus, which, in the adult, it nearly or entirely fills, leaving at most only a narrow chink along the anterior surface. Umbilical keel obtuse, concealed in its posterior extent by the callus; a sickle-shaped area exposed in front, the broader surface at the apertural face.

Dimensions of holotype: Height, 12.5 millimeters; maximum diameter, 11.5 millimeters.

Holotype: U. S. Nat. Mus. No. 371875.

Type locality: No. 2564, McClelland farm, 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.

Natica platabasis was included by Dall under *N. floridana* Dall. The type of his species came from the Ballast Point silex beds and is a smaller, more globose form, with little or no trace of either a basal or an umbilical carina. The very young of the Chipola species are equally rounded, but they have a flattened spire. The suture line at the aperture of *N. platabasis* drops forward a little more than it does in *N. floridana,* but the spire is distinctly higher in the adult of the latter than in the young of the former. Dall noted the wide difference in outline in his *floridana* and considered it as a sexual variation, but in several hundred individuals examined from the Chipola all of the adults are more or less obtusely angulated at the periphery and flattened on the base, while none of the forms examined from Ballast Point show any trace of the development of either a peripheral or umbilical angulation.

The species is common in the Chipola formation in the vicinity of Baileys Ferry and far from rare in the lower bed at Alum Bluff. It has not been collected at the higher horizons.

The dimensions of *N. platabasis* exceed those of typical *Tectonatica.*

Occurrence: Chipola formation, localities 10609^{r}, 2212^{c}, 2213^{c}, 2564^{c}, 3419^{c}, 2211^{c}, 7183^{c}.

Genus POLINICES Montfort

1810. *Polinices* Denys de Montfort, Conchyliologie systématique, vol. 2, p. 222.

Type by original designation: *Polinices albus* Montfort = *Natica mammillaris* Lamarck = *Natica brunnea* Link. Recent in the West Indies.

Woodring[18] has clarified the obscurity in the type designation as follows:

Montfort cites 'nerita mamilla Linn.' in the synonymy of *Polinices albus*, but his figure, which represents the type of the genus, shows the West Indian shell generally known as *Natica mammillaris* Lamarck, for which the earliest name seems to be *Natica brunnea* Link. In the oriental *"Nerita" mammilla* Linné the umbilicus is filled with callus.

The shell characters of *Polinices* are similar to those of *Natica;* however, the operculum of *Polinices* is corneous, and that of *Natica* is calcareous.

The shell is of medium size, ovate, including a few closely wound whorls appressed at the suture. The aperture is semiovate, the parietal callus heavy and indented near the upper margin of the umbilicus.

The genus, though of later origin than *Natica,* is more abundantly represented in the middle and late Tertiary beds and in the east coast waters of today and constitutes, indeed, one of the more conspicuous elements of the univalve faunas of eastern North America.

Polinices judsoni (Maury)

Plate LIX, figures 15, 16

1910. *Natica Judsoni* Maury, Bull. Am. Paleontology, vol. 4, No. 21, p. 29, pl. 7, fig. 6.

Shell smooth and polished, small, with four sloping whorls; suture distinct; lines of growth conspicuous but not forming wrinkles; callus heavy especially on the body, but not extending over the profound sink. Length of shell 18; greatest width 13 millimeters.

Named in honor of Dr. Judson, of Dobbs Ferry, New York.

Oak Grove, Santa Rosa County, Florida.

Mr. Aldrich's collection.—Maury, 1910.

Shell highly polished, rather small and slender for the genus, ovoid. Aperture approximately two-thirds the total altitude of the shell. Protoconch small, obtuse, the 2½ component volutions feebly inflated, symmetrically coiled, and nearly uniform in diameter. Whorls of conch 3 to 4, closely appressed, somewhat obliquely coiled; the later turns bulging a little behind the suture. Body whorl obscurely flattened in front of the suture, broadly rounded at the periphery. Surface smooth and lustrous, brownish in color, with occasional streaks of yellowish tan that may indicate the original color pattern. Whorls closely appressed, the suture line distinct, dropping forward a little near the aperture. Aperture rather narrow for the genus, auriculate. Outer lip thin, sharp, the maximum expansion only a little below the median horizontal; separated posteriorly from the parietal callus by an ill-defined sulcus. Inner lip approximately vertical except for a slight bulge at the umbilical margin, reinforced in all but the extreme anterior portion. Enamel thickly deposited on the body wall at the posterior commissure, continued forward and partially roofing the umbilical cavity. Incipient umbilical rib present but rarely developed. Umbilical carina obtuse, elongated, margining a funicular cavity which is striate within.

Dimensions of figured specimen: Height, 18.3 millimeters; maximum diameter, 13.5 millimeters.

Figured specimen: U. S. Nat. Mus. No. 351575.

Locality of figured specimen No. 3856, 6 miles west-northwest of Mossyhead, Walton County, Fla.

The young are relatively not so high and much stouter than the adults and the umbilical pit is a mere chink.

About a dozen rather battered individuals collected at the old millrace at Sommerville, 1 mile east of Argyle Station, Walton County, are tentatively referred to *P. judsoni,* although the differences may prove to be of at least subspecific value. They are decidedly stouter than the type abundant at Shell Bluff, and the umbilical rib is thickened at the margin of the aperture so that it half fills the umbilical cavity.

Polinices judsoni represents still another group of naticoids widespread in the Tertiary of the mid-Americas and existent to the present day. The Gatun species, *Polinices canalizonalis* (Brown and Pilsbry, 1913) is more inflated, with a much wider umbilicus limited by a less obscure umbilical keel and a shallow but well defined sulcus cutting across the anterior part of the parietal callus. *Polinices stanislas-meunieri* Maury from the Cercado formation of the Dominican Republic and *Polinices (Dallitesta) coensis* (Dall) from the *Cancellaria* zone of the Choctawhatchee formation of Florida are also more inflated than *P. judsoni* and faintly sculptured spirally. *Polinices subclausa* (Sowerby), considered by Woodring as no more than a subspecies of the Recent *P. brunnea* Link, is larger than *P. judsoni,* more widely umbilicate, and the aperture is slightly wider and more oblique. The Sowerby species occurs both in the Cercado and Gurabo formations of the Dominican Republic, but more commonly in the Cercado; it occurs also in the Gatun formation of the Canal Zone and of Costa Rica, the Bowden beds of Jamaica and, according to Brown and Pilsbry, 1917, in the Miocene of Colombia. The Recent species *P. brunnea,* probably in the line of descent from the *P. judsoni* stock and ranging along both the east and west coasts of Florida, in the Gulf of Mexico, and in the West Indies, is relatively large and widely umbilicate. The dimple or groove which separates the parietal callus from the callus that roofs the anterior portion of the umbilical opening seems to be characteristic of the group.

The species is by far the most prolific in the Shoal River sands.

Occurrence: Oak Grove sand, localities 2646^{a}, 5632^{p}, 5630^{r}, 7054^{r}, 2652^{r}, 7055^{r}, 10659^{p}, Cornell University collection; Shoal River formation, localities 3856^{pr}, 3732^{p}, 3742^{pr}, 3731^{p}, 10658^{p}, 5184^{c}, 5195^{r}, ?5079^{r}, ?2238^{r}, ?3748^{r}, 7264^{r}, 5618^{r}, 9959^{p}.

[18] Woodring, W. P. Miocene Mollusks from Bowden, Jamaica: Carnegie Inst. Washington Pub. 385, p. 385.

Polinices? demicryptus Gardner, n. sp.

Plate LIX, figures 20, 21

1892. *Polinices (Lunatia) hemicryptus* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 371 (in part).

Not *Natica hemicrypta* Gabb, 1860.
Not *Natica hemicrypta* Conrad, 1868.

Shell small, highly polished, rather slender for the genus. Whorls 4½ including the turn and a half of the protoconch, which is vitreous, small and flattened, the initial half turn almost entirely immersed. Whorls of conch increasing rapidly in size, wound somewhat obliquely so that the position of the suture line becomes more and more anterior toward the aperture. Body whorl somewhat obliquely flattened in front of the suture, smoothly rounded medially. Surface smooth except for incremental striae, which are most obvious posteriorly. Whorls closely appressed but the sutures distinct. Aperture semielliptical, slightly patulous anteriorly. Outer lip arcuate, somewhat flattened posteriorly and more strongly rounded anteriorly. Columellar margin oblique. Parietal wash heavily deposited from the labrum to the umbilical area, the callus partially cut off from the margin of the labrum by a surficial sulcus. Umbilicus roughly crescentic, overhung posteriorly by the parietal wash. Parietal callus commonly cut off from umbilical callus by a surficial groove. Umbilical rib low, broad, evanescent in front, filling a little less than half of the umbilical pit. Outer margin of the umbilicus abruptly rounded but not angulated. Interior striations rather deep. Margin of aperture reinforced directly in front of the umbilical area.

Dimensions of holotype: Height, 7.5 millimeters; maximum diameter, 6.0 millimeters.

Holotype: U. S. Nat. Mus. No. 112926.

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

Polinices? demicryptus n. sp. has been confused with *Euspira hemicrypta* (Gabb) from the lower Miocene of New Jersey. It is separable by the heavier shell, the lower spire, the less inflated body, and by the low umbilical rib. The relatively heavy shell, the obliquely compressed outline, and the development of a funicle seem to exclude this species from *Euspira*.

Polinices? demicryptus has much in common with the youthful *P. judsoni* from the later horizons of the Alum Bluff group, and may be an undersize representative of that group in the Chipola formation. It is a larger species, however, than *N. semen* Lea and has a less elevated, less rounded spire.

Occurrence: Chipola formation, localities 10609^{r}, 2212^{a}, 3419^{r}, 7151^{p}.

Polinices robustus Gardner, n. sp.

Plate LIX, figures 5, 14

Shell large, heavy, coiled between 6 and 7 times. Apex of the unique type somewhat decorticated and nuclear characters indeterminate. Aperture less than two-thirds the total height. Early whorls feebly but evenly convex, increasing in size with moderate rapidity. Later turns more elevated and closely appressed, obliquely flattened behind; the maximum diameter falling a little in front of the median horizontal. Surface sculptured only with faint incremental striations, least faint posteriorly. Sutures closely appressed, distinct but inconspicuous. Aperture relatively narrow; the outer margin imperfect. Columella oblique. Parietal wall heavily padded from the posterior commissure to the umbilical pit, which is overhung by the callus. Umbilicus relatively small, elongate, partially filled with a broad but little elevated umbilical rib, strongest along the medial portion of the columellar margin. Umbilical keel obtuse, feebly reinforced anteriorly.

Dimensions of holotype: Height 39± millimeters; diameter (outer lip lost), 29± millimeters.

Holotype: U. S. Nat. Mus. No. 351586.

Type locality: No. 5184, first ravine below Shell Bluff, Shoal River, Walton County, Fla.

P. robustus suggests a giant *P. judsoni,* but, aside from its being more than double the size of the latter, the whorls of the spire are more numerous and more inflated.

Polinices caparonus Maury from the Manzanilla formation of Trinidad is a species comparable in outline and dimensions, but in *P. caparonus* the area in front of the suture is more depressed and the posterior and medial portions of the umbilicus are filled with callus united along a sinuous margin with the heavy parietal callus.

The type is unique.

Occurrence: Shoal River formation, locality 5184^{r}.

Subgenus NEVERITA Risso

1826. *Neverita* Risso, Histoire naturelle de l'Europe méridionale, vol. 4, p. 149.

Type by monotypy: *Neverita Josephinia* Risso.

Shell of moderate dimensions, depressed, suborbicular. Spire very low, broadly conical or flattened. Aperture more or less oblique. Umbilicus large, partially filled, the padded extremity of the funicle continuous with the parietal callus. Operculum corneous.

The group is much more depressed than *Polinices* sensu stricto. For the most part, it is confined to the temperate waters.

Polinices (Neverita) chipolanus Dall

Plate LIX, figure 22

1892. *Polynices (Neverita) chipolanus* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 368.

Most of them from the Chipola beds exhibit rounded whorls, an excavated, spirally striated umbilicus only half filled by the callus, which has its surface divided by a deep transverse sulcus. It is diffcult to decide whether this form should be assigned, as a variety *chipolana*, to the Eocene *gibbosa* or to the Miocene *duplicata*, or whether it should be regarded as a distinct species from either. In any case it is an almost exactly intermediate form between them. It reaches an altitude and diameter of 29 millimeters and has been obtained from the lower bed at Alum Bluff and the Old Miocene of the Chipola River.—Dall, 1892.

Dimensions of holotype: Height 21.5 millimeters; maximum diameter, 22 millimeters.

Type: U. S. Nat. Mus. No. 112870.

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

Shell polished, moderately large, depressed. Spire very low, almost entirely concealed by the body whorl. Nucleus small, highly polished, flattened, of 1½ volutions. Conch coiled a little more than four times. Surface smooth except for faint incremental striations near the suture. Sutures closely appressed, distinct. Aperture ovate, widening anteriorly. Columellar lip nearly vertical. Parietal wall thickly callused, the deposit most heavy in the umbilical region and at the posterior commissure, where it is separated from the outer lip by a shallow groove. Posterior part of umbilical pit veiled by a linguiform extension of the parietal callus, which unites with the heavy umbilical rib; a surficial sulcus indicating the line of division between the two. Umbilicus spirally striate within. Umbilical keel obtuse, reinforced anteriorly.

No other species combines the depressed contour with the partial filling of the umbilical pit. The somewhat similar *Neverita cuspidata* (Guppy), from the Springvale horizon in Trinidad, is larger and the callus is more extensive.

Occurrence: Chipola formation, localities 10609^{r}, 2212^{pr}, 2213^{pr}, 2564^{p}, 3419^{p}, 7151^{r}, 2211^{a}, 7183^{p}; Oak Grove sand, localities 2646^{p}, 5632^{r}, 7054^{r}, 7055^{r}, 9961^{r}; Shoal River formation, 5195^{r}, 5079^{c}, 10661^{r}, ?5193^{r}, 9959^{r}.

Polinices (Neverita) eucallosus Gardner, n. sp.

Plate LIX, figures 29, 30

Shell moderately large, low, turbinate. Whorls 5 or 6, closely appressed, rapidly enlarging, those of the spire very low and partially concealed by the embracing body whorl. Periphery of body evenly rounded. Surface smooth except for incremental striations, which are least feeble near the posterior suture and in the umbilical region. Suture lines distinct, a little impressed. Aperture large, slightly patulous anteriorly, auriculate in the adults, semielliptical in the young. Outer lip thin and sharp, strongly but asymmetrically arcuate, overlapping the inner posteriorly and cut off from the parietal callus by a shallow groove. Columella feebly concave. Body wash heavy, particularly at the posterior commissure; the margin of the enamel slightly contracted about halfway between the suture and the umbilicus. Umbilical cavity completely filled with a flat, closely fitting pad.

Dimensions of holotype: Height, 24.7 millimeters; maximum diameter, 26.5 millimeters.

Holotype: U. S. Nat. Mus. No. 350487.

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

P. eucallosus may be an antecedent of *P. duplicatus* (Say), but the differences between the two forms are much more marked in the immature stages than in the adult. The young of the species from the Alum Bluff are shaped like little round biscuits, the maximum diameter falling near the median horizontal, and the entire umbilical depression is evenly padded with callus. In the young of *P. duplicatus*, on the other hand, the outline is higher relatively and more or less turbinate, and the process of filling the umbilical cavity incomplete.

P. eucallosus is best represented at Shoal River, though it is far from rare in the Oak Grove sands.

Occurrence: Oak Grove sand, localities 3386^{p}, 3385^{c}, 7148^{a}, 2646^{pr}, 5632^{r}, 5631^{r}, 5633^{r} 7054^{p}; 10659^{p}; Shoal River formation, localities 3856^{c}, 3742^{c}, 3731^{c}, 10658^{p}, 5184^{p}, 5079^{c}, 10661^{p}, 3733^{p}, 2238^{c}, 3748^{a}, 9958^{p}, 7264^{r}.

Genus EUSPIRA Agassiz

1838. *Euspira* Agassiz in Sowerby, Mineral conchology, German ed., pp. 14, 320 (fide Sherborn).

1919. *Labellinacca* Cossmann and Peyrot, Conchologie néogénique de l'Aquitaine, vol. 3, p. 392. Type by monotypy: *Natica labellata* Lamarck. Eocene of the Paris Basin.

1925. *Labellinacca* Cossmann, Essais de paléoconchologie comparée, vol. 13, p. 137.

Type by subsequent designation (Bucquoy, Dautzenberg, and Dollfus, Mollusques marins du Roussillon, vol. 1, fasc. 4, p. 143, 1883): *Natica glaucinoides* Sowerby. London clay of England.

Cossmann discarded *Euspira* and created *Labellinacca*, in the first place, possibly, because he was not aware of the earlier name. Later, in 1925 (op. cit., p. 50), he gave as his reason, Herrmannsen's citation in 1848[19] of *Euspira* as a synonym of *Globularia*. Herrmannsen, however, designated no type, so that the name is not invalidated by the mere citation as a synonym. Stewart in 1927[20], stated that two species were

[19] Herrmannsen, A. N., Indicis generum malacozoorum, Primordia, vol. 1, p. 436, 1847.

[20] Stewart, R. B., Gabbs' California fossil type gastropods, Acad. Nat. Sci. Philadelphia, vol. 78, p. 324, 1927.

mentioned in the original description of *Euspira,* which I have not seen—*Natica glaucinoides* Sowerby, later designated as the type, and *Natica depressa* Lamarck? Sowerby, which is referred to *Ampullina.*

Euspira is commonly given place under *Lunatia* Gray, 1847. The monotype of *Lunatia* is *Natica ampullaria* Lamarck, a species broadly described as a large, thin, inflated shell with an open umbilicus, unfigured, with no reference to a published figure, and from an unknown habitat. It is supposed that Lamarck had before him the British species, *Natica catena* da Costa, but its identity with *N. ampullaria heros* was suggested by Tryon. *Euspira* differs most obviously from the common concept of *Lunatia* in the smaller size. The character of the operculum of the fossil species is, however, unknown, and the group has been isolated.

Euspira is characterized by a rather thin shell, globose outline, and small umbilicus. The internal umbilical rib is little or not at all developed. The pillar callus is much reduced and may be absent. The majority of the Recent species are temperate or boreal.

Euspira rotunda Gardner, n. sp.

Plate LIX, figures 25, 26, 27

Shell rather small, polished. Aperture a little more than two-thirds the total height of the shell. Whorls 3 to 4, strongly and evenly inflated. Protoconch small, highly polished, depressed, of approximately 1¾ volutions, the initial half turn largely immersed, the succeeding whorl more elevated. Conch differentiated from protoconch by the less lustrous surface and the presence of incremental striations. Whorls of spire regularly increasing in size, broadly and symmetrically convex. Body whorl strongly and evenly rounded, its maximum diameter at the median horizontal. Surface smooth except for incrementals, which are least feeble near the posterior suture. Suture lines distinct, impressed. Aperture semielliptical or auriculate, slightly wider anteriorly, the outer lip convex, the inner oblique. Parietal wall washed with callus from the labrum to the umbilicus, the deposit slightly heavier near the posterior commissure and cut off from the outer lip by a shallow, ill-defined sulcus. Umbilicus rather small, semi-lunar, striated within, partially obscured by a thickening of the posterior portion of the columellar wall. Umbilical keel obtuse, reinforced anteriorly.

Dimensions of holotype: Height, 9.5 millimeters; maximum diameter, 9.0 millimeters.

Holotype: U. S. Nat. Mus. No. 351597. Paratype (juvenile): U. S. Nat. Mus. No. 497119.

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

Euspira rotunda is characterized by the even rotundity of its whorls. In general contour it suggests a young *Natica guppiana* Toula, but it shows no trace of the axial sulcations identified with that species, and unlike the latter the umbilicus is free from callus except for a posterior marginal thickening.

Polinices (Euspira) propeinternus Mansfield, from the *Arca* zone of the Choctawhatchee formation of Florida, is slightly larger than *E. rotunda* and the spire is much higher. The whorls are more numerous by almost a complete volution and increase less rapidly in diameter. No umbilical rib is developed in either species, but the entering, ascending groove in *P. propeinternus* suggests such a character. The relationship between the two species is probably close.

Natica subinterna Böse, 1910, from Tehuantepec, seems also to be related, but in the characters of the umbilicus the resemblance to *P. propeinternus* is closer than it is to *E. rotunda.*

Occurrence: Shoal River formation, localities 3856^{p}, 3742^{r}, 9959^{r}.

Subfamily SININAE

Genus SINUM "Bolten" Roeding

1798. *Sinum* "Bolten" Roeding, Museum Boltenianum, pt. 2, p. 14.
=*Sigaretus* Lamarck, Prodrome d'une nouvelle classification des coquilles: Soc. histoire nat. Paris Mém., p. 77, 1799.

1909. *Sinum* Bolten. Dall, U. S. Geol. Survey Prof. Paper 59, p. 91.

Type by subsequent designation (Dall, U. S. Nat. Mus. Bull. 90, p. 109, 1915): *Helix haliotoidea* [Gmelin in Roeding] Linnaeus.

Shell depressed, auriform. Protoconch smooth, paucispiral. Spire lateral, very low, with rapidly widening whorls. Sculpture delicate, spiral or reticulate. Aperture very large, oblique, dilated. Outer lip thin, sharp, retractive. Inner apertural margin concave. Parietal wall calloused. Umbilicus narrowly perforate or imperforate.

The genus, though never abundant, is fairly well represented in the Tertiary and Quaternary beds. The Recent species live on the mud and sand flats bordering the warm seas.

The species of *Sinum* are local in their distribution. *Sinum chipolanum,* is known from only a single locality outside the type horizon. *Sinum dodoneum* is restricted to the Oak Grove sand, and it is far from common even at the two localities at which it has been collected. *Sinum waltonense,* is abundant at the horizon which it characterizes, although no trace of it has been found elsewhere.

Apical surface more or less elevated:
Diameter of adult shell exceeding 20 millimeters; base of adult more or less flattened.... *Sinum chipolanum* Dall.
Diameter of adult shell not exceeding 20 millimeters; base of adult smoothly rounded ..... *Sinum waltonense* Gardner, n. sp.
Apical surface depressed .... *Sinum dodoneum* Gardner, n. sp.

Sinum chipolanum Dall

Plate LIX, figures 31, 32

1892. *Sigaretus chipolanus* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 379 (in part); not pl. 17, fig. 7.

1915. *Sinum chipolanum* Dall, U. S. Nat. Mus. Bull. 90, p. 109 (in part); not pl. 12, fig. 29, pl. 16, fig. 1.

Shell solid, rather thick, varying in rotundity with age, the young ones as a rule being more naticoid in shape, while the more advanced are relatively flatter, and the fully mature specimens again are more rotund; whorls four or five, sculptured with rather fine, flattish, revolving threads of varying size, separated by channeled interspaces, varying in width and minutely undulated or reticulated by the sharp, close-set, fine incremental lines; aperture large, oblique; base somewhat flattened, periphery rounded; pillar-lip arched, broad, flattened somewhat and sometimes excavated, with a narrow sulcus behind it, running up to the imperforate umbilical region; callus on the body moderate, lip not reflected. Max. lon. of adult 33; diam. 27 mm.; lon. of young shell 16.5; axial elevation 11; diam. 15 mm.

This species is most nearly related to *S. declivis*, from which it may be separated by its closed umbilicus and the absence of the emargination of the pillar, which is the most characteristic feature of *S. declivis*. It also recalls *S. bilix var. mississippiensis*, which has a perforate umbilicus and is more rotund. The specimen figured is from the silex beds; the much larger and more characteristic specimens from Chipola were only obtained later. The sculpture may be close or sparse; it varies in this respect in nearly all the species.—Dall, 1892.

Dimensions of holotype: Height, 31 millimeters; maximum diameter, 31 millimeters.

Holotype: U. S. Nat. Mus. No. 112967.

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

The Ballast Point forms are more evenly inflated, the aperture relatively smaller, and the umbilicus more open than those from Chipola. The outline of the adult is fairly constant but the adolescent individuals vary widely in the degree of flattening behind the periphery and the consequent relative proportions.

Sinum gabbi (Brown and Pilsbry) from the Gatun formation of the Isthmus of Panama is also more evenly inflated, the whorls more numerous and less rapidly enlarging.

Occurrence: Chipola formation, localities 7893[r], 2212[p], 2213[c], 2564[c], 3419[p], 7151[p]; Oak Grove sand, locality 2646[c].

Sinum waltonense Gardner, n. sp.

Plate LIX, figures 33?, 34?, 35, 36, 38

Shell very thin, fragile, transversely ovate. Spire relatively small and low, the body whorl very large and strongly inflated; maximum diameter falling in front of the median horizontal, the body obliquely flattening behind but strongly and smoothly rounded in front. Volutions of conch 2 and a fraction, of the protoconch 2½. Surface of protoconch smooth and highly polished; the initial half turn largely immersed, the succeeding volutions somewhat rounded but not elevated, increasing in size regularly but not rapidly; separated by deeply impressed sutures. Beginning of conch indicated by a shallow sulcus, the flattening of the conchal surface, and the abrupt initiation of the spiral sculpture. Whorls of conch broadly convex, increasing rapidly in diameter. Surface sculptured with submicroscopically fine and crowded lirae, minutely crinkled by the incrementals, tending to alternate but more or less irregular, numbering approximately 5 primaries to the millimeter on the body and more than that on the final whorl of the spire. Suture lines feebly impressed. Aperture rudely semielliptical, patulous anteriorly. Outer lip thin, sharp, very much expanded. Columellar wall cutting oval of the basal outline into two unequal parts, of which the apertural is the larger. Inner margin of aperture sinuous. Parietal wall thinly glazed. Inner lip thickened and reflected over the narrow umblical chink. A very small part of the umbilical area exposed and differentiated by the absence of the spiral sculpture that covers the rest of the conch.

Dimensions of holotype: Height, 15.5 millimeters; maximum diameter, 13.5 millimeters.

Holotype and juvenile topotype: U. S. Nat. Mus. No. 371887.

Locality of holotype and juvenile topotype: No. 3856, 6 miles west-northwest of Mossyhead, sec. 6, T. 3 N., R. 21 W., Walton County, Fla.

A very large adult from Whites Creek (U. S. Nat. Mus. No. 498393, figs. 33, 34) is doubtfully referred to *Sinum waltonense*. It includes almost 3 volutions and measures 27 millimeters both in height and diameter, almost double the size of the usual specimens from Shoal River. The body of the specimen from Whites Creek, unlike that of typical *S. waltonense*, is obtusely shouldered and obliquely flattened laterally. The differences may be due to unusual age. The character of the sculpture is similar in the two forms and the seemingly more expanded and patulous aperture of the larger individual is exaggerated by the pose of the specimens. Unfortunately, a uniform scale was not used in the illustrations.

Sinum waltonense is rarely so large as *S. chipolanum* Dall, is more rounded and more finely sculptured. In *S. nolani* Maury from the Gurabo formation of the Dominican Republic, the aperture, judging by the illustration, is less patulous and the shell much broader relatively. *S carolanum* Spieker from the lower Zorritos formation in Peru is a species of similar aspect but less trapezoidal when viewed from the rear. *S. naticoidale* Vokes from the upper Miocene of Springvale, Trinidad, is a more chunky shell with a less patulous aperture. *S. waltonense* is restricted in its distribution to the Shoal River, but it is very abundant

within that limited area. No other *Sinum* has been recognized from the horizon.

Occurrence: Shoal River formation, localities 3856[a], 3732[r], 3742[c], 3731[p], 5184[p], 5195[r], 3733[r], 2238[p], 3748[c], 14436[p].

Sinum dodoneum Gardner, n. sp.

Plate LIX, figures 37, 39

Shell depressed, auriculate. Apical surface flattened, rudely semielliptical; the margin of the outer lip approximately straight, the periphery of the body strongly arcuate. Nucleus small, smooth, highly polished, naticoid, coiled 3 times; the initial turn flattened on the apical surface, the succeeding volutions moderately inflated and separated by deeply impressed sutures. True conch of less than two full turns. Line between conch and protoconch marked by a slight jog due to greater depression of the surface of the protoconch and by the abrupt establishment of the spiral sculpture. Spirals on final whorl of spire in type approximately 9 near their origin, but their number almost doubles before the end of the whorl. Body sculpture of low, flattened fillets, subequal in size and spacing; occasional secondaries intercalated near the suture, more or less minutely nodulated by the incrementals and growth lines, numbering between 2 and 3 to the millimeter at the aperture but more than that away from it and becoming increasingly finer and more crowded toward the periphery and microscopically fine and more or less obsolete toward the umbilicus. Periphery of body whorl sharply but smoothly rounded. Aperture occupying in the type more than two-thirds of the basal surface. Outer lip thin, sharp, its maximum expansion a little in front of the median horizontal. Inner margin obliquely arcuate. Parietal wall thinly glazed. Inner lip reflected over the umbilical opening and continuous with the body wash. Margin feebly reinforced in front of the umbilicus.

Dimensions of holotype: Height, 7 millimeters; maximum diameter, 23 millimeters; diameter at right angles to maximum diameter, 16 millimeters.

Holotype: U. S. Nat. Mus. No. 136075.

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

Sinun dodoneum is by far the most depressed of any of the Alum Bluff species that have been described. In general outline the type suggests *S. perspectivum* of the post-Pliocene and Recent faunas but differs from it in the more depressed nuclear turns, the more uniform sculpture on the apical surface, and the persistence of the spirals on the base. It also suggests *S. multiplicatum* Dall of the Pliocene of the Carolinas and Florida, but apparently the Miocene form has a greater number of protoconchal and a lesser number of conchal turns than the Pliocene species. The latter is decidedly more elevated than the type of the former, but *S. dodoneum* may vary widely in outline and relative proportions. The species was described from the only perfect individual collected. Fragments of broken and worn individuals indicate that the type is not fully grown, and that it is more depressed than the normal adult. One imperfect individual collected attained a height of almost 20 millimeters and a diameter of probably 45 millimeters.

The species is rare even at the single horizon at which it is represented.

Sinum gatunense (Toula) is smaller than *S. dodoneum,* even more depressed, and more nearly ellipsoidal in outline.

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

Genus SIGATICA Meyer and Aldrich

1886. *Sigatica* Meyer and Aldrich, Cincinnati Soc. Nat. History Jour., vol. 9, no. 2, p. 42.

Type by monotypy: *Sigaretus (Sigatica) Boettgeri* Meyer and Aldrich. Lower Claiborne of Mississippi and Alabama.

Shell small, depressed naticiform. Aperture semielliptical, moderately wide. Outer lip thin, sharply rounded posteriorly, expanded, slightly patulous anteriorly. Inner lip adnate to the body posteriorly, free medially and forming the inner wall of the wide umbilical funnel. Sculpture in genotype restricted to a few spiral grooves in front of the suture and surrounding and entering the umbilicus.

Eunaticina, with which *Sigatica* has been commonly confused, is little more than a rather strongly sculptured, widely umbilicate *Sinum,* with an incipient funicle. The genotype is *Natica papilla* Gmelin from the western Pacific. *Sigatica* is a compact group of a few species, most of them rare and recorded only from the Tertiary and Recent faunas of the Gulf Province and the West Indies.

Section GLYPTANATICA Gardner, new section

Type by original designation: *Sigatica euglypta* Gardner, n. sp.

Shell relatively large for the group and not conspicuously thin. Roughly naticiform but narrowly tabulated in front of the suture. Spirals well trenched, evenly and not very closely spaced. Aperture obovate, moderately wide, obtusely angulated behind, broadly rounded and somewhat patulous in front. Inner lip adnate to the body, constricted at the base of the body and forming the inner wall of the moderately wide umbilical funnel; umbilical rib suggested by slightly insinuated inner lip. Base of body rounding smoothly into the umbilicus; only the marginal spirals entering it.

Glyptanatica includes the larger, more strongly sculptured members of *Sigatica*. Like *Sigatica* s.s., to which it is very closely related, it is a warm-water western Atlantic group.

Sigatica euglypta Gardner, n. sp.

Plate LX, figures 1, 5

Shell large, moderately thin, inflated, ovate-conic. Aperture approximately two-thirds the height of the shell. Whorls of conch 3½ in the holotype, narrowly tabulated posteriorly, broadly convex, increasing rapidly in diameter. Body obliquely flattened behind, rounding smoothly but rather abruptly into the base. Sutures distinct, channeled toward the aperture. Protoconch low, small, smooth, highly polished, coiled 2½ times. Initial turn minute and largely immersed in the succeeding volution; remaining turn and a half increasing rather rapidly in diameter but slowly in height. Opening of conch marked by a slight change in the texture of the shell and by the appearance of faint spirals. Axial sculpture restricted to incrementals; sharp, regular and retractive on the shoulder and in the spiral grooves on the posterior part of the shell; sharp and crowded, too, in the umbilical funnel but obsolete on the medial part of the whorl. Spiral sculpture incised; sulci angular, rather deep, linear, not quite so narrow posteriorly, 5 on the whorls of the spire, 18 on the body, equispaced except on the base of the body, where they are more crowded. Basal sulci wider and deeper than those behind them; in many individuals 2 or 3 obscure lirations developed in the umbilical funnel. Aperture lobate, acutely angulated posteriorly, patulous and smoothly rounded anteriorly. Outer lip thin, sharp, broadly and asymmetrically arcuate. Inner lip oblique to the axis; callus dense on the body wall but not very thick, feebly constricted along the anterior part of the umbilical funnel. Umbilicus narrow but deep; funnel well rounded at the base of the whorl, almost vertical along the dextral wall, sharply striated by the incrementals.

Dimensions of holotype: Height, 19.5 millimeters; maximum diameter, 16.5 millimeters.

Holotype: U. S. Nat. Mus. No. 371886.

Type locality: No. 7893, Boynton Landing, Choctawhatchee River, Washington County, Fla.

Sigatica caractica (Dall) is only about one-third the size of *S. euglypta* and is much more finely sculptured.

Occurrence: Chipola formation, locality 7893[r].

Sigatica caractica (Dall)

Plate LX, figure 2

1900. *Eunaticina caracticus* Dall. Wagner Free Inst. Sci. Trans., vol. 3, pt. 5, pl. 42, fig. 6 (no description).

Shell polished, small, solid, globose; the whorls of the low spire narrowly tabulated, broadly and feebly convex; the body more inflated toward the base than directly in front of the suture. Whorls of conch 2½, the protoconch a little more than twice coiled. Initial quarter turn largely submerged, the succeeding volutions well rounded but not elevated, separated from one another by impressed sutures. Beginning of conch marked by the initiation of the spiral sculpture. Spirals appearing as incised linear sulci, approximately 9 on the initial whorl of the conch and, in the type, about 30 on the body, uniform for the most part but somewhat wider and deeper near the suture and the umbilical area; rendered more or less irregular by the incremental sculpture. Sutural channel closely striated by the growth lines and threaded near the outer margin with a single fine lira. Aperture lobate, somewhat patulous anteriorly. Outer lip ample, broadly and asymmetrically arcuate. Inner lip oblique; glazing the base of the body, reverted slightly over the umbilical pit and forming its ventral wall; feebly insinuated, indicating an incipient umbilical rib. Umbilicus deep but not very wide, striated within by incrementals only but spirally threaded near the outer margin at the periphery.

Dimensions of holotype: Height, 8 millimeters; maximum diameter, 6.6 millimeters.

Holotype: U. S. Nat. Mus. No. 107379.

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

The species varies within rather narrow limits in the number and spacing of the spirals, especially near the umbilicus. *Sigatica euglypta* is almost three times as large as *S. caractica* but with not much more than half as many spirals. The Recent southern east coast and West Indian *Sigatica carolinensis* (Dall) has a smaller thinner shell with less pronounced posterior tabulation.

The species is rather common at the type locality and the type horizon and occurs, though very rarely, in the Chipola and Shoal River formations as well.

Occurrence: Chipola formation, locality 2564[r]; Oak Grove sand, localities 2646[c], 5632[p], 5633[r], 7054[r]; Shoal River formation, 3742[r].

Subfamily AMPULLINAE

Genus GLOBULARIA Swainson

1840. *Globularia* Swainson, Treatise on malacology, p. 345. =*Ampullina* auctores.

1927 (January). *Globularia* Stewart, Acad. Nat. Sci. Philadelphia Proc., vol. 78, p. 330.

1927 (September). *Globularia* Cox, Rept. on Paleontology, Zanzibar Protectorate, p. 20.

Type by subsequent designation (Herrmannsen, Indicis generum malacozoorum, vol. 1, p. 480, 1847): *Natica sigaretina* Lamarck. Eocene of the Paris Basin.

Shell moderately large, thin, globose. Whorls more numerous than in *Natica*, highly inflated, flattening a

little in front of the suture, rapidly increasing in diameter. Surface smooth except for incrementals. Aperture wide, auriculate, angulated posteriorly, much expanded and produced anteriorly. Outer lip thin and sharp. Inner lip sigmoidal following the contour of the body and of the excavated pillar. Parietal wash continuous with the pillar callus. Umbilicus open in the young, the funnel glazed; the elevated outer margin of the glaze marking the umbilical periphery and contrasting with the lower luster of the body wall, partially fused in the adult with the less highly polished callus that reinforces the slightly reverted inner lip and closes the umbilicus.

The first established record of the Latinized *Ampullina* is that by Bowdich.[21] He badly figured an unnamed species that has been commonly identified as *Ampullaria depressa* Lamarck, from the Eocene of the Paris Basin. Stewart in January, 1927, rejected *Ampullina* as a doubtful name. The relationships between the Tertiary groups seem more clear, however, if *Ampullina* is retained for the relatively heavy, nonchanneled umbilicate ampullinids of the Paris Basin, which are closely related to *Ampullinopsis* Conrad of the Eocene and Oligocene Gulf faunas.

Ampullina s.s., according to Stewart,[22] is restricted to the Eocene, *Ampullinopsis* to the Oligocene and lower Miocene, while *Globularia* is widely though not abundantly recorded in the Eocene, Oligocene, and Miocene and is represented in the Recent fauna of the western Pacific by *Cernina fluctuata* (Sowerby).

Globularia fischeri (Dall)

Plate LIX, figure 28

1892. *Ampullina fischeri* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 374, pl. 22, fig. 36.

1927. *Globularia fischeri* (Dall). Stewart, Acad. Nat. Sci. Philadelphia Proc., vol. 78, p. 331.

Shell closely related to *Ampullina sigaretina* of the Parisian Eocene, from which it differs by its somewhat more depressed spire, less impressed suture, wider basal fasciole, and by the thick, complete coat of callus, which in the adult covers completely the fasciole and umbilicus, as in *Cernina fluctuosa*. The shell is also slightly less expanded and rounded than the European fossil. It has a low but pointed spire, six or seven whorls, smooth surface with impressed incremental lines, slightly flattened callus, and in front of the suture the whorl is flattish instead of rounded, as in *A. sigaretina*. A shell of six whorls measures 33 mm. high and 38 mm. in maximum diameter, but I have fragments which measure over 60 mm. in diameter.

This form was at first regarded by me as being merely a mutation of *A. streptostoma*, but of more than twenty-five specimens from various localities which were in a state to show the base, not a single one has an open umbilicus, while all the Ballast Point and Claibornian specimens have the umbilicus open. The young of both are not separable. It may eventually prove to be a local race of *A. streptostoma*, but at present would seem better kept apart.

It is respectfully dedicated to Dr. Paul Fischer, of Paris, the distinguished paleontologist and malacologist.—Dall, 1892.

Type: U. S. Nat. Mus. No. 112934?.

Dall's type specimen is not marked. The figured individual is not an adult for the parietal wall is not callused; neither is it the measured specimen for the only individuals with a maximum diameter of 38 millimeters are fully adult. Either the specimen is lost, which seems improbable, or the artist has figured a smaller individual from the same locality (U.S.G.S. Sta. 2212). The slight imperfections by which the shell may be positively identified have not been reproduced. The fragile outer lip of the individual most closely resembling the illustration has been broken but that may well have occurred in the forty years since the shell was figured.

The Museum number 112934 includes the measured individual, the immature specimen most closely resembling the figure and a third individual.

Type locality: Tenmile Creek, 1 mile west of Baileys Ferry, Calhoun County, Fla.

Globularia fischeri (Dall) is distinguishable from other naticoids by the large, thin, highly inflated whorls, the wide, auriform aperture, and the excavated columella. In the young the umbilicus is perforate and outlined by an acute carina.

Occurrence: Chipola formation, localities 2212^{c}, 2213^{p}, 2564^{r}, 3419^{r}, 7151^{r}, ?2211^{c}; Oak Grove sand, locality 2646^{r}.

Genus PACHYCROMMIUM Woodring

1928. *Pachycrommium* Woodring, Carnegie Inst. Washington Pub. 385, Miocene mollusks from Bowden, Jamaica, pt. 2, p. 391.

Type by original designation: *Amaura guppyi* Gabb. Miocene of the Dominican Republic.

Shell medium-sized, stout, imperforate, spire moderately high, whorls shouldered. Aperture semi-ovate. Outer lip extending backward from suture. Basal part of inner lip folded back and closely appressed, the upper part covered by the parietal callus, which extends far down.—Woodring, 1928.

Pachycrommium is recorded in the lower and middle Tertiary beds of the warm and warm-temperate zones both in Europe and North America. Most of the species now referred to *Pachycrommium* were hitherto called *Amauropsis* Mörch, a cold-water group, in which the inner lip is not reverted.

Sutures channeled ..... *Pachycrommium burnsii* (Dall).
Sutures simple:
Shoulder angle acutely rounded ..... *Pachycrommium dodonum* Gardner, n. sp.

[21] Bowdich, T. E., Elements of conchology, pt. 1, p. 31, 1822.

[22] Stewart, R. B., Gabb's California Cretaceous and Tertiary type lamellibranchs: Acad. Nat. Sci. Philadelphia Spec. Pub. 3, p. 40, 1930.

Pachycrommium burnsii (Dall)

Plate LIX, figure 12

1892. *Amauropsis burnsii* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 377, pl. 22, fig. 33.

Shell ampullariae-form, solid, smooth except for periodically impressed lines of growth; with seven or eight whorls; apex depressed, minute, pointed; suture distinct, with a wide channel in front of it; whorls in front of the channel evenly rounded, full, and smooth; base rounded, imperforate, the pillar with a very narrow fasciole; aperture subovate, not very oblique, the lips thickened and reflected, joined over the body by a continuous callus. Alt. of shell 18; max. diam. 15 mm.—Dall, 1892.

Holotype: U. S. Nat. Mus. No. 112954.

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

Aside from the perfectly preserved type, the representatives of this species occur only in fragments.

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

Pachycrommium dodonum Gardner, n. sp.

Plate LIX, figures 4, 13

Shell rather large and very fragile. Spire high scalariform. Apex decorticated in all available material. Whorls probably 7, increasing uniformly in size, all but the earliest strongly tabulated; sides of whorls nearly vertical; shoulder angle acutely rounded. Body only feebly inflated, smoothly rounded at the base. Surface smooth except for faint incremental striae and vaguely suggested spirals. Suture line distinct. Aperture wide, the exact outline lost by the imperfect labrum. Outer lip thin and sharp, patulous anteriorly, its margin broken away. Inner lip sigmoidal, reverted and reinforced anteriorly by a rather heavy callus. Parietal wall thinly washed. Umbilicus imperforate, evenly glazed.

Dimensions of holotype: Height, 37.5 millimeters; maximum diameter (outer lip lost), 25± millimeters.

Holotype: U. S. Nat. Mus. No. 136073.

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

Pachycrommium dodonum is separated from *Amauropsis floridana* Dall of the Ballast Point silex beds by the larger size, more slender, less inflated outline and relatively higher spire, more strongly shouldered whorls, and more patulous anterior extremity. *Amauropsis burnsii* Dall is a smaller, more acutely tapering shell.

Some of the examples of *Amauropsis Guppyi gurabensis* Maury approach *dodonum* very closely, but the number of whorls seems a little higher and the shoulder flattening less pronounced in the West Indian forms. The individual variation, as Miss Maury noted, seems unusually high.

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

Superfamily STROMBACEA

Family STROMBIDAE

Genus STROMBUS Linnaeus

1758. *Strombus* Linnaeus, Systema naturae, 10th ed., p. 742.

Type by subsequent designation, (Montfort, Conchyliologie systématique, vol. 2, p. 515, 1810): *Strombus pugilis* Linnaeus. Recent off the Florida Keys and the West Indies.

One of the largest and heaviest of the univalves. Outline ovate-conic. Spire rarely half as high as the entire shell. Whorls numerous, commonly angulated at the periphery, usually more or less nodulous or spinose in the adult, axially costate in the young and adolescent shells. Aperture elongated, not very wide, its margins subparallel. Outer lip thickened, usually lirate within, dilated but not digitate, produced backward but rarely beyond the final whorl of the spire, lobate at the posterior extremity in many species. Anal sulcus usually well-developed; a so-called "stromboid notch", possibly for the extrusion of the eye stalks, also developed near the base of the outer lip. Columella nonplicate. Parietal wall thinly washed with enamel over a large and ill-defined area. Anterior canal short, recurved, deeply emarginate. Umbilicus imperforate. Recent shells protected by an epidermis and closed by a small linguiform operculum.

Strombus has been reported from the Cretaceous, but it does not become well established until the Tertiary. A single, not very abundant species occurs in the Eocene of the Gulf Province and another in India. In some of the lower and middle Miocene faunas of the southern Atlantic States and the West Indies the genus is exceedingly abundant and constitutes perhaps the most conspicuous element of the univalve fauna. The late Miocene seas, however, were apparently too cool to favor its development. In the warmer Pliocene seas the group regained the prominence, which it still holds in the Floridian, Antillean, and west-coast faunas. The genus has also a meager representation on the Brazilian and Senegal coasts, and a single species has been reported from the Indian Ocean.

These "conchs"—so-called in popular parlance—are restricted in their Recent distribution to warm and very shallow waters, none of the Recent east-coast forms occurring north of Hatteras and only in very shallow water. Their presence, in such great numbers in the Alum Bluff faunas is, therefore, extremely significant of the habitat in which they lived.

Labrum produced posteriorly beyond suture line ..... *Strombus aldrichi* Dall.

Labrum not produced posteriorly beyond suture line:

Axial costae of early whorls not exceeding 18; terminal tubercle normally more prominent than the two behind it ..... *Strombus chipolanus* Dall.

Axial costae of early whorls exceeding 18; terminal tubercle normally less prominent than the two behind it ..... *Strombus dodoneus* Gardner, n. sp.

Strombus aldrichi Dall

Plate LV, figures 3, 8

1890. *Strombus Aldrichi* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 1, p. 175, pl. 12, figs. 1, 4.

1910. *Rimella Aldrichi* Maury, Bull. Am. Paleontology, vol. 4, no. 21, p. 27, pl. 7, fig. 1.

Shell of moderate size, with about nine whorls, of which two are small, smooth, and nuclear; subsequent whorls spirally threaded and ribbed or tuberculate at the shoulder; spirals fine, variable, most threadlike on the early whorls, on the last whorl wavy and obsolete; early whorls transversely ribbed with 10-14 small, rounded riblets, which gradually become fewer and more nodulous until nothing but the nodules are left; on the first half of the last whorl the nodules are obsolete, on the second half there are three or four large nodules much larger than any others on the shell; behind the shoulder the shell is slightly excavated and the suture distinctly appressed and sometimes marginated by a few extra large spirals in front of it; in the vicinity of the last nodule the posterior edge of the last whorl is produced backward until it reaches the second or third whorl, counting backward; on the back of the last whorl are often a few feeble, elevated, irregular waves or obscure tubercles midway between the shoulder and the canal, recalling the stronger and more numerous waves in *S. granulatus;* aperture narrow, produced backward, squarish behind, with a groove at the commissure and an obscure subsutural ridge; outer lip in front of the angle nearly straight, smooth inside, or with a few faint granulations or lirations anteriorly; genital sulcus well marked; canal short, recurved; body with a wide and moderately thick coat of callus, but no lirae. Max. lon. of shell 62.0; max. lat. 36.0 millimeters.

This fine species forms, in its characters, a sort of transition from *S. albirupianus* toward *S. pugilis* and *S. granulatus* of the Recent fauna, being more like the latter than the former. It is also recalled by the *S. Bonellii* Brogn. of the European Miocene (Dax, Vienna Basin), which is a larger and less elegant species. *S. Aldrichi* cannot be regarded as a link in the ancestral chain of *S. pugilis*, since the latter was already in existence in the Haitian Miocene, but its relations to *S. granulatus* are closer. At all events, it combines characters which in Recent species seem to be parted among several specific forms.

This species is very abundant in the Chipola beds, holding there much such a place as *S. pugilis* does at some points on the Floridian coast to-day. It varies very much as *S. pugilis* does, having varieties corresponding to var. *alatus* and other mutations of *S. pugilis*. The strength and to some extent the character of the spirals on the last whorl varies: sometimes we have two sets of coarser and finer wavy grooves, with wider, flattish interspaces; sometimes the fine grooves are obsolete and the sculpture is of wide, well-marked, rounded channels, with rounded, not much elevated ridges between them. The sculpture of the young, as might be expected, is more uniform, and the species is sufficiently characteristic to be easily recognized, even in its most extreme variations.—Dall, 1890.

Holotype: U. S. Nat. Mus. No. 112226.

Type locality: No. 2212, 1 mile west of Baileys Ferry, Chipola River, Fla.

Three volutions are sometimes completed in the larval stage.

Miss Maury's species was described from a broken tip, but there is no doubt of its identity with *Strombus aldrichi.*

Occurrence: Chipola formation, localities 2212^{p}, 2213^{a}, 2564^{c}, 3419^{a}, 7151^{p}, 7256^{r}, 2211^{p}; Cornell University collection.

Strombus chipolanus Dall

Plate LV, figure 6

1890. *Strombus chipolanus* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 1, p. 176, pl. 4, fig. 1.

1915. *Strombus chipolanus* Dall, U. S. Nat. Mus. Bull. 90, p. 87, pl. 9, figs. 8, 10 (in part).

Shell with nine or ten whorls, of which about two are small, smooth, and nuclear, the others ribbed, varicose, tuberculate and spirally sculptured; early whorls with twelve or more narrow, rounded ribs, gradually becoming angular, tuberculate, larger, and finally tubercles pure and simple, of which there are nine or ten on the shoulder of the last whorl, the last or penultimate being the most prominent of all; spiral sculpture of rounded threads, becoming gradually obsolete, and on the last whorl narrower and more distant than in *S. Aldrichi* in most cases, but varying much as in that species; spire variable in height, sometimes high and slender as in the silex fossil figured, but generally much the same proportions as in *S. Aldrichi;* last whorl attentuated anteriorly; shoulder less excavated and less regular than in *Aldrichi*, usually with two more prominent threads in front of the somewhat appressed suture; outer lip widest behind, little ascending, not reaching the suture at the beginning of the last whorl; commissure deep, narrow, not grooved; there is no subsutural ridge, but on the body behind are four or five lirae; outer lip angulated and widest at the shoulder, simple, a row of small, short lirae within it as in dwarf specimens of *S. bituberculatus;* pillar with a thin callus, sharply recurved in front, with a distinct fasciole; canal narrow, much recurved, obliquely truncate; genital sulcus distinct; last whorl sometimes wavy on the back as in *S. integer*. Max. lon. of adult shell 70.0; max. lat. 45.0 millimeters.

This form recalls the smallest specimens of *S. bituberculatus* and is the analog of *S. coronatus* Defrance, of the European Miocene, but is considerably smaller. It is much less common than *S. Aldrichi*, from which it may readily be distinguished by its nonascending posterior lip, its lirate body and throat, and the general form of the aperture. It transmits several of the features of *S. albirupianus*, and we fancy that they seem to reappear in the recent *S. bituberculatus* Lam. It may possibly be identical with Sowerby's *S. bifrons*, but which is a much smaller shell, of which the aperture has not been figured. The differences appear too great to unite them without more data.—Dall, 1890.

The almost perfect adult measured in 1890 but not figured until 1915 is the lectotype (U. S. Nat. Mus. No. 112227), from U. S. Geological Survey locality 2213, 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla. The incomplete spire figured in 1890 is diagrammatically drawn and difficult to identify. It may be one of the spires included under U. S. Nat. Mus. No. 112224, from U. S. Geological Survey locality 2212, 1 mile west of Baileys Ferry, Calhoun County, Fla.

Strombus chipolanus Dall differs from *S. dodoneus,* so prolific in the Oak Grove fauna, in the more slender spire, the greater number of whorls both of the conch and protoconch, the fewer axial costae on the early whorls—12 or 15 as opposed to 20 to 24—the slightly higher average number of spinose tubercles on the body

—usually 10 instead of 9—the greater prominence of the terminal tubercle, and the more uniform and more evenly lirate spiral sculpture.

The species has not been certainly recognized except from the vicinity of Baileys Ferry on the Chipola River, and it is comparatively rare even within this limited area.

The fragmentary specimens from the Tampa silex beds referred by Dall 1892 and Dall 1915 to *Strombus chipolanus* are included by Mansfield under *Strombus liocyclus* Dall, a species with a more slender spire and more numerous and more regularly spaced axials.

Occurrence: Chipola formation, localities ?7893^{r}, 2212^{p}, 2213^{p}, 2564^{p}, 3419^{p}, ?7151^{p}, 10971^{r}, ?7468^{r}.

Strombus dodoneus Gardner, n. sp.

Plate LV, figures 4, 7, 9

Shell rather small for the genus, heavy, ovate-conic. Spire rather low. Nuclear whorls small, smooth, highly polished when perfectly preserved, acutely tapering, 4 to 5 in number; initial half turn slightly bulbous, the 4 succeeding volutions rounded, trapezoidal, and increasing in size and inflation with a moderate degree of rapidity. Line between conch and protoconch marked by a slight thickening of the shell. Adult conch 9 or 10 times coiled. Earliest sculpture feeble and irregular, but before the end of the second conchal whorl there is a well-established ornamentation of approximately 22 sharply rounded axial costae, equisized except for an occasional varix, equispaced, and uniform in prominence from suture to suture; spiral sculpture a little later in development and less uniform, usually about 12 low, flat, crowded lirae to a turn in the adolescent shell. First 4 to 6 whorls of conch laterally compressed with a tendency toward a peripheral bulge and regularly increasing in size; fifth or sixth whorl marked by abrupt development of an obtuse shoulder and by increased rapidity in growth. Sculpture much more variable after initiation of shoulder. Costals rapidly evanescing behind the periphery, less rapidly in front of it, and becoming gradually transformed into peripheral tubercles and on the body whorl into obtuse spines, of which the last 2 before the terminal tubercle are usually the most prominent; number of axial protuberances decreasing from 22 on the early whorls of the conch to about 9 on the body. Spirals irregular, varying in number and character, usually 7 to 9 sharp, V-shaped elevations upon the shoulders of the whorls with intercalated lirae or finer ridges, all of them finely crenulated in many individuals by the incrementals; sculpture in front of the periphery generally absent or concealed by the succeeding volution; spiral sculpture on body whorl unevenly developed, the primaries in the most strongly sculptured forms numbering 20 to 25, lirate or more frequently V-shaped, either low and rather wide or high, sharp, and narrow; intercalaries fortuitous; spirals commonly obsolete over the posterior two-thirds of the body, especially in the earlier half, strongest and most persistent near the anterior canal; siphonal fasciole obscurely lirate. Suture lines distinct, impressed, varying in the degree of appression, sometimes placed well in front of the peripheral tubercles or quite as often closely appressed to the summit of the tubercles on the shoulder of the preceding whorl and deeply sinuated by them. Aperture moderately wide, the margins subparallel. Outer lip thickened in the adult, irregularly lirate within, flaring away from the aperture, obtusely angulated at the shoulder, obliquely retreating before and behind it; basal constriction broad and not very deep. Labrum produced backward but not more than halfway across to the suture line. Posterior commissure obscurely sulcate. Labium straight, simple. Body callus extensive, moderately heavy. Siphonal fasciole well differentiated. Anterior canal recurved, broadly emarginate. Umbilicus closed by the reflected callus of the inner lip.

Dimensions of holotype: Height, 69 millimeters; maximum diameter including tubercles, 51 millimeters; diameter at right angles to maximum diameter, 36 millimeters.

Holotype: U. S. Nat. Mus. No. 350381; figured juvenile, U. S. Nat. Mus. No. 371867.

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

Strombus dodoneus is the very prolific analog in the Oak Grove fauna of the rather rare *S. chipolanus* of the Chipola beds. The two species are similar superficially, but the early whorls are dissimilar, and there are some specific differences that persist to the final whorl. The nucleus of *S. dodoneus* is 4 or 5-whorled; that of *S. chipolanus* 2 or at the most 3. The axial costae run about 22 on the earlier whorls of *S. dodoneus,* about 12 to 15 on the earlier whorls of *S. chipolanus.* The spire is, as a rule, more slender and more regularly tapering in the Chipola species, although there is considerable variation in relative altitude on both forms. The abrupt angulation of the periphery, the sudden increase in rate of growth, and the frequent immersion of the later whorls of the spire to the tips of their tubercles are all characters peculiar to the Oak Grove form. The adolescent stage is apparently longer-continued in *dodoneus,* and the youthful sculpture persists through at least two additional turns. The total number of whorls in *S. chipolanus* is usually 9 or 10, in *S. dodoneus* 14 or 15, and the excess number of whorls is accounted for during the larval and adolescent stages of the latter. The adult spiral sculpture of *S. chipolanus* is more uniform and more evenly lirate than the more or less unequal and inequispaced, V-shaped ridges of *S. dodoneus.* The body tubercles are usually 9 in the latter and commonly 10 in the former,

and in *S. dodoneus* the terminal tubercle is less prominent than the 2 behind it; in *S. chipolanus* it is usually more so. The relation of *S. dodoneus* to the Recent forms is not very obvious, but it suggests *S. tuberculatus* Lamarck in the characters of the adolescent shell and in the relative prominence of the tubercles on the adult. It differs, however, in the outline of the labrum and in the absence of the two spiral series of nodules developed on the body of the adult in the Recent form.

Strombus dodoneus compensates in number of individuals for the paucity of species in the Oak Grove *strombus* fauna.

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

Genus ORTHAULAX Gabb

1872. *Orthaulax* Gabb, Acad. Nat. Sci. Philadelphia Proc., vol. 24, p. 272.
(=*Hippochrenes* Zittel (in part).=*Wagneria* Heilprin, Wagner Free Inst. Sci. Trans., vol. 1, p. 105, 1887; type by monotypy: *Wagneria pugnax* Heilprin; Tampa Silex beds.)
1890. *Orthaulax* Gabb. Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 1, p. 169.
1921. *Orthaulax* Cooke, U. S. Geol. Survey Prof. Paper 129-B, p. 23.

Type by monotypy: *Orthaulax inornatus* Gabb. Tampa limestone of Florida; Baitoa formation of the Dominican Republic.

Shell rounded fusiform, canal moderate, straight and regularly tapering; adult shell enveloped over the whole spire by an extension of the inner lip; posterior canal fissurelike, formed by the continued edge of the outer lip and running directly to the apex. Outer lip apparently sharp and simple; anterior notch oblique and broad.—Gabb, 1872.

The essential difference between *Orthaulax* and *Hippochrenes, Calyptrophorus, Rimella*, etc., is that the involution of the spire, once commenced, is carried on by the posterior edge of the last or growing whorl continuously from the young condition in *Orthaulax;* while in the others the spire remains normal until the shell reaches its adult state and then, with the changes in the mantle, which incite the deposition of the thickened and enlarged outer lip, a process is developed at the posterior commissure of the aperture and mantle, which deposits enamel on the spire against which it lies, and it thus forms a gutter, sometimes straight, sometimes recurved, in which it is sheltered; apart from this the spire is enveloped, if at all, not by any expansion of the lip, but by a deposit of enamel which covers the whole, as frosting does a cake, without any relation to the coil of the shell considered as an organic product. Strip off the whole involving, continuous enamel from *Calyptrophorus* and the whorls will remain intact; strip off the equivalent deposit in *Orthaulax* and the shell itself is destroyed. The latter, so far as its structure is concerned, is more nearly like an involute *Terebellum* (such as *T. sopitum* Brander, figured by Zittel) than like the enameled *Calyptrophorus* or winged *Hippochrenes*.

The latter wait until they have attained their majority and then spread their outer lips and lay down their enamel, once for all. In *Orthaulax* the involution, as in *Ovulum*, begins before maturity and continues with the growth of the shell without regard to its age or periodical resting stages. In this particular it is clearly distinguished from any other group included in the *Strombidae*, excepting the sufficiently distinct *Terebellum*.—Dall, 1890.

Orthaulax gabbi Dall

Plate LV, figures 1, 2, 5

1890. *Orthaulax gabbi* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 1, p. 170, pl. 12, figs. 5, 5a, 5b.

Shell large, solid, many-whorled; in the very young (fig. 5) smooth and polished, except for incremental lines and a few faintly impressed spiral lines anteriorly; nucleus small, polished, glassy, not differentiated from the rest of the shell; early whorls with a very distinct, not channeled suture; the whorl in front of it is slightly turreted; each whorl after the third has three slightly elevated, narrow, rounded varices, somewhat irregularly spaced, so that they do not follow each other continuously down the slope of the spire; about the end of the eighth whorl the posterior edge of the outside whorl begins to be prolonged backward more and more as the shell grows, so that the suture thus formed makes an irregular spiral line ascending the spire over the antecedent whorls until by about the tenth turn the whole of the spire is enveloped, as well as any barnacles, vermetus, or other semiparasitic growth which may have become attached to the surface of the spire; the anterior part of the shell has the shape of *Leiorhynus*, the pillar is rather thick and slightly recurved, with a moderately distinct fasciole; the canal moderately wide, shorter than the pillar; the outer lip simple, sharp, a little thickened at the resting stages, but not lirate internally; body with a moderate callus, which at the resting stages is considerably enlarged, so that when the whorl comes to grow over it (as it is not absorbed) it produces an irregularity somewhat like a varix; the whorls are ovately rounded, smooth, except for occasional transverse undulations due to irregularities of growth, and polished; no indications of color pattern have been observed.

The adolescent form (figs. 5 a, 5 b [pl. LV, figs. 1, 2 of this report]) a good deal resembles a *Strombus*, except that the anterior sulcus of the outer lip behind the canal is absent or represented only by the faintest wave in the margin; the spire is entirely enveloped by the backward prolongation of the last whorl, except at the tip, where the envelope is usually a little eroded or defective; there appears to be a resting stage at every two-thirds of a revolution of the whorl around the axis, for which reason, looking down on the spire, the outline of the shell transverse to the axis is subtriangular or three-sided; the outer lip is simple, rather sharp-edged, and very slightly, if at all, recurved; it extends backward to the tip of the spire, near which it recedes somewhat from its parallelism with the axis; at the shoulder, also, it is slightly excavated and thickened; the body is smooth, with a moderate callus, which becomes thicker near the shoulder; at the shoulder, in front of the excavation above noted, it becomes very thick, and is continued on to the spire parallel with the outer lip, and very near it, so that between the two is a narrow, flexuous groove of considerable depth; when the shell begins to grow again the whorl is carried over this ridge, which is not absorbed, and the surface is thus rendered, as it were, varicose; the canal is short, strongly recurved, with a remarkably deep siphonal sulcus, so that the end of the pillar stands forward in a marked way; on the shoulder, half way around the shell, is an ill-defined, narrow ridge, which ceases a little way behind the

lip. The dimensions of the figured specimen are: Lon. 68.0 [65.5]; max. lat. 35.0 millimeters.

The adult form differs from the adolescent by the disproportionate strength of the ridge at the shoulder, by which the surface behind the ridge has become flattish as in a *Cassis*, but more irregular, and the width at the shoulder has increased in proportion to the total length. No entirely complete specimen of the adult has been found, but from the numerous fragments the proportions can be approximately determined. The max. diam. is 74.0 and the length about 110.0 mm., of which 15.0 mm. are behind the shoulder, while, in the specimen only 68.0 mm. long, there are 17.0 mm. of length behind the shoulder.

This species appears abundantly, though in a poor state of preservation, in the lower bed at Alum Bluff, and in the Chipola beds to the westward. The group in America would seem to be characteristic of the lower beds of the Southern Miocene, as far as our present knowledge permits us to judge.

I have observed that, occasionally, the ridge on the shoulder in young specimens is represented by a nodule rather than a ridge.—Dall, 1890.

Cotypes: U. S. Nat. Mus. No. 112218.

Type locality: No. 2112, 1 mile west of Baileys Ferry, Chipola River, Calhoun County, Fla.

Although numerous collections have been made in Florida since the publication of Dall's Wagner papers, no new localities have been added nor has more perfect material been found.

The species is still limited in its known distribution to the Alum Bluff and Chipola beds.

Occurrence: Chipola formation, localities 2212^{c}, 2213^{a}, 2564^{r}, 3419^{p}, 7256^{r}, 10971^{r}, 2211^{c}, 7183^{c}.

Family XENOPHORIDAE

Genus XENOPHORA Fischer von Waldheim

1807. *Xenophora* Fischer von Waldheim, Museum Démidoff, vol. 3, p. 213.

Type by subsequent designation (Gray, Zool. Soc. London Proc., pt. 15, p. 158, 1847): *Xenophora laevigata* Fischer von Waldheim=*Trochus conchyliophorus* Born. Recent off the eastern coast of the United States from Hatteras to the Antilles and in the Gulf of Mexico. Fossil throughout the East Coast and Gulf Tertiaries and in the Pleistocene.

Shell trochiform but not nacreous; imperforate or narrowly unbilicate. Base flattened or subconic; the peripheral keel commonly acute. Aperture obliquely quadrate. Shell armoured with agglutinated extraneous objects of such dimensions that the diameter of the shell may be doubled by the load that it carries.

Xenophora textilina Dall

Plate LVII, figures 31, 32

1892. *Xenophora textilina* Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 2, p. 361.

It [*Xenophora conchyliophora* (Born)] is followed in the Older Miocene of the Chipola beds by an analogous form, *X. textilina* Dall, which differs in having the granulation of the surface coarser and stronger, being marked even on the upper surface, and in having the base, especially round the umbilicus (which is small and sometimes nearly closed), distinctly spirally grooved. This shell reaches 55 millimeters in diameter (exclusive of its load, which is a large one), has eight or nine whorls, and an elevation of 35 millimeters. The basal grooves are shallow and narrower than their interspaces, which have the effect of half a dozen flattish spiral ribs. The umbilicus is larger than in *X. conchyliophora*, but not so large as in *Tugurium*. The basal margin is little excavated and not at all produced.—Dall, 1892.

The surface of the spire when not concealed by agglutinated objects is closely and finely lirated, the lirae uniform in strength and spacing but inconsistent in direction.

The fragment from the Shoal River beds, the only trace of the presence of the genus at that horizon, has apparently a somewhat larger umbilicus than the Chipola form and the spiral sculpture around the umbilicus is heavier and more sharply defined.

Occurrence: Chipola formation, locality 2213^{r}; Shoal River formation, locality ?3742^{r}.

Superfamily CALYPTRAEACEA

Morley Davies, 1935,[23] has questioned the propriety of uniting the Calyptraeidae, the Capulidae, and the Hipponicidae under a single superfamily, believing that the members of these three families may be of diverse stock and that their apparent resemblance is due to their adaptation to a sessile environment. However, he admits that "In all there is a dextral spiral protoconch, which rapidly opens out in trumpet form before the adult sculpture begins." The anatomical characters which the three families share may be degenerate and result from their common sessile habit.

Family CALYPTRAEIDAE

Genus CALYPTRAEA Lamarck

1799. *Calyptraea* Lamarck, Prodrome d'une nouvelle Classification des coquilles, Soc. histoire nat. Paris Mém., p. 78.

Type by monotypy: *Patella chinensis* Linnaeus. Recent on the European coast from the British Isles to the Mediterranean. Fossil in the Pliocene and Pleistocene.

Shell conic to trochiform. Base circular or rarely oval. Apex medial, spiral. Inner diaphragm developed analogous to inner cup of *Crucibulum* and posterior lamina of *Crepidula*. Columellar margin of diaphragm twisted to form a false umbilicus. Outer margin adherent to periphery of shell. Free margin convex.

The genus originated in the Cretaceous and the distribution of the Recent representatives is world-wide. The forms attach themselves to extraneous objects and are peculiarly characteristic of the inshore waters.

Periphery subcircular in outline; external surface smooth except for faint incremental striae ..... *Calyptraea centralis* (Conrad).

[23] Davies, Morley, Tertiary faunas, vol. 1, The Composition of Tertiary faunas, p. 243, 1935.

Periphery oval in outline; external surface sculptured with approximately 10 or 12 fine edged, crenulated, concentric lamellae ..... *Calyptraea crenata* Gardner, n. sp.

Calyptraea centralis (Conrad)

Plate LVI, figures 3, 4, 5

1841. *Infundibulum centralis* Conrad, Am. Jour. Sci., 1st. ser., vol. 41, p. 348.
1845. *Infundibulum centralis* Conrad, Fossils of the Medial Tertiary of the United States, p. 80, pl. 45, fig. 5.
1846. *Calyptraca (Infundibulum) concentricum* H. C. Lea, Am. Phil. Soc. Trans., new ser., vol. 9, p. 249, pl. 35, fig. 39.
1856. *Trochita centralis* (Conrad). Tuomey and Holmes, Pleiocene fossils of South Carolina, p. 109, pl. 25, fig. 8.
1858. *Trochita centralis* Conrad. Emmons, North Carolina Geol. Survey Rept., p. 276, fig. 193.
1863. *Trochita (Infundibulum) centralis* Conrad, Acad. Nat. Sci. Philadelphia Proc. for 1862, vol. 14, p. 568.
1863. *Trochita (Infundibulum) concentrica* Lea. Conrad, Acad. Nat. Sci. Philadelphia Proc. for 1862, vol. 14, p. 568.
1864. *Trochita centralis* Conrad. Meek, Miocene check list, Smithsonian Misc. Coll., No. 183, p. 15.
1864. *Trochita concentrica* (H. C. Lea) Conrad. Meek, Miocene check list, Smithsonian Misc. Coll. No. 183, p. 15.
1875. (?)*Galerus parvulus* Dunker. Deutsche Mal. Gesell. Jahrb., p. 244.
1881. *Trochita Collinsii* Gabb, Acad. Nat. Sci. Philadelphia Jour., 2d ser., vol. 8, p. 342, pl. 44, figs. 11, 11a. Described from the lower Miocene at Sapote, Costa Rica.
1889. (?)*Calyptraea Candeana* D'Orbigny. Dall, Harvard Coll., Mus. Comp. Zoology. Bull. 18, p. 284.
1892. *Calyptraea centralis* (Conrad). Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 353.
1904. *Calyptraea centralis* (Conrad). Martin, Maryland Geol. Survey, Miocene, p. 248. pl. 59, figs. 2a, 2b, 2c.
1909. *Calyptraea centralis* Conrad. Grabau and Shimer, North American index fossils, vol. 1, p. 713, figs. 1029a-c (after Martin).
1919. *Calyptraea centralis* Conrad. Gardner and Aldrich, Acad. Nat. Sci. Philadelphia Proc., p. 18 (check list, name only).
1922. *Calyptraea centralis* (Conrad). Pilsbry, Acad. Nat. Sci. Philadelphia Proc., p. 385.
1925. *Calyptraea centralis* Conrad. Maury, Bull. Am. Paleontology, vol. 10, No. 42, p. 243, pl. 43, fig. 2.
1930. *Calyptraea centralis* (Conrad). Mansfield. Florida Geol. Survey Bull. 3, p. 120.
?1937. *Calyptraea centralis* Conrad. Smith. Maxwell, East coast marine shells, p. 95, pl. 36, fig. 9.

Obtusely ovate, with fine concentric irregular lines; apex central.—Conrad, 1841.

Type locality: Natural Well, 2 miles southwest of Magnolia, Duplin County, N. C.

Shell rather small, capuloid or conic. Apex central. Nucleus glassy, of one and one-half volutions, the initial half turn largely immersed, the succeeding whorl coiled in the same horizontal plane but more inflated and rapidly increasing in diameter. Axis of coiling of conch at a high angle to that of protoconch. Lateral slope steeper in the apical region, rather abruptly flattening a third or a half of the way to the periphery. Surface smooth except for swirling incrementals. Outline of free margin of diaphragm sigmoidal, deeply and narrowly sinuated near the periphery but arching forward between the sinus and the reverted inner edge of the septum.

This species is well marked by a sort of umbilicus on the pillar, where it is reflected, and by the arching forward of the free edge of the septum, characters which have been exactly preserved since the early Miocene. The only modification visible during the whole of that period, as represented by a full series of specimens, is a slight increase of size from the early to the later Miocene, and a slight average decrease since, the Recent specimens being about the size of those from the Chipola beds, while those from the Natural Well, Duplin County, are the largest. The differences, however, are not great, and may be accidental to the particular locality rather than characteristic of chronological changes.—Dall, 1892.

The Chipola forms in question are probably young; an individual from Shoal River measures 25.0 millimeters in diameter. The Recent individuals in our collections average no more than 6.0 millimeters, and this consistent difference in size is probably of taxonomic significance.

The figured individual, from St. Marys River, Maryland, is in the Aldrich collection of Johns Hopkins University. It measures 10 millimeters in height and 18 millimeters in maximum diameter.

Calyptraea centralis (Conrad) is one of the few forms common to all horizons of the Alum Bluff.

Occurrence: Chipola formation, localities 7257^{r}, 2213^{c}, 2564^{r}, 3419^{c}, 7151^{p}, 2211^{p}; Oak Grove sand, localities 3385^{r}, 7148^{r}, 2646^{a}, 5632^{c}, 5631^{p}, 5633^{p}, 7054^{p}, 10659^{r}; Shoal River formation, 3856^{p}, 3742^{a}, 10658^{r}, 5184^{r}, 5079^{p}, 3733^{r}, 5618^{r}.

Outside occurrence: Miocene: St. Marys formation, Maryland-Virginia; Yorktown formation, North Carolina; Duplin marl, North Carolina-South Carolina; Choctawhatchee formation (*Ecphora* and *Cancellaria* zones), Florida; Waccamaw formation, North Carolina. Pliocene: Caloosahatchee marl, Florida. Recent: Reported from Cape Hatteras to the Gulf of Mexico and the West Indies in 1 to 52 fathoms.

Pilsbry has reported the species from the Miocene of Santo Domingo, Gabb from the lower Miocene of Costa Rica, and Miss Maury from the upper Miocene and the Pliocene of Trinidad.

Calyptraea crenata Gardner, n. sp.

Plate LVI, figures 1, 2

Shell rather large and low for the genus, oval turbinate. Apex posterior and sinistral. Nucleus small, smoothly coiled in 1½ volutions at a low angle to the axis of the conch. Initial half turn largely immersed; succeeding whorl inflated and increasing rapidly in size. Conch performing approximately two elliptical volutions, the final whorl contracted at its extremity like the infolded end of a turban. External surface

sculptured with incremental striae and, at regular intervals, sharp, crenate lamellae, 10 in number in the type, 12 in the only other individual known. Peritreme irregularly emarginate. Internal diaphragm thin, concave, its outer edge adherent to the periphery. Columellar margin twisted into a minute loop which simulates a true umbilicus; columella strongly posterior and sinistral.

Dimensions of holotype: Height, 6.5 millimeters; maximum diameter, 14.8 millimeters; diameter at right angles to maximum diameter, 13.7 millimeters.

Holotype: U. S. Nat. Mus. No. 136053.

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

Calyptraea crenata is a remarkable form, conspicuous for its oval, turbinate outline, and its sculpture of fine-edged, crenulated lamellae. It is known only from the type locality; two individuals were collected.

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

Genus CREPIDULA Lamarck

1799. *Crepidula* Lamarck, Prodrome d'une nouvelle classification des coquilles: Soc. histoire nat. Paris Mém., p. 78.
1892. *Crepidula* Dall, W. H., Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, pp. 354-356.

Type by monotypy: *Patella fornicata* Linnaeus. Miocene to Recent on the east coast and Gulf and in the West Indies.

Ovate or oblong, slightly concave to strongly convex in outline. Apex posterior, submarginal. Aperture closed posteriorly by a horizontal lamella analogous to the inner cup of *Crucibulum* and the diaphragm of *Calyptraea;* free margin of septum straight, concave, or sigmoidal.

The genus is first recognized in the Cretaceous, although it does not become abundant until the middle of the Tertiary. The Recent "boat" or "slipper" shells are among the most prolific denizens of the shallower waters of the warm and tropical seas.

Dall, 1892, has discussed at length the influence of situs upon a perching form like *Crepidula.*

Two of the three common Tertiary species are represented at each horizon of the Alum Bluff group, and no new forms have been introduced, unless some peculiar dwarfish little forms from Oak Grove, which have been tentatively referred to *C. fornicata* Lamarck, are included. The genus is best represented at the Oak Grove horizon.

Surface sculptured.....*Crepidula aculeata costata* Morton
Surface not sculptured:
  Surface convex.....*Crepidula fornicata* (Linnaeus)
  Surface flattened or slightly concave..*Crepidula plana* Say

Crepidula aculeata costata Morton

1829. *Crepidula costata* Morton, Acad. Nat. Sci. Philadelphia Jour., 1st ser., vol. 6, p. 115, pl. 7, figs. 2, 3.
?1843. *Crepidula spinosa* Conrad, Acad. Nat. Sci. Philadelphia Proc., vol. 1, p. 307.
1856. *Crypta spinosa* (Conrad). Tuomey and Holmes, Pleiocene fossils of South Carolina, p. 111, pl. 25, fig. 10.
1856. *Crypta costata* (Morton). Tuomey and Holmes, Pleiocene fossils of South Carolina, p. 112, pl. 25, fig. 11.
1892. *Crepidula aculeata* Gmelin, var. *costata* Morton. Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 357.
1919. *Crepidula aculeata* subsp. *costata* Morton. Gardner and Aldrich, Acad. Nat. Sci. Philadelphia Proc., p. 18 (check list, name only).
1930. *Crepidula aculeata* var. *costata* Morton. Mansfield, Florida Geol. Survey Bull. 3, p. 115.
1930. *Crepidula aculeata* var. *spinosa* Conrad. Mansfield, idem, p. 115.

Shell oval, thick, very convex, with numerous longitudinal elevated costae; beaked side flattened; margin plain.

Length 1⅞ inch. Breadth 1½ inch. Depth 1 inch.—Morton, 1829.

Morton's type was among the shells in the Finch collection, reported, apparently erroneously, to have been made from Maryland. This species, like many other of the Finch shells, is not recorded in the later extensive work of Clark and Martin, but as Mansfield indicated in 1930, it is characteristically represented in the Yorktown formation of Virginia and rarely in the St. Marys. Mansfield has considered the varietal form *C. spinosa* Conrad, described from the James River near Smithfield, Va., as taxonomically distinct. In Florida, *C. aculeata* is restricted almost or altogether to the *Ecphora* zone; *C. spinosa* is abundant, according to Mansfield, at Jackson Bluff, which is in the *Ecphora* zone; it is also common in the *Cancellaria* zone at the Deadens, a local name given to an area of prairie topography broken by numerous sinks. In North Carolina, at Natural Well, the two forms are apparently coexistent, and the differences in outline and sculpture pattern seem to be without taxonomic significance.

The Recent forms, like *Calyptraea centralis,* are consistently smaller than the upper Miocene individuals. The representation in the Alum Bluff group is restricted to three specimens from a single locality in the Shoal River formation, all of them small, not strongly arched, and with a nonspinose, *C. costata* type of sculpture.

Shell heavy, ovate or oblong, varying rather widely in degree of convexity. Beak posterior, submarginal, more or less twisted. Protoconch small, similar to that of *Calyptraea centralis;* smooth, polished, one and a half times coiled. Surface sculptured with spinose or rugose lirae radiating from the beak to the outer margin. Internal lamina posterior, covering approximately half the aperture. Free margin of lamina loosely sigmoidal.

Crepidula aculeata costata Morton is distinguished from all other coexistent members of the genus in the east-coast Neogene by the development of a strong external sculpture. In abundance and wide distribution, it is second only to *Crepidula fornicata* (Linnaeus).

Occurrence: Shoal River formation, locality 5618[r].

Outside occurrence: Miocene: St. Marys formation,

Virginia; Yorktown formation, Virginia-North Carolina; Duplin marl, North Carolina-South Carolina. Pliocene: Choctawhatchee formation, Florida; Waccamaw formation, North Carolina-South Carolina.

Crepidula fornicata (Linnaeus)

1758. *Patella fornicata* Linnaeus, Systema naturae, 10th ed, p. 781.
1822. *Crepidula fornicata* Lamarck, Systéme des animaux sans vertèbres, vol. 6, p. 24.
1822. *Crepidula fornicata* ? var. Say, Acad. Nat. Sci. Philadelphia Jour., 1st ser., vol. 2, p. 225.
1843. *Crepidula densata* Conrad, Acad. Nat. Sci. Philadelphia, Proc., vol. 1, p. 311.
1844. *Crepidula cymbaeformis* Conrad, Acad. Nat. Sci. Philadelphia Proc., vol. 1, p. 173.
1846. *Calyptraea (Crepidula) ponderosa* H. C. Lea, Am. Phil. Soc. Trans., new ser., vol. 9, p. 249, pl. 35, fig. 40.
1846. *Calyptraea (Crepidula) cornucopiae* H. C. Lea, Am. Phil. Soc. Trans., new ser., vol. 9, p. 250, pl. 35, fig. 41.
1856. *Crypta fornicata* (Lamarck). Tuomey and Holmes, Pleiocene fossils of South Carolina, p. 110, pl. 25, fig. 9.
1858. *Crepidula fornicata* Emmons, North Carolina Geol. Survey Rept., p. 276, fig. 194.
1861. *Crypta cymboeformis* Conrad, Fossils of the medial Tertiary of the United States, p. 81, pl. 45, fig. 7.
1861. *Crypta densata* Conrad, Fossils of the medial Tertiary of the United States, p. 81, pl. 45, fig. 9.
1861. *Crypta fornicata* Lamarck. Conrad, Fossils of the medial Tertiary of the United States, p. 81, pl. 45, fig. 10.
1863. *Crypta (Crepidula) cornucopia* H. C. Lea. Conrad, Acad. Nat. Sci. Philadelphia Proc. for 1862, vol. 14, p. 569.
1863. *Crypta (Crepidula) cymbaeformis* Conrad, Acad. Nat. Sci. Philadelphia Proc. for 1862, vol. 14, p. 569.
1863. *Crypta (Crepidula) densata* Conrad, Acad. Nat. Sci. Philadelphia Proc. for 1862, vol. 14, p. 569.
1863. *Crypta (Crepidula) fornicata*? Say. Conrad, Acad. Nat. Sci. Philadelphia Proc. for 1862, vol. 14, p. 569.
1864. *Crypta cornucopia* (H. C. Lea) Conrad. Meek, Miocene check list, Smithsonian Misc. Coll., No. 183, p. 15.
1864. *Crypta cymbiformis* Conrad. Meek, Miocene check list, Smithsonian Misc. Coll., No. 183, p. 15.
1864. *Crypta densata* Conrad. Meek, Miocene check list, Smithsonian Misc. Coll., No. 183, p. 15.
1864. *Crypta fornicata* (Say?) Conrad. Meek, Miocene check list, Smithsonian Misc. Coll., No. 183, p. 15.
1870. *Crepidula rostrata* Conrad, Am. Jour. Conchology, vol. 6, p. 77.
1870. *Crepidula virginica* Conrad. Am. Jour. Conchology, vol. 6, p. 78.
1870. *Crepidula recurvirostra* Conrad, Am. Jour. Conchology, vol. 6, p. 78.
1886. *Crepidula fornicata* Linneaus. Tryon, Manual of Conchology, vol. 8, p. 124, pl. 36, figs. 1-8.
1892. *Crepidula fornicata* (Lamarck) Say. Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 356.
1904. *Crepidula fornicata* (Linnaeus). Martin, Maryland Geol. Survey, Miocene, p. 249, pl. 59, figs. 4a, 4b.
1905. *Crepidula fornicata* (Linnaeus). Clark, Maryland Geol. Survey, Pliocene and Pleistocene, p. 189, pl. 51, figs. 1-4.
1908. *Crepidula fornicata* Linnaeus. Rogers, The shell book, p. 148, pl. 44, figs. 5, 6.
1909. *Crepidula fornicata* (Linnaeus). Grabau and Shimer, North American index fossils, vol. 1, p. 714, figs. 1031c and d.
1919. *Crepidula fornicata* (Linnaeus). Gardner and Aldrich, Acad. Nat. Sci. Philadelphia Proc., p. 18.
1925. *Crepidula fornicata* Linnaeus. Maury, Bull. Am. Paleontology, vol. 10, no. 42, p. 244.
1930. *Crepidula fornicata* (Linnaeus). Mansfield, Florida Geol. Survey Bull. 3, p. 116.
1930. *Crepidula fornicata* var. *ponderosa* H. C. Lea. Mansfield, Florida Geol. Survey Bull. 3, p. 117.
1930. *Crepidula fornicata cymbaeformis* Conrad. Mansfield, Florida Geol. Survey Bull. 3, p. 117.
1930. *Crepidula fornicata rostrata* Conrad. Mansfield, Florida Geol. Survey Bull. 3, p. 117.
1937. *Crepidula fornicata* Linnaeus. Maxwell Smith, East coast marine shells, p. 95, pl. 36, figs. 5a, 5b; pl. 68, fig. 16; pl. 69, figs. 23, 24.

P. testa integra ovali postice oblique recurva, labio postico concavo. * * * Habitat ad Ilvam (Elba) insulam.—Linnaeus, 1758.

Shell transversely wrinkled, varying in convexity, with obsolete longitudinal, undulated, rufous lines; one side more oblique than the other; apex excurved, a little prominent, but not separated from the body of the shell, and generally united with the margin of the aperture; aperture suboval; diaphragm a little concave, occupying at least half of the length, edge generally reclivate.

Inhabits the coast of the United States.

Length 2 inches.—Say, 1822.

The typical *fornicata* is found as characteristic in the Chesapeake Miocene as in the Recent fauna. *C. cymboeformis* is a station variety due to growth on a narrow, arched surface of moderately large size, such as the exterior of a *Melongena* shell.

C. ponderosa is due to luxuriant growth on a similar but smaller surface, necessitating an increased vertical and consequently spiral enlargement; *C. densata* to growth on a flatter but still inconveniently limited surface in the matter of area; *C. rostrata* is one of a series of Crepidulae which probably grew on each other's backs, as they may frequently be seen to do now among the oyster-beds, sometimes as many as six being mounted one upon another; *C. recurvirostra* is the same thing, and *C. virginica* is a frank synonym of the typical *fornicata*.—Dall, 1892.

Shell ovate or oblong, varying widely in degree of convexity. Apex posterior, submarginal. Nucleus small, smooth, polished, of one and one-half or two dextrally inclined volutions. Sculpture absent except for incrementals. Internal lamina flattened or slightly concave, covering, as a rule, a little more than the posterior half of the aperture. Free edge of septum concave or loosely sigmoidal.

Like all perching forms, *Crepidula fornicata* (Linnaeus) is exceedingly variable in outline. It is isolated from the co-existent species by the absence of characters diagnostic of other forms rather than by the presence of constant characters of its own. *Crepidula aculeata costata* Morton develops an axial sculpture; *Crepidula plana* Say runs much smaller than *C. fornicata* and is flattened or concave rather than convex. The Recent *Crepidula convexa* Say is similar in absence of sculpture and outline but is characterized by the straight margin of the septum.

Crepidula fornicata (Linnaeus) is the most common of the "slipper" or "boat" shells of the east coast. Indeed, so abundant are these "quarter-decks," as they are called in trade, that they have a commercial value and are sold to the oyster growers for four or five cents a bushel to serve as "clutch" for the oyster spat.

Occurrence: Chipola formation, localities 2213[p], 2564[p] (young), 3419[c]; Oak Grove sand, localities 3385[p], 7148[r], 2646[a], 5632[p] (young), 5631[p] (young), 5633[p]; Shoal River formation, localities 3742[c], 5079[p], ?3733[p] (young), ?5618[r] (young), 9959[r].

Outside occurrence: Miocene: Calvert formation, Maryland-Virginia; Choptank formation, Maryland; St. Marys formation, Virginia; Yorktown formation, Virginia-North Carolina; Duplin marl, North Carolina-Georgia; Choctawhatchee formation, Florida. Pliocene: Waccamaw formation, North Carolina-South Carolina; Nashua marl, Florida; Caloosahatchee marl, Florida; Croatan sand, North Carolina. Pleistocene: Massachusetts; Maryland; New Jersey; Virginia; South Carolina; Florida. Recent: Prince Edward Island to the West Indies in 2 to 19 fathoms.

Crepidula aesop Dall

1903. *Crepidula aesop* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 6, p. 1610, pl. 55, figs. 6, 7 (no description).

1930. *Crepidula aesop* Dall (? *Crepidula fornicata* var. *rostrata* Conrad). Mansfield, Florida State Geol. Survey Bull. 3, p. 118.

Dall figured a young shell from Shell Creek characterized by the laterally compressed outline, high free beak, and obscure and irregular radial sculpture.

Mansfield was not sure that it was separable from *Crepidula rostrata* Conrad. Conrad's species was described from a shell from the Virginia Miocene. No locality was given and no figure. He listed among the characters a short diaphragm with a slightly concave but not a sinuous margin. The diaphragm in *Crepidula aesop* is short and deeply inset. The margin in the adult is sinuous.

About 25 or 30 individuals from the Oak Grove sand are dubiously referred to *C. aesop* Dall, although they may be nothing more than another mutant of *Crepidula fornicata.* They are all laterally compressed, 5 or 6 millimeters high, and relatively heavy, suggesting adult dwarfs. In most of them an irregular radial corrugation is developed over a whole or a part of the shell, but this is of such a character as to suggest a derivation from the object to which it was attached rather than a specific tribute. In the Oak Grove shells the nuclear tip is in the plane of the margin and, in all but the most perfect specimens, is worn down. In *Crepidula aesop* the nuclear shell tips the high free beak.

Occurrence: Oak Grove sand, localities ?2646[p], ?5632[r], ?5631[r].

Outside occurrence: Pliocene, Caloosahatchee marl, Shell Creek, Fla.

Crepidula plana Say

Plate LVII, figures 25, 26?

1822. *Crepidula plana* Say, Acad. Nat. Sci. Philadelphia Jour., 1st ser., vol. 2, p. 226.

1846. *Calyptraea (Crepidula) lamina* H. C. Lea, Am. Phil. Soc. Trans., new ser., vol. 9, p. 250, pl. 35, fig. 42.

1856. *Crypta plana* (Say). Tuomey and Holmes, Pleiocene fossils of South Carolina, p. 111, pl. 25, fig. 12.

1858. *Crepidula plana* Say. Emmons, Rept. of North Carolina Geol. Survey, p. 276, fig. 195.

1863. *Crypta (Crepidula) plana* ? Say. Conrad, Acad. Nat. Sci. Philadelphia Proc. for 1862, vol. 14, p. 569.

1864. *Crypta plana* Say?. Meek, Miocene check list, Smithsonian Misc. Coll., No. 183, p. 16.

1889. *Crepidula protea* D'Orbigny. Dall, *Blake* Repts., Mollusca, pt. 2, Gastropoda and Scaphopoda, Harvard Coll., Mus. Comp. Zool. Bull., vol. 18, p. 285.

1892. *Crepidula plana* Say. Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 358.

1904. *Crepidula plana* Say. Martin. Maryland Geol. Survey, Miocene, p. 250, pl. 59, figs. 5a, 5b.

1906. *Crepidula plana* Say. Clark, Maryland Geol. Survey, Pliocene and Pleistocene, p. 190, pl. 51, figs. 5-8.

1908. *Crepidula plana* Say. Rogers, The shell book, p. 150, pl. 44, fig. 2.

1909. *Crepidula plana* Say. Grabau and Shimer, North American index fossils, vol. 1, p. 713, figs. 1031a-b.

1911. *Crepidula plana* Say. Brown and Pilsbry, Acad. Nat. Sci. Philadelphia Proc. for 1910, p. 360.

1919. *Crepidula plana* Say. Gardner and Aldrich, Acad. Nat. Sci. Philadelphia Proc. for 1918, p. 18 (check list, name only).

1922. *Crepidula plana* Say. Pilsbry, Acad. Nat. Sci. Philadelphia Proc. for 1921, pt. 2, p. 385.

1922. *Crepidula plana* Say. Olsson, Bull. Am. Paleontology, vol. 9, no. 39, p. 159.

1930. *Crepidula plana* Say. Mansfield, Florida Geol. Survey Bull. 3, p. 116.

1937. *Crepidula plana* Say. Maxwell Smith, East coast marine shells, p. 96, pl. 36, fig. 14, pl. 68, fig. 12 (radula); pl. 69, fig. 26.

Shell depressed, flat, oblong oval, transversely wrinkled, lateral margins abruptly deflected; *apex* not prominent, and constituting a mere terminal angle, obsolete in the old shells; *within* white; *diaphragm* occupying half the length of the shell, convex, contracted in the middle and at one side.

Length 1 and 1-10 of an inch.

Inhabits the coast of the United States.

Cabinet of the Academy and Philadelphia Museum.

A remarkably distinct species, the surface of the shell is flat, and sometimes slightly concave. The young shell is generally orbicular, and gradually becomes proportionally more elongated as it increases in size. I have found it on the coasts of Maryland, Carolina, Georgia and East Florida, and my brother, Mr. Benjamin Say, discovered it on the shores of New Jersey.—Say, 1822.

Two individuals from locality 2646, Oak Grove, Yellow River, are figured in this report. One of them (U. S. Nat. Mus. No. 136061) is 37.5 millimeters long and 20.5 millimeters wide and displays the characteristic features of the species. The other (U. S. Nat.

Mus. No. 350470) is warped to a length of only 22 millimeters and a width of 20 millimeters. The latter may more properly be referable to *C. fornicata.*

Shell rather thin for the genus, flattened or feebly concave, often a little twisted. Apex marginal, central or slightly dextral, commonly inflated. Protoconch small, smooth, polished, of about 1-¾ volutions, coiled in a single plane and opening like a trumpet. Growth lines conspicuous; faint radial striations may be present but no true sculpture developed. Internal lamina straight or a little convex at the margin, covering approximately half the aperture. Free edge of septum feebly contracted medially.

Though Dall considered *Crepidula plana* Say as nothing more than a dynamic mutant, it is so readily isolated by the peculiarities of its outline that it seems unnecessary to deprive it of specific rank without definite proof that the diagnostic outline, and, in the Recent species, the absence of color markings are due merely to situs and cannot be inherited. Even the protoconch seems to have been affected by the narrow confines of its habitat, as it is a little smaller relatively and more flattened than in *C. fornicata.* The species is very common in the Recent seas, and there is no apparent reason why the permanence of its characters should not be made a subject for experimentation rather than speculation. *Fulgur* and *Polinices* were the most popular lodging houses for the *Crepidula plana* of the east coast later Tertiary period.

Occurrence: Chipola formation, localities 2212^{p}, 2213^{c}, 2564^{p}, 3419^{r}, 2211^{p}; Oak Grove sand, localities 2646^{p}, 5632^{r}, 5633^{r}, 7054^{r}; Shoal River formation, localities 3856^{p}, 3742^{r}.

Outside occurrence: Miocene: Calvert formation, Maryland; Choptank formation, Maryland; St. Marys formation, Maryland-Virginia; Yorktown formation, Virginia-North Carolina; Duplin marl, North Carolina-South Carolina; Choctawhatchee formation (*Ecphora* and *Cancellaria* zones), Florida. Pliocene: Waccamaw formation, North Carolina-South Carolina; Nashua marl, Florida; Caloosahatchee formation, Florida; Croatan formation, North Carolina. Pleistocene: Massachusetts to Florida. Recent: Prince Edward Island to Bahia, Brazil, in shallow waters. Dredged by the Woods Hole Survey in 2 to 25 fathoms on various bottoms. Most commonly found inside shells occupied by hermit crabs, more rarely on the outside of *Ostrea, Limulus,* and some other shells.

Genus CRUCIBULUM Schumacher

1817. *Crucibulum* Schumacher, Essai d'un nouveau système des habitations des vers testacés, pp. 56, 182.

Type by subsequent designation (Gray, Zool. Soc. London Proc., pt. 15, p. 157, November 1847): *Patella auriculata* of Chemnitz and Dillwyn = *Patella auricula* Gmelin = *Crucibulum planum* Schumacher.

Herrmannsen's earlier designation in March, 1847, is invalid for "*Calyptraea Chinensis* Linn." is not one of the two species first mentioned by Schumacher.

Shell limpetlike, subconic, rarely spiral, with central or subcentral nucleus. Sculpture dominantly radial. Incremental corrugations commonly pronounced. Adductor muscles attached to a funnel-shaped process, adherent by the apex alone, by a lateral seam along the left wall, or by a considerable part of the wall.

Although the animal retains the power of locomotion, it rarely exercises it and accepts as a permanent abode the situs upon which it has perched early in life. The resulting adaptive characters account for the wide range of variation within a single species.

Crucibulum is common in the Miocene and Pliocene formations of the east coast. The Recent representatives, the so-called "cup and saucer limpets", occur on both the east and west coasts in considerable abundance and are recorded from the Indian Ocean and the China Sea. The species range widely, as a rule, in time and place and vary with their location to such an extent that determinations cannot be made with any degree of assurance from the outline or the external sculpture.

In the distribution of the genus in the Alum Bluff group, however, the three horizons are well defined. Of the six species only one is represented in all three formations. Two are common to the Oak Grove sand and Shoal River formation, a third is a later Miocene species questionably present in the Oak Grove sand; each of the three remaining species is clearly restricted to a single horizon.

Internal cup adherent in adult by lateral seam ..... *Crucibulum chipolanum* Dall s. l.
Radials usually exceeding 35 in number at their initiation ..... *C. chipolanum* Dall, s. s.
Radials rarely exceeding 32 in number at their initiation ..... *C. chipolanum dodoneum* Gardner, n. subsp.

Internal cup adherent over a part of the wall:
Radial sculpture not developed over any part of the shell:
Apex subcentral:
Cup adherent over one-sixth to one-tenth of its surface ..... *Crucibulum waltonense* Gardner, n. sp.
Cup adherent over approximately one-third of its surface ..... *Cricubulum constrictum conjuge* Gardner, n. subsp.
Apex well within the posterior half of the shell ..... *Crucibulum grande* (Say).
Radial sculpture developed over a part or the whole of the shell:
Radials not spinose:
Cup adherent over one-sixth to one-tenth of its surface ..... *Crucibulum waltonense* Gardner, n. sp.
Cup adherent over approximately one-third of its surface ..... *Crucibulum constrictum conjuge* Gardner, n. subsp.
Radials spinose over a whole or a part of the shell ..... *Crucibulum multilineatum* (Conrad).

Crucibulum chipolanum Dall

Plate LVI, figures 10, 11

1892. *Crucibulum auriculum* var. *chipolanum* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 349.

Shell with sharply cut radiating threads and riblets, rarely dichotomous, stronger than in the typical form, yet not reaching the strength of the ribs in *C. costatum*. From the older Miocene of the Chipola River, a mile below Baileys Ferry, Burns. All the specimens from this horizon appear to have this particular sculpture, which otherwise would hardly have authorized the application to them of even a varietal distinctive name.—Dall, 1892.

Dimensions of cotype: Height, 4.5 millimeters; maximum diameter, 12.9 millimeters; diameter at right angles to maximum diameter, 10.8 millimeters.

Dimensions of figured specimen: Height, 14.5 millimeters; diameter, 24.5 millimeters; diameter at right angles to maximum diameter, 19.5 millimeters.

Cotypes: U. S. Nat. Mus. No. 112782. Figured specimen: U. S. Nat. Mus. 112783.

Type locality: No. 2213, 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla. Figured specimen from No. 2212, Tenmile Creek, 1 mile west of Baileys Ferry, Calhoun County, Fla.

Shell of medium size and height. Peritreme subcircular or somewhat compressed laterally, commonly irregular. Apex submedial, in line with the area of attachment. Protoconch small, smooth, highly polished, coiled in a single plane of 1-¾ or 2 volutions, the first half turn largely immersed, the succeeding coil evenly inflated; inclined to the right when the attached area of the inner cup is held upward facing the observer. Surface in apical region smooth; sculpture initiated rather abruptly, with about 40 somewhat irregularly cordate radials separated by sharply cut linear interspaces; this number increased by intercalation and bifurcating so that it is often more than doubled at the periphery; general character of radials constant from origin to base. Peripheral margin crenulated in harmony with the sculpture. Cup rather small, pyriform in the adult and attached by a posterior seam; area of attachment much wider in the young, the cup being commonly adnate over a third or more of the parietal wall.

Dall considered *Crucibulum chipolanum* a subspecies of *C. auriculum*, but the protoconchs are dissimilar; that of *C. auriculum* is much broader and more flattened and performs but little more than a single complete volution. The differences in the sculpture are more obvious though of less systematic value.

Occurrence: Chipola formation, localities 2212[c], 2213[c], 2564[r], 3419[p], 7151[p], 2211[r].

Crucibulum chipolanum dodoneum Gardner, n. subsp.

Plate LVI, figures 18-20

Shell moderately large and heavy, conical, the base rudely circular and irregularly oval. Apex submedial, in line with the area of attachment of the inner cup. Nucleus smooth, polished, coiled in a single plane, a minute cornucopia of a little more than two complete volutions. Sculpture exceedingly variable; in many individuals, as in the type, including 25 to 30 vigorous radials abruptly initiated at the beginning of the conch, increasingly stronger toward the periphery and 50 to 100 per cent more numerous; interradials sharply grooved. Peripheral margin crenate in the thinner individuals, simple in the heavier. Internal cup not quite half so high as the entire shell; pyriform; in the fully adult, adnate by a posterior seam but adnate in the young over a considerable portion of the parietal surface.

Dimensions of holotype: Height, 13 millimeters; maximum diameter, 25 millimeters; diameter at right angles to maximum diameter, 20 millimeters. Dimensions of larger but less perfect individual: Height, 21.5 millimeters; maximum diameter, 35.5 millimeters; diameter at right angles to maximum diameter, 25.7 millimeters.

Holotype: U. S. Nat. Mus. No. 350451.

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

Crucibulum chipolanum dodoneum is separated from its Chipola analog by the tendency toward the larger, coarser shell and the consistently coarser sculpture.

The sculpture is paralleled in some of the *C. auriculum,* but the nucleus of the Recent species is more flattened, less evenly inflated, initially immersed, and performs but little more than a single volution.

Occurrence: Oak Grove sand, localities 2646[a], 5632[c], 5631[r], 5630[p], 5633[c], 7054[p], 9961[p]; Shoal River formation, localities ?5184[r], 5079[p] (juveniles), ?3733[r].

Section "DISPOTAEA" auctores

The section *Dispotaea* Say (Acad. Nat. Sci. Philadelphia, Jour., vol. 4, p. 131, 1824) has been commonly used for those species in which an appreciable part of the cup, possibly a third or more, is adherent to the body wall. Say described the "genus" *Dispotaea* as follows: "Shell univalve, conoidal, patelliform, with an internal entire cup-shaped appendage, adhering by its side and apex to the side of the shell." From this description alone, the extent of the area of attachment is not clear. He listed two species, a Recent form from South America, whether from the east or the west coast is not stated, and *Calyptraea costata* Say, 1820. I have been unable to identify the Recent species from South America, and there is some doubt about the type locality and determination of the unfigured *C. costata.* The strongly costate individuals from the Yorktown and St. Marys formations, which have been commonly referred to *costata,* are attached only along a seam, and *Dispotaea* thus becomes a synonym of *Crucibulum* s.s. In fact Dall has considered *C. costata* as nothing more than a varietal form of the genotype of *Crucibulum* s.s.

The following species are characterized by the adhesion in the adult stage of a considerable part of the cup to the body wall.

Crucibulum waltonense Gardner, n. sp.

Plate LVI, figures 16, 17

Shell of moderate size and inclined to be high and warped. Apex slightly posterior, in line with the area of attachment of the inner cup. Nucleus small, smooth, polished, planorbiform, a little more than twice coiled; initial turn largely immersed; succeeding volution inflated, dextral. Early part of conch usually smooth except for incrementals or irregularly corrugated. True sculpture abruptly established in the form of 40 (in the type) irregular, cordate costals that either persist to the base or disappear to be replaced by others; intercalations and diastomosing common. Periphery finely crenulated by the radials. Cup rather large, more than half as high as the shell, pyriform, adnate to the posterior wall by one-eighth to one-tenth of its surface.

Dimensions of holotype: Height, 14 millimeters; maximum diameter, 25.5 millimeters; diameter at right angles to maximum diameter, 23 millimeters.

Holotype: U. S. Nat. Mus. No. 371873.

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

Crucibulum waltonense suggests *C. chipolanum* and its subspecies *dodoneum* in the general type of sculpture, but it differs from them in the usually later initiation of the radial sculpture, the relatively larger cup, and its wider area of adhesion.

The species is limited in its distribution to the Shoal River beds. Though not so abundant nor so widespread as *C. constrictum conjuge* it is far from rare at the single horizon.

Occurrence: Shoal River formation, localities 3856[c], 3742[c], ?5079[r], 5193[r].

Crucibulum constrictum conjuge Gardner, n. subsp.

Plate LVI, figures 14, 15

Shell of medium size, moderately high, slightly ovate, a little narrower as a rule at the posterior end than at the anterior. Peritreme usually regular. Nucleus dextral, minute, polished, the two volutions coiled in a single plane. Surface of conch generally smooth except for incremental and microscopically fine, irregular radial striae; undulatory radials may be developed over a whole or part of the surface; radials when present overridden by the incrementals, which appear as fine, sharp, overlapping lamellae. Margin entire except in the most ornate individuals. Cup moderately large, adnate to the posterior wall of the shell over about a third of the cup surface; posterior angle between cup wall and shell approximately 90°; anterior angle very small.

Dimensions of holotype: Height, 9.2 millimeters; maximum diameter, 16.7 millimeters; diameter at right angles to maximum diameter, 14.2 millimeters.

Holotype: U. S. Nat. Mus. No. 371874.

Type locality: No. 3732, Dave Adams Mill Creek, sec. 2, T. 3 N., R. 21 W., Walton County, Fla.

Crucibulum constrictum conjuge is intermediate in its characters between the true *C. constrictum* (pl. LVI, figs. 8, 9, 21, 22) and *C. waltonense.* From the former it differs in the consistently smaller area of attachment of the cup, from the latter in the larger area of attachment and the strong tendency toward an obsolete sculpture. It is quite possibly a direct ancestor of *C. constrictum,* and may be related to *C. waltonense,* probably along a lateral line. The range of variation in sculpture is parallel to that exhibited by *C. constrictum.* The group as a whole is puzzling. The nuclear characters are the same in all three races, and the species have been separated almost entirely by the degree of adhesion of the cup. This is always relatively greater in the young than in the adult, but it is usually constant through a given species at a given stage of development.

The subspecies is the most widespread and abundant *Crucibulum* within the Shoal River marls, but it is restricted in its range to the single horizon.

Occurrence: Shoal River formation, localities 3856[p], 3732[r], 3742[c], 5080[r], 5184[r], 9958[p], 9960[p], 9959[p].

Crucibulum grande (Say)

Plate LVI, figures 12, 13

1824. *Calyptraea grandis* Say, Acad. Nat. Sci. Philadelphia Jour., 1st ser., vol. 4, p. 130, pl. 7, figs. 6a, 6b.
1854. *Crucibulum grandis* Say. Conrad, Acad. Nat. Sci. Philadelphia Proc., vol. 7, p. 30.
1892. *Crucibulum grande* Say. Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 351.

Ovate; internal appendage dilated, and attached to the side of the shell.

Shell large, ovate at base, inequilateral, concentrically wrinkled, destitute of spines or processes: apex behind the middle nearly erect; internal appendage transverse, patulous, occupying a considerable portion of the cavity of the shell, and attached by one side, from its summit to its edge, to the shorter side of the shell, its summit corresponding to the inner apex of the shell.—Say, 1824.

Type locality: One of the Finch collection, presumably from "Maryland" but more probably from northern Virginia.

Crucibulum grande (Say) is characterized by its large size, erect or only slightly inclined apex and the absence of any but incremental sculpture. *Crucibulum constrictum* (Conrad), may approximate it in size, but the area of adhesion in the cup is more restricted and the posterior angle between the adherent and the free margins is much lower.

Two half-grown individuals and half a dozen younger shells were collected at Oak Grove that differ in no essential character from the Miocene species of the Middle Atlantic States. The rather heavy, unsculptured shell, the posterior apex, and the degree of attachment of the cup are all suggestive of *C. grande*. *C. constrictum conjuge* is usually unsculptured, but it is smaller and lighter in weight and the cup is adherent over a wider surface. However, more material must be collected before the range of *C. grande* can be extended downward even to the Oak Grove with any assurance.

Occurrence: Chipola formation, locality ?7893[r]; Oak Grove sand, locality ?2646[p].

Outside occurrence: Yorktown formation, Virginia and North Carolina.

Crucibulum multilineatum (Conrad)

Plate LVI, figures 6, 7

1841. *Dispotoea multilineta* Conrad, Am. Jour. Sci., 1st ser., vol. 41, p. 346, pl. 2, fig. 8.
1845. *Dispotoea multilineata* Conrad, Fossils of the medial Tertiary of the United States, p. 80.
1856. *Crucibulum multilineata* Conrad. Tuomey and Holmes, Pleiocene fossils of South Carolina, p. 107, pl. 25, fig. 7.
1858. *Crucibulum multilineatum* Conrad. Emmons, Rept. of North Carolina Geol. Survey, p. 276, fig. 192.
1863. *Crucibulum multilineatum* Conrad, Acad. Nat. Sci. Philadelphia Proc. for 1862, vol. 14, p. 568.
1864. *Crucibulum multilineatum* Conrad. Meek, Miocene check list, Smithsonian Misc. Coll. No. 183, p. 15.
1892. *Crucibulum multilineatum* Conrad. Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 351.
1904. *Crucibulum multilineatum* Conrad. Martin, Maryland Geol. Survey, Miocene, p. 246, pl. 58, figs. 12a, 12b.
1919. *Crucibulum multilineatum* Conrad. Gardner and Aldrich, Acad. Nat. Sci. Philadelphia Proc., p. 18.
1930. *Crucibulum multilineatum* (Conrad). Mansfield, Florida State Geol. Survey Bull. 3, p. 120.

Subovate, depressed; apex prominent; one side with squamose lines, the opposite with finer ramose lines destitute of scales; diaphragm contracted.—Conrad, 1841.

Type locality: Natural Well, 2 miles southwest of Magnolia, Duplin County, N. C. The individual figured (Johns Hopkins University) is from the Choptank formation at Jones Wharf, St. Marys County, Md. It is 7 millimeters high and 30 millimeters in diameter.

Shell small, capuloid, moderately low, subcircular or elliptical in basal outline. Protoconch dextral, performing two minute volutions in a single plane. Radial scupture variable, usually 15 to 20 cordate costae originating a short distance away from the apex and obliquely radiating from it, some or all of which bear minute tubular spines; secondary radials commonly ramifying and intersecting the primaries at an angle of 10° to 25°. Inner cup adherent posteriorly over about a third of its surface; dextral portion of free margin contracted with a peculiar, characteristic little kink.

Crucibulum multilineatum (Conrad) is readily isolated from the other members of the section characterized by the adherent cup, by the spinose, more or less oblique primary radials, the ramose secondary radials, and the diagnostic contraction of the posterior portion of the inner cup.

The species is fairly widespread through the Oak Grove and Shoal River.

Occurrence: Chipola formation, locality 7893[p]; Oak Grove sand, localities 3386[p], 3385[p], 7148[a], 2646[a], 5632[p]. Shoal River formation, localities 3856[r], 2645[r], ?3732[r], 3742[p], 5079[p], 5193[r].

Outside occurrence: Miocene. Duplin marl, North Carolina, South Carolina. Choctawhatchee formation, *Cancellaria* zone of northern Florida.

Family CAPULIDAE

Genus CAPULUS Montfort

1810. *Capulus* Montfort, Conchyliologie systématique, vol. 2, pp. 54, 55.

Type by monotypy: *Patella ungarica* Linnaeus. Recent in the European seas.

Shell obliquely conical. Apex posterior and posteriorly directed, more or less incurved. Nucleus small, smooth, paucispiral, dextrally coiled. Sculpture radial, concentric or reticulate. Peritreme oval or subcircular,

not reflected nor interrupted but commonly more or less distorted by the object to which the individual was attached. Muscle impressions two, symmetrically placed and forming with the pallial line a horseshoe with slightly expanded arms. Shelly pad not secreted as in *Hipponix*.

The genus is venerable even as geologic ages go, for it has been reported from the mid-Paleozoic. Though never prolific it has been much more tenacious than most of its contemporaries, for it still survives in restricted numbers in the seas of today.

Capulus chipolanus Gardner, n. sp.

Plate LVII, figures 22, 23

Shell very small and rather light, obliquely conical. Apex posterior but not marginal, posteriorly directed. Protoconch small, smooth, polished, turned sharply to the right when the shell is oriented so that the aperture faces the observer; performing between 1½ and 2 volutions. Surface of conch sculptured with 25 to 45 primary radials; secondaries rather regularly introduced in the interradial spaces. Incremental sculpture strong, minutely imbricated, not overriding the radials except at the resting stages but sufficient to finely crenate them and to give to the entire sculpture an irregular, granulose aspect. Peritreme slightly thickened and only feebly affected by the radial ornamentation, broadly and evenly arcuate in front, more or less broadly constricted behind. Interior smooth, devoid of processes. Muscle scars indistinct, submedial, forming with the pallial line a horseshoe with expanded arms.

Dimensions of holotype: Height, 4.5 millimeters; maximum diameter of base, 3.7 millimeters. Dimensions of paratype: Height, 3.2 millimeters; maximum diameter of base, 2.6 millimeters.

Holotype and paratype: U. S. Nat. Mus. No. 329059.

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

Capulus chipolanus suggests most strongly *Hipponix pygmaeus* Lea of the Eocene, but it is much less solid, and more strongly and evenly inflated. The revolute apex is more posterior, the primaries stronger, less numerous, and better differentiated and the secondaries more regularly intercalated.

Both of the Tampa species of *Hipponix, H. willcoxii* Dall and *H. tampensis* Mansfield, are larger and more strongly and coarsely sculptured than *Capulus chipolanus.*

The species is assigned to *Capulus* rather than *Hipponix* because of its relatively thin shell and gyrate apex. Previous citations of the genus from the Tertiary are rather dubious, and most of the species are referable to other genera. None of the Recent capulids are closely related to *C. chipolanus,* although it resembles them in general outline and ornamental characters.

Occurrence: Chipola formation, locality 2213[r].

Family HIPPONICIDAE

Genus CHEILEA Modeer

1793. *Cheilea* Modeer, Kongliga Svenska Vetenskaps-Akademiens Nya Handlingar, Band 14, pp. 110-111.

Type by subsequent designation (Woodring, Carnegie Inst. Washington Pub. 385, p. 374, 1928): *Patella equestris* Linnaeus. Recent from Hatteras to the Barbados.

Modeer, as pointed out by Dall,[23a] was the first to attempt a logical subdivision of Linnaeus' heterogenous *Patella.* He segregated the true limpets under *Patella,* and to those developing shelly internal processes, he gave the name *Cheilea.* In the subsequent division of the group Modeer's name was lost until resurrected by Dall and substituted for the *Mitrularia* of Schumacher, 1817.

Shell limpet-shaped, conical; the apex subcentral or slightly posterior. Nucleus paucispiral. Sculpture dominantly radial. Internal septa central, scoop-shaped, attached only at the apex, the concave surface anteriorly directed.

The genus has not been previously recorded from the east coast in strata older than the Pliocene. The recent species are widely distributed in the temperate and tropical seas.

Cheilea dryas (Dall ms.) Gardner, n. sp.

Plate LVII, figures 20, 21

Shell of moderate size for the genus, rather low, conic. Periphery subcircular to ovate; regular. Apex obtuse, slightly posterior, posteriorly inclined. Nucleus worn but apparently small, smooth, and polished and performing between 1 and 2 complete volutions. Surface uniformly sculptured from apical region to periphery with very fine and somewhat irregular radial lirae numbering 5 or 6 to the millimeter and separated from one another by linear sulci. Incremental sculpture manifested in the minute, irregular jogs and wavelets in the radials; a few of the resting stages so strongly marked that the surface is corrugated and the profile broken. Inner process slightly higher than the shell, scoop-shaped, attached by its smaller end to the posterior and lateral walls; the concave surface toward the front; the ventral extremity slightly imperfect but apparently with only a feeble medial depression.

Dimensions of holotype: Height, 6 millimeters; maximum diameter, 11 millimeters.

Holotype: U. S. Nat. Mus. No. 371877.

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

The genus is represented in the Alum Bluff group by the unique type.

Cheilea dryas is lower and more symmetrical than the type of the genus, *C. equestris* (Linnaeus) of the later

[23a] Dall, W. H., Nautilus, vol. 14, p. 44, 1900.

Tertiary and Recent faunas. It differs further in the regular peritreme, in the finer and nonspinose radial sculpture, and in the higher inner process very much more feebly depressed on its ventral surface.

The unique type was determined and named by Dr. Dall, of the National Museum, but no description or figure was published.

Occurrence: Shoal River formation, locality 3742r.

Superfamily AMALTHEACEA

Family FOSSARIDAE

Genus FOSSARUS Philippi

1841. *Fossarus* Philippi, Archiv für Natürgeschichte, year 7, vol. 1, pp. 42, 47.

1844. *Fossarus* Philippi, Fauna molluscorum Siciliae, vol. 2, p. 147.

Type by monotypy: *Fossarus adansonii* Philippi= *Helix ambigua* Linnaeus. Recent off the coast of Senegal and in the Mediterranean (fide Pilsbry).

Shell perforate, subglobose. Spire low, of few volutions; body whorl relatively large. Sculpture dominantly spiral. Aperture entire, semicircular. Outer lip strongly arcuate, scalloped by the spiral ridges. Parietal wall heavily calloused. Columellar margin thickened, oblique, reverted anteriorly. Umbilical opening funicular.

The representation of *Fossarus* is meager throughout the Tertiary, and the Recent species are confined, for the most part, to the warmer waters.

In the Alum Bluff group *Fossarus* is so rare at even the few localities at which it is present that its distribution is without significance.

Fossarus chipolanus (Dall)

Plate LVII, figure 29

1892. *Cyclostrema chipolanum* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 420, pl. 22, fig. 35.

Shell small, turbinate, with three or four rounded whorls; nucleus small, smooth, subsequent whorls sculptured with (between the sutures three) eight prominent spiral ribs with wider channeled interspaces crossed by well-marked lines of growth which are occasionally almost lamellose; suture distinct, not channeled, though the whorl in front of it is a little tabulated by the upper spiral rib; basal surface sculptured like the spire; aperture circular, expanded at the margin; pillar lip thin; the space between it and the lowest spiral rib is excavated, but there is no umbilical perforation. Altitude of shell 2.25; diameter 2.3 millimeters.

This is a well-marked and characteristic little shell, notable for its bold, strong yet simple sculpture.—Dall, 1892.

Holotype: U: S. Nat. Museum No. 112660.

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

The umbilicus was choked with matrix, which entirely concealed the small but very deep pit. The type is unique.

Occurrence: Chipola formation, locality 2212r.

Fossarus florius Gardner, n. sp.

Plate LVII, figure 30

Shell small, solid, subglobose. Spire relatively high for the genus, the height of the aperture, however, more than half the total height. Whorls about 3½ in all. Initial half turn moderately inflated, immersed at the tip, doubled sharply back within the succeeding and final turn of the protoconch, which is obtusely shouldered and broadly convex. The two postnuclear turns increasing rapidly in size; obtusely shouldered, broadly convex laterally. Base of body smoothly and rather abruptly constricted. Surface spirally banded with flattened or broadly rounded fillets equal in size and spacing; 4, rarely 3, on the final whorl of the spire and double that number on the body; interspiral areas of approximately the same width as the spiral, minutely punctated by the incremental laminae. Sutures deeply impressed but not channeled, coincident with the fifth spiral. Aperture rather small for the genus, obliquely elliptical. Peristome continuous. Outer lip obscurely angulated at the shoulder, expanding slightly in front, crenulated at the margin in harmony with the external sculpture. Inner lip oblique, adnate to the body wall over a space the width of 3 spirals and 2 interspiral areas; reinforced anteriorly. Anterior extremity of aperture smoothly rounded. Umbilicus small, twisted, its outer margin defined by the anterior of the 8 spirals.

Dimensions of holotype: Height, 2.8 millimeters; maximum diameter, 2.0 millimeters.

Holotype: U. S. Nat. Mus. No. 371866.

Type locality: Sta. 3742, Shell Bluff, Shoal River, Walton County, Fla.

The individual from Oak Grove referred to this species may prove, with the acquisition of further material, to be distinct. It is a larger shell and contains one more volution than the usual *F. florius*. It is possible that it may be the only fully adult specimen, but all of the Shoal River forms are of approximately the same size and none show any evidence of immaturity. With the exception of the single individual in question, the species is restricted in its known distribution to the Shoal River formation.

Occurrence: Oak Grove sand, locality ?2646r; Shoal River formation, localities 3856r, 3742r, 5079r, 3733r.

Superfamily GYMNOGLOSSA

Family PYRAMIDELLIDAE

Paul Bartsch, Honorary Associate Curator of Mollusca of the U. S. National Museum, is monographing the Pyramidellidae.

Genus ISELICA Dall

1854. *Isapis* H. and A. Adams, Genera Recent Mollusca, vol. 1, p. 320.

1918. *Iselica* Dall, Biol. Soc. Washington Proc., vol. 31, p. 137. Substitute name for *Isapis* H. and A. Adams, 1854, not Doubleday, 1847 (Lepidoptera).

1929. *Iselica* Dall. Thiele, Handbuch der Systematischen Weichtierkunde, vol. 1, p. 233. Considered a section under *Phasianema*.

Type by monotypy: *Narica? anomala* C. B. Adams. Recent in Jamaican waters.

The genotype is spirally banded like *Fossarus* but was separated from it because of the development of a single nearly horizontal columellar fold opposite the umbilicus.

The status of the genus is not clear. *"Fossarus (Iselica) obtusa"* Carpenter, a Recent species ranging from Monterey to the Gulf of California is strikingly similar to the new species from the Chipola formation. Some of the individuals of Carpenter's species in the collections of the U. S. National Museum retained the soft parts. The radulas of several of these specimens were examined by Dr. J. P. E. Morrison of the U. S. National Museum. He found them to be characteristic of the Pyramidellidae, the family to which Thiele had referred *Iselica*. The study of the radulas of other species, particularly of the genotype, should be made, for the West Coast species differs rather markedly from the genotype, *Iselica anomala*.

Iselica psila Gardner, n. sp.

Plate LVII, figures 27, 28

Shell small and relatively thin, subglobose. Aperture about three-fourths as high as the entire shell. Whorls only 3 in all, rapidly increasing in size. Protoconch very small, moderately inflated, of less than one complete volution; immersed at the tip. Earliest whorl of conch broadly convex at the beginning, gradually flattening posteriorly into a horizontal shoulder, which becomes increasingly broad toward the aperture. Body well-rounded, expanding rapidly. Sculpture obscure; 1 to 3 exceedingly faint sulci symmetrically spaced on the final whorl of the spire of the holotype. Body sculptured with a faintly suggested shoulder lira and, as a rule, a sulcus near the periphery or a little in front of it; a sulcus or a feeble lira about halfway between the shoulder and the median sulcus; other lirae and striations fortuitously developed. Aperture semielliptical, the labium dividing the basal oval into two unequal parts, of which the apertural is the larger. Outer lip thin, sharp, obscurely angulated at the shoulder, arcuate medially, broadly rounded in front. Labium slightly oblique, adnate to the body wall from the periphery to the obscure umbilical keel, reinforced along the umbilical face. Umbilicus small, open; umbilical keel obtuse.

Dimensions of holotype: Height, 3.0 millimeters; diameter, 2.5 millimeters.

Holotype: U. S. Nat. Mus. No. 329026.

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

Iselica psila varies rather widely in the details of the obscure ornamentation and in the size of the umbilical opening.

An individual from the type locality similar in outline and apertural characters and probably nothing more than an end member of *I. psila* exhibits a body sculpture of 5 moderately impressed sulci, microscopically punctated by the incrementals.

Nothing very close to *Iselica psila* has been recognized in either the Tertiary or the Recent faunas of the Atlantic, although a Recent West Coast species, *"Fossarus (Iselica) obtusa"* of Carpenter, is remarkably like it in form and in the obscure sculpture pattern.

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

Iselica myttonis (Maury)

1910. *Isapis Myttonis* Maury, Bull. Am. Paleontology, vol. 4, No. 21, p. 28, pl. 7, fig. 4.

Shell with five convex whorls ornamented with a beautiful cancellation formed by the crossing of the raised spiral bands and the longitudinal riblets. Number of spiral bands on the whorl preceding the last, three, on the last whorl seven. These are crossed somewhat obliquely by less prominent longitudinal riblets and are slightly nodular at the intersections. Suture distinct; spire acute; aperture oval; outer lip simple, crenulated within by the seven revolving elevated bands of the exterior; columella arched, bearing within a single central tooth. Length of shell 8; of aperture 3; greatest width 4 millimeters.

This exquisite little shell is entirely distinct from *I. dalli* Whitfield of the Miocene of New Jersey.

Chipola marls, Baileys Ferry, Florida.

Cornell University collection.—Maury, 1910.

This species is closely related to *Isapis anomala* C. B. Adams described from Jamaican waters, but the earlier form is more slender and contains a greater number of whorls, the spirals are narrower, and the axial laminae less prominent than in Adams' *I. anomala*.

Iselica myttonis (Maury) is very rare and when found, is usually in a more or less battered condition.

Occurrence: Chipola formation, localities 2213^{r}, 3419^{r}, Cornell University collection.

Family MELANELLIDAE

Genus STROMBIFORMIS Da Costa

1778. *Strombiformis* Da Costa, British conchology, p. 107.

Type by subsequent designation (Iredale, Malacol. Soc. London Proc., vol. 11, p. 293, 1915): *Strombiformis glaber* Da Costa =*Turbo subulatus* Donovan *fide* Jeffreys. Recent from the British Isles to the Mediterranean.

These shells have nothing to do with *Strombus*, the giant conch, but are the "needle shells," named from the Greek word meaning a spindle. They are exceedingly slender little forms with long-drawn-out spires

and bodies, a narrow lobate aperture, and a reflected and closely appressed inner lip. The Recent shells are banded in color.

Strombiformis scotti (Maury)

Plate LV, figure 17

1910. *Eulima scotti* Maury, Bull. Am. Paleontology, vol. 4; No. 21, p. 30, pl. 7, fig. 12.

Shell very slender, acute, polished, about nine-whorled; sides of spire straight; suture visible only with a lens; outer lip thin; inner lip with a well-marked bandlike callus.

Length of shell 8.5; of aperture 2; greatest width 2 mm.

Chipola marls, Baileys Ferry, Florida.

Cornell University collection.—Maury, 1910.

Dimensions of figured specimen: Height, 7.6 millimeters; maximum diameter, 1.7 millimeters.

Figured specimen: U. S. Nat. Mus. No. 498017.

Type locality: Baileys Ferry, Chipola River, Calhoun County, Fla.

Strombiformis scotti (Maury) is the most slender of the described species of *Strombiformis* with the exception of *S. ischna* from the Shoal River formation.

Occurrence: Chipola formation, locality 2213r, Cornell University Collection.

Strombiformis ischna Gardner, n. sp.

Plate LV, figure 16

Shell small, exceedingly slender, smooth and highly polished. Protoconch slender, paucispiral, probably including not more than the partially immersed tip and the two glassy and feebly inflated succeeding turns. Line between conch and protoconch not certainly determined. Whorls 11 to 12 in all, increasing regularly but very slowly in diameter but less slowly in height. Sutures appearing not as lines but as feebly depressed bands, a little less opaque than the intermediate areas. Body attenuated, smoothly and gently rounded at the base. Aperture narrow, deltoid, grooved and angulated posteriorly, patulous anteriorly. Outer lip thin, sharp, almost vertical, rounding broadly into the anterior end, not sinuated in front of the suture. Inner lip oblique, reverted, feebly constricted in the umbilical area, the callus not fused with the parietal wall, widest and heaviest at the umbilicus, which it completely closes; margin of lip in front of the umbilicus slightly thickened, free, rounding abruptly into the narrow anterior extremity.

Dimensions of holotype: Height, 7.5 millimeters; diameter, 1.6 millimeters.

Holotype: U. S. Nat. Mus. No. 498019.

Type locality: No. 5079, ½ mile below Shell Bluff, Shoal River, Walton County, Fla.

The type is unique. The excessively slender outline is sufficient to isolate the species from all of its Alum Bluff associates.

Strombiformis leonensis Mansfield from the *Cancellaria* zone of the Choctawhatchee formation, has the same general aspect, but it is a less elegant shell and the whorls are less numerous than in *S. ischna*.

Occurrence: Shoal River formation, locality 5079r.

Subgenus POLYGIREULIMA Sacco

1892. *Polygireulima* Sacco, Molluschi dei terreni terziarii del Piemonte e della Liguria, pt. 11, p. 10.

Type by original designation: *Melania spina* Grateloup. Lower and middle Miocene of southern France.

There may well be some earlier name for the less slender, nonarcuate, and polygyrate melanelids. Several of the better known names seem, however, to be unavailable.

The type by monotypy of *Melanella* Bowdich,[24] according to the illustration, is a strongly flexed shell, *Melanella dufresnii* Bowdich.

Risso[25] proposed *Eulima* and cited four species, *E. elegantissima* Montagu and Donovan, *E. glaberrima* Allan, *E. striata* Brocchi, and *E. subulata* Brocchi. The first type designation that I have noted is that of Herrmannsen,[26] who cited *Turbo subulatus* Donovan, 1803, which Sacco considers synonymous with *Helix subulata* Brocchi, 1814. Donovan's *T. subulatus* is the type of *Strombiformis* Da Costa, 1778, and also of *Subularia* Monterosato, 1884. *Acicularia* Monterosato, 1884, is preoccupied by *Acicularia* Archiac, 1843.

Strombiformis (Polygireulima?) chipolana (Maury)

Plate LV, figure 18

1910. *Eulima chipolana* Maury, Bull. Am. Paleontology, vol. 4, No. 21, p. 30, pl. 7, fig. 9.

Shell elongated, very slender, highly polished and shining, smooth, whorls thirteen; the five nearest the apex inclining slightly from the main axis of the shell; aperture oval; outer lip simple, inner lip reflexed upon the columella.

Length of shell 9; greatest width 2 mm.

Chipola Oligocene, Baileys Ferry, Florida.

Cornell University collection.—Maury, 1910.

Dimensions of figured specimen: Height, 8 millimeters; diameter, 2 millimeters.

Figured specimen: U. S. Nat. Mus. No. 498016.

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

The inflection of the earlier whorls is barely perceptible. The numerous narrow, very feebly inflated whorls of the spire and the short, rounded body characterize the species.

Occurrence: Chipola formation, locality 2213r, Cornell University collection.

[24] Bowdich, T. E., Elements of conchology, p. 27, pl. 6, fig. 17, 1822.

[25] Risso, Antoine, Histoire naturelle des principales productions de l'Europe méridionale, vol. 4, p. 123, 1826.

[26] Herrmannsen, A. N., Indicis generum malacozoorum, vol. 1, p. 431, 1847.

Strombiformis (Polygireulima?) parasitos (Maury)

1910. *Eulima parasitos* Maury, Bull. Am. Paleontology, vol. 4, no. 21, p. 30, pl. 7, fig. 10.

Shell very slender, small, smooth and polished, with seven whorls exclusive of the eroded nucleus; without sculpture.

Length of shell 4; greatest width 1 mm.

Oak Grove, Florida.

Mr. Aldrich's collection.—Maury, 1910.

Strombiformis parasitos seems from the illustrations to have much in common with *S. chipolana* but apparently it is shorter and relatively stouter. It has not been recognized in the later collections.

Strombiformis (Polygireulima) defuniak Gardner, n. sp.

Plate LV, figure 15

Shell small, moderately slender, smooth and polished. Spire a flat-sided, evenly and acutely tapering cone. Body short, the base obliquely truncate. Whorls 9 to 10 in all, the sutures exceedingly obscure, more so than might be supposed from the figure. Protoconch smooth and paucispiral, but the exact number of whorls not distinguishable. Aperture obliquely lobate, angulated and faintly grooved at the posterior commissure. Outer lip sinuated posteriorly, flaring forward medially and patulous anteriorly. Inner lip reverted, glazing the parietal wall, the callus free and sharp-edged in the umbilical region, with a narrow groove behind it. Anterior extremity narrow, the inner surface flattened slightly.

Dimensions of holotype: Height, 4.5 millimeters; diameter, 1.6 millimeters.

Holotype : U. S. Nat. Mus. No. 498018.

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

The rostrate body whorl suggests that the unique type may be a juvenile and probably close to *Strombiformis makista*. The glaze on the parietal wall, however, and the character of the lip in the umbilical region bespeak maturity. The increase in the diameter of the whorls in *S. defuniak* is more regular than in *chipolana*, and the whorls are relatively wider in the De Funiak species. Otherwise, the two forms are similar.

Occurrence: Shoal River formation, locality 5618r.

Strombiformis (Polygireulima) makista Gardner

Plate LXII, figures 6-8

1936. *Melanella (Melanella) makista* Gardner, Florida Dept. Cons., Geol. Bull. 14, p. 51, pl. 10, figs. 7-9.

Shell imperforate, straight, moderately slender and rather large for the group. Porcelaneous, highly polished, devoid of sculpture. Whorls narrow, appressed, slowly and regularly increasing in diameter, flattened laterally, slightly undercut anteriorly, probably exceeding 20 in number in the perfect adult. Body whorl about one-third as high as the entire shell, broadly rounded at the periphery. Extreme tip not preserved and characters of protoconch not known. Faint brownish flammules, which may be the remnants of a color pattern, occasionally visible on the conch. Suture strong. Aperture obliquely lobate, acutely angulated posteriorly. Outer lip expanded and slightly pouting, not thickened, rounding smoothly into the labium, which is thickened and closely appressed against the body wall. Umbilicus entirely closed but faintly indicated by a very narrow, depressed, and arcuate area along the margin of the sharply raised and thickened basal portion of the inner lip.

Dimensions of holotype: Height (estimated), 23 millimeters; maximum diameter, 6.4 millimeters; height of aperture, 5 millimeters. Dimensions of paratype: Height, 7.8 millimeters; maximum diameter, 2.7 millimeters. Dimensions of third figured specimen showing an unusually well rounded body whorl: Height, 20 millimeters; maximum diameter, 6.0 millimeters.

Type material: Holotype, 1 juvenile paratype, and a third individual, also figured, from the same locality and probably referable to the same species, U. S. Nat. Mus. No. 483782.

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

Strombiformis (Polygireulima) makista resembles *S. magnoliana* Gardner and Aldrich, from the higher Miocene of Florida and the Carolinas, in the many slowly enlarging whorls separated by conspicuous suture lines. The Alum Bluff species is the more slender, and the body whorl relatively shorter and more abruptly constricted.

Occurrence: Shoal River formation, locality 3856p.

"Eulima" nemoralis Maury

1910. *Eulima nemoralis* Maury, Bull. Am. Paleontology, vol. 4, no. 21, p. 30, pl. 7, fig. 11.

Shell smooth and polished, small, immature, conic, *Niso*-like in general form; whorls seven, the earlier slightly convex, the remainder flattened, no sculpture except a basal carina on the last whorl.

Length of shell 3; greatest width 1.5 mm.

Oak Grove, Florida.

Mr. Aldrich's collection.—Maury, 1910.

The illustration of Miss Maury's species does not suggest a mellanellid. It has not been recognized in the later collections, and its position is doubtful.

Genus NISO Risso

1826. *Niso* Risso, Histoire naturelle des principales productions de l'Europe méridionale, vol. 4, p. 218.

Type by monotypy: *Niso eburnea* Risso. Pliocene (Plaisancien) of Italy.

Niso resembles *Melanella* in its elevated spire and smooth, polished surface, but it is less slender and has a fairly large, deep, and regularly formed umbilicus.

Niso aldrichi Maury

1910. *Niso Aldrichi* Maury, Bull. Am. Paleontology, vol. 4, no. 21, p. 31, pl. 8, fig. 1.

Shell small, smooth, polished and shining, conic, with a rapidly tapering and acute spire: whorls nine, the first three slightly convex; the following flattened. Shell without sculpture. Suture distinct; basal keel of the last whorl sharply defined.

Length of shell 4; greatest width 2 millimeters.

Oak Grove, Santa Rosa County, Florida.

Mr. Aldrich's collection.—Maury, 1910.

The species has not been recognized in the later collections.

Superfamily PTENOGLOSSA
Family EPITONIIDAE
Genus EPITONIUM "Bolten" Roeding

1798. *Epitonium* "Bolten" Roeding, Museum Boltenianum, pt. 2, p. 91.

Type by subsequent designation (Suter, Manual of New Zealand Mollusca, p. 319, 1913): *Turbo scalaris* Linnaeus=*Scalaria pretiosa* Lamarck. Recent in the western Pacific.

Shell turriculate, perforate or imperforate. Whorls numerous, convex, commonly loosely coiled. Sculpture dominantly axial; axial flanges and varices prominent in many groups, usually continuous and fused at the suture; in the type species forming the only contact between the whorls. Aperture subcircular or ellipsoidal. Peristome entire, thickened or reflected.

The genus has been gradually increasing in prominence since the Triassic and is represented in the Recent seas by some 150 to 200 species of "wentle trap" distributed from the polar regions to the tropics and from between tides to abysmal depths.

There are probably at least a dozen species included in the collections from Alum Bluff, but they are most of them new and so imperfectly preserved that only subgeneric determinations have been made. The subgenera are all recorded in the Tertiary beds of central and southern Europe.

Spiral sculpture not developed:
- Axials not spinose or subspinose posteriorly ..... *Hyaloscala* de Boury.
- Axials spinose or subspinose posteriorly ..... *Spiniscala* de Boury.

Spiral sculpture developed:
- Surface not cancellated; axials laminar and elevated:
  - Axials relatively narrow on their summits, not honeycombed ..... *Cinctiscala* de Boury.
  - Axials wide on their summits, finely honeycombed.... *Crisposcala* de Boury.
- Surface cancellated; axials low:
  - Axials thin and sharp, not nodose medially..... *Scalina* Dall.
  - Axials obtuse, nodose medially..*Nodiscala* de Boury.

Subgenus HYALOSCALA de Boury

1890. *Hyaloscala* de Boury, Révision des Scalidae Miocènes et Pliocènes de l'Italie, Soc. malacologica italiana Boll., Vol. 14, p. 90.

Type by original designation: *Scalaria clathratula* Adams. Recent in the western Atlantic from Marthas Vineyard to Key West.

Hyaloscala includes small, thin shells, usually of slender outline, made up of convex whorls separated by moderately impressed sutures, sculptured by laminar axials not fused at the sutures into a continuous series. The aperture is oval, broadening anteriorly, and the reflected inner lip completely closes the umbilical chink.

A number of species from the European Tertiary beds have been referred to this subgenus. The Recent forms, though not numerous, have a wide distribution both in longitude and latitude.

Epitonium (Hyaloscala) sp.

A number of *Epitonium* in the Alum Bluff group have been referred to this subgenus, although the representatives are not typical *Hyaloscala*. The axials are fewer and heavier than is normal for *Hyaloscala*, and the summits of the axials show excellent cross sections of the component laminae. These differences, however, seem less radical than the differences that separate the forms in question from *Nitidoscala*, a subgenus in which the axials are well fused at the sutures. In the individuals from the Alum Bluff there is no fusing; the axials, however, are commonly flexed, those at the posterior suture rather sharply toward the left, and those of the preceding whorl slightly toward the right; their extremities not fusing but dovetailing into one another at the suture line.

There are probably as many as half a dozen species represented, but all of the shells are either imperfect or immature. None of them are large, none are very stout, but there is a wide range in the degree of slenderness. The number of axials to the whorl ranges from 8 to 12. Spiral sculpture is not developed; there is no basal disk, and the umbilicus is imperforate.

The group is restricted in its distribution to the Shoal River horizon and for the most part to the environs of Summerville.

Occurrence: Shoal River formation, localities 3856^{r}, 3748^{c}.

Subgenus SPINISCALA de Boury

1909. *Spiniscala* de Boury, Jour. conchyliologie, vol. 57, p. 257.

Type by original designation: *Scalaria frondicula* Wood? subsp. Pliocene of Italy.

Spiniscala includes forms of rather low, somewhat turbinate outline made up of convex contiguous whorls, pseudotabulated by the axials, increasing rapidly in diameter and separated by deep sutures. The axials

are heavy and laminar, not crowded, prominently elevated; their summits flexed and turned toward the right, expanded posteriorly and produced into short, trigonal spines, which form a coronal about the suture. The axials behind the spines are relatively low, abutting against the corresponding axials of the preceding whorl but not fused with them. The spiral sculpture is altogether absent or reduced to microscopically fine, fortuitous striae. The base of the body is smoothly rounded and not reinforced. The aperture is ovate or subelliptical, the peristome continuous. The inner margin of the aperture is reverted, completely closing the umbilical chink.

This group, like many of the others, has not been well segregated and may have a wider distribution than is apparent from the check lists. It is certainly well represented in the middle and late Tertiary of central and southern Europe and is recorded both in the Atlantic and the Pacific Oceans.

Epitonium (Spiniscala) sp.

The single individual referred to *Spiniscala* exhibits the characteristic features of the subgenus. It is a rather small shell made up of convex whorls that increase rapidly in diameter and are separated by deeply impressed sutures; the prominent axials are expanded and subspinose posteriorly and form a fairly well-defined shoulder. No spiral sculpture is developed and there is no basal disk. The umbilicus is imperforate. So many of the specific characters have been lost that the form has not been named. The axials are 9 and only moderately heavy, and the spines are very short. The flexure of the summits of the costals toward the right is less marked than in the type. The apex of the individual in question is broken away, but the five remaining whorls measure 5 millimeters in height.

Occurrence: Shoal River formation, locality 3748r.

Epitonium (Spiniscala) virginiae (Maury)

1910. *Scala virginiae* Maury, Bull. Am. Paleontology, vol. 4, no. 21, p. 29, pl. 7, fig. 8.

Shell small, delicate, seven-whorled: nuclear smooth and polished, subsequent whorls convex, sharply separated by a deep suture; transverse sculpture of prominent, slightly oblique, sharp-edged, lamellar varices (ten on the body-whorl) which tend to coronate the whorls; spiral sculpture of microscopic striae between the varices; aperture round.

Length of shell 3.75; greatest width 1.5 mm.

Only one specimen of this pretty species was found.

Chipola Oligocene, Baileys Ferry, Florida.

Cornell University collection.—Maury, 1910.

The axials are posteriorly produced into short, trigonal spines that lend the coronated aspect to the whorls. The spiral striation is exceedingly fine and crowded. The base is smoothly rounded and imperforate. The aperture is broadly elliptical, the curvature of the outer lip higher than that of the inner. The reflected margin of the peristome is also broadest along the labrum from the posterior spine forward to the rounded anterior extremity.

Occurrence: Chipola formation, locality 2211r, Cornell University collection.

Subgenus CINCTISCALA de Boury

1909. *Cinctiscala* de Boury, Jour. conchyliologie, p. 258.

Type by original designation: *Scalaria antillarum* de Boury nom. mut.=*Scalaria turrita* Nyst 1871, not Blainville 1827.=*Scalaria turricula* Sowerby 1844, not Cantraine 1842. Recent in the West Indies and north to Hatteras.

Cinctiscala is characterized by the elevated, acutely tapering spire, the convex whorls separated by deeply impressed sutures, the rather numerous, moderately elevated, commonly unequal axials, and the fine spiral threading which crowds the interaxial areas. The base of the body is smoothly rounded. There is a slight change in the character of the spiral sculpture on the base, but no other indication of a disk. The peristome is continuous, and in the subgenotype, the reverted inner margin does not entirely conceal the narrow umbilical chink.

Epitonium (Cinctiscala) sp.

Fragments varying so widely in outline and dimensions that they should probably be distributed through two if not three species are not uncommon at Summerville and Shell Bluff. Some of the individuals are exceedingly slender; others are moderately stout and taper rapidly. They have in common, however, an axial sculpture of rather heavy laminae numbering 10 or 11 to the whorl, arranged in continuous series and fused at the sutures. The spiral sculpture is fine and crowded.

Occurrence: Shoal River formation, locality 3748p, Aldrich collection, Johns Hopkins University.

Subgenus CRISPOSCALA de Boury

1886. *Crisposcala* de Boury, Monographie des Scalidae, pt. I, p. 1.

Type of original designation: *Scalaria crispa* Lamarck, Eocene of the Paris Basin.

Coquille pourvue dans la région ombilicale, tantôt d'une perforation bien nette, tantôt d'une fente quelquefois rudimentaire, mais toujours indiquée, allongée, turbinée, munie de côtes longitudinales; la spire est allongée, turbiné; son sommet est obtus et lisse; la suture profonde est formée par la jonction des lames longitudinales; les tours sont convexes, plus ou moins aplatis au voisinage de la suture; ils sont ornés de côtes longitudinales en formes de lames le plus souvent repliées, anguleuses à leur partie supérieure et presque toujours subépineuses dans cette région. Le dernier tour, plus petit que la spire, a sa base convexe et est orné de côtes longitudinales. Il porte un cordon épais, qui entoure la région ombilicale. L'ouverture arrondie a son péristome double. La partie interne est continue, très

mince et presque tourjours repliée sur la columelle. Le péristome externe est dilaté et formé dans sa partie extérieure par la dernière lame. Il est auriculé a chaque extrémité et devient étroit dans la région columellaire.

Observations: Lorsque les exemplaires sont très frais, ce qui est assez rare chez les espèces fossiles, la surface est ornée de stries spirales très fines et nombreuses visibles seulement à la loupe. Les lames sont également couvertes d'un réseau microscopique excessivement élégant, mais très souvent détruit. Ce réseau est ordinairement formé de losanges accolés. Si l'on étudie avec soin la structure intime des lames longitudinales, il devient très facile de comprendre leur ornementation, mais, pour bien l'observer, il faut employer un très fort grossissement. Elles sont constituées par des tubes accolés dont la section est rectangulaire. Si par suite de l'usure ces tubes sont coupés obliquement ou dans leur longueur on a des losanges ou des sortes de rigoles qui, vues à un grossissement plus faible, simulent des stries transverses. Le dessinateur a parfaitement compris et rendu ce détail pour le C. junctilamella (pl. II, fig. 6).

Nous avons souvent remarqué chez les coquilles dont nous nous occupons deux formes, qui, pour chaque espèce, semblent assez constantes: une normale et l'autre plus étroite que nous indiquons comme variété. Cette différence ne concorderait-elle pas avec les sexes? On sait en effet que chez les Scalidae ceux-ci sont séparés. La forme étroite se rapporterait sans doute aux individus mâles.

Distribution: Tel que nous le connaissons actuellement ce genre apparaît dans le tertiaire inférieur (Sables du Soissonnais supérieurs aux lignites. Etage Yprésien). Il est surtout développé dans l'éocène des environs de Paris. Les espèces vivantes sont fort peu. nombreuses. Ce groupe ne comprend donc pour le moment qu'une vingtaine de formes.—De Boury, 1886.

This excellent description has been quoted in full because it appears in a publication of limited distribution.

The subgenus is rather widely dispersed in the Eocene of central and southern Europe and northern Africa, but its presence outside of that relatively restricted area and time has not been established.

Fragments from the Chipola formation exhibit the peculiar sculpture details of *Crisposcala* and have been referred to that group. The differences in perfect specimens, however, might justify their separation from a subgenus seemingly so far removed in space and time.

Epitonium (Crisposcala) sp.

Fragments occur in the Chipola formation that exhibit the characteristic sculpture of the subgenus. The whorls are rather high, convex, and pseudoshouldered by the flanges of the 18 to 20 axials. The wide and flattened summits of the costals exhibit the honeycomb structure peculiar to the subgenus. The interaxial spaces are striated with linear spirals, evenly and closely packed posteriorly and arranged on the medial and anterior portions, in five groups of three spirals each.

Subgenus CLATHRUS Oken

1815. *Clathrus* Oken, Lehrbuch der Zoologie, pt. 1 [Lehrbuch der Naturgeschichte, pt. 3, no. 1], p. 256.

Type by tautonomy: *Turbo clathrus* Linnaeus = *Scalina communis* Lamarck (Hanley). Recent along the European shores from Scandinavia to the Mediterranean.

Clathrus sensu stricto is unrepresented in the faunas of the Atlantic Coast.

Section NITIDISCALA de Boury

1909. *Nitidiscala* de Boury, Jour. Conchyliologie, vol. 57, p. 257.

Type by original designation: *Scalaria unifasciata* Sowerby. Recent in the West Indies.

The shells included under *Nitidiscala* are smaller and more delicate than those of *Clathrus* s. s.

Epitonium (Clathrus) alaquaënse Mansfield

Plate LV, figure 14; plate LXII, figure 4

1935. *Epitonium alaquaënse* Mansfield, Florida Dept. Cons. Geol. Bull. 12, p. 40, pl. 3, fig. 12.

Shell small, moderately acute, only axially sculptured, and consisting of 2 nuclear and 6 postnuclear whorls. Nucleus slender, whorls rounded and smooth. Postnuclear whorls rapidly enlarging. Axials nearly vertical along the spire, contiguous at the sutures, 12 on the body whorl and 9 on the preceding whorl, upright, thin on the earlier whorls and thicker on later whorls. Aperture broadly elliptical, the longitudinal axis being a little greater.

The holotype (U.S.N.M. Cat. No. 373149) measures: Length, 7½ millimeters; diameter, 3 millimeters.

Epitonium (Nitidiscala) aduncum Woodring, from the Bowden formation, Jamaica, is closely allied to *E. alaquaënse* n. sp., differing mainly from the latter in having a slimmer shell and fewer axials.

Type locality: Station 12046, Vaughan Creek, upper locality, Walton County, Florida.

Occurrence: Upper middle Miocene, *Arca* zone [Choctawhatchee formation]. Known only at the type locality.—Mansfield, 1935.

An incomplete but otherwise well-preserved speciman (U. S. Nat. Mus. No. 498013) was recovered from the shell marls at locality 9957, 6.7 miles south of Argyle, Walton County, a horizon slightly higher than the typical Shoal River formation. The fragment, which includes little more than the two final whorls, is 7 millimeters high and 4 millimeters in maximum diameter.

Occurrence: Shoal River formation, locality 9957r.

Genus SCALINA Conrad

1865. *Scalina* Conrad, Am. Jour. Conchology, vol. 1, p. 27. No description but *Scala staminea* Conrad and *Scala trigintinaria* Conrad listed.

1908. *Ferminoscala* Dall, Harvard Coll. Mus. Comp. Zoology Bull., vol. 43, no. 6, p. 315. Type by original designation: *Scala ferminiana* Dall (*Epitonium* [*Ferminoscala*] *ferminianum* Dall). Recent on the west coast from the Gulf of California to Panama.

Type by subsequent designation: Palmer, Bull. Am. Paleontology, vol. 7, p. 102, 1937): *Scala staminea* Conrad. Gosport sand of Alabama.

De Boury's "Etude sur les sous-genres de Scalidae" was apparently awaiting publication when Dall's report on the *Albatross* dredgings came out. Dall noted the similarity of *Textiscala* to *Ferminoscala* and excused the retention of *Textiscala* by the seeming difference in the outer lip. None of the species of his *Textiscala* show the diagnostic varicose lip, and, as a matter of fact, although Dall includes the character in his description, none of his specimens show it.

The spiral sculpture in *Scalina* is relatively more prominent than in *Acrilla* H. Adams, and the axial sculpture usually finer, sharper, and less crowded. The spaces between the spirals show under the microscope a crowded linear grooving. The axials are fine, sharp laminae not very closely spaced. The basal disk is a conspicuous feature.

It is unfortunate that so rare a form must serve as the genotype of Conrad's *Scalina*. We have no example in the collections of the U. S. National Museum, and Mrs. Palmer makes no mention of any other than the genotype in Ithaca or in Philadelphia.

The group is represented in the Eocene faunas of Europe and Mexico, in the later Tertiary faunas of northern Italy, the southern United States, and the mid-Americas, and in the Recent faunas of the east and west coasts of North America and the Gulf of Mexico.

Scalina species

Fragments occur in the Chipola formation too imperfect to name, but showing the characteristic surface of *Scalina,* the fine, sharp, numerous but not crowded axial laminae, the low, flattened, irregular spirals, broadest on the medial portion of the whorls and separated by shallow interspaces filled with microscopically fine, linear groovings. *Epitonium leroyi* (Guppy), described from Trinidad and reported from the Bowden beds of Jamaica, is also referable to this genus, although it differs from the Chipola species in details of the sculpture.

Occurrence: Chipola formation, locality 2213r.

Subgenus NODISCALA de Boury

1890. *Nodiscala* De Boury, Revision des Scalidae Miocènes et Pliocènes de l'Italie, Pisa, p. 12.

Type by original designation: *Scalaria bicarinata* Sowerby. Recent in the Philippines.

Shell rather small, heavy, solid, imperforate. Whorls of conch inflated medially, in some species obtusely angulated at the periphery. Sutures more or less deeply impressed, the anterior margin usually crenulated or denticulate; axials low, numerous, commonly unequal, more or less nodose on the periphery. Spirals fine crowded, punctate. Basal disk usually distinct. Aperture oval, widening anteriorly. Peristome continuous; labral varix prominent.

Nodiscala has been reported from the Eocene of Australia, but it is peculiarly characteristic of the Miocene of central Europe. There are, however, several species in the Pliocene of Italy, and the recent representatives, though few in species are widely distributed through the warmer waters.

Fragments of individuals of this well-characterized subgenus occur in the Shoal River formation, but nothing sufficiently well preserved to name.

Scalina (Nodiscala) sp.

The fragments of *Nodiscala* that occur in the Shoal River indicate a small but heavy species of slender outline, obtusely carinated medially and at the base of the body. The axials are low and rather ill-defined, approximately 12, obscurely nodulated at the peripheral and basal keels, absent altogether on the base. The spirals are fine, irregular, and crowded and are separated by microscopically punctate, linear interspirals. The aperture is oblique, oval, broadening anteriorly. The labral varix is prominent and persists around the anterior extremity. The basal disk is defined only by the absence of the axial sculpture and the more regular spirals, but the meager material may include no fully adult individuals.

Occurrence: Shoal River formation, locality 3742r, Aldrich collection, Johns Hopkins University.

Family ?EPITONIIDAE
Genus GEGANIA Jeffreys

1833. *Tuba* Isaac Lea, Contributions to geology, p. 127. Not *Tuba* Renier, 1804, Vermes.

1884. *Gegania* Jeffreys, Zool. Soc. London Proc., sig. 25, p. 365. Type by monotypy: *Gegania pinguis* Jeffreys. Collected by the *Porcupine* expedition off Cape Mondego, North Lat. 39° 39′ to 39° 55′ in 740 to 1,095 fathoms.

Type of *Tuba* Lea by subsequent designation (Cossmann, Catalogue illustré des coquilles de l'Eocène des environs de Paris, vol. 3, p. 316, 1888): *Tuba alternata* Lea=*Littorina antiquata* Conrad. Claiborne Eocene of the Gulf Province. Herrmannsen in 1849 designated *"Turbo sculptus"* Pilkenhorn as the type. Doubtless he had in mind *Turbo sulcatus* Pilkenhorn, a Barton shell mentioned by Lea in his original description. The error, however, makes the designation worthless.

Shell conical, reticulated, not umbilicated; nucleus globular and intorted, not spiral, nor sinistral. Differs from *Mathilda* in having a short spire and an intorted but not heterostrophe nucleus.—Jeffreys, 1884.

The nucleus is bulbous and tipped at the apex like that of *Architectonica.* Even though the initial tendency of the nuclear whorls is sinistral, as Dall maintained when he placed the family in the Mathildiidae, the fact that only the dextral whorls are exposed may

be of importance taxonomically. The genera most closely related seem to fall in the families Architectonicidae and Epitoniidae, the two main groups which according to Morley-Davies make up the suborder Ptenoglossa, and *Gegania* is tentatively placed within the wide limits of the Epitoniidae.

The genus has been reported from strata as early as the Jurassic and still persists in restricted numbers in the warmer seas.

Gegania acutissima (Dall)

Plate LVII, figure 18

1892. *Tuba acutissima* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 319, pl. 18, fig. 4a.

Shell with eight or nine rapidly enlarging whorls; nucleus minute, decollate in all the specimens, but from the slenderness of the subsequent whorls evidently not immersed; the three whorls succeeding the decollation nearly smooth, gradually taking on faint spiral striation which in the later whorls becomes a rather uniform series of sharp threads to the number of five or six above the periphery, separated by wider interspaces; on the base the spirals are still more sparse, except around the umbilicus; transverse sculpture of closer, fine, elevated lines most prominent in the interspaces and covering the whole surface in harmony with the lines of growth; whorls rounded and full, except at the periphery, which is more or less distinctly angulated; base convex, with an obscure angle about its middle; umbilicus distinct, variable in size, funicular, shadowed in front by the inner lip; pillar arched, thin, sometimes with a slight callus near the anterior end; aperture gibbously lunate, effuse near the pillar, slightly angulated by the basal and peripheral angles; a thin wash of callus covers the body, the throat is smooth; the suture is very distinct and runs a little below the peripheral angle. Altitude of shell 7.5; maximum diameter 5 millimeters.

This species has somewhat the aspect of a *Trichotropis* on account of the effuse aperture and angulated periphery. As the nucleus is not immersed, it is interesting as combining the broad form of *Tuba* proper with the naked nuclear coil of the section *Mathilda*, thus illustrating the slight systematic value which the characters relied on to separate the groups really possess.—Dall, 1892.

Holotype: U. S. Nat. Mus. No. 113472.

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

Gegania acutissima has not been recognized in any of the collections other than those accessible to the author of the species. The form is known only from the type locality.

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

Gegania sp. ind.

A single individual, apparently new, was found in the Shoal River materials. The rounded whorls converge at an angle of approximately 30° and are sculptured with 7 or 8 sharply elevated, flattened spirals equal in size and spacing and intersected by microscopically fine but sharp axial threadlets, about 25 or 30 to the whorl. As the form is probably young and somewhat imperfect it can serve only to establish the presence of the genus in the Shoal River formation.

Occurrence: Shoal River formation, locality 3742[r].

Superfamily CERITHIACEA
Family LITIOPIDAE
Genus LITIOPA Rang

1829. *Litiopa* Rang, Annales des sciences naturelles, vol. 16, p. 306.

Type by subsequent designation (Gray, Zool. Soc. London Proc., pt. 15, p. 155, 1847): *Litiopa bombix* Kiener=*Litiopa melanostoma* Rang. Described from Newfoundland.

Shell very thin, not large, ovate-conic. Whorls closely appressed, very feebly convex. Surface smooth or feebly striate concentrically. Aperture lobate, angulated posteriorly. Outer lip very thin and sharp, arcuated. Inner lip excavated, simple or reflected. Umbilicus usually imperforate. Anterior extremity of aperture truncate and more or less emarginate.

Litiopa has been reported from the early Tertiaries, although its occurrence, at least in the European Eocene, has been questioned. The Recent species are pelagic and are especially abundant in the Sargasso Sea, where they hang suspended from the sargasso weed by glutinous threads 2 or 3 feet in length.

Litiopa palaeosargassina Maury

Plate LIV, figure 16

1910. *Litiopa palaeosargassina* Maury, Bull. Am. Pal., vol. 4, No. 21, p. 28, pl. 7, fig. 5.

Shell small, thin and delicate, polished, whorls four exclusive of the eroded nucleus, rather convex. Sculpture consisting of very fine spiral striae visible only under a lens. Aperture oval: outer lip simple, thin. Length of shell 5; greatest width 2.5 millimeters.

Oak Grove, Santa Rosa County, Fla.

Mr. Aldrich's collection.—Maury, 1910.

Shell very thin and fragile, rather small, ovate-conic in outline. Whorls closely appressed, a little more than 6 in all including the minute, highly polished, inflated nucleus of a trifle more than one volution. Initial whorls of conch also inflated, gradually flattening into a feebly convex, buccinoid outline. Body whorl smoothly constricted at the base. Surface lustrous, lineated with microscopically fine spiral striae, 10 or 12 on the penultima, and even finer incrementals. Suture lines feebly impressed. Aperture lobate, sharply angulated and sulcated at the posterior commissure. Outer lip thin, very sharp, expanding anteriorly. Inner lip reflected, smoothly glazing the parietal wall and roofing but not concealing the umbilical chink. Anterior extremity of aperture squarely truncate and obscurely emarginate. Umbilical chink a very narrow, rather deep depression that runs parallel to the labium from

the base of the body to the anterior extremity. Umbilical keel obtuse, outlined by 5 or 6 faint lirae.

Dimensions of topotype: Height, 3.8 millimeters; maximum diameter, 2 millimeters.

Topotype: U. S. Nat. Mus. No. 350402.

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

In general outline and ornamentation, *Litiopa palaeosargassina* suggests *L. bombix,* the type of the genus, but is readily isolated by the reflected labium. It has been recognized only in the immediate environs of the type locality.

Occurrence: Oak Grove sand, localities 2646[r], 5632[r], 10659[r], Cornell University collection.

Genus ALABA H. and A. Adams

1853. *Alaba* H. and A. Adams, Genera Recent Mollusca, vol. 1, p. 241 (as subgenus of *Cerithiopsis*, family Cerithiopsidae).

1862. *Alaba* A. Adams, Annals and Mag. Nat. History, vol. 10, p. 294.

Type by subsequent designation (Nevill, Hand list of Mollusca, Indian Museum, Calcutta, pt. 2, p. 181, 1885); *Alaba melanura* (C. B. Adams)=*Rissoa? melanura* C. B. Adams. Recent off Jamaica.

The *Alaba melanura* from Jamaica in the museum collections is a more slender shell than *Alaba tervaricosa* described from the same area, but it is otherwise similar. Only the two species were mentioned by Henry and Arthur Adams in their original description of the genus, and *A. tervaricosa* was erroneously cited as *A. trivaricosa.* In 1862, however, Arthur Adams described a number of additional species of *Alaba* and noted the close resemblance of the group to *Litiopa,* rather than to *Cerithiopsis.*

The genus was restricted by Smith[27] to those forms characterized by "whorls tumidly varicose; columella more or less truncated; labrum thickened in the adult state." The subgenus *Diala* was established to include those with "whorls not varicose (sometimes noduled around the middle); columella straightish, not truncated; labrum not thickened."

The character of the outer lip is dependent on the growth stage. It is varicose during the resting periods, but in the intermediate seasons it is thin.

The Recent forms are denizens of the strands bordering the warmer seas.

Alaba has a meager representation in the Alum Bluff group. Only two species have been recognized—one of them fairly common in the Chipola formation but not known outside of it; the other restricted in its distribution to the type locality in the Oak Grove sand.

Diameter more than one-third the altitude; base of body whorl not spirally striated ..... *Alaba chipolana* Dall.

Diameter less than one-third the altitude; base of body whorl spirally striated ..... *Alaba dodona* Gardner, n. sp.

[27] Smith, E. A., Remarks on the genus *Alaba,* Zool. Soc. London Proc., pp. 537-540, 1875.

Alaba chipolana Dall

Plate LIV, figure 17

1892. *Alaba chipolana* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 292, pl. 21, fig. 9.

Shell small, smooth, with two very minute nuclear and eight or nine subsequent well-rounded whorls; sculpture only of faint incremental lines, obscure malleations and faint varices; the varices are irregular in number, sometimes as many as three on one whorl, but they are little elevated; the penultimate varix is usually more pronounced in the adult than any of the others; aperture subovate, outer lip slightly thickened inside, simple; basal part rounded, with a faint sinus at the end of the pillar; body without perceptible callus; pillar straight, slender, perceptibly axially twisted. Lon. of shell 6.0; max. diam. 2.75 millimeters.

This species is smoother than most of the genus but has the characteristic features of *Alaba.*—Dall, 1892.

Holotype: U. S. Nat. Mus. No. 113384.

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

The young are obtusely angulated at the periphery; the adults elevated, acutely tapering, smoothly rounded on the body, and more or less drawn out basally. The early volutions are more convex and relatively lower than the later and obscurely tabulated posteriorly. The suture lines are distinctly impressed. A somewhat smoother and more slender form is associated with the typical *A. chipolana*—an individual 4.0 millimeters in height but with a maximum diameter of only 1.4 millimeters. Though probably distinct at least subspecifically the specimens available all show signs of immaturity and had best be excluded from the literature for the present.

Occurrence: Chipola formation, localities 2213[a], 2564[r], 3419[p], 2211[c].

Alaba dodona Gardner, n. sp.

Plate LIV, figures 14, 15

Shell small, very slender. Whorls approximately 10 in all, increasing very gradually in diameter. Protoconch probably three-whorled, not preserved in the holotype, differentiated only by the higher luster; the volutions broadly convex and moderately elevated. Whorls of conch becoming rather irregular toward the aperture and more and more constricted at the sutures. Axial varices well-defined though irregular in size and arrangement, usually about 3 to the whorl. Later volutions lineated with faint spiral sulci, 12 on the body, less faint on the posterior portion and on the base of the body. Suture lines impressed, more deeply so on the later volutions than on the earlier. Aperture at a low angle to the axis, broadly lenticular, angulated at the posterior commissure. Outer lip of holotype thin, sharp, and arcuate, but varicose directly behind the margin. Inner lip concave. Parietal wall thinly washed. Pillar feebly reinforced and slightly twisted. Anterior sinus broad but very shallow.

Dimensions of holotype: Height, 4.5± millimeters; maximum diameter, 1.4 millimeters. Dimensions of incomplete paratype: Height, 2.6 millimeters; maximum diameter, 1.2 millimeters.

Holotype: U. S. Nat. Mus. No. 350405. Paratype: U. S. Nat. Mus. No. 136045.

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

Alaba dodona is smaller than the Chipola species, more slender, more strongly varicose, and distinctly though faintly striated spirally on the later whorls. The slender race at Chipola is less strongly varicose. The species is rare even at the type locality.

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

Family MODULIDAE
Genus MODULUS Gray

1842. *Modulus* Gray, Synopsis Contents British Museum, ed. 44. pp. 60, 90. Genus without species.

1847. *Modulus* Gray, Zool. Soc. London Proc., pt. 15, p. 150. =*Pseudotrochus* Heilprin, 1887. Wagner Free Inst. Sci. Trans., vol. 1, p. 114; (type: *Pseudotrochus turbinatus* Heilprin, from the Tampa limestone at Ballast Point, Fla.).

Type by original designation and tautonomy: *Trochus modulus* Linnaeus. Recent in the West Indies.

Shell rather heavy, low, turbinate or trochiform. Nucleus smooth, naticoid, paucispiral. Conchal sculpture usually ornate. Spirals dominant, commonly beaded by the incrementals. Axials undulatory, commonly retractive and continuous. Base oblique or feebly convex. Aperture entire, subcircular, rounded or angulated posteriorly, expanding anteriorly. Outer lip sharp, lirate within. Columella excavated, terminating anteriorly in a strongly oblique or horizontal buttress which forms the posterior margin of the fasciolar notch. Fasciole short, deeply emarginate. Umbilicus narrowly perforate in the genotype.

Modulus is the sole member of the Modulidae family.

The *Modulus* fauna has not been increased by a single individual since the publication of the Wagner papers and is restricted in its known distribution to the Chipola formation. The Recent species are relatively few in number but world-wide in their distribution in the warmer seas.

Whorls of spire axially costate:
- Spirals approximately uniform in prominence over the entire surface ..... *Modulus compactus* Dall.
- Spirals much more prominent on the periphery and the base than on the sides of the spire ..... *Modulus biconicus* Gardner, n. sp.

Whorls of spire not axially costate.... *Modulus willcoxii* Dall.

Modulus compactus Dall

Plate LV, figure 27

1892. *Modulus compactus* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 294, pl. 22, fig. 10.

Shell small, turbinate, with a rather pointed apex and about six whorls (nucleus lost), rapidly enlarging; transverse sculpture of ten rounded ribs extending from the suture to the periphery, where they cease abruptly, the interspaces wider than the ribs; lines of growth well-marked; spiral sculpture of (on the last whorl seven above and seven below the periphery) strong equal rounded threads with wider regular interspaces in which run minute spiral striae; whorls full, subangulate at the periphery, the base slightly flattened; suture distinct; umbilicus pervious, bounded by a rather wide smooth fasciole; aperture subquadrate, sharply lirate inside; a thin callus on the body; pillar thin, short, with a broad, sharp, nearly horizontal tooth at the base. Alt. 9.0; max. diam. 8.0 millimeters.

A single specimen of this well-marked little species was obtained. It has the same pointed spire as the other Chipola species, but differs from them and from the other American species in the details of its sculpture.—Dall, 1892.

The figure does not clearly indicate that the buttress at the anterior extremity of the columella is also the posterior part of the margin of the fasciolar notch.

Holotype: U. S. Nat. Mus. No. 113387.

Type locality: No. 2211, lower bed at Alum Bluff, Chattahoochee River, Fla.

The species is allied to *Modulus biconicus* but is readily separable by the uniformity of the spiral threading and the absence of a prominent peripheral fillet. The sculpture of *Modulus compactus* is similar in general pattern to that of the genotype, but the Chipola shell is smaller and the spire higher.

Occurrence: Chipola formation, locality 2211[r].

Modulus biconicus Gardner, n. sp.

Plate LV, figure 26

Shell rather small, rudely biconic, the spire much more acute, however, and more attenuated than the base. Whorls approximately 7. Apex more or less decorticated in all available material so that the nuclear characters are lost and the exact number of whorls indeterminate. Early volutions of conch trapezoidal, regularly increasing in size, sculptured with 5 or 6 low, rather broad lirations, equal in size and spacing except for the stronger peripheral spiral. Axials initiated on the later whorls of the spire, rapidly increasing in prominence, numbering approximately 10 to the whorl; body sculpture dominantly axial, the 10 costae uniform in size and spacing, evanescent toward the posterior suture, very broad and undulatory, separated by concave intercostals of nearly the same width as the costals. Spirals irregular on the body; 4 primaries between the suture and the periphery of the type more closely spaced posteriorly, with 1 or 2 secondaries intercalated in each of the interspiral areas except the anterior, which is threaded with about half a dozen exceedingly fine lirae; margin raised directly in front of the suture, thus simulating a heavy spiral. Periphery obtusely angulated, outlined by a broad and elevated fillet which is feebly undulated by the axials and minutely corrugated by the incrementals. Base

low, rounded, conic, adorned with 6 sharply elevated, evenly spaced cords, the posterior of which is the strongest and is more distantly spaced from the peripheral spiral than it is from the basal cord in front of it. Early whorls closely appressed, later more loosely wound. Suture indistinct in the apical region, deeply channeled and overhung by the periphery of the preceding whorl toward the aperture. Aperture subcircular, obtusely angulated at the posterior commissure. Outer lip sharp, strongly arcuate, obscurely angulated at the periphery, somewhat patulous, crenulated at the margin and internally lirate in harmony with the external sculpture. Parietal wall heavily glazed. Columella excavated, terminating anteriorly in a heavy horizontal buttress which forms the posterior margin of the fasciolar notch. Fasciole obscurely defined, lirated with two rather feeble spirals, emarginate at the apertural face. Umbilicus a mere chink.

Dimensions of holotype: Height, 9.5 millimeters; maximum diameter, 7.8 millimeters.

Holotype: U. S. Nat. Mus. No. 114117.

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

Modulus biconicus suggests *Modulus compactus* Dall in general contour and character of sculpture, but it is more elevated than the latter, the spirals are much less uniform in size and spacing, the axials tend to evanesce toward the posterior suture, and the periphery is outlined by a broad and prominent fillet.

The species is known only from the environs of the type locality.

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

Modulus willcoxii Dall

Plate LV, figure 19

1892. *Modulus willcoxii* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 294, pl. 18, fig. 1a.

Shell large, strong, with two (or more) small, smooth nuclear and seven subsequent sculptured whorls; whorls with a blunt duplex carina, on which the suture is wound; spiral sculpture, above the carina, of five or six strong, rather sharp, elevated ribs, subequal, with about equal interspaces; below the carina, on the base, are about seven more, growing stronger and flatter toward the pillar; these spirals are undulated by the intersection of numerous transverse sulci in harmony with the lines of growth; base flattish, subconic; aperture subquadrate; outer lip sharp-edged, sharply lirate inside in harmony with the spiral sculpture; body with a thin callus; pillar short, bearing a broad and strong revolving lamella; umbilicus closed; suture distinct, slightly turriculate. Altitude of shell 20; maximum diameter 14 [17.8] millimeters.

Mr. Burns obtained but a single specimen of this fine species, which it gives me much pleasure to dedicate to Mr. Joseph Willcox, to whose energy and interest this investigation of our Southern Tertiary is largely due.—Dall, 1892.

Holotype: U. S. Nat. Mus. No. 113386.

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

Modulus willcoxii Dall is the largest and finest of the three Chipola species. It stands apart from the other two Chipola shells and from the Recent West Indian species by reason of its larger size and stronger sculpture and also because of the slight shouldering of the whorl in front of the suture. *Modulus angulatus* C. B. Adams shares with it the absence of axial sculpture, but the spire of *M. angulatus* is a broad cone with no trace of tabulation in front of the suture line.

Modulus tamanensis Maury from the Machapoorie Quarry, Trinidad, is, however, strikingly similar. The Trinidad species exceeds the Chipola form in size and strength of sculpture. The shell figured by Mansfield[28] is 29.0 millimeters high, overtopping that of the holotype of *M. willcoxii* by 9.0 millimeters. The spirals are prominently elevated cords, and the interspirals are deeply channeled. The peripheral spiral is simple instead of duplex as in *M. willcoxii* and is not trenched by the incrementals. The similarity between the two species is sufficiently striking, however, to be considered in correlation of the Trinidad beds.

Occurrence: Chipola formation, localities ?7893^{r}, 2212^{r}.

Family CAECIDAE

Genus CAECUM Fleming

1813. *Caecum* Fleming, Brewster's Edinburgh Encyclopedia, vol. 7 (1), p. 67 (fide Sherborn).

Type by subsequent designation (Gray, Zool. Soc. London Proc., pt. 15, p. 203, 1847): *Dentalium trachea* Montagu. Recent from the British Isles to the Mediterranean.

Shell a small, gently arcuate tube. Protoconch caducous, planorboid, coiled two or three times. Nuclear and adolescent shells successively outgrown and discarded; a septum or "plug" serving to close the posterior extremity of the shell. Form and position of "plug" constant and characteristic of the species. Outer surface of the arcuate adult tube dorsal, the inner surface ventral. Adult shell smooth, axially sulcate, annulate or reticulate. Aperture circular, entire.

The genus is rather abundant in the Tertiaries and more than a hundred species have been listed from the warm waters of the Recent seas.

Caecum is inadequately represented in the Alum Bluff. Most of the few individuals that have been collected are young, and there is nothing very significant about their apparent affinities.

Surface smooth.

Apertural ring developed ..... *Caecum chipolanum* Gardner, n. sp.

Apertural ring not developed ..... *Caecum* sp. cf. *C. carolinianum* Dall.

[28] Mansfield, W. C., Miocene gastropods and scaphopods from Trinidad, British West Indies: U. S. Nat. Mus. Proc., vol. 66, art. 22, p. 49, pl. 7, figs. 1, 2, 1925.

Surface annulated throughout its extent..... *Caecum pararegulare* Gardner, n. sp.
Surface annulated near the aperture; faintly longitudinally striate ..... *Caecum carolinianum* Dall.

Caecum chipolanum Gardner, n. sp.

Plate LV, figure 13

Shell small but rather solid and not very slender, approximately uniform in diameter throughout its extent, gently and nearly symmetrically arched. Surface rather highly polished, smooth except for a heavy apertural ring. Aperture obliquely truncated, feebly contracted in front of the ring. Plug low, mucronate, bearing a small, rather slender spur near the dorsal margin.

Dimensions of holotype: Height 2.6 millimeters; maximum diameter 0.6 millimeters.

Holotype: U. S. Nat. Mus. No. 329000.

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

Caecum chipolanum is readily isolated from coexistent members of the genus by the entire absence of sculpture. It is larger and less slender than *C. glabrum* Montagu of the Recent fauna and smaller, more uniform in diameter and more gently arcuate than *C. virginianum* Meyer of the later Tertiaries. It further differs from both of these species in the development of an apertural ring.

Caecum putnamense Mansfield, 1924, from the later Pliocene or early Pleistocene of Putnam County, Fla., is comparable in its small dimensions and arcuate outline but the anterior ring of *C. putnamense* is not so heavy as it is in *C. chipolanum* and the plug is not mucronate but mammillate.

Occurrence: Chipola formation, localities 2213[r], 3419[r], 7151[p], 2211[a], 7183[c].

Caecum pararegulare Gardner, n. sp.

Plate LV, figure 12

Shell a minute, gently arcuated tube, slightly larger at the anterior extremity. Surface finely and sharply annulated, the rings 40 to 50, a little less crowded dorsally and toward the aperture. Aperture not constricted, obliquely truncated, outlined by a rather wide and somewhat thickened simple margin. Plug ungulate, a low dorsally truncated, asymmetric cone set well behind the median vertical.

Dimensions of holotype: Height, 2.3 millimeters; maximum diameter, 0.6 millimeters.

Holotype: U. S. Nat. Mus. No. 351485.

Type locality: No. 3733, three-fourths of a mile west of Shell Bluff, Shoal River, Walton County, Fla.

Caecum pararegulare suggests a very closely crenulated *C. regulare* Carpenter. The two species present approximately the same dimensions and contour, but the number of rings in the earlier form is almost double that in the later form. *Caecum floridanum compactum* Dall is much larger and the annulations upon it broader and less sharply elevated than those of *C. pararegulare.*

Caecum properegulare Mansfield, from the Brasso beds, is doubtless closely related. The two shells are of similar dimensions, but the Trinidad species is much less closely annulated than the species from Shoal River.

Occurrence: Chipola formation, localities 7893[r], 2213[r]; Shoal River formation, localities 5079[r], 10661[r], 3733[r].

Caecum species cf. C. carolinianum Dall

Three individuals—two from the Chipola formation and one from the Oak Grove sand, all of them obviously juvenile—resemble more closely the young of *Caecum carolinianum* Dall (Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 300, pl. 22, fig. 25, 1892) from the Caloosahatchee marl of Florida than of any other described species. The young and the adult are so dissimilar however, not only in this species but in many other members of the genus, that in the absence of adult material determinations can be only suggested.

Occurrence: Chipola formation, locality 2213[r]; Oak Grove sand, locality 2646[r].

Occurrence of *Caecum carolinianum*: Miocene—Duplin marl, Natural Well, 2 miles southwest of Magnolia, Duplin County, N. C. Pliocene—Waccamaw formation, Tilly's Lake, Horry County, S. C.; Caloosahatchee marl, Caloosahatchee River, Fla. Recent—Atlantic Ocean from Cape Hatteras to Egmont Key in 2 to 63 fathoms.

Family VERMETIDAE

The family includes aberrant, vermiform mollusks that exhibit external irregularity in growth and sculpture. In outward appearance these mollusks are very near to some of the annelid worms. The Vermetidae are characterized, however, by a spiral nuclear shell, internal septae, and a tube composed of three calcareous layers instead of only two as in the genus *Serpula* of the annelids. The septae are considered by Carpenter and Mörch to be analogous to the internal cup of the *Crucibulum* and to the diaphragm of the *Crepidula.* Mörch's "Review[29] is still the most exhaustive published study of the family, but he overvalued individual and specific variations. In the fossil forms, however, specific and even generic separations are difficult, for the best diagnostics, the nucleus and the operculum, are usually wanting, and even the septae are commonly concealed or absorbed.

The family is fairly well represented in the Oak Grove sand, but in the other formations it constitutes an inconspicuous member of the fauna.

[29] Mörch, Otto, A. L., Review of the "Vermetidae," Zool. Soc. London Proc., pp. 145-181, 326-365, 1861; pp. 54-83, 1862.

Genus LEMINTINA Risso

1826. *Lemintina* Risso, Histoire naturelle des principales productions de l'Europe méridionale, vol. 4, p. 114.

1845. *Anguinella* Conrad, Fossils of the Medial Tertiary or Miocene formation of the United States, p. 77. No generic description but monotype *Anguinella virginiana* Conrad=*Serpula virginica* Conrad, described and figured. Chesapeake Miocene of Virginia and North Carolina.

Type by monotypy: *Lemintina cuvieri* Risso=*Serpula arenaria* Linnaeus. Recent in the Mediterranean.

The shell is tubular and irregularly coiled or twisted and attached or free. The external surface is usually lirate and often more or less granulose. No longitudinal laminae are developed, but the tube is commonly chambered by perpendicular partitions or pouches concave forward. The operculum is absent.

The genus is widely distributed in the warmer waters of the Recent seas.

The determinable Alum Bluff species are restricted to the Oak Grove sand, but fragments of individuals occur in the Chipola formation which may be properly referable to this genus.

Lemintina granifera (Say)

Plate LV, figure 11

1824. *Serpula granifera* Say, Acad. Nat. Sci. Philadelphia Jour., 1st ser., vol. 4, p. 154. pl. 8, fig. 4.

1892. *Serpulorbis granifera* Say. Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 303.

1894. *Anguinella virginiana* Conrad. Whitfield, U. S. Geol. Survey Mon. 24, p. 132, pl. 24, figs. 1-5.
Not *Anguinella virginiana* Conrad, Fossils of the Medial Tertiary or Miocene formation of the United States, p. 44, fig. 4, 1845.

1896. *Serpula granifera* Say. Reprint of Say, 1824, Harris, Bull. Am. Paleontology, vol. 1, no. 5, p. 60, pl. 8, fig. 4.

1904. *Vermetus graniferus* (Say). Martin, Maryland Geol. Survey, Miocene, p. 232, pl. 55, figs. 14, 15.

1909. *Vermetus graniferus* (Say). Grabau and Shimer, North American index fossils, vol. 1, p. 737, fig. 1072a-b (after Martin).

1915. *Serpulorbis granifera* Say. Dall, U. S. Nat. Mus. Bull. 90, p. 95.

1930. *Serpulorbis granifera* (Say). Dall, Mansfield, Florida Geol. Survey Bull. 3, p. 102, pl. 14, fig. 4.

1937. *Serpulorbis granifera* (Say)?. Mansfield, Florida Dept. Conserv. Geol. Bull. 15, p. 160.

Covered with longitudinal, contiguous, slightly elevated, granulated striae.

Shell subcylindric, contorted, inferior side flat; the whole surface is composed of very numerous, small, contiguous striae, each consisting of a single row of granules; these series are alternately smaller.

Diameter of the larger end three-tenths, of the largest specimen two-fifths of an inch.

The continuity of the tube within is interrupted by oblique diaphragms. It sometimes approaches the spiral form, and one specimen has three complete volutions of much regularity.—Say, 1824.

Lemintina granifera was described from one of the shells in the Finch collection, made presumably in Maryland. All that is known of these shells is Say's statement concerning them, namely, "The following descriptions were made out from specimens in a very large and fine collection of fossil shells which Mr. John Finch obtained with much labor and some expense in Maryland, and which that gentleman with great liberality submitted to my examination." Mansfield believed from internal evidence that they came not from Maryland but from Virginia. Among them is *Pecten clintonius* Say, which has not since been recorded from Maryland and which is otherwise restricted to zone 1 of the Yorktown formation in Virginia and North Carolina. Mansfield also expressed some doubt that the tubes from the Choctawhatchee formation of Florida which are referred to *L. granifera* are specifically identical with those from the Chesapeake.

The species is characterized by loose but intricate coiling, granular axial lirations and numerous little pouches, concave anteriorly, set into the tube at right angles to the axis. In abundance and wide distribution in the North Carolina and Virginia Miocene, it is outstripped only by the *Petaloconchus sculpturatus* H. C. Lea, a larger, more angular, more closely and regularly coiled form, with fewer and more coarsely granular, axial lirations. The character which separates the two species generically—the development of internal, axial laminae in the latter—is so commonly absent that it is necessary to supplement it with criteria of no generic significance.

The Miocene forms from Florida seem a little more finely sculptured and a little less granular than those from the higher Miocene of the Atlantic seaboard, but the constant differences are not sufficient to afford a basis for specific separation.

Occurrence: Oak Grove sand, localities ?2646[a], ?5632[r], ?5630[p], ?7054[p].

Outside occurrence: Tampa limestone, Ballast Point, Hillsboro County, Fla., (Dall and Mansfield?); White Beach near Osprey, Manatee County, Fla. (Dall). Calvert formation, Jericho, N. J.; Plum Point, Chesapeake Bay; and 3 miles west of Centerville, Queen Annes County, Md. Choptank formation, Jones Wharf, Governor Run (lower bed), and Greensboro, Caroline County, Md. St. Marys formation, St. Marys River, Md.; Urbanna Cliffs on the Rappahannock River, Middlesex County, Va., and Union Mills, 2½ miles south of Farnham, Richmond County, Va. Yorktown formation, many localities along the rivers in York, Isle of Wight, Southampton, and Nansemond Counties, Va.; many localities along the Tar and Chowan Rivers in Edgecombe, Hartford, and Bertie Counties, N. C. Duplin marl, Natural Well, Duplin County, N. C. Waccamaw formation, Wilmington, New Hanover County, N. C. Choctawatchee formation, *Ecphora* zone and possibly *Cancellaria* zone in Leon County, Fla.

Lemintina papulosa (Guppy)

Plate LV, figure 20

1866. *Vermetus papulosus* Guppy. Geol. Soc. London, Quart. Jour., vol. 22, p. 292, pl. 17, fig. 3.
1917. *Serpulorbis papulosa* Guppy. Maury, Bull. Am. Paleontology, vol. 5, no. 29, p. 127, pl. 22, fig. 10.
1922. *Serpulorbis papulosus* (Guppy). Pilsbry, Acad. Nat. Sci. Philadelphia, Proc. for 1921, pt. 2, p. 376.
1922. *Serpulorbis papulosa* (Guppy). Olsson, Bull. Am. Paleontology, vol. 9, no. 39, p. 145, pl. 12, fig. 1.
1925. *Serpulorbis papulosa* Guppy. Maury, Bull. Am. Paleontology, vol. 10, no. 42, p. 225.
1928. *Lemintina papulosa* (Guppy). Woodring, Carnegie Inst. Washington Pub. 385, p. 346, pl. 26, fig. 6.

Shell nearly straight, rather irregularly spirally contorted, ornamented with regular longitudinal rows of tubercles interlined with crenate striae; aperture subcircular.—Guppy, 1866.

Holotype (British Museum, Natural History, Geological Department No. 64081.—Woodring, 1928.

A tube about 33.0 millimeters long and 9 millimeters in diameter is the only record of the existence of this typically mid-American species on the mainland north of Costa Rica. It is a slightly contorted short length of an adult shell, decorated with incrementals and with 11 rows of fairly evenly spaced pustules.

Figured specimen: U. S. Nat. Mus. No. 498201, from locality 14436, which is the gully south of the road and east of the bridge over Whites Creek, on road from Eucheeanna to Knox Hill, 6.7 miles south of Argyle and 1.7 miles southeast of Eucheeanna, Walton County, Fla.

Occurrence: Shoal River formation, 14436r.

Lemintina papulosa is recorded from the middle Miocene (Gatun formation) of Costa Rica, the middle and upper Miocene (Manzanilla beds and Springvale beds) of Trinidad, the upper Miocene (Bowden beds) of Jamaica, and the middle Miocene (Cercado and Gurabo beds) of the Dominican Republic.

Genus PETALOCONCHUS H. C. Lea

1846. *Petaloconchus* H. C. Lea, Am. Philos. Soc. Trans., n. ser., vol. 9, p. 233.

Type (by monotypy): *Petaloconchus sculpturatus* H. C. Lea. Upper Miocene of the Atlantic seaboard from Virginia to Florida.

Shell tubular, solid, irregularly twisted, with two internal longitudinal plates.

The singular shell, on which I propose to found the above genus, differs from all the known tubular shells that I have met with, in the two internal longitudinal plates * * *.—H. C. Lea, 1846.

The genus has a meager representation in the Tertiary and Recent faunas. The Miocene representatives are numerous in the Oak Grove sand and not rare in the Chipola formation, and a few fragments of doubtful affinities from the Shoal River formation have also been referred to this genus.

Petaloconchus sculpturatus H. C. Lea

Plate LV, figures 10, 21

1846. *Petaloconchus sculpturatus* H. C. Lea, Am. Philos. Soc. Trans., 2d ser., vol. 9, p. 233, pl. 34, fig. 3.
1856. *Petaloconchus sculpturatus* Lea. Tuomey and Holmes, Pleiocene fossils of South Carolina, p. 123, pl. 26, fig. 13.
1858. *Petaloconchus sculpturatus* Lea. Emmons, Rept. North Carolina Geol. Survey, p. 271, fig. 169.
1892. *Vermetus (Petaloconchus) sculpturatus* H. C. Lea. Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 305.
1930. *Petaloconchus sculpturatus* H. C. Lea. Mansfield, Florida Geol. Survey Bull. 3, p. 104, pl. 14, fig. 10.

Shell sometimes twisted, sometimes turreted, thick, with small longitudinal noduliferous ribs; internal laminae smooth, polished, obsolete at the mouth; mouth round. Diam. .20 of an inch.

The longitudinal costae are generally nodulous, but they occasionally seem rather to be cancellated by transverse sulci, which, in other specimens, appear to usurp their place. The two internal laminae are placed at about one-sixth of the circumference apart. They are generally directed towards the centre, and sometimes nearly meet. In some specimens they are much smaller than in others. They rarely or never seem to be continued to the aperture.

This is a very variable shell, both as to the sculpture and internal plates. I at first thought that there were two or three distinct species, but the varieties glide imperceptibly into each other. It appears to be by no means an uncommon shell at Petersburg.

The form figured is a very usual one. I have but few specimens which do not exhibit a decided tendency to form regular revolutions, and in some, the axis is so straight that a pin may be thrust through the umbilicus from the apex to the base.

The second figure is a specimen fractured to exhibit the appearance of the laminae.—H. C. Lea, 1846.

Figured specimen: U. S. Nat. Mus. No. 350411.

Type locality: Petersburg, Va.

Figure 10 illustrates a specimen from Oak Grove enlarged 15 times. The photograph is made from beneath, so that the surface of attachment was exposed to the camera. Figure 21 is No. 1575 in the collections of the Academy of Natural Sciences in Philadelphia, presumably the holotype of *sculpturatus* from Petersburg, Va. It does not, however, represent the individual illustrated by Lea, 1846, unless that specimen has been badly broken in the meantime.

Petaloconchus domingensis Sowerby, 1850, widespread in the mid-Americas, is closely related. Olsson, 1922, and Mansfield, 1930, considered it identical with the Costa Rican species. Pilsbry, 1922, and Woodring, 1928, thought it deserved no more than subspecific rank. Miss Maury believed that she could detect a difference in the coiling plan, stating that "*P. domingensis* typically coils in a widening cylinder, with whorls much flattened on the sides and angulate at the base" and that "*P. sculpturatus* coils in a tapering cone, with whorls less flattened and more convex at the base." That distinction does not hold very well for the specimens in our collections. In the mid-American species

the sculpture seems rather more subdued than it does in the Atlantic seaboard form and so long as the two names are well established in the literature, *P. domingensis* may perhaps be retained as a subspecies of the more northern *P. sculpturatus*.

Petaloconchus alcimus Mansfield, 1925, included under *P. sculpturatus* by Guppy, 1910, and under *P. sculpturatus* var. *domingensis* by Maury, 1925, is the representative of the group in the upper Miocene of Trinidad.

Petaloconchus sculpturatus is the most abundant species in the Alum Bluff group, particularly at Oak Grove. The earlier Miocene representatives do not attain the dimensions reached by the later Miocene individuals, but they are similar in their habit of growth, in the general character of the external sculpture, and the disposition of the internal laminae. The species is remarkable for its close coiling; commonly half a dozen or so whorls, all of them 6 to 8 millimeters across, are piled one on top of the other, with the tubes flattened laterally and along the plane of contact and angulated at the sutures. One individual which is quite certainly referable to this genus still retains its protoconch of four smooth, rather inflated volutions, which increase regularly in size and with a moderate degree of rapidity. The external surface, particularly in slightly weathered individuals, may present an evenly reticulate aspect. The spiral lirae are usually 3 or 4 on the exposed surface of the tightly coiled tubes, and the axials, which are commonly dominant, are somewhat rugose in character and similar in spacing to the spirals.

Occurrence: Chipola formation, locality 10609^{p}, 2212^{c}; Oak Grove sand, localities 2646^{a}, 5632^{p}, 5631^{r}, 5633^{p}, 7054^{r}, 9961^{p}; Shoal River formation, locality ?3742^{r}.

Outside occurrence: Yorktown formation, widely distributed in Virginia and North Carolina; Duplin marl, widely distributed in North and South Carolina; Choctawhatchee formation, *Ecphora* and *Cancellaria* zones in Florida.

Family ARCHITECTONICIDAE

Genus ARCHITECTONICA "Bolten" Roeding

1798. *Architectonica* "Bolten" Roeding, Museum Boltenianum, pt. 2, p. 78.
=*Solarium* Lamarck, 1799, Prodrome d'une nouvelle classification des coquilles, Soc. histoire nat. Paris Mém., p. 74.
1909. *Architectonica* Bolten. Dall, U. S. Geol. Survey Prof. Paper 59, p. 80.

Type by subsequent designation (Gray, Zool. Soc. London Proc., pt. 15, p. 151, 1847): *Trochus perspectivus* Linnaeus. Recent in the Indo-Pacific.

The family of the Architectonicidae is placed by Morley Davies under the Ptenoglossa.

Periphery of body whorl acutely angulated; base flattened at least near the periphery ..... *Architectonica* s. s.
  Spirals 4 on the adult whorls ..... *Architectonica quadriseriata* (Sowerby) s. s.
    Spirals cut into sharply rounded granules; at least three beaded cords surrounding the denticulate margin of the umbilicus ..... *Architectonica chipolana* Dall.
    Spirals simple on the body whorl of the adult, cut in the early volutions into somewhat flattened squarish areas; usually only a single beaded cord surrounding the denticulate margin of the umbilicus:
      Sutures impressed but not channeled ..... *Architectonica quadriseriata* (Sowerby), subsp.
      Sutures channeled ..... *Architectonica quadriseriata waltonensis* Gardner, n. subsp.
  Spirals 1 to 3 on the adult whorls:
    Outer basal spirals less prominent than the peripheral cord; a second spiral developed outside that which outlines the umbilical keel ..... *Architectonica alvear* Gardner.
    Outer basal spiral equal in size to the peripheral cord; a single spiral outlining the umbilical keel ..... *Architectonica verecunda* Gardner.
Periphery of body whorl rounded or obtusely angulated; base smoothly convex ..... *Architectonica (Pseudotorinia) bisulcata* D'Orbigny.

Subgenus ARCHITECTONICA s. s.

1798. *Architectonica* "Bolten" Roeding, Museum Boltenianum, pt. 2, p. 78.

Type by subsequent designation (Gray, Zool. Soc. London Proc., pt. 15, p. 151, 1847); *Trochus perspectivus* Linnaeus. Recent in the Indo-Pacific.

The outline is that of a low beehive. The nucleus dips vertically downward at the apex so that only the final small, well-rounded nuclear whorl is visible. The spiral bands on the earlier part of the shell are trenched by very strong and strongly retractive incrementals but on the later volutions become lower, less regular and almost obsolete. The periphery is subacute, the aperture subquadrate, and the umbilicus wide and encircled by the dentate umbilical keel, which can be traced to the apex.

The West Indian *A. nobilis* is remarkably close to the genotype. It is a much smaller shell, and the umbilicus is rather wider and more conspicuously funicular. The general outline and sculpture plan are, however, the same.

Three out of the five species or subspecies of *Architectonica* isolated in the Alum Bluff group are members of the *A. nobilis* group. The relationship of the Alum Bluff forms is significant in view of the tendency within the group toward a simplification of the sculpture.

Each horizon is represented by a distinct and a restricted race. The Chipola form is the most ornate of the three, the Shoal River the most subdued.

Architectonica nobilis "Bolten" Roeding

1781. *Trochus perspectivus* Linnaeus. Chemnitz, Conchylien-Cabinet, vol. 5, pp. 121-127 (part), pl. 172. figs. 1695, 1696.
1798. *Architectonica nobilis* "Bolten" Roeding, Museum Boltenianum, pt. 2, p. 78.
1822. *Solarium granulatum* Lamarck, Animaux sans vertèbres, vol. 7, p. 3.

Neither Roeding nor Lamarck figured their species, but they both referred to figures of the polynomial Lister, 1785. Thus Roeding's *Architectonica* of 1798 supplants Lamarck's *Solarium* of 1799, and Roeding's *A. nobilis* supplants Lamarck's *S. granulatum;* thus *Solarium granulatum* Lamarck becomes *Architectonica nobilis* Roeding. Woodring, in 1928, used *Architectonica nobilis quadriseriata* (Sowerby) for the West Indian shell and discussed at length the closely related variants in the mid-Americas. Dall in 1892 noted that the fossil individuals were more granulose than the Recent, but he included the forms found in the Duplin marl and Waccamaw formations with the Recent *Solarium granulatum,* and Mansfield in 1930 referred to it the specimens from the *Ecphora* and the *Cancellaria* zones of the Choctawhatchee formation of Florida.

The close relationship between the Recent West Indian *A. nobilis* and *A. nobilis quadriseriata* described from the middle Miocene of Santo Domingo is accepted. However, the nomenclature becomes so cumbersome when the attempt is made to recognize variants of *A. nobilis quadriseriata* that the Tertiary West Indian form has been treated as a species.

Architectonica quadriseriata (Sowerby) s. s.

1850. *Solarium quadriseriatum* Sowerby, Geol. Soc. London, Quart. Jour., vol. 6, p. 51, pl. 10, figs. 8a, 8b, 8c.
1928. *Architectonica (Architectonica) nobilis quadriseriata* (Sowerby) Woodring, Miocene mollusks from Bowden, Jamaica, pt. 2, Carnegie Inst. Washington Pub. 385, p. 354, pl. 27, figs. 5-7.

The typical mid-American Miocene shell has not been recognized in the Alum Bluff group of Florida.

Architectonica chipolana (Dall)

Plate LVIII, figures 1, 2

1892. *Solarium granulatum* var. *chipolanum* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 329.

Those from Chipola are all small specimens, but agree perfectly with the younger *granulatum* except in having the periphery and basal ribs conspicuously beaded. They may form a variety *chipolanum*.—Dall. 1892.

Dimensions of holotype: Height, 7.5 millimeters; maximum diameter, 1.5 millimeters.

Holotype: U. S. Nat. Mus. No. 329031.

Type locality: No. 2564, 1 mile below Baileys Ferry, Calhoun County, Fla.

Architectonica quadriseriata (Sowerby) was considered by Dall [30] as a synonym of *Solarium granulatum* Lamarck=*A. nobilis* Roeding, although he noted that "the Jamaica Miocene variety *quadriseriatum* Sby. is slightly more flattened above the periphery than the type." In addition to the uniformly lower height the granules are sharper and less elongated than in the Recent form and are more persistent. The Miocene race in the West Indies is intermedial between the Chipola form and the later Tertiary and Recent forms, although much nearer to the former than to the latter. The outlines of the two Miocene races are similar, but in the earlier or Chipola type the sculpture is a little sharper and the beading, particularly on the periphery and the base, noticeably more prominent and persistent. The tendency toward a simpler sculpture is perceptible even in the comparison of a series of Pliocene and Recent species. The subspecies is described from immature individuals.

Occurrence: Chipola formation, localities 2213^{c}, 2564^{p}, 3419^{p}, 7151^{r}, 2211^{p}.

Architectonica quadriseriata (Sowerby), subsp.

Architectonica quadriseriata (Sowerby) is represented in the Oak Grove fauna of both Florida and Georgia by still another unnamed subspecific race. It is characterized by a more subdued sculpture than that which ornaments *A. quadriseriata* s. s. Both on the apical and basal surfaces the spirals are similar in number and arrangement to those of the species s. s., but in the Oak Grove subspecies the incremental sculpture is relatively feeble, and instead of dissecting the spirals into a series of sharply rounded beads it cuts them into squarish or oblong areas that seem from the somewhat oblique undercutting to overlap one another like tiles on a roof. The incrementals are also less persistent in the Oak Grove subspecies and evanesce anteriorly as early as the fifth whorl, leaving the anterior and peripheral spirals simple. The basal sculpture is similar in both the species s. s. and the subspecies, though the spirals are less deeply dissected in the subspecies.

A. quadriseriata (Sowerby) subsp. is intermediate in sharpness of sculpture between species from the Bowden beds of Jamaica and the subspecies from the Shoal River formation, which is characterized by a relatively subdued and flattened ornamentation.

The form is rare even at the single horizon at which it is represented.

Occurrence: Oak Grove sand, localities 3385^{r}, 7148^{r}, 2646^{r}, 5632^{r}, 7054^{r}.

[30] Dall, W. H., Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 328, 1892.

695462—47—7

Architectonica quadriseriata waltonensis Gardner

Plate LVIII, figures 8, 10

1936. *Architectonica quadriseriata waltonensis* Gardner, Florida Dept. Cons., Geol. Bull. 14, p. 47, pl. 9, fig. 1, pl. 10, fig. 4.

Shell of normal size for the group and of normal proportions. Whorls very broadly and feebly inflated, 7 or 8 in number, including the small, loosely coiled protoconch of 1½ volutions. External sculpture dominantly spiral, similar in general character and in the number and arrangement of the spirals to *A. quadriseriata* s. s., but more subdued and less persistent; incrementals more shallow and more widely spaced than in the Jamaican or even the Oak Grove race, obliquely undercutting the low fillets so that they appear to be made up of a series of minute, overlapping tiles; sulci beginning to evanesce as early as the sixth whorl, where they appear for the most part as incised, linear grooves cutting obliquely across the spirals, replaced on the body whorl by microscopically fine striae; basal sculpture much reduced. Umbilical pit outlined by a wide and heavily corrugated spiral, which is separated by a profund sulcus from the somewhat rugose band outside it. Periphery outlined by a heavy cord, and just within it but separated from it by a very fine threadlet, another cord of almost equal size and also simple. Area between the umbilical and peripheral spirals about half the width of the entire base, feebly convex and smooth in the adult except for 2 or 3 faint spiral striations and incremental scratches that radiate from the umbilical keel. Sutures so deeply channeled that the profile of the spire is interrupted and the whorls assume a gibbosity greater than that which they really possess. Characters of aperture normal for the species. Umbilical funnel a trifle narrower and less open than that of *A. quadriseriata* s. s.

Dimensions of holotype (a slightly imperfect specimen): Height, 14 millimeters; maximum diameter, 26 millimeters.

Type material: Holotype, U. S. Nat. Mus. No. 351515.

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

This subspecies differs from the form from the Bowden beds of Jamaica only in the somewhat less flattened whorls, the less ornate and less persistent sculpture, the channeled suture, the slightly smaller umbilicus, and the development of only one instead of two spiral bands encircling the heavily corrugated umbilical spiral. *Architectonica bellastriata* var. *vicksburgensis* (Dall) is probably more closely allied with the *A. nobilis* group than it is with *A. bellastriata*. It differs from the Shoal River race in the somewhat more elevated and more rounded outline, the rather finer sculpture on the sides of the spire, the more ornate base, and, most obviously, in the exposure of the peripheral spiral as a fine piping directly behind the suture line. The species is the most common representative of the genus within the Shoal River beds.

Occurrence: Shoal River formation localities 3856[a], 3742[a], 2238[r], 5618[r].

Architectonica alvear Gardner

Plate LVIII, figures 6, 7, 9

1936. *Architectonica alvear* Gardner, Florida Dept. Cons., Geol. Bull. 14, p. 48, pl. 9, fig. 2, pl. 10, figs. 5-6.

Shell of moderate size for the genus, somewhat rounded, suggesting in outline a very low beehive. Whorls about 7½ in number, including the small, loosely coiled protoconch of approximately 1½ volutions, the initial half turn, however, largely immersed. Whorls of conch flattened between the channeled sutures, the body whorl somewhat tumid, sharply angulated at the periphery, and flattened on the base. Sculpture simple for the genus; earliest spiral initiated, as in others of the *A. nobilis* group, directly behind the suture on the first turn of the conch, growing increasingly prominent and more sharply granulose until it reaches the ultima, where it tends to flatten out and become more simple; a second spiral introduced soon after the first directly in front of the suture, but this is quickly reduced to a series of fine incremental puckerings; wide, flattened interspiral area smooth except for oblique incremental rugae, which are most pronounced on the spire and correspond in number to the posterior puckers and the granules of the anterior spiral. Periphery outlined by a very heavy, rounded, feebly corrugated cord, which appears to be wider on the basal surface than on the apical, and a second strongly rounded and well-elevated cord developed on the base just within the peripheral spiral and separated from it by only a deep linear sulcus. Umbilical carina sharp, outlined by a wide denticulate spiral; outer margin separated from the flattened, more or less rugose spiral that surrounds it by a narrow but deep channel; area between the umbilical and peripheral spirals flattened, smooth except for radial-growth striae and a vague spiral sulcus a little less than halfway from the periphery to the umbilicus. Umbilical pit rather large, open to the apex, the wall displaying the umbilical keel of the successive whorls. Shell broken at the mouth, and characters of aperture not well known.

Dimensions of imperfect holotype: Height, 17 millimeters; maximum diameter, 25 millimeters.

Type material: Holotype, U. S. Nat. Mus. No. 350446.

Type locality: No. 5633, Oak Grove, Yellow River, Okaloosa County, Fla.

Architectonica alvear is allied to *A. amphiterma* Dall from the Miocene of Maryland. It is relatively higher, however, with a more prominent and, on the spire, more sharply annulate anterior spiral. The young are discoidal in outline.

Architectonica quadriseriata waltonensis is lower than *A. alvear* and the whorls are more flattened and more deeply channeled at the sutures. Intermediate spiral fillets are present in *waltonensis,* which on the later whorls are as strong as the anterior and posterior spirals.

The species is restricted in its distribution to the Oak Grove sand.

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

Section PSILAXIS Woodring

1928. *Psilaxis* Woodring, Miocene mollusks from Bowden, Jamaica, pt. 2, Carnegie Inst. Washington Pub. 385, p. 355.

Type by original designation: *Architectonica (Philippia) krebsii* Mörch. Recent in the West Indies and off the Florida Coast.

Shape of shell and umbilicus, and apertural features as in *Architectonica* s. s., though the aperture is more ovate. Dorsal part of nucleus consisting of one large whorl. Axial sculpture of dorsal surface confined to sutural wrinkles on first postnuclear whorl. Spiral sculpture of dorsal surface consisting of cords adjoining periphery. Ventral sculpture consisting of a crenulated umbilical cord, separated from a narrower crenulated thread by a groove, which in turn is separated by a groove from the smooth main part of base. A narrow spiral thread adjoins the periphery.

The recognition of this group of Architectonicas seems justified because of the very large nuclear whorl, as seen in dorsal view, and because of the distinctive sculpture. It is represented by living species in the western Atlantic and western Pacific. The species here described are the first American fossils recorded.—Woodring, 1928.

Architectonica verecunda Gardner

Plate LVIII, figures 3, 4, 5

1936. *Architectonica (Psilaxis) verecunda* Gardner, Florida Dept. Cons., Geol. Bull. 14, p. 50, pl. 10, figs. 1-3.

Shell small, a much depressed cone, acutely angulated at the periphery, flattened on the basal surface, and broadly rounded in the apical region. Nucleus porcellaneous, large, ill-shaped, broadly inflated, completing a little more than a single revolution, strongly differentiated from the conch both by the abrupt change in the texture of the shell and by the initiation of the conchal sculpture. Whorls of conch 3 in the unique type, which is probably not fully mature; earliest whorl obscurely rounded, the two later volutions flattened laterally. Sculpture very simple; two narrow ornate bands of equal width marked off by incised lines, the one placed directly in front of the suture and the other directly behind it; a second anterior, noncrenate, and slightly narrower band delimited by a more feebly incised line, set about one-third the distance from the anterior to the posterior suture. Suture line deeply impressed but very narrow. Periphery of body wound with a very strong cord; a second cord equally strong revolving on the base directly in front of it and separated from it by only a linear interspace. Area between the umbilicus and periphery broadly rounded, devoid of spiral sculpture except for a feeble thread, delimited by incised lines revolving about one-third the distance from the periphery to the umbilical keel and marking the outer limit of the radial sulci of the umbilical area; keel sharply crenulated, set off by a deeply impressed channel. Incremental sculpture manifested in the puckerings of the base, the crenate bands on the spire, and the very faint striae on the smooth medial portion of the whorl. Aperture rudely quadrate, sharply angulated at the peripheral and umbilical keels and at the union of the parietal wall with the labrum and the pillar. Outer lip thin and sharp. Body wall thinly glazed. Umbilicus small, its diameter less than one-third that of the entire base, persistent to the apex, revealing within the umbilical keels of the earlier volutions.

Dimensions of holotype: Height, 4 millimeters; maximum diameter, 6.5 millimeters.

Holotype: U. S. Nat. Mus. No. 352117.

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

Architectonica verecunda is interesting as the first record in the Floridian Miocene of the section *Psilaxis* Woodring. The Shoal River shell differs from the two described Bowden species in slight details of the spiral sculpture and in the stronger incremental striae, which have sufficient depth and regularity to bead the spirals on the dorsal surface.

Occurrence: Shoal River formation, locality 5618[r].

Subgenus PSEUDOTORINIA Sacco

1892. *Pseudotorinia* Sacco, Molluschi dei terreni terziarii del Piemonte e della Liguria, pt. 12, p. 66.

Type by original designation: *Solarium obtusum* Bronn. Miocene and Pliocene of northern Italy.

Torinia Gray [31] (type, *Trochus variegatus* Gmelin from the Indo-Pacific) includes a group of *Architectonica* characterized by a small, top-shaped operculum. Sherborn [32] considered *Torinia,* 1840, a nude name. He made no reference to the 44th edition, 1842, which Iredale [33] cited. Neither edition is available for consultation. Iredale quotes Gray's characterization as follows: "*Torinia* differs [from *Solarium*] in having a nearly orbicular operculum, which is very convex and marked with a spiral ridge looking like a pagoda."

Sacco indicated the difficulty of recognizing in the

[31] Gray, J. E., Synopsis of the contents of the British Museum, ed. 42, p. 147, 1840 (vide Sherborn).
Gray, J. E., Idem, ed. 44, p. 60, 1842 (vide Iredale).

[32] Sherborn, C. D., Index Animalium, pt. 26, p. 6539, 1931.

[33] Iredale, Tom, A collation of the molluscan parts of the Synopses of the Contents of the British Museum, 1838-1845; Malacological Soc., London, vol. 10, p. 308, 1913.

fossil state a group characterized by peculiarities of the operculum and proposed the name *Pseudotorinia* for the fossil shells which share with *Torinia* a rounded periphery and an ornate sculpture pattern.

Architectonica (Pseudotorinia) bisulcata (D'Orbigny)

1853. *Solarium bisulcatum* D'Orbigny, Sagra, R. de la, Histoire physique, politique, et naturelle de l'île de Cuba, pt. 2 (Mollusques), vol. 2, p. 66, pl. 19, figs. 17-20.

1874. *Solarium semidecussatum* Guppy, Geol. Mag., new ser., dec. 2, vol. 1, p. 438, pl. 18, fig. 14 (in part).

1887. *?Torinia bisulcata* (D'Orbigny) Tryon, Manual of conchology, vol. 9, p. 22, pl. 6, figs. 14-16.

Coquille orbiculaire, très déprimée, ornée, en dessus, de cinq côtes peu élevées, avec lesquelles viennent se croiser d'autres côtes longitudinales, régulières, qui rendent toute la coquille comme granuleuse; en dessous il y a six côtes; des deux côtes les côtes latérales sont les plus larges, et c'est même la réunion des côtes externes qu'on voit représenter un double bourrelet sur le pourtour de la coquille. Spire très courte, obtuse, composée de six tours; ombilic assez large, canaliculé en dedans, crénelé sur ses bords et bordé, extérieurement, de deux côtes plus larges que les autres. Bouche subarrondie.

Elle habite la Jamaïque et la Martinique.—D'Orbigny, 1853.

Because of the relatively finer, more subdued sculpture, two very young forms have been referred tentatively to this species rather than to the closely allied *A. nupera* Conrad. Guppy's *S. semidecussatum* was described from two juveniles, one of which is almost certainly this species; the other is probably a *Solariella*.

Architectonica nupera Conrad, apparently restricted to the Yorktown, is possibly the cool water analog of the warmer-water *A. bisulcata*.

Occurrence: Chipola formation, locality ?2213[r].

Family TURRITELLIDAE

Genus TURRITELLA Lamarck

1799. *Turritella* Lamarck, Soc. histoire nat. Paris Mém., Prodrome d'une nouvelle classification des coquilles, p. 74.

Type by monotypy: *Turbo terebra* Linnaeus. Recent in the China Sea and the Gulf of Siam.

A slender, imperforate, polygyrate form, spirally sculptured. Aperture holostomous, oval, subcircular or subquadrate. Outer lip thin, simple, sinuous, retractive posteriorly, slightly produced anteriorly in most species. Columella simple, concave. Posterior portion of shell vacant and partitioned at each half turn.

Before the end of the Cretaceous, *Turritella* had become one of the more conspicuous elements in the gastropod faunas of North America. The genus culminated during the Tertiary, and was represented at that time by a large number of prolific species. In the Recent seas, it is relatively meager and confined, largely to the warm waters of the Old World.

A number of classifications of *Turritella* have been made, none of them adequate for the grouping of the small diversified Alum Bluff assemblage of species. Among the most careful of the later studies is that of Guillaume.[34] Guillaume rejected the results of an attempt of Cossmann[35] to include under a few subgenera a large number of widely distributed fossil and Recent species. Two characters have been stressed in the later, more important attempts at classification: (1) The trace of the growth lines; (2) the nuclear and juvenile characters, the shape of the whorls and the number and order of appearance of the spirals. In Cossmann's classification, species with similar growth line patterns may be placed in different subgenera; and species with different patterns of growth lines in the same subgenera. Guillaume introduced no new names, but he assembled the species under "Groupes" one typified by *T. hybrida* Deshayes, another by *T. imbricataria* Lamarck, etc. Merriam[36] grouped the mass of the fossil West Coast Turritellas under a certain number of "stocks" each typified by a single species. Unlike Guillaume, who based his separations on the growth trace alone, Merriam considered also the apical angle, and particularly the characters of the early whorls. Neither Guillaume nor Merriam attempted to separate the mass of their material into subgenera nor did either one introduce any new superspecific names.

Turritella terebra Linnaeus, the type of the genus is a slender species of 30 to 35 rounded whorls. The maximum height may exceed 150 millimeters, and a height of 120 millimeters is common. The posterior part of the adult whorl is flattened a little in front of the channelled suture, and the spirals are less prominent than on the medial and anterior portions of the shell. The aperture is oval and higher than it is wide. The earliest whorls increase very slowly in diameter and are asymmetrically rounded. The growth lines are strongly retractive across the flattened posterior area but nearly vertical medially and anteriorly. Judging from the number of specimens in the collection, the species seems to be fairly common in the China Sea and the Gulf of Siam and south to Singapore.

No East Coast Tertiary species is sufficiently like the genotype to be placed with it in a restricted subgenus.

Turritella subgrundifera Dall

Plate LVII, figure 1

1892. *Turritella subgrundifera* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 313, pl. 22, fig. 23.

Shell thin, acute, with twenty-four sharply carinated sculptured whorls and a nucleus of two smooth, swollen whorls, of which the first is set obliquely to the axis of the adult shell;

[34] Guillaume, Louis, Essai sur la classification des Turritelles; ainsi que sur leur évolution et leurs migrations, depuis le début des temps tertiaires: Soc. Géol. France, ser. 4, t. 24, pp. 281-311, pls. 10, 11; 33 text figs., 1924.

[35] Cossmann, Maurice, Essais de Paléoconchologie comparée, vol. 9, pp. 106-130, August, 1912.

[36] Merriam, Charles W., Fossil Turritellas from the Pacific Coast Region of North America; Univ. California Pub., Dept. Geol. Sci., Bull., vol. 26, no. 1, pp. 1–214, pls. 1–41, 19 text figs., 1 map, 1941.

transverse sculpture only of lines of growth, which are not prominent and rarely undulate even the finest of the spirals; the periphery of the whorl is near the suture in front, and is ornamented with an extremely sharp keel, which overhangs, like eaves, the succeeding whorl; above this are four narrow less prominent keels or elevated spirals, with much wider about equal interspaces, which on the later whorls carry a fine intercalary spiral line; the surface is polished, but shows traces under the lens of microscopic spiral striae; in front of the main carina are one or two elevated spirals between it and the almost invisible suture; the base inside of the sutural line is distantly spirally sculptured and rather convex; the aperture is subquadrate, the pillar arched, thin, and twisted so as to offer a minutely pervious axis; the throat is provided with strong sharp lirae independent of the sculpture. Lon. of shell [estimated] 77; max. diam. of base 17 millimeters.

This is a very elegant and distinct species which in some of its features faintly recalls *T. imbricataria* Lam. of the Parisian Eocene.

The American species which is nearest to it in form, though a much smaller shell, is the unfigured *T. alticostata* from the Miocene of Virginia and Maryland. This has been identified from Conrad's type by Mr. Harris, but it has rounded, close-set threads and is only about half the size of the Chipola species. *T. alticostata* will probably turn out to be a carinated variety of *T. variabilis*.

It occasionally happens that the main carina in *T. subgrundifera* is no larger than the other, in which case, of course, the whorls have a more rounded appearance. But these specimens are rare compared with the carinated, which seems to be the normal form. It is the only fossil species here referred to with sharp lirae in the throat; the others have the throat quite smooth except in cases where the sculpture is reflected by sulci in the interior of the aperture.—Dall, 1890.

Holotype: U. S. Nat. Mus. No. 113440.

Type locality: No. 2214, Tenmile Creek, 1 mile west of Baileys Ferry, Calhoun County, Fla.

The two to three nuclear whorls are narrow, inflated and smooth; the initial whorl, tilted slightly. The first five or six of the sculptured whorls are convex and carinated medially. The posterior of the two initial spirals outlines the periphery; the anterior spiral is midway between the periphery and the suture line. With the increasing angularity of the whorl, the anterior spiral becomes increasingly prominent relatively.

The growth lines are strongly retractive posteriorly and feebly arcuate medially and anteriorly. Merriam (ibid, p. 48) has noted the similarity of *T. subgrundifera* to the *T. ocayana* group of the middle Miocene of California and Lower California.

Turritella imbricataria Lamarck, mentioned by Dall, is a synonym of *Haustator gallicus* Montfort, the monotype of *Haustator,* a group characterized by strongly insinuated growth lines. The resemblance of *T. subgrundifera* to the *Haustator* group is not fundamental. The growth traces differ, and though I have not seen perfect tips of *T. imbricataria,* the earliest whorls of *T. carinifera* Deshayes, which Guillaume considers a varietal form of *T. imbricataria,* have straight sides separated by channeled sutures and are girdled with three equal lirae symmetrically disposed on the whorl.

Pilsbry and Brown, 1917, reported *Turritella subgrundifera* from Cartagena, Colombia. Spieker, 1922, has noted its resemblance to *infracarinata* Grzybowski of the Zorritos formation of Peru.

Occurrence: Chipola formation, localities 10609[p], 7893[p], 2212[c], 2214[c], 2213[c], 2564[c], 3419[c], 7151[p], 2211[c], 7183[a], 2566[r], 7468[p]; Oak Grove sand, localities 2646[p], 5632[p], 5631[r], 5633[r], 9961[r].

Turritella alcida Dall

Plate LVII, figure 2

1896. *Turritella alcida* Dall, U. S. Nat. Mus. Proc., vol. 18, No. 1035, p. 23.

1903. *Turritella alcida* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 6, p. 1632, pl. 59, fig. 26.

Shell resembling *T. aequistriata,* Conrad, but more acute and more rapidly enlarging, shorter, with the anterior ridge on the whorl compressed and almost keeled, closer to the suture in front, to which the base drops abruptly, and, on the final base, flatter; owing to the form of the base and the constriction of the upper part of the whorl, the turns appear to overhang the suture. Length, 85; diameter, 21.5 mm., in a specimen with 17 whorls.—Dall, 1896.

Holotype: U. S. Nat. Mus. No. 135054.

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

Shell moderately large and stout for the genus. Whorls commonly exceeding 20, regularly increasing in size, rudely trapezoidal, conspicuously carinated a little behind the suture and more or less obscurely so a little in front of the median horizontal. Periphery of body rounded or obscurely angulated; a tendency toward a second angulation along a line which the suture would follow if produced. Protoconch small, smooth, inflated, even a little bulbous, paucispiral; line of demarcation between conch and protoconch rather obscure. Sculpture initiated gradually on the third whorl of the shell, with a medial spiral liration strong enough to feebly carinate the whorl and fainter lirae, one in front of and another behind, the periphery; additional spirals rapidly introduced. Medial carina conspicuous, as a rule, until the eighth or tenth volution, where a keel, developed directly behind the suture, becomes increasingly prominent toward the aperture; area behind the medial keel gently sloping to the suture or in the strongly carinate forms feebly concave; area between the two keels more or less concave, the degree of depression varying with the strength of the carinae; anterior carina overhanging the succeeding volution. Adult sculpture of 25 to 40 fine, crowded lirae. Incrementals strongly retractive posteriorly, broadly and very feebly arcuate medially and anteriorly. Basal lirae regularly spaced, the interspaces increasingly wider toward the periphery. Suture lines distinct, feebly impressed, overhung by the anterior carina of the preceding volution. Aperture rudely quadrate. Outer lip so thin that it is rarely preserved intact, ob-

tusely angulated by the anterior carina and in the bicarinate individuals by the medial carina as well; inner lip strongly concave, reinforced along its margin. Parietal wall thinly glazed; throat nonlirate.

Turritella alcida Dall is peculiarly characteristic of the Oak Grove fauna. It is exceedingly abundant at that horizon and has not been recognized elsewhere. It differs from *T. subgrundifera* Dall, which occurs along the Yellow River, though never abundantly, in the development of a medial carina, the finer and very much more crowded spirals, and the nonlirate throat. The sculpture pattern of *T. alcida* suggests that of *T. gatunensis* Conrad, but the Gatun shell is smaller than that from Florida, and the whorls are less flattened. A closer analog and quite possibly a descendant is *T. aequistriata* Conrad of the Chesapeake Miocene. The Miocene species is smaller, with a more regular and less crowded sculpture, but it resembles the Oak Grove species in its general outline, its incipient medial carina, and its type of sculpture.

Occurrence: Oak Grove sand, localities 2646[a], 5632[c], 5631[p], 5630[p], 5633[p], 7054[c], 9961[p].

Turritella alcida bicarinata Gardner, n. subsp.

Plate LVII, figure 3

Shell rather large and heavy, of about 20 volutions. Nucleus paucispiral, similar to that of *T. alcida* s.s. Whorls of conch bicarinate; the medial carina first to be developed, strongest on the earlier whorls, though persistent to the aperture; in the juvenile growth stage, the anterior carina less prominent than the medial, approximately equal to it in the adolescent, and more prominent in the adult. Intercarinal area strongly concave; area between medial carina and posterior suture feebly concave; whorl abruptly contracted in front of the anterior carina. Periphery of body obtuse, with a suggestion of an angulation along the line which the suture would follow if produced. Surface, as in *T. alcida* s.s., ornamented with 25 to 40 fine and crowded lirae, somewhat unequal in size. Sculpture on base similar to that on the spire, minutely crenulate; about half a dozen spirals less feeble than the rest, regularly spaced but increasingly crowded toward the axis. Incrementals, as in *T. alcida,* strongly retractive posteriorly, approaching the vertical medially and anteriorly. Suture lines distinct but overhung by the carina of the preceding whorl. Aperture rudely quadrate. Outer lip obtusely angulated by the medial and anterior keels, retractive posteriorly as in *T. alcida* s.s. Inner lip concave, reinforced. Parietal wall washed with a thin enamel.

Dimensions of holotype: Height, 73 millimeters; maximum diameter, 19.5 millimeters.

Holotype: U. S. Nat. Mus. No. 350427.

Type locality: No. 5630, 100 yards below Oak Grove, Yellow River, Okaloosa County, Fla.

It is with some hesitation that the individuals in question are isolated even subspecifically, so obvious is the close relationship in even the end members. However, they are readily separable by the relatively greater prominence of the medial carina, and the differences are present at an early stage. The distribution of the subspecies is similar to that of *T. alcida* Dall s.s., although it is less abundant than the normal form.

Occurrence: Chipola formation, localities 2302[p], 7468[p]; Oak Grove sand, localities 3386[r], 3385[r], 2646[c], 5632[p], 5631[r], 5630[p], 5633[p], 7054[p].

Turritella gatunensis blountensis Mansfield

Plate LVII, figures ?11, ?12

1935. *Turritella gatunensis blountensis* Mansfield, Florida Dept. Cons., Geol. Bull. 12, p. 41, pl. 4, figs. 1, 2.

Shell of medium size, moderately slender and constricted at the excavated sutures. Earliest whorls rounded and weakly medially carinated. On the following whorls a basal spiral appears, weak at first but soon becoming as strong as the medial one, forming between them a shallow depression. Another spiral comes in on the later whorls on the posterior slope, which becomes anteriorly nearly as strong as the one in front of it. In addition to the primary spirals, secondary and tertiary spirals overrun the whorls. The suture winds against the base of the preceding whorl.

The cotypes (U. S. Nat. Mus. No. 373151) measure: Specimen with preserved earlier whorls.—Length, 41 millimeters; diameter, 8 millimeters. Specimen with lost earlier whorls.—Length, 40 millimeters; diameter, 12 millimeters.

Turritella gatunensis Conrad is closely related to the new subspecies but differs from the latter in having more medially carinate early whorls and an earlier development of the basal spiral. It also has a less slender shell than the new subspecies.

Type locality: No. 12046, Vaughan Creek, upper locality, Walton County, Fla.—Mansfield, 1935.

Mansfield has reported his species from several localities in the *Arca* zone of the Choctawhatchee formation, and he has also observed that "four small specimens at locality 5618, 3½ miles southwest of DeFuniak Springs, Fla., uppermost bed of Shoal River formation, appear to belong to the new subspecies." The juveniles figured in this report are from locality Sta. 10603, another outcrop of the high Shoal River, probably synchronous with that 3½ miles southwest of DeFuniak Springs.

The whorls are a little higher in the specimens from Whites Creek, 6.7 miles south of Argyle, than they are in those from Vaughan Creek, but the species represented must certainly be close if not identical.

The trace of the growth lines is similar to that in *Turritella subgrundifera* and *T. alcida,* and the general characters of the early whorls are also similar.

The figured juvenile (U. S. Nat. Mus. No. 498024) is 9.3 millimeters high and 2.8 millimeters in diameter. The older individual (also U. S. Nat. Mus. 498024) is 15.5 millimeters high and 5.1 millimeters in diameter.

Occurrence: Shoal River formation, locality 10603[r].

Turritella segmenta Gardner, n. sp.

Plate LVII, figures 13, 14

Shell small and rather slender, the early whorls inflated medially, the later volutions carinate behind the suture, probably about 20 in number in the perfect adult shell. Protoconch not well preserved in any of the material available, but doubtless small, smooth, acute, and paucispiral. First 8 or 9 whorls of conch evenly convex, quite strongly constricted at the sutures, sculptured with microscopically fine, sharp, linear threadlets approximating 30 or 35 in number, subequal in some individuals, in others every fifth or sixth lira less feeble than the rest; interspaces linear. Carina initiated about the eighth or ninth volution at or a little in front of the median line, increasing in strength toward the aperture and emphasized by the prominent spiral that outlines it; a second keel developed shortly after the first directly behind the suture line. Adult whorls gently sloping from the posterior suture to the medial carina, straight-sided or nearly so between the medial and anterior carinas and very strongly and abruptly constricted in front of the anterior carina. Shoulder of adult sculptured with approximately 20 lirae, equisized except for the one about halfway between the suture and the keel, which is commonly more prominent than the rest, and breaks the even profile of the shoulder. Anterior keel outlined by a spiral which is only a little less prominent than that which crowns the periphery, and a little behind it another almost or equally prominent, while a third is developed at a similar distance in front of it but is commonly more or less obscured by its position on the under surface of the keel, although in the older forms it outlines the carina. Interspaces between the three anterior primaries slightly concave and finely lirate; space in front of the periphery, also feebly concave and sculptured with 10 or 12 linear threadlets; under surface of anterior keel almost horizontal in some individuals and closely lirated. Suture line distinct but concealed by the overhanging whorl behind it. Aperture holostomous, broadly oval. Outer lip thin, sharp, and obscurely angulated at the base. Inner lip evenly concave, reinforced. Parietal wall rather heavily glazed; throat strongly lirate in some individuals, not at all in others.

Dimensions, estimated from two cotypes, which may be parts of a single individual: Height, 38 millimeters; maximum diameter, 7.5 millimeters.

Cotypes: U. S. Nat. Mus. No. 371863.

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

Turritella segmenta is not confusable with any of the species with which it is associated. The early whorls suggest *T. plebeia* Say, of the Chesapeake Miocene, in contour and sculpture, but *T. plebeia* shows no tendency toward the development of abruptly overhanging whorls in later life. The later whorls of *T. segmenta* recall in outline and general sculpture pattern those of *T. gatunensis* Conrad, but the early whorls of *T. segmenta* seem to be rounded and obscurely carinate through a longer growth period than those of *T. gatunensis*. *T. segmenta* may be an antecedent form of *T. subannulata* Heilprin, most closely resembling the variety *T. subannulata acropora* Dall, possibly through *T. subannulata jacksonensis* Mansfield from the *Ecphora* zone of the Choctawatchee formation at Jackson Bluff, Leon County, Fla. *Turritella blackwaterensis* Mansfield, 1937, probably from the Tampa limestone, may be a still earlier ancestral type. The known representatives of *T. segmenta* are confined to the Shoal River beds in Walton County and are not abundant even within that restricted area.

Occurrence: Shoal River formation, localities 3742^{p}, 5080^{r}, 5618^{r}.

Subgenus TORCULA Gray

1847. *Torcula* Gray, Zool. Soc. London Proc., pt. 15, p. 155.

Type by original designation: *Turbo exoletus* Linnaeus. Recent in the Gulf of Mexico and the West Indies in 45 to 170 fathoms (C. W. Johnson); Dry Tortugas in 30 to 35 fathoms (C. W. Merriam).

Shell rather small, slender, polygyrate. Apical angle very small, not far from 15°. Only about two narrow, polished nuclear whorls, the initial whorl tilted slightly, the second turn inflated but tending to flatten toward its close. Line between conch and protoconch obscure, indicated by duller texture of shell of conch. The four or five earliest whorls of conch inflated and keeled anteriorly, the whorls rapidly flattening and the anterior keel becoming a low anterior spiral; posterior spiral introduced on about the fourth or fifth whorl of the genotype. Original spirals increasingly strong, becoming the prominent anterior and posterior cords in the adult; cords rarely simple, usually beaded by the growth lines which override them. Growth lines strongly arcuate and symmetrically disposed between the sutures.

Torcula includes a number of Tertiary and a few later species. The tertiary forms are prolific in the warm temperate and tropical waters of the Province of the Gulf of Mexico and the West Indies. The Recent species are not so common and live in deeper water. *Torcula* probably reached the peak of development during the middle Miocene. It includes *T. altilira* and allied forms, prolific in the Canal Zone and Costa Rica, allied species in Jamaica and the Dominican Republic, in northern South America, and in Ecuador and Peru on the Pacific Coast, and the *T. "inezana* stock" of Merriam in central and southern California and in Lower California.

Turritella (Torcula) dalli Gardner, n. sp.

Plate LVII, figures 4, 5

1892. *Turritella terebriformis* Conrad. Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 311 (in part).

Not *Turritella terebriformis* Conrad, 1863. Name only.

The locality from which Conrad's type specimen was collected is Greensboro, Md. Martin [37] was doubtless correct in referring Conrad's type of *T. terebriformis* to *T. variabilis* var. *alticostata*. The Florida form differs from the Maryland species in its flatter whorls, sharper and more elevated primary sculpture, more accentuated incrementals, and more shallow sutures. The initial whorl of the Chipola species is bulbous, the succeeding volution low and angulated at the periphery, and the early whorls of the conch smooth and gently rounded. In the Maryland species, on the other hand, the earliest whorl is small and obtuse and the succeeding turn rather slender and gently convex, the sculpture is initiated very early on the conch, certainly not later than the third volution and in the form of two subequal spirals symmetrically spaced between the sutures. The differences both in the general aspect and in the details of the sculpture seem sufficiently great to demand the separation of the northern and the southern races. Since the Maryland form received Conrad's name, a new one must be given to the Florida shell.

The nuclear and early post-nuclear whorls of *T. dalli* have been lost. The earliest remaining whorls are high and narrow with an obscure carinal lira set about two-thirds the distance from the posterior to the anterior suture. In front of this slight keel, the whorl is feebly constricted. The second spiral to be introduced is that which revolves a little in front of the posterior suture. A third spiral is introduced during adolescence directly behind the anterior suture. On the adult whorls the sculpture is strong but rather simple. The carinal spiral of the juvenile whorls remains the strongest of the three and is crenated by the incrementals. The posterior spiral is usually double and less strongly crenate than that in front of it. Between them is a strongly concave medial area sculptured only with incrementals. The anterior spiral holds its position directly behind the suture and is overridden with fine lirae. The incrementals are sharp and sinuated; the axis of the sinus falls symmetrically on the concave area between the two strongest spirals. The sutures are deeply impressed. The base is broadly rounded and obscurely lirate. The aperture is subcircular and holostomous, the outer lip thin and sharp, not preserved entire. The inner margin is strongly concave, the parietal wash moderately heavy and widely spread, the pillar reinforced.

[37] Martin, G. C., Gastropoda, in Case, E. C., and others, Systematic paleontology of the Miocene deposits of Maryland: Maryland Geol. Survey, Miocene (text), p. 237, 1904.

Dimensions of incomplete holotype: Height, 55.5 millimeters; diameter, 19.0 millimeters. Dimensions of immature paratype: Height, 47.5 millimeters, diameter, 11.0 millimeters.

Holotype and paratype: U. S. Nat. Mus. No. 329008.

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

Turritella (Torcula) dalli is one of the earliest members of the group that includes the more ornate *T. waltonensis* from the Shoal River and *T. guppyi* Cossmann from the Bowden beds. The early whorls of the three species mentioned are very similar.

Occurrence: Chipola formation, localities 7893[p], 2212[p], 2213[a], 2564[c], 3419[c], 7151[p], 2211[p], 7183[p], 7468[p]; Oak Grove sand, locality 3385[p].

Turritella (Torcula) waltonensis Gardner, n. sp.

Plate LVII, figure 16

Shell high, slender, porcelaneous in texture. Whorls increasing gradually in size, approximately 30 in the adult shell. Apical angle about 10°. Protoconch very small, smooth, paucispiral; initial half turn partially immersed; succeeding turns strongly inflated. Line of demarcation between conch and protoconch not distinct but probably within the second complete volution; indicated by the gradual establishment of a carina, at first medial but migrating toward the anterior portion of the whorl and gradually pinching into a prominent primary spiral, which on the later whorls revolves a little less than halfway between the median horizontal and the anterior suture; a second spiral introduced at a similar distance behind the median line, rapidly increasing in prominence until it equals that in front of it; minute riblets developed by the incrementals first on the posterior spiral, later on the anterior; a third primary spiral introduced directly behind the anterior suture at about the tenth or eleventh whorl but feebler than the two behind it and only slightly affected by the incrementals. Entire surface threaded with microscopically fine lirae, the medial threadlet becoming increasingly vigorous and at about the twentieth whorl minutely beaded by the growth lines; an additional spiral introduced in the adults directly behind the posterior primary and in some individuals merged with it. Normal adult sculpture thus consisting of two prominent tuberculate spirals symmetrically placed with respect to the sutures, the posterior commonly a little the heavier, separated from one another by a strongly concave area in which a finely crenulated lira revolves at or just in front of the median line; a prominent cord directly behind the anterior suture and a finer beaded lira directly behind the posterior spiral; the entire surface microscopically lirate, the threadlets most distinct on the elevated surfaces. Incrementals overriding the spirals and conspicuously crenulating all ex-

cept the anterior spiral; strongly arcuate, thus producing a series of minute, protractive riblets on the anterior portion of the whorl and retractive riblets on the posterior portion. Suture lines distinct but inconspicuous. Periphery of body sharply outlined by the cord, which on the spire follows the posterior margin of the suture. Base in front of the keel slightly depressed, then elevated and arching feebly to the columella. Basal surface smooth except for vigorous incrementals. Aperture rudely quadrate, the outer lip rather heavy, obtusely angulated at the periphery. Columella lip evenly concave, reinforced. Parietal wall thinly glazed; throat lirate or nonlirate, the lirae when present corresponding in position to the interspirals on the exterior.

Dimensions of holotype: Height estimated, 85± millimeters; height of incomplete specimen, 46 millimeters; diameter, 15.6 millimeters.

Holotype: U. S. Nat. Mus. No. 371862.

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

Turritella (Torcula) waltonensis is another ornate type exceedingly abundant in the Shoal River beds, particularly at the type locality. Though readily recognizable in the entirety of its characters, it is inconstant in details. The axial sculpture is much more prominent in some individuals than in others and in the gerontic stage tends to evanesce toward the aperture. The posterior spiral may be a fine, sharply beaded threadlet distinct from the primary in front of it, or it may be low and broad and more or less merged with the primary. The posterior primary may be equal to or less prominent than the anterior, though normally it is the more elevated. In the late whorls of old and large individuals the median spiral is obsolete.

The species is probably the ornate analog in the Walton County fauna of *T. dalli* of the Chipola beds. In *T. dalli* the axial sculpture is very feeble, although the primaries, particularly that in front of the median line, may be obscurely crenulated. The spiral directly behind the suture is relatively stronger in the Chipola form and more similar in character to the primary behind it. The median spiral is not developed, and the fine posterior spiral is not so distinct as that of *T. waltonensis*. *T. dalli* is on the whole a larger, less slender, and much heavier form, with a more strongly serrate profile.

Turritella (Torcula) waltonensis is also the representative of one of the most prolific and widespread groups of the mid-American Turritellas in middle Miocene time. Many of these have been included under *Turritella altilira* Conrad, an abundant and characteristic species in the Gatun formation but, according to Olsson, 1922, "limited to the small Gatun sedimentary basin of the Canal Zone and the adjacent Province of Colon." Closely allied species or subspecies include *T. costaricensis* Olsson, 1922, from Costa Rica; *T. chiriquiensis* Olsson, 1922, from Costa Rica and Trinidad (Mansfield, 1925); *T. carlottae* Hodson, 1925, *not* Watson, 1881, from Venezuela and the Gurabo formation of Santo Domingo; *T. calestemma* Brown and Pilsbry from Haiti; and in the higher Miocene, *T. guppyi* Cossmann of the Bowden beds of Jamaica. *Turritella perattenuata* Heilprin of the Caloosahatchee Pliocene of Florida may be a descendant.

The associated specimen shown in figure 17 (U. S. Nat. Mus. No. 498023) from locality 14436, is a fragment of an unidentified species in which the sculpture pattern is similar to that of *T. altilira* Conrad. It differs from *T. waltonensis* in the more vigorous spirals and in the development of several secondaries rather than a single one in the concave area between the two primaries. The fragment differs from *T. altilira* in the relatively less prominent posterior spiral and the less deeply impressed sutures.

Occurrence: Shoal River formation, localities 3856^{pr}, 2645^{p}, 3732^{c}, 3742^{pr}, 3731^{p}, 5080^{a}, 5184^{a}, 5195^{p}, 10612^{p}.

Turritella (Torcula?) sp.

Plate LVII, figure 15

Shell small, exceedingly slender. Whorls numerous, so flattened laterally that the profile of the spire is almost a straight line. Initial 3 or 4 whorls feebly inflated and obscurely unicarinate, the carinal spiral continued as the posterior of the 2 faint primary threadlets of the later whorls; anterior threadlet commonly a little less feeble than the posterior on the adolescent and adult whorls; surface crowded with other spiral lirae, too faint to be visible except under high magnification. Growth lines distinct, the sinus deep and symmetrically disposed between the primary spirals, the anterior arm of the U, however, a little shorter than the posterior. Sutures feebly impressed in the adolescent stages, more deeply in the adult.

Dimensions of incomplete specimen: Height, 23 millimeters; diameter, 5.6 millimeters.

Figured specimen: U. S. Nat. Mus. No. 498025.

Locality: No. 10603, gully south of the road and east of the bridge over Whites Creek, on road from Eucheeanna to Knox Hill, 6.7 miles south of Argyle and 1.7 miles southeast of Eucheeanna, Walton County, Fla.

These small, slender, acutely tapering forms, smooth to the unaided eye, were originally set aside as the young of an undescribed species, but they appear in all the collections made in the vicinity of Whites Creek and there are no comparable adults, either associated with them or in our other collections from the later Tertiary of Florida. The species most closely allied may be the varietal form *T. obsoleta* Dall, 1892, of the

Caloosahatchee species, *Turritella perattenuata* Heilprin. The variety is characterized by a "surface destitute of spiral sculpture except the angular borders of the equatorial sulcus and a faint line behind the suture."

Occurrence: Shoal River formation, localities, 10603[p], 10608[p].

Section EURYTORUS Gardner, n. sec.

Type by original designation: *Turritella mixta* Dall. Chipola formation (lower Miocene) of Florida.

Eurytorus resembles *Torcula* in the juvenile characters and in the direction of the growth lines. It differs from *Torcula* in the broader apical angle and base and the flat-sided, trapezoidal whorls forming an evenly tapering cone. The sculpture pattern does not differ greatly from that of some of the species of *Torcula,* but the spirals are much less prominent and scarcely interrupt the regular profile of the spire.

The section is best represented in the lower Miocene of Florida, not only in the Chipola formation but in the Tampa limestone as well. It may also have a representation in the Suwanee limestone.

Turritella (Torcula?) mixta Dall

Plate LVII, figure 7

1892. *Turritella indenta* var. *mixta* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 309.

This variety has the basal carina double as in well-developed specimens of the type, together with the equatorial spiral sculpture of *T. bipertita*. The lines of growth are periodically sharp and elevated, and the sides of the whorls are comparatively flat. The apical whorls are only faintly sculptured, and the nucleus is very minute. The best-preserved specimen measures 60 [62] millimeters long and has a maximum diameter of 21.5 [22.0] millimeters. These specimens are somewhat more compact than the type, though it is quite variable in this respect.—Dall, 1892.

Topotype: U. S. Nat. Mus. No. 113476.

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

Shell elongate-conic, the base broad, the 15 to 20 whorls laterally compressed and regularly increasing in size. Nuclear characters not known. Early whorls of conch obscurely lirate directly behind the anterior suture, keeled a little in front of the median horizontal and adorned posteriorly with a double thread; additional spirals later introduced. Sculpture of adult whorls complex; directly behind the suture, a stout, rounded cord on which 3 or 4 fine, sharp lirae are developed; this cord second in prominence only to the cord behind it, which is the carinal cord of the early whorls; medial portion, in holotype, sculptured with rather obscurely defined fillets, the broadest and flattest representing the posterior of the 3 original spirals. Microscopically fine spiral striae overrunning the whorl from suture to suture, least faint on the posterior and medial portions. Incrementals sharply arcuate, strong enough to crenulate the spirals. Suture lines distinct, impressed. Base rounded, its circumference outlined by the anterior spiral of the earlier whorls; base feebly depressed in front of the cord, not sculptured except for accentuated growth lines and resting stages. Aperture holostomous, subquadrate. Outer lip thin, sharp, sinuous, obtusely angulated at the periphery; incrementals strongly recurved, the axis of the sinus, like that of the *Turritella hybrida* group, falling at or a little in front of the posterior of the original spirals. Inner lip strongly and evenly concave, reinforced with a thin callus. Umbilicus imperforate.

Because of the closer coiling and difference in sculpture detail, *Turritella (Torcula) mixta* Dall should be specifically isolated from the Maryland species, *T. indenta.* It is, indeed, less suggestive of *T. indenta* than of *T. chipolana* Dall, a more slender and more sharply sculptured race, adorned with three subequal and subequispaced moniliform spirals.

Occurrence: Chipola formation, localities 2212[r], 2213[r], 3419[r].

Turritella (Torcula?) jacula Gardner, n. sp.

Plate LVII, figure 6

Shell a rather slender obelisk drawn out into a straight-sided spire that tapers at an angle of about 15 degrees. Apical whorls and body lost. Earliest whorl preserved displaying a trilirate sculpture, the anterior simple and directly behind the suture line, a position which it holds throughout the life of the shell, the intermediate spiral placed a little in front of the median horizontal, the posterior a little in front of the posterior suture and inclined to be beaded; a fourth spiral introduced between the intermediate and the posterior spiral, and later, a fifth between the posterior spiral and the suture; adult whorls of holotype sculptured with 4 beaded spirals, the 2 pairs separated by a concave channel threaded by a fine beaded lira; the posterior of each pair of spirals slightly stronger than that behind it, and representing respectively the medial and the posterior of the original spirals; entire surface of whorl finely lirate, the lirae least fine upon the broad anterior spiral. Incrementals beading the spirals and deeply sinuated, the axis of the sinus symmetrically disposed on the channel between the 2 pairs of strong beaded spirals. Characters of body and of aperture unknown.

Dimensions of imperfect holotype: Height, 36 millimeters; diameter, 12 millimeters.

Holotype: U. S. Nat. Mus. No. 498021.

Type locality: No. 10603, gully south of the road and east of the bridge over Whites Creek, on road from Eucheeanna to Knox Hill, 6.7 miles south of Argyle, 1.7 miles southeast of Eucheeanna, Walton County, Fla.

Turritella (Torcula) jacula is closely related to *T. mixta* Dall from the Chipola formation. Its shell is more slender and has a more definite sculpture pattern than that of *T. mixta*, but it may well be in the direct line of descent from that species. The resemblance to *Turritella burdeni* Tuomey and Holmes from the Duplin formation of South Carolina may be even more striking. Fragments indicate that the species reaches dimensions double those of the figured holotype. The range of variation is considerable; the posterior pair of beaded spirals on the body may be decidedly less elevated and more simple than those in front of them. The slenderer individuals approach *T. waltonensis* in general aspect, but *T. waltonensis* is consistently more slender and differs slightly in sculpture detail; *T. jacula* is characterized by two pairs of beaded spirals with a narrow, threaded groove between them.

Occurrence: Shoal River formation, localities 10603[c], 10608[c].

Turritella (Torcula?) chipolana Dall

Plate LVII, figure 8

1892. *Turritella chipolana* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 312, pl. 22, fig. 24.

1914. *Turritella chipolana* Dall, U. S. Nat. Mus. Bull. 90, p. 98.

Shell strong, acute-conic, of eighteen or more whorls; nucleus decollate; early whorls showing one undulated posterior and one plain anterior spiral rib, with a less prominent one behind the suture; a fourth appears between the first two, and on the later whorls nearly equals them in size; on the last whorl we find at the basal margin a squarish primary spiral under which the suture is closely and evenly appressed; behind this is the most prominent spiral, then two slightly smaller, between which is the equatorial sulcus, in the middle of which is a very fine, sharp undulated line; between the last-mentioned primary and the suture behind it are two somewhat obscure spirals successively smaller; the equatorial and two anterior interspaces are nearly equal in width and channeled rather than excavated; the whole surface of the shell is covered with obscure spiral striations; the transverse sculpture undulates all the spirals on the later whorls and is formed by the lines of growth, which in some specimens are elevated and imbricate at intervals; the whorls are strongly sculptured to the tip and rather rounded, the suture distinct, but nowhere discontinuous; the base in the young is flattish, somewhat excavated inside the marginal rib, the inner edge of the excavation forming a sort of disk about the pillar; in the adult the base is more convex, but without distinct spiral ribbing; the pillar is thin, arched, and so twisted that the axis of the shell, vertically regarded, is somewhat pervious; the aperture is somewhat rounded. Lon. of shell 68; max. diam. of base 18 millimeters.

This species, which appears to be rare, is one of the most elegantly sculptured of the group. It recalls *T. mississippiensis* Conrad, from the Vicksburg, which is flatter and less ornamented. *T. indenta* var. *mixta* has a similar succession of spirals on the whorl, but they are comparatively feeble and grow feebler up the spire, while in *T. chipolana* they are, if anything, stronger. The latter is more slender, with rounder whorls and no tendency to discontinuity at the suture.—Dall, 1892.

Holotype: U. S. Nat. Mus. No. 113442.

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

This fine species has not been taken in any of the later collections.

Occurrence: Chipola formation localities 2212[r], 2213[r].

Superfamily RISSOACEA
Family VITRINELLIDAE

Confusion is prevalent throughout the Skeneid and Vitrinellid taxonomy. A knowledge of the animals is essential for a correct classification, and without that it seems hardly worth while to attempt an interpretation of the tangled relationships of the genera included under the Vitrinellidae and other families of small discoidal forms. Two important series of papers are coming out at the present time.[38] They are concerned exclusively with the Recent species but are sure to throw light on the relationships of their Tertiary ancestors.

Genus VITRINELLA C. B. Adams

1850. *Vitrinella* C. B. Adams, Monograph of *Vitrinella*, Amherst, Mass., p. 3.

Type by subsequent designation (Bush, Connecticut Acad. Arts and Sci. Trans., vol. 10, p. 105, 1897): *Vitrinella helicoidea* C. B. Adams. Recent off Jamaica.

Adams' genus included small, vitreous shells of turbinate outline, with a large subcircular aperture, and with or without an open umbilicus.

Katherine Bush in 1897 restricted the genus as follows:

I propose *V. helicoidea* as the type and restrict the genus to small, more or less hyaline, low-spired shells of few convex whorls, having a moderate-sized deep umbilicus; nearly circular, oblique aperture, with simple more or less continuous peritreme, modified on the body whorl into a more or less conspicuous glaze, which may be absent in the young; columellar margin often flattened in the adult, having the appearance of being thickened, and angulated at the lower, outer edge.

Periphery rounded:
- Umbilical carina thickened, not visible for any distance within the pit ..... *"Vitrinella" seminola* Gardner, n. sp.
- Umbilical carina acute, not thickened, visible within the pit almost to the apex ..... *"Vitrinella" waltonia* Gardner, n. sp.

Periphery obtusely angulated ..... *"Vitrinella" excavata* Gardner, n. sp.

"Vitrinella" seminola Gardner, n. sp.

Plate LX, figure 18-20

Shell minute, moderately heavy for the genus, depressed turbinate. Whorls closely appressed, 5 includ-

[38] Pilsbry, H. A., and McGinty, T. L., Cyclostrematidae and Vitrinellidae of Florida: Nautilus, vol. 59, no. 1, pp. 1-13, pls. 1, 2, July 1945; no. 2, pp. 52-59, pl. 6, October 1945; no. 3, pp. 77-83, pl. 8, January 1946; to be continued. Pilsbry, H. A., and Olsson, A. A., Acad. Nat. Sci. Philadelphia, vol. 97, pp. 249-278, pls. 22-30, December 27, 1945.

ing the nucleus, which is very small and probably twice-coiled. Volutions of conch increasing rather rapidly in size, broadly and feebly inflated, the body whorl flattened in front of the suture, smoothly rounded at the periphery. Base very feebly convex. Surface polished, lineated in one individual, but not in the type, with microscopically fine, close-set striae visible only under high magnification, least feeble near the suture. Sutures obscure, inclined to creep up on the preceding whorl. Aperture oblique to the axis, sinuous, feebly constricted at the periphery of the body and expanded behind it, strongly concave along the columellar margin. Parietal wall heavily glazed. Peritreme continuous, the outer lip expanded, the inner lip constricted and reinforced directly behind the pillar with a heavy callus, apparently the remnant of a former marginal thickening. Umbilicus deep but not very wide, revealing the rounded base of the preceding whorl; outlined externally by an obscure keel. Callus thinly spread over a little less than half the basal area.

Dimensions of holotype: Height, 1.5 millimeters; maximum diameter, 2.7 millimeters.

Holotype: U. S. Nat. Mus. 351624.

Type locality: No. 3748, old mill at Summerville, 1 mile east of Argyle, Walton County, Fla.

"Vitrinella" seminola more closely resembles the genotype than any other of the Alum Bluff vitrinellids, but it is not glossy.

The species is remarkable for the pronounced thickening of the inner margin of the aperture. This character alone will serve to distinguish it from the smaller, more depressed *"Vitrinella" waltonia.*

Occurrence: Chipola formation, locality 10609r, 3419r; Shoal River formation, locality 3748r.

"Vitrinella" waltonia Gardner, n. sp.

Plate LX, figures 17, 23, 24

Shell minute but solid, subdiscoidal, highly polished. Conch and protoconch not clearly differentiated. Whorls closely appressed, 4 to 4½, well-rounded, increasing regularly in size and with moderate rapidity. Periphery smoothly convex. Posterior margin of whorl creeping up a little on the preceding volution, thus obscuring the sutures at least on the later turns and causing a slight depression in front of the sutures. Surface lustrous, devoid of ornamentation. Aperture rounded, transversely ovate-trigonal, oblique to the axis of the shell. Peristome continuous. Posterior commissure faintly sulcated. Outer lip thin, sharp, sinuous, expanded in front of the commissure, feebly constricted at the periphery and very slightly expanded in front of the periphery. Inner margin of the aperture adnate to the body wall for more than half the distance from the periphery to the umblical keel. Pillar lip excavated and reinforced, most conspicuously so at the umbilical keel and directly behind it. Umbilicus not very wide but very deep. Carina acute, visible within the pit almost to the apex.

Dimensions of holotype: Height, 1.0 millimeters; maximum diameter, 2.0 millimeters.

Holotype: U. S. Nat. Mus. No. 351626.

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

"Vitrinella" waltonia is smaller than *"V." seminola,* the spire is more depressed, the whorls more rounded and increasing less rapidly in size, and the umbilical keel more acute and visible for a much greater distance within the funnel. A keel such as that developed in *"V." waltonia* is probably a superspecific character. *"V." blountana* Mansfield, from the *Arca* zone of the Choctawhatchee formation, is smoothly rounded and not carinate basally.

Occurrence: Shoal River formation, locality 3742r.

"Vitrinella" excavata Gardner, n. sp.

Plate LX, figures 14, 22, 25

Shell minute, rather fragile, depressed, subdiscoidal, of 3 to 3½ volutions. Apical region somewhat decorticated in the unique type so that the exact number of whorls and the nuclear characters are indeterminate. Apical surface depressed. Basal surface flattened near the periphery, broadly and deeply excavated around the eccentric umbilical pit. Whorls feebly inflated, flattened in front of the suture, and obtusely angulated at the periphery. Sutures creeping up a little against the sides of the preceding volution, causing a shallow depression in front of the sutures. Suture lines obscure. Surface highly polished, incrementally striated. Aperture subtrigonal, feebly sulcated at the posterior commissure, oblique to the axis of the shell. Outer lip thin, sharp, symmetrically expanded between the commissure and the periphery. Peritreme adnate to the body wall from a little behind the periphery almost halfway across the base of the whorl. Pillar deeply excavated, not reinforced except from the parietal wash. Umbilical funnel very broad, open to the apex, outlined by an obscure keel.

Dimensions of holotype: Height, 1.1 millimeters; maximum diameter, 3.0 millimeters.

Holotype: U. S. Nat. Mus. No. 351628.

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

"Vitrinella" excavata is well characterized by the obtusely angulated periphery and the widely excavated umbilicus. The width of the umbilicus is probably a superspecific character and of sufficient importance to exclude *"V." excavata* from *Vitrinella* s.s.

Occurrence: Shoal River formation, locality 3742r.

Genus CIRCULUS Jeffreys

1865. *Circulus* Jeffreys, British Conchology, vol. 3, p. 315.= *Adeorbis* Searles Wood (part).

Type by monotypy: *Delphinula duminyi* Requien= *Adeorbis striatus* Searles Wood, *fide* Bush, 1897. Recent in European waters.

Very small, circular, nearly flat-spired with an exceedingly wide and open umbilicus. * * *

Operculum circular with about a dozen volutions which wind spirally and gradually, and converge to the centre.—Jeffreys, 1865.

In the typical species the apical surface of the shell is decorated with a few sharp evenly spaced spiral lirae.

The confusion more or less prevalent throughout the vitrinellid taxonomy is particularly noticeable among the spirally lirate forms. A knowledge of the animals is essential for a correct classification, and, without this, it is not worth while to attempt to interpret the tangled relationships of *Circulus, Adeorbis,* and *Tornus.* Several families may be represented in the shells that have been assigned to these genera.

"Circulus" mitorraphes Gardner, n. sp.

Plate LXI, figures 1, 2, 27

Shell minute, depressed, subdiscoidal. Whorls possibly 4, the apex slightly decorticated, so that the exact number is not determinable and the nuclear characters are lost. Conch a little more than twice coiled, evenly inflated except for a shallow depression in front of the suture line on the later volutions. Sculpture initiated by the posterior spiral, followed almost immediately by the anterior and later by the medial, becoming within an eighth of a turn equal and equispaced and symmetrically disposed on the whorl; number of spirals increased by the introduction of additional spirals at the anterior suture. Body whorl of type sculptured behind the periphery with 7 sharply elevated lirae, subequal in size and spacing; intercalaries introduced near the aperture; depressed area in front of the suture threaded with 2 to 4 crowded threadlets; rounded periphery outlined by a liration slightly more elevated than those either in front of or behind it; 7 primary lirae in front of the periphery; secondaries intercalated near the aperture; 5 finer additional lirae regularly disposed within the umbilical funnel. Umbilicus large and open, the reverse of the spire, perforate to the apex. Aperture subcircular. Peritreme continuous, closely adnate to the body wall, reverted slightly in the umbilical area.

Dimensions of holotype: Height, 1.6 millimeters; maximum diameter, 3.4 millimeters.

Holotype: U. S. Nat. Mus. No. 350505.

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

"Circulus" mitorraphes is the Oak Grove and Shoal River member of the large and very closely allied group represented on the one hand by *Circulus supra-nitidus* (Searles Wood) and on the other by *"Circulus" costulatus* (H. C. Lea). *"C." mitorraphes* most closely resembles *"C." d'orbignyi* (Fischer) and *"C." liratus* Bush, but it differs from both in the uniform and more numerous lirations on the main body of the whorl and the development of a finer threading in the depressed area in front of the suture and in the umbilical pit.

Occurrence: Oak Grove sand, localities 2646r, 5632r; Shoal River formation, locality 3742r.

"Circulus" anthera Gardner, n. sp.

Plate LXI, figures 3, 6, 18, 22, 26, 28

Shell minute, subdiscoidal. Nucleus relatively large, smooth, apparently of 3 turns, the whorls erect and increasing in size with uniform rapidity. Whorls of conch apparently only 2, more rapidly increasing in size than those of the protoconch, closely appressed, bicarinate at the periphery, flattened or broadly concave in front of the suture in the adult, horizontally tabulated in the young, flattened on the base. Spiral sculpture abruptly initiated at the beginning of the conch, the spirals increasing in number by intercalations at the suture line; primaries 7 or 8 in number behind the periphery of the adult, including the slightly more elevated thread that outlines and emphasizes the posterior keel. Shoulder depression broadly and evenly concave, occupying a little less than half the space between the suture and the periphery; threaded with 4 to 7 subequal secondaries. Space between the anterior and posterior keels flattened, only a little narrower than the sculptured portion of the base; threaded with 6 or 7 microscopically fine lirae. Sutures inconspicuous, creeping up a little on the preceding whorl. Base flattened in front of the posterior carina, smooth or obscurely striate except on the final half turn, where it is sculptured with 6 or 7 equal and equispaced primaries, the posterior of which outlines the peripheral, the anterior the umbilical keel. Funnel broad and deep, persistent to the apex; smooth or finely lirate. Aperture subcircular or rounded-trigonal, oblique to the axis of the shell, obtusely angulated at the carinae. Peristome continuous, adnate to the body wall from a point a little behind the posterior keel to one a little in front of the anterior carina. Outer lip expanded. Inner lip excavated but not thickened.

Dimensions of holotype: Height, 1.8 millimeters; maximum diameter, 3.8 millimeters. Dimensions of paratype: Height, 1.3 millimeters; maximum diameter, 2.6 millimeters.

Holotype: U. S. Nat. Mus. No. 351632. Paratype, U. S. Nat. Mus. No. 498022.

Type locality: 3742, Shell Bluff, Shoal River, Walton County, Fla.

"Circulus" anthera is closely allied to *"C." mitorraphes,* and it may be possible, with the aid of further material to establish a connecting series. The former species suggests a *"C." mitorraphes* that has developed double peripheral keels, separated by a rather wide, flattened area; a flattened base, and a broad tabula-

tion or depression in front of the shoulder. It also suggests a *"Circulus" trilix* in which the sculpture on the apical surface is obsolete except for the primaries that outline the carinae.

The adolescent forms are so distinct that they were at first mistaken for another race. They are similar to *"C." trilix* but are spirally threaded in front of the shoulder of the final whorl of the spire and have a second sharply elevated spiral revolving directly in front of that which outlines the shoulder.

Occurrence: Oak Grove sand, localities 5632[p], 7054[r]; Shoal River formation, locality 3742[p].

"Circulus" trilix Bush

1885. *Skenea trilix* Bush, U. S. Fish Commission, Rept. for 1883, p. 584 [82].

1885. *Skenea trilix* Bush, Connecticut Acad. Arts and Sci. Trans., vol. 6, p. 464.

1889. *Adeorbis supranitidus* Wood. Dall, Harvard Coll. Mus., Comp. Zoology Bull., vol. 18, p. 278 (part).

Not *Adeorbis supranitidus* Searles Wood, Annals and Mag. Nat. History, vol. 9, p. 530, 1842.

1889. *Adeorbis supranitidus* Wood. Dall, U. S. Nat. Mus. Bull. no. 37, p. 150, pl. 41, figs. 7-7a.

1897. *Circulus trilix* Bush, Connecticut Acad. Arts and Sci. Trans., vol. 10, p. 127.

This species closely resembles *Adeorbis supranitida* Wood in form and sculpture, but it has a thin, horny operculum and an animal like *Skenea*.—Bush, 1885, p. 584.

Shell small, disk-shaped, with the spire nearly flat, but with the nuclear whorls rising a little above the level of the last whorl. Whorls four or more, the body whorl strongly tricarinate, one carina at the periphery, one around the base, and one around the shoulder, the spaces between them equal, convex and nearly smooth. The upper carina shows on all except the nuclear whorls and the one next following; above this carina the whorl is flattened or slightly concave, joining the preceding whorl nearly at right angles, but swelling a little close to the suture; on this band four or five faint spiral striae sometimes occur; more rarely traces of them are found below the carina and on the base. On the basal side, the last whorl is pretty regularly rounded and strongly convex and the umbilical depression is large and deep, funnel-shaped, extending to the apex. Within this, the whorls are distinctly spirally grooved and sometimes its border is defined by a small, distinctly raised carina. Aperture nearly circular though slightly angulated at the carinae. Lip a little thickened, slightly expanded next the body whorl; inner lip represented only by a thin, closely adherent layer of enamel. Nucleus small, a little prominent, smooth, glossy and subvitreous, the apical whorl minute and slightly turned up. Surface of the shell lustrous and usually nearly smooth, though often showing faint, flexuous lines of growth * * *.

Very abundant, both alive and dead, in 7 to 17 fathoms.—Bush, 1885, p. 464.

Through the courtesy of Mr. Dall, I have been able to study two authentic specimens of *supranitidus* from the Crag, in the U. S. National Museum.

They are about half the size of a full-grown *trilix* and differ from specimens of that species of the same size in lacking the distinct tricarination of the whorls, in having the whorls more convex and more regularly coiled, so that the body whorl is not so abruptly enlarged, in having the spire relatively larger, and in the striation of the umbilicus. Both specimens of *supranitidus* have three conspicuous revolving threads separated by deep grooves in the umbilicus; one has a very prominent basal carina, the other has it but partially developed; in this specimen the whorls are perfectly smooth, while in the former the two faint upper carinae commence just back of the aperture; neither show any trace of the microscopic striations found in *trilix*. In the many specimens of the latter which I have, there seems to be no variation in the size of the small nucleus, the relatively much smaller spire and abruptly enlarged body whorl (a peculiarity which becomes more marked as the shell increases) and in the strong tricarination of the whorls, even in very small specimens. They differ only in the number and prominence of the threads in the umbilical region, and in the distinctness of the microscopic striations on the upper part of the whorls. The constancy of these characters ought to prove that the two species are quite distinct.—Bush, 1897.

It is of especial interest to be able to correlate a fossil species with a Recent form on which accurate bathymetric observations have been made.

Occurrence: Chipola formation, locality 2213[c]; Shoal River formation, localities 5079[r], 5618[r].

Genus COCHLIOLEPIS Stimpson

1858. *Cochliolepis* Stimpson, Boston Soc. Nat. History Proc., vol. 6, p. 307.

Type by monotypy: *Cochliolepis parasitica* Stimpson. Recent in Charleston harbor and the Florida Keys. Parasitic on the annelid *Acoctes lupinus* Stimpson.

Shell minute, thin, fragile, depressed, nautiliform, paucispiral. Surface smooth in the genotype; spirally lirate in other species. Aperture holostomous. Peristome thin, sharp, interrupted at the body wall. Umbilicus the reverse of the spire.

A number of these small forms have been reported from the Tertiary beds and from the waters of the Recent seas.

The only species represented in the Alum Bluff group is restricted in its distribution to a single locality in the Oak Grove sand.

Cochliolepis arietina Gardner, n. sp.

Plate LXI, figures 23-25

Shell minute, depressed, nautiliform, the body whorl rather inflated for the genus, smoothly rounded at the periphery. Apical surface flattened to feebly convex. Basal surface well rounded. Nucleus asymmetric in its position on the apical surface; minute, erect; the 2 to 3 whorls smooth, partially submerged, increasing regularly and not very rapidly. Conch twice-coiled, increasing rapidly in diameter, the later turn enveloping and largely concealing the earlier. Apical surface lineated with exceedingly fine *Sinum*-like spiral threadlets, finest and most crowded toward the periphery. Spirals on the basal surface also finest and most crowded toward the periphery, becoming less fine and more irregular toward the umbilical pit. Incremental striae

irregular in size and spacing. Suture lines distinct, slightly impressed. Aperture obliquely lobate, the outer margin thin and sharp; somewhat compressed at the periphery. Peristome interrupted, adnate to the body wall for a greater distance behind the periphery than in front of it. Inner lip a trifle heavier than the outer. Umbilicus the reverse of the spire, open to the apex; microscopically lirate.

Dimensions of holotype: Height 1.2 millimeters; maximum diameter, 3.2 millimeters.

Holotype: U. S. Nat. Mus. No. 136081.

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

Cochliolepis arietina resembles *C. striata* of the Neocene and Recent faunas. Its height, however, is relatively greater than that of the later species, and it is less compressed both on the apical and basal surfaces, with a consequently broader periphery.

Several individuals have been found at the type locality, but it has not been recognized elsewhere.

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

Genus EPISCYNIA Mörch

1875. *Episcynia* Mörch, Synopsis Molluscorum marinorum Indiarum occidentalium: Malakozoologische Blätter, vol. 22, p. 155.

Type by monotypy: *Architectonica (Episcynia) inornata* (D'Orbigny)=*Solarium inornatum* D'Orbigny. Recent off St. Thomas, Virgin Islands.

Shell hyaline, small, fragile, smooth, or nearly so; depressed-conic. Whorls rather numerous, regularly increasing in size, moderately convex, strongly carinate. Aperture entire, its transverse axis nearly in line with the horizontal axis of the shell. Peritreme continuous, adnate to the body wall between the peripheral and umbilical carinae. Umbilicus small but deep and regular in outline, the ascending spiral of the umbilical keel traceable within.

The presence of a heavy epidermis, according to Miss Bush,[39] excludes this genus from the Vitrinellidae.

Episcynia has not been recorded from pre-Tertiary strata. The Recent species are, for the most part, tropical and subtropical in distribution.

Episcynia mauryi Gardner, n. sp.

Plate LXI, figures 4, 5, 7

1910. *Adeorbis aldrichi* Maury?, Bull. Am. Paleontology, vol. 4, no. 21, p. 29, pl. 7, fig. 7.

Shell small, very thin and highly polished; depressed-turbinate on the apical surface, flattened on the base. Whorls approximately 5, including the 2 planorboid nuclear coils, which are rather inflated and open rather rapidly from the immersed tip. Whorls of conch very broadly convex, increasing slowly and regularly in size, sharply carinate at the periphery, which is concealed on all but the body whorl. Surface smooth except for incrementals retractive behind the periphery, least feeble near the aperture; and for the spiral thread that outlines the acutely angulated periphery and is demarcated on either side by an incised line. Sutures distinct, impressed, coincident with the periphery of the preceding volution. Base feebly convex. Aperture holostomous, transversely elliptical, the axis nearly in line with the horizontal axis of the shell; obtusely angulated at the periphery, which is symmetrically placed at one end of the ellipse. Peristome continuous, adnate to the body wall for approximately two-thirds the distance from the peripheral to the umbilical keel. Umbilical perforation small but persistent to the apex; regular in outline, central in position, very finely threaded spirally and revealing within, the carinae of the successive volutions. Outer margin of pit acutely angulated.

Dimensions of holotype: Height, 2.5 millimeters; maximum diameter, 4.4 millimeters.

Holotype: U. S. Nat. Mus. No. 350510.

Type locality: No. 5632, Oak Grove, Yellow River, Okaloosa County, Fla.

The Alum Bluff species differs from the later Tertiary and Recent forms, to which it is very closely allied, in the slightly higher relative outline and more numerous whorls and in the absence of any trace of secondary carinae such as the two that are developed in *Episcynia multicarinata,* one in front of and the other behind the periphery. In *E. naso* (Pilsbry and Johnson) the whorls are more inflated behind the periphery, and the peripheral cord is finely crenulated.

The species is restricted to the Oak Grove sand, but it is fairly well represented at that single horizon.

Miss Maury's *Adeorbis aldrichi* seems to be a larval form and identical with the protoconch of this species.

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

Family SYNCERATIDAE

Genus SYNCERA Gray

1821. *Syncera* Gray, London Medical Repository, vol. 15, p. 239.
1828. *Assiminea* W. E. Leach, in Fleming, History of British Animals, p. 275.
1920. *Syncera* Bartsch, U. S. Nat. Mus. Proc., vol. 58, p. 163.

Type by monotypy: *Nerita Syncera hepatica* Gray. Estuarine in the south of England.

The type species was described from the animal that "differs from all the others of this order, by the eyes appearing to be at the ends of the tentacula; but I believe," wrote the astute Doctor Gray "that they are placed on a peduncle, as long as the tentacula, and the peduncle and tentacula are soldered together."

The name *Syncera,* signifying without a horn, probably refers to the fusion of the tentacles.

[39] Bush, K. J., Revision of the marine gastropods referred to *Cyclostrema, Adeorbis, Vitrinella,* and related genera; with descriptions of some new genera and species belonging to the Atlantic fauna of America: Connecticut Acad. Trans., vol. 10, pp. 107, 112, 1897.

Gray considered *Syncera* as a subgroup of *Nerita*. In explanation of the arrangement which he used, he wrote as follows:

> The genera that are here given mostly contain many subgenera, and are what are called by several modern naturalists natural families: but I prefer to call them genera and their subdivisions subgenera, because then either name can be used separately and so suits both opinions; for the genera may be made into families by changing the termination, as from *limax* to limacidae, and because I think that it is easier to recollect *limax arion hortensis*, than *arion hortensis* alone, as genera are now become so numerous [year 1821] that naturalists really want something to let them know to what part of natural history they belong.

Shell minute, turbinate or biconic. Whorls feebly or not at all convex. Surface usually smooth except for incrementals. Aperture holostomous, obliquely ovate or elliptical, angulated posteriorly, broadly and smoothly rounded anteriorly. Outer lip thin, sharp, simple. Inner lip formed by a heavy glaze that washes the parietal wall and reinforces the pillar. Umbilicus closed or narrowly crescentic; the umbilical keel, if present, subacute or narrowly obtuse.

The Recent species have a wide distribution in the estuarine and littoral zones of the warm and temperate waters.

Syncera microgaza Gardner, n. sp.

Plate LVII, figure 9

1892. *Assiminea affinis* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 347 (partim).
Not *Paludestrina affinis* D'Orbigny, 1842.

Shell a rather slender little cone tapering to an acute apex at a uniform angle of approximately 40°. Periphery of body whorl obtusely keeled. Base obliquely rounded. Protoconch very small and blunt, of 1½ volutions; the initial half turn almost entirely immersed, the succeeding whorl moderately inflated. Whorls of conch 4½, flattened laterally, the profile scarcely interrupted at the sutures. Surface smooth, opaque. Sutures distinct, impressed, coincident with the periphery except at the aperture, where the line drops a little in front of the keel. Aperture obliquely lenticular, sharply angulated at the posterior commissure. Outer lip rather strongly arcuate, feebly expanded in front. Inner margin of aperture formed by a heavy glaze that washes the parietal wall and reinforces the pillar. Anterior extremity of aperture obscurely emarginate. Umbilical chink narrow, crescentic, bounded by an obtuse carina.

Dimensions of holotype: Height, 3.0 millimeters; maximum diameter, 1.5 millimeters.

Holotype: U. S. Nat. Mus. No. 329042.

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

This species has been confused with *Assiminea affinis* (D'Orbigny), a smaller shell in which the whorls are feebly constricted at the sutures, the periphery rounded instead of angulated, and the umbilicus entirely concealed.

Occurrence: Chipola formation, localities 2212[r], 2213[a], 2564[p], 3419[p], 2211[p].

Family RISSOINIDAE
Genus RISSOINA D'Orbigny

1840. *Rissoina* D'Orbigny, Voyage dans l'Amerique méridionale, vol. 5, pt. 3 (Mollusques), p. 395.
1928. *Rissoina* D'Orbigny. Woodring, Miocene mollusks from Bowden, Jamaica, pt. 2; Carnegie Inst. Washington Pub. 385, p. 362. An exhaustive treatment of the Bowden *Rissoina* fauna with particular emphasis on the superspecific groups.

Type by monotypy: *Rissoina inca* d'Orbigny. Recent off the west coast of South America from Peru to the Island of Chiloe (Chile).

Shell minute, elongate-turbinate. Whorls numerous, tapering gradually to the mamillar apex. Surface axially or spirally ribbed or cancellated, rarely smooth. Aperture semielliptical. Outer lip protractive, thickened, slightly reflected, effuse, or faintly channeled anteriorly. Columella nonplicate. Operculum thick, horny, semilunar, paucispiral, bearing a claviform process on the internal face.

The form of the operculum, the sinuous outer lip, and the depression of the anterior portion of the aperture are distinguishing features of the genus. Like the closely related *Rissoa,* which is usually more squat with a vertical instead of a protractive outer lip, *Rissoina* frequents the shallower waters, where the vegetation is abundant.

The restriction of the genus to the Chipola formation must be due rather to the accidents of collecting than to the original distribution.

External surface axially costate or feebly cancellated.
- Aperture slit at anal fasciole; siphonal fasciole clearly defined and bulging ... *Rissoina (Mirarissoina) juncea* Gardner, n. sp.
- Aperture not slit at anal fasciole; siphonal fasciole not clearly defined nor bulging:
  - Axials exceeding 25 in number ... *Rissoina (Zebinella) decussata* (Montagu)
  - Axials not exceeding 25 in number ... *Rissoina (Zebinella) chipolana* Dall

External surface spirally costate ... *Rissoina vittata* Gardner, n. sp.

External surface smooth ... *Rissoina (Cibdezebina) browniana* D'Orbigny

Subgenus MIRARISSOINA Woodring

1928. *Mirarissoina* Woodring, Miocene mollusks from Bowden, Jamaica, pt. 2; Carnegie Inst. Washington Pub. 385, p. 365.

Type by original designation: *Rissoina (Mirarissoina) lepida* Woodring. Miocene of Bowden, Jamaica.

Shell small, or medium-sized, slender. Nucleus consisting of between two and a half and three and a half smooth whorls. Outer lip varicose, strongly extended forward, bearing at suture a strongly constricted, narrow anal notch. Anterior channel broad and shallow. Siphonal fasciole narrow, low or high. Sculpture generally consisting of fine protractive axial ribs and finer spiral threads.

The distinct anal notch and broad anterior channel are distinctive of *Mirarissoina*. The outer lip and sculpture are like that of other subgenera of *Rissoina*, but so far as I know no other fossil or living shells have such a characteristic *Rissoina* shape and outer lip, and so distinct an anal notch.—Woodring, 1928.

Rissoina (Mirarissoina) juncea Gardner, n. sp.

Plate LVII, figure 34

Shell small for the genus and very slender. Volutions 8 including the 3 whorled protoconch. Initial turn rather inflated and immersed at the tip; succeeding turns of protoconch flattened laterally, rather elevated and separated by impressed sutures. Beginning of conch marked by the loss of the high luster and the initiation of the sculpture. Whorls of conch closely appressed, feebly constricted at the sutures, increasing very gradually in size; body whorl broadly and smoothly rounded toward the base. Surface delicately but rather elaborately sculptured. Axials low and rounded, approximately 40 on the later whorls, uniform in strength between the sutures but weakening near the base of the body and on the final half turn, protractive and performing approximately a quarter of a revolution around the axis. Surface from apex to canal threaded with exceedingly fine spiral lirae, restricted to the intercostal areas and least feeble toward the base. Aperture lobate, acutely angulated and slit posteriorly. Outer lip effuse anteriorly, varicose, the spiral sculpture persistent across the varix; inner margin smooth and simple. Labium oblique, nonplicate, smoothly glazed from the posterior commissure to the slight thickening at the base of the pillar. Anterior extremity feebly emarginate. Umbilicus closed; surface narrowly depressed, however, behind the pillar, the depression limited posteriorly by a low well-defined siphonal fasciole.

Dimensions of holotype: Height, 3.1 millimeters; maximum diameter, 1.2 millimeters.

Holotype: U. S. Nat. Mus. No. 329041.

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

Rissoina juncea resembles the Bowden subgenotype, but the axial sculpture of the Chipola species is finer and the anterior fasciole decidedly more swollen. The varicose outer lip indicates the maturity of the unique type.

Occurrence: Chipola formation, locality 2213[r].

Subgenus ZEBINELLA Mörch

1876. *Zebinella* Mörch, Malakozoologische Blätter, vol. 23, p. 47.

Type by subsequent designation (Nevill, Hand list of Mollusca of Indian Museum, pt. 2, pp. 73, 87, 1885): *Rissoina decussata* (Montagu)=*Helix decussata* Montagu. Recent from North Carolina to the Gulf of Mexico and the West Indies.

The shell is moderately small and slender. The 2½ to 3 nuclear whorls are small, smooth, and shining. The whorls of the conch are moderately high and feebly constricted at the sutures, the body smoothly produced. The axials are numerous and blunt; the spirals numerous, very fine and sharp, and strongest on the anterior portion of the body, where the axials are commonly obsolete. The aperture is obliquely lobate, angulated and channeled at the posterior commissure. The outer lip is thickened a little behind the margin, thin at the margin, dropping almost vertically from the commissure, expanded forward to form a sort of a scoop. The inner apertural margin is oblique and heavily glazed, the reverted wash completely concealing the umbilical chink. The margins of the aperture are depressed forward to form an incipient channel.

The subgenus is prolific and widely distributed in the later Tertiary and Recent faunas of the mid-Americas.

Rissoina (Zebinella) decussata (Montagu)

1803. *Helix decussata* Montagu, Testacea Brittanica, p. 399, pl. 15, fig. 7.

?1850. *Rissoa striosa* C. B. Adams, Contributions to conchology, p. 116.

?1852. *Rissoa Janus* C. B. Adams, Catalogue of shells collected at Panama, p. 179; Lyceum Nat. History, New York Ann., vol. 5, p. 538.

1853. *Rissoa decussata* (Montagu). Forbes and Hanley, History of British Mollusca, vol. 3, p. 147.

1860. *Rissoina decussata* (Montagu). Schwartz von Mohrenstern, Akad. Wiss. Wien, Math-Naturwiss. Kl., Denkschr., p. 80, [148], pl. 6, figs. 44, 44a.

1892. *Rissoina decussata* (Montagu). Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 343 (partim?).

H[elix]. with a slender white shell, with eight or nine spires tapering to a fine point: volutions very little raised and the separating line extremely fine; these are strongly and regularly striated in a longitudinal direction crossed by very minute striae that gives it a slight decussated appearance when examined by a lens; aperture narrow, suboval, contracted at both ends; outer lip somewhat expanded and a little thickened at the back; inner lip a trifle replicated. Length three-tenths of an inch; breadth one-tenth.—Montagu, 1803.

Type locality: Southern coast of England between Weymouth and Portland Island, possibly introduced.

The species in the Chipola formation allied to *Rissoina decussata* (Montagu) is the largest and stoutest of any member of the genus within the Alum Bluff. The young, as is usual with the group, are stouter than the adults and rather sharply angulated at the periphery of the body. The axial costae number, as a rule, from 30 to 40, although there may be as many as 60. Concomitant with the increase in the number of the ribs is a decrease in their elevation and an increase both relative and absolute in the strength of the microscopically fine spiral threading that covers the shell from the apex to the canal.

Although forms that cling to seaweed are much more widely distributed than bottom forms, it is highly probable that the limits of distribution of the species have been made entirely too wide and that the American form first described by D'Orbigny from Cuba under the name *R. striato-costata* is at least subspecifically distinct from the European race. The American form is apparently somewhat larger and perceptibly stouter, more finely sculptured axially and less finely spirally. Both types of sculpture pattern seem to be represented at a single locality in the Chipola formation; the finely costate is much more abundant, however. The relationship of the two forms can be determined only with the aid of a suite of Recent material from both the American and the European shores.

Rissoina decussata has been reported from the late Tertiaries of southern Europe, and records of it in the Recent faunas are almost world wide. Jeffreys, 1867, does not, however, recognize the species in the European faunas, and Forbes and Hanley, 1853, regard it as an introduced West Indian species and the reports of it from other waters as spurious.

The American race ranges from Cape Fear to the Gulf of Mexico and through the West Indies in 2 to 17 fathoms.

Occurrence of *Rissoina* sp. cf. *R. decussata* (Montagu): Chipola formation, locality 2213[c].

Rissoina (Zebinella) chipolana Dall

Plate LVII, figure 35

1892. *Rissoina chipolana* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 343, pl. 22, fig. 20.

Shell slender, acute, with a minute nucleus of two and a half smooth whorls, followed by seven subsequent whorls; whorls slightly rounded, suture appressed; transverse sculpture of sixteen to twenty narrow, rounded, slightly flexuous ribs, usually with about equal interspaces, which completely cross the whorls; spiral sculpture of fine striae, generally confined to the base of the shell, but sometimes extending over the whole surface; aperture semicircular; lip thickened and varicose, produced at the middle, receding at the base of the pillar and at the posterior commissure, basal fasciole obscure, slightly tumid, interior of aperture smooth and simple. Lon. of shell 6; max. diam. 2.5 mm.

The average size is smaller than that above given. The nearest species to this is the *R. triangularis* Watson, a recent Australian species. The *R. mississippiensis* Meyer has some characters in common, but is smaller and has a much blunter apex; on the whole, this is a very distinct species.—Dall, 1892.

Holotype: U. S. Nat. Mus. No. 113582.

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

The compound microscope reveals the spiral threading over the entire shell of the holotype, although it is least feeble at the base. In fresher specimens from a nearby locality, fine but very sharp threadlets, usually 11 or 12 to the whorl, override the axials. The relative dimensions vary, so that the peripheral members have a very different aspect from the type. The young are relatively stouter than the adults and obtusely angulated at the periphery. The parietal wall is heavily calloused, and the inner lip reverted and slightly thickened at the base of the pillar. The umbilicus is entirely concealed.

Occurrence: Chipola formation, localities 2213[c], 2564[a], 3419[a], 2211[c].

Subgenus CIBDEZEBINA Woodring

1928. *Cibdezebina* Woodring, Miocene mollusks from Bowden, Jamaica, pt. 2; Carnegie Inst. Washington Pub. 385, p. 369.

Type by original designation: *Rissoina browniana* d'Orbigny. Recent in the West Indies.

Shell very small, relatively stout, perfectly smooth, whorls of spire almost flat. Nucleus consisting of about two and a half whorls. Outer lip varicose, extending forward. Anterior channel broad and shallow. Interior of outer lip bearing a denticle near its posterior end, basal lip bearing a similar denticle. Siphonal fasciole weakly inflated.—Woodring, 1928.

The description is based on the subgenotype.

The development of the denticles seems to be an inconstant character both in the Recent and in the fossil individuals.

Rissoina (Cibdezebina) browniana D'Orbigny

?1845. *Rissoina browniana* d'Orbigny, in De la Sagra, Historia, fisica politica y natural de la Isla de Cuba, pt. 2, (Historia natural), vol. 5 (Moluscas), p. 164, pl. 12, figs. 33-35. French ed., pt. 2, (Mollusques), vol. 2, p. 28, 1853.

1850. *Rissoa laevigata* C. B. Adams, Contributions to conchology, p. 114.

1860. *Rissoina browniana* D'Orbigny. Schwartz von Mohrenstern, Akad. Wiss. Wien, Math.-naturwiss. Kl., Denkschr., vol. 19, pt. 2, p. 178, pl. 10, fig. 78.

1860. *Rissoina laevigata* C. B. Adams. Schwartz von Mohrenstern, idem, p. 179, fig. 79.

1873. (February). *Iopsis fusiformis* Gabb, Acad. Nat. Sci. Philadelphia, Proc. for 1872, p. 272, pl. 11, fig. 6.

1873. *Iopsis fusiformis* Gabb, Am. Philos. Soc. Trans., n. ser., vol. 15, p. 228.

1873. *Eulima crassilabris* Gabb, idem, p. 227.
Not *Eulima crassilabris* Gabb, Acad. Nat. Sci. Philadelphia Jour., ser. 2, vol. 8, p. 358, pl. 46, fig. 43, 1881.

1887. *Rissoina browniana* D'Orbigny. Tryon, Manual of Conchology, vol. 9, p. 390, pl. 59, figs. 45, ?46.

1892. *Rissoina laevigata* (C. B. Adams). Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 342.
1896. *Rissoina brourniana* D'Orbigny. Guppy and Dall, U. S. Nat. Mus. Proc., vol. 19, p. 322 (partim).
1917. *Rissoina crassilabris* Gabb. Maury, Bull. Am. Paleontology, vol. 5, no. 29, p. 132, pl. 21, fig. 19.
1922. *Rissoina (Zebina) laevigata* (C. B. Adams). Pilsbry, Acad. Nat. Sci. Philadelphia Proc., vol. 73, p. 382, pl. 34, figs. 3, 4, text fig. 19.
1928. *Rissoina (Cibdezebina) browniana* D'Orbigny. Woodring, Miocene mollusks from Bowden, Jamaica, pt. 2, Carnegie Inst. Washington, Pub. 385. p. 370, pl. 29, fig. 6.
1937. *Rissoina laevigata* C. B. Adams. Maxwell Smith, East coast marine shells, p. 97, pl. 33, fig. 6; pl. 37, fig. 16a.

D'Orbigny in his original description reported the species to be common at St. Thomas and rare off Martinique and Haiti.

The Tertiary individuals run a little smaller and a little stouter than the Recent, but these unadorned shells, which change their outline with their age and offer a moderately wide range in age variation, can not be separated on the basis of outline alone with any degree of satisfaction. Not all of the Alum Bluff individuals exhibit the inflation of the nuclear whorls that characterizes the species, but some of them do and it is futile to attempt a specific separation on that character. The shells are slender little cones, including as many as 9 whorls in all. The winding is close and tight, the whorls laterally compressed, and the sutures linear. Near the aperture the outer lip creeps backward a little. The aperture is obliquely lobate, angulated posteriorly and feebly channeled; smoothly rounded anteriorly. The outer lip is feebly protractive, thickened, expanded forward and commonly bearing a denticle on the inner margin not far from the commissure. The glaze on the parietal wall is evenly spread and reverted along the pillar, completely concealing the umbilicus. An average specimen measures 4.6 millimeters in height and 1.8 millimeters in diameter.

Mansfield's *R. tersa* from the *Cancellaria* zone of the Choctawhatchee formation is apparently adult, but it includes only 5½ whorls in all. Mansfield noted that the Recent species "has a more attenuated upper spire and more numerous, more loosely coiled and smaller nuclear whorls." He included under it the specimens from the Duplin formation at Natural Well, N. C.

Rissoina browniana may be susceptible to further division. But some at least of the Alum Bluff individuals can not properly be separated from the Recent forms, which they resemble more closely than they do the Choctawhatchee individuals.

The young forms are stouter relatively than the adults and are inclined to be obtusely angulated instead of smoothly rounded at the periphery of the body. The whorls are closely appressed and sometimes a little constricted at the sutures in the later whorls of mature individuals.

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

Outside occurrence: Cercado and Gurabo formations of the Dominican Republic. Bowden Beds of Jamaica. Caloosahatchee marl of Florida. Recent from Cape Lookout to the Gulf of Mexico and St. Thomas to a depth of 22 fathoms.

Rissoina vittata Gardner, n. sp.

Plate LVII, figure 33

Shell small, solid, moderately slender. Whorls approximately 6. Apex somewhat decorticated and nuclear characters partially lost; protoconch probably not more than twice coiled. Whorls flattened laterally, their outline obscured by the sculpture; regularly and rather slowly increasing in size; body whorl smoothly rounded at the base. No axial sculpture except faint, flexuous incrementals. Spiral sculpture initiated by a single, strong band originally medial but on the later whorls slightly anterior and very prominent; surface directly in front of the suture line raised, thus simulating a posterior spiral; suture following a third cord which, however, is concealed on all but the final volution; two additional spirals less elevated than those behind them developed on the base of the body; area between the spirals somewhat concave. Suture lines indistinct, obscured by the posterior spiral. Aperture obliquely lobate, angulated at the posterior commissure. Outer lip varicose, effuse and slightly reverted anteriorly, smooth and simple within; body sculpture continuous across the varix. Inner lip oblique, very feebly excavated. Parietal wash rather thin, calloused, perceptibly thickening at the base of the pillar. Anterior extremity slightly depressed, suggesting an incipient canal.

Dimensions of holotype: Height, 3.6 millimeters; maximum diameter, 1.5 millimeters.

Holotype: U. S. Nat. Mus. No. 114359.

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

The type is unique in the east-coast faunas both in number and in character of sculpture.

It seems improbable that the likeness in sculpture pattern to members of the subgenus *Iravadia* Blanford[40] should be indicative of a fundamentally close kinship. *Iravadia ornata* Blanford, the type of the group, is a brackish-water form, described from the Irawady Delta, and the entire group is restricted in its published distribution to the China Sea and the Indian Ocean.

Occurrence: Chipola formation, locality 2211[r].

[40] Blanford, W. T., List of estuary shells collected in the delta of the Irawady, in Pegu [India], with descriptions of the new species, in Contributions to Indian Malacology, No. 8: Asiastic Soc. Bengal Jour., vol. 36, pt. 2, p. 56, 1867.

Family RISSOIDAE
Genus RISSOA Fréminville

1813. *Rissoa* Fréminville in Risso, Nouveau Bull. Sci. par la Société philomatique de Paris, vol. 3, 5th year, pp. 340, 341.

1814. *Rissoa* Fréminville, Demarest, Nouveau Bull. Sci. par la Société philomatique de Paris, vol. 4, p. 7.

Type by subsequent designation (Bucquoy, Dautzenberg and Dollfus, Mollusques marins du Rousillon, vol. 1, p. 262, 1884): *Rissoa ventricosa* Demarest. Reported from the Pliocene and Pleistocene of northern Italy. Recent in the Mediterranean and Adriatic Seas.

Fréminville, in 1813, discussed a collection he had made near Nice and mentioned a new genus allied to *Turbo,* which he proposed to name in honor of the French naturalist Risso. He gave a list of 8 species, all of them undescribed, so that *Rissoa* Fréminville, 1813, was a genus without species. Demarest, in 1814, described the species listed by Fréminville in 1813. Type designations were made by Anton, 1830, and Woodward, 1851 and 1870, but in no case was the species designated included in the first list.

Shell small, imperforate or subperforate, usually heavy, oblong-turbinate. Surface smooth, axially ribbed or cancellated, more rarely spirally sculptured. Aperture entire, oval. Peristome thick, continuous, simple or reflected. Labrum simple or varicose. Operculum thin, horny, paucispiral.

The large group of Recent forms has a wide geographic distribution; they are, for the most part, phytophagous, and abound in the inshore waters on beds of seaweed.

Axial sculpture dominating the spiral . . . . . *Rissoa phagon* Gardner, n. sp.

Axial sculpture reduced to feeble incrementals . *Rissoa litiopaopsis* Gardner, n. sp.

Rissoa phagon Gardner, n. sp.

Plate LVII, figure 10

Shell minute, squat-conic, coiled between 4½ and 5 times. Protoconch smooth, rather dull, not sharply differentiated from the conch, composed of approximately 2¼ turns; initial half turn partially immersed; succeeding volution convex, becoming increasingly elevated; final nuclear turn broadly convex and tending to be obscurely shouldered. Sculpture initiated by exceedingly fine axial riblets, the first two or three restricted to the medial and anterior portions of the whorl, the succeeding riblets persistent to the posterior suture but more feeble behind; final whorl of spire ornamented with 24 or 25 narrow, sharply rounded axial riblets separated by shallow interaxials of approximately the same width. Spiral sculpture initiated near the middle of the first whorl of conch by a faint liration at the shoulder and another at the periphery; a couple of intermediate spirals introduced before the end of the whorl; axials on the body reduced to 17 but more elevated and separated by more broadly concave interspaces than those on the preceding turn; spiral lirae 8, very fine, absent on the posterior fourth, very faint medially, less feeble anteriorly. Suture line impressed, dropping a little in front of the periphery on the last two turns, so that it is somewhat overhung by the preceding volution. Aperture holostomous, obliquely ovate. Outer lip varicose but rather thin at the margin, smooth within, effuse anteriorly and slightly patulous. Peristome continuous, the lining of the inner lip heavily glazing the parietal wall and reinforcing the columella. Umbilical chink narrowly crescentic, very shallow.

Dimensions of holotype: Height, 1.25 millimeters; diameter, 0.9 millimeters.

Holotype: U. S. Nat. Mus. No. 136051.

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

Rissoa phagon is more squat than *Rissoa lipeus* Dall from the Caloosahatchee and the subspecies *R. lipeus floridana* Mansfield from the Choctawhatchee. In *R. lipeus* and its subspecies the axials are thin and sharp and form with the spirals an evenly cancellate sculpture, but in *R. phagon* the axials are blunt and relatively broad.

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

Section ONOBA H. and A. Adams

1854. *Onoba* H. and A. Adams, Genera Recent Mollusca, vol. 1, p. 331.

Type by subsequent designation (Nevill, Hand List Mollusca Indian Museum, pt. 2, p. 119, 1885): ***Turbo striatus,*** John Adams. Recent along the European shores from Norway to the Mediterranean; fossil in the Crag.

Operculum ovate, simple, subspiral.

Shell elongated, whorls numerous, rounded, spirally striated; aperture oval, entire in front, peritreme continuous, thickened, straight or slightly everted.

Syn. *Turbonilla* Leach, not Risso.

Ex. *O. striata* Montagu, pl. 35, fig. 4.

This genus includes a small group of elegantly formed shells, more or less partaking of the characters of *Rissoa,* but their whorls are not longitudinally ribbed, and the peritreme is not dilated.—H. and A. Adams, 1854.

It is doubtful if *Onoba* merits even sectional rank. A variety of the type species of the section is axially puckered in front of the suture line, and it was apparently this variant which Montagu had in mind when he discussed *O. striata* which he credited to John Adams.[41] The John Adams specimens are apparently printed backward and so resemble *Physa* rather than

[41] Adams, John, The specific characters of some minute shells discovered on the coast of Pembrokeshire, with an account of a new marine animal: Linnean Soc. London Trans., p. 66, pl. 13, figs. 25, 26, 1797.

the rissoids. The description given by Adams is in Latin and covers two lines, in which mention is made of five whorls spirally striated, an oval aperture, white color, and an uncommonly elegant shell. No measurements are given.

If the *O. striata* of John Adams and of Montagu should later be shown to be distinct, Nevill's type designation will no longer be valid, for only *O. striata* Montagu is included in the original list of *Onoba*. The thickening of the outer lip, like the incipient axial sculpture, seems to be an inconstant character even within the species. In so large and cumbersome a group, the section may perhaps be retained for rissoids in which the axial ribbing is absent or fortuitous, the aperture little or not at all expanded, and the outer lip little or not at all varicose.

Rissoa litiopaopsis Gardner, n. sp.

Plate LVII, figures 19, 24

Shell minute, compact, ovate. Whorls very closely appressed, increasing regularly and not very rapidly in size; 6 including the 3 minute nuclear volutions. Initial half turn highly inflated and immersed at its origin, thus simulating a slight apical tilt, the succeeding volution of the protoconch less inflated and gradually assuming the feebly convex, buccinoid outline of the whorls of the conch; body whorl smoothly constricted at the base. Line of demarcation between conch and protoconch obscure, marked only by the gradual initiation of the feeble sculpture. Entire surface of conch spirally grooved with narrow and very shallow sulci separated by flattened interspiral areas, 12 or 13 on the final whorl of the spire and approximately 25 on the body, subequal in size and spacing except for the sulcus directly anterior to the suture, which is slightly wider and slightly deeper than those in front of it. Axial sculpture restricted to feeble incrementals that minutely punctate the spiral sulci. Sutures faintly impressed. Aperture lobate, angulated and grooved at the posterior commissure. Outer lip expanding slightly anteriorly, varicose, the spiral sculpture of the body persistent across the varix. Inner lip smoothly and rather heavily glazed, the parietal wash merging into the pillar callus; labial varix continuous around the truncated anterior extremity of the aperture and joining the base of the pillar at rather a sharp angle. Umbilicus imperforate.

Dimensions of holotype: Height, 3.4 millimeters; maximum diameter, 1.9 millimeters.

Holotype: U. S. Nat. Mus. No. 329036.

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

The type is unique.

The figure of *Litiopa palaeosargassina* Maury recalls *Onoba*. The shell, which I have never seen, must be more slender than that of *R. litiopaopsis*, the aperture less oblique and the umbilical chink moderately wide. Miss Maury's[42] species was collected at Oak Grove.

Occurrence: Chipola formation, locality 2213r.

Order ASPIDOBRANCHIA
Suborder RHIPIDOGLOSSA
Superfamily NERITACEA
Family NERITIDAE
Subfamily SMARAGDINAE
Genus SMARAGDIA Issel

1869. *Smaragdia* Issel, Malacalogia del Mare Rosso, p. 212.

Type by subsequent designation (Bucquoy, Dautzenberg, and Dollfus, Mollusques marins du Roussillon, vol. 1, p. 328, 1884): *Neritina feuilleti* Audouin. Recent in the Red Sea.

Shell small, obliquely ovoid, thin-shelled for the group, imperforate. Spire very low, body relatively large and inflated. Basal surface semielliptical, the aperture occupying a little less than half the area. Outer margin of aperture thin, sharp, symmetrically arcuate. Columellar wall flattened, heavy calloused, sunk beneath the level of the sharp apertural margin, thin-edged and, in the later growth stages, serrate.

Smaragdia is found in much the same habitat as that favored by the larger and heavier *Nerita*—the tropical and warm temperate shores bordered with rocks and coral reefs—but according to the anatomists, it differs both from *Nerita* and from the nonmarine oriental *Neritina* in the unstalked, sessile eyes.

The family has received the attention of naturalists since the day of Aristotle, who first recorded the name *Nerita* and noted its habit of clinging to rocks. It is of unusual interest to the malacologist because there are certain anatomical characters that the Neritidae share with the Pulmonates.[43]

Color markings not zigzag, subequal and equispaced..... *Smaragdia grammica* Gardner, n. sp.

Color markings more or less zigzag, often broken and segregated into groups of 3 to 5 ....*Smaragdia chipolana* (Dall).

Smaragdia grammica Gardner, n. sp.

Plate LXII, figure 9

Shell very small, thin, elliptical, flattened on the apertural surface. Body obliquely flattened behind, strongly and smoothly inflated medially. Protoconch and earliest whorls of conch broken away but doubtless low and small. Surface smooth but retaining a decided color pattern of slightly ragged, dark-brown lines, about 9 to the millimeter, separated by equal or slightly wider interspaces; color lines strongly protractive anteriorly, inclined to be broadly and feebly arcuate toward the suture and arcuate on the base,

[42] Maury, C. J., New Oligocene shells from Florida: Bull. Am. Paleontology, vol. 4, no. 21, pp. 28, 29, pl. 7, fig. 5, 1921.

[43] Simroth, H., Some remarks with regard to Professor Bourne's Monograph on the Neritidae: Malacol. Soc. London Proc., vol. 9, p. 31, 1910.

forming concentric lines around the body callus. Aperture occupying a little less than half the basal surface, obliquely semielliptical, acutely angulated and feebly sulcated at the posterior commissure. Outer lip thin, sharp, asymmetrically arcuate. Inner wall of aperture oblique, reinforced. Glaze of the reflected inner lip spread in a broad arc from the posterior to the anterior extremity of the aperture, completely concealing the umbilicus.

Dimensions of holotype: Height, 1.7 millimeters; maximum diameter, 1.8 millimeters.

Holotype: U. S. Nat. Mus. No. 351640.

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

The inner margin of the pillar is smooth, so the shell is probably not mature, but the color pattern is so well preserved and so diagnostic that the form, imperfect as it is, has a systematic value. In *Smaragdia chipolana* the color lines are even finer than in *S. grammica* and less ragged, commonly segregated into groups of three to five, and irregularly zigzagged. The type is unique.

Smaragdia grammica suggests in outline a minute *S. viridis* (Linnaeus), but there is no trace in *S. grammica* of the sea-green color that characterizes the West Indian species, both Recent and fossil, and the color pattern of *S. grammica* is much finer and distinct in its direction.

Occurrence: Shoal River formation, locality 5079[r].

Smaragdia chipolana (Dall)

Plate LXII, figure 11

1892. *Neritina chipolana* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 422, pl. 23, fig. 19.

Shell small, polished, smooth, with a low spire and three whorls; nucleus swollen, prominent, suture distinct; general form resembling that of *N. pupa* L.; aperture produced, the outer margin thin, the body with a moderately thick callus; at the base of the pillar lip is a slight projection, outside of which the callus is impressed; pillar above this prominence irregularly and minutely denticulate, the teeth when continuously present numbering ten or twelve. Alt. of shell 5.0; max. diam. 5.3 mm.

This neat little shell retains its color markings, which are composed of dark, narrow lines radiating from the axis and over the whorl in every conceivable form of zigzag or curve, either singly or in groups of three to five, either continuous or broken. In general, however, there is much more of the surface of an individual free from lines than covered by them—a feature apparently characteristic of this form. Some rare varieties of *N. virginea* Lam. exhibit much such a style of painting, but in that species when little triangles are formed the line bounding the triangle behind is always broader than elsewhere, giving the effect of a shadow; in *N. chipolana* the lines are not widened. Size and coloration being considered, there is no recent American species which approaches this one very closely.—Dall, 1892.

Holotype: U. S. Nat. Mus. No. 112664.

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

The protoconch is small, vitreous, and highly polished, immersed at the tip, and somewhat bulbous. The oblique line of demarcation between conch and protoconch is strongly defined. The conch is a little more than twice-coiled; the component whorls increase rapidly in size and are obscurely shouldered behind and well-rounded in front.

This small form is remarkable for the persistence of its color markings, which are curiously sketchy and oriental in design.

The species is restricted in its distribution to the Chipola formation. A single indeterminate juvenile was collected, however, from the Oak Grove sand. It differs from the Chipola form in the fewer and more rapidly increasing volutions and somewhat suggests in general outline the Recent *Smaragdia viridis* (Linnaeus).

Smaragdia grammica from Shoal River is ornamented with fine, subequal and equispaced, somewhat ragged, brownish-black lines.

Occurrence: Chipola formation, localities 2212[p], 2213[c], 2564[r], 3419[r], 7151[r], 2211[r].

Superfamily TROCHACEA
Family TRICOLIIDAE
Genus TRICOLIA Risso

1826. *Tricolia* Risso, Histoire naturelle des principales productions de l'Europe méridionale, vol. 4, p. 122.

Type by subsequent designation (Gray, Zool. Soc. London Proc., pt. 15, p. 144, 1847): *Turbo pullus* Linnaeus. Recent from the British Isles to the Mediterranean.

Woodring[44] noted Gray's error in the spelling of Risso's name, which appears on page 144 of Gray's Synopsis as *Tricolea* and in the index as *Tricolaea*. The same type was designated two years later by Herrmannsen.[45]

Shell small, porcelaneous; ovate-conic. Whorls rather numerous, closely appressed, moderately inflated. Surface usually smooth and polished, never strongly sculptured. Aperture holostomous, channeled posteriorly, broadly rounded anteriorly. Outer lip thin, sharp. Inner lip smoothly arcuate, folded back, glazing the body wall and either closing the umbilicus entirely or leaving only a crescentic chink along the outer margin. Operculum in the genotype calcareous, convex on the outer surface, the maximum convexity on the side nearest the labium; smoothly concave on the inner surface, the nucleus spiral, excentric and anterior in position.

The type *(Buccinum australis* Gmelin) of *Phasianella,* to which many of the species of *Tricolia* have been

[44] Woodring, W. P., Miocene mollusks from Bowden, Jamaica: Carnegie Inst. Washington Pub. 385, p. 418, 1928.

[45] Herrmannsen, A. N., Indices generum malacozoorum, vol. 2, p. 589, 1849.

commonly referred, is a large form, comparable in dimensions and general aspect to the larger Cuban land shells. The operculum, however, is similar to that of *Tricolia.*

Umbilical pit almost or entirely concealed; shell ovate-conic.. *Tricolia affinis chipolana* Gardner, n. subsp.
Umbilical pit narrow, elongated, deep; shell low, turbinate.... *Tricolia probrevis* Gardner, n. sp.

Tricolia affinis chipolana Gardner, n. subsp.

Plate LX, figures 6, 13

1892. *Phasianella affinis* C. B. Adams. Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 382.
Not *Phasianella affinis* C. B. Adams, Contributions to conchology, p. 67, 1850.

Shell small, varying widely in outline with the age of the individual. Young stout, the body whorl relatively much larger than the whorls of the spire. Adolescents and some adults ovate-conic; other adults rather elevated and slender. Whorls 7¼, including the three-whorled nucleus. Initial nuclear whorl exceedingly small and almost entirely immersed; second whorl coiled in the same plane as the first but larger and more inflated; third whorl flattened on the summit near its origin but gradually assuming the outline of the whorls of the conch. Line between conch and protoconch marked by a faint and irregular sulcus and a slight change in the texture of the shell. Whorls of spire broadly inflated medially, feebly constricted at the sutures. Body whorl of adult rounded at the periphery, not much larger in some individuals than the final whorl of the spire. Surface smooth except for feeble incrementals and an occasional suggestion of miscroscopically fine spiral striae—probably the remnants of a former color pattern rather than of a sculpture. Aperture ovate to semielliptical. Labrum thin, sharp, strongly arcuate. Columella smoothly excavated. Parietal wall glazed, the body wash separated from the lining of the labrum by a shallow sulcus. Labial margin reinforced in the umbilical region and in front of it. Umbilical chink narrow, elongated, obscurely keeled. Worn opercula similar in general character to that of the genotype associated with this form in the lower bed at Alum Bluff.

Dimensions of holotype: Height, 8.6 millimeters; maximum diameter, 4.2 millimeters. Dimensions of paratype: Height, 8.5 millimeters; maximum diameter, 5.0 millimeters.

Holotype: U. S. Nat. Mus. No. 329107.

Paratype: U. S. Nat. Mus. No. 114369.

Holotype locality: No. 3419, 1 mile below Baileys Ferry, Calhoun County, Fla. Paratype locality: No. 2211, lower bed at Alum Bluff, on the Apalachicola River, Liberty County, Fla.

The lower Miocene individuals have been united with the Recent *T. affinis* C. B. Adams from the West Indies. The Chipola form runs larger than the Recent, has more whorls and a body that is relatively lower in proportion to the height of the spire. The nuclear characters of the two forms are similar. The young of *T. chipolana* are more conical than the adult *T. probrevis* and more attenuated basally. The umbilicus of the latter is narrowly but deeply perforate, while in the former the pit itself is concealed, although a small part of the umbilical area is exposed.

The shells of the analogous group from the Cercado formation of the Dominican Republic, to which Woodring in 1928, gave the name *Tricolia (Tricolia) affinis gabbi,* run smaller than the Chipola shells. They have, on the average, a wider and deeper umbilical chink than the Recent forms, and the umbilical keel is more acute. In this character, also, the Chipola specimens are usually closer to the Dominican Cercado shells than to the Recent. *Tricolia precursor* Dall from the Tampa limestone is related, but the aperture is less expanded than in *T. affinis chipolana,* the inner lip is not quite so thin, and its margin more feeble and reverted in the umbilical area.

Occurrence: Chipola formation, localities 10609^{r}, 2212^{c}, 2213^{a}, 2564^{a}, 3419^{a}, 2211^{pr}, 7183^{p}; Oak Grove sand, locality ?2646^{r}.

Tricolia probrevis Gardner, n. sp.

Plate LX, figure 8

1892. *Phasianella brevis* d'Orbigny. Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 381.
Not *Phasianella brevis* d'Orbigny, 1843?
Not *Phasianella brevis* C. B. Adams, 1850.

Shell minute, low, turbinate. Nucleus naticoid, made up of approximately 3 volutions, the initial coil for the most part immersed, the succeeding volutions moderately inflated, increasing regularly in size. Protoconch differentiated from conch by a slight break and a change in the texture of the shell. Whorls of conch a little less than 2, low and moderately inflated, the periphery of the body abruptly rounded but not angulated, the base more or less flattened. Surface smooth except for sinuous incremental striations. Sutures impressed. Aperture holostomous, ovate, wider in front than behind, and depressed at the base of the columella into an incipient spout. Outer lip thin, sharp, strongly arcuate. Inner lip smooth, feebly excavated. Parietal wall thinly glazed, the wash continuous with the feebly reflected labium; columella reinforced. Umbilicus narrow, arcuate; umbilical area sickle-shaped, widening anteriorly, the keel usually less acute than in *T. affinis chipolana.*

Dimensions of holotype: Height, 2.0 millimeters; maximum diameter, 1.8 millimeters.

Holotype: U. S. Nat. Mus. No. 114434.

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

The Recent species *T. brevis* d'Orbigny has been referred to the subgenus *Eulithidium* Pilsbry, 1898, which

is characterized by a very low outline, highly inflated whorls, and usually a deeper umbilical pit than is found in *T. probrevis*. The Chipola form, *T. probrevis,* does not seem to differ in any superspecifically important characters from the associated *T. affinis chipolana,* which is a *Tricolia (Tricolia)*.

Tricolia brevis (d'Orbigny), the Recent species with which this form has been confused, is more smoothly rounded than the Miocene form and more evenly turbinate in outline. The young of *T. affinis chipolana* differ not only in the closed or less open umbilicus but also in the less inflated whorls, more ovate-conical outline, and less flattened base. Faint traces of a color pattern of small rose-colored polka dots spirally arranged still persist on some individuals.

Occurrence: Chipola formation, localities 2212[c], 2213[c], 2211[c]; Oak Grove sand, locality 2646[p].

Family TURBINIDAE Gray

Genus ASTRAEA "Bolten" Roeding

1798. *Astraea* "Bolten" Roeding, Museum Boltenianum, pt. 2, p. 79.
Not *Astrea* Lamarck. 1801, Systême des animaux sans vertèbres, p. 371. A coral.

1909. *Astraea* Dall, U. S. Geol. Survey Prof. Paper 59, p. 92.

Type by subsequent designation (Suter, Manual of New Zealand Mollusca, p. 166, 1913): *Trochus imperialis* Gmelin=*Trochus heliotropium* Martyn. Recent off the coasts of New Zealand and neighboring islands.

The genotype is a rather large, thinnish, turbinate shell, adorned with scaly spirals; the periphery compressed and serrated by a series of triangular spines; the base widely umbilicate. The operculum is rather thick, smooth and oval, and the outer margin is pinched into a narrow cord. Of the subgenus *Astraea* s.s., only the section *Astralium* has been recognized in the Alum Bluff deposits.

Section ASTRALIUM Link

1807. *Astralium* Link, Beschreibung der Naturalien Sammlung der Universität zu Rostock, p. 135.

Type by subsequent designation (Woodring, Carnegie Inst. Washington Pub. 385, Miocene mollusks from Bowden, Jamaica, pt. 2, p. 412, 1928): *Astralium deplanatum* Link=*Trochus costulatus* Lamarck, regarded as a subspecies of *Trochus longispina* Lamarck. Recent in the West Indies.

Astralium has been commonly considered a synonym of *Astraea* but, following Woodring, it is here retained for the medium-sized, rather low, broadly conical astraeid shell, with a narrow or imperforate umbilicus and thickened operculum. In contrast also to *Astraea* s.s., *Astralium* is characteristically a mid-American group.

Astraea dalli (Maury)

Plate LX, figures 3, 11

1892. *Astralium* sp. indet. Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 385.

1910. *Astralium dalli* Maury, Bull. Am. Paleontology, vol. 4, No. 21, p. 31, pl. 8, fig. 3.

Several specimens of a young *Astralium* were collected by Mr. Burns from the Chipola beds which are not the young of *A. chipolanum*. They have four whorls, which are rather depressed, and carry at the periphery eight rather long and slender imbricated spines; the upper surface just in front of the suture, which is overhung by the preceding whorl, is pinched up or fluted with a number of short folds, forming a sort of band on the upper margin of the whorl; in front of this the surface is more or less covered with oblique, close-set, imbricated lamellae, crossed by three or four fine spiral lines; the base is flattish, with four or five spiral, elevated, sometimes beaded, lines, and the umbilical carina is marked by two coarsely beaded spirals, the whole crossed by elevated, sometimes imbricated, radiating lines in harmony with the lines of growth. The base recalls that of *A. longispina* Lam., but the upper surface is quite different from that species. The specimens are about 5 mm. in greatest diameter and 3.5 mm. high.—Dall, 1892.

Shell small, depressed, trochiform, four-whorled, with eight slender spines at the periphery; surface of the whorls coarsely wrinkled just beneath the spines and finely wrinkled just above the spines. Between these wrinkled bands are four faint spirals generally seen only with a lens. Base rather flat with 4 or 5 raised threads, either smooth or slightly beaded.

Height of shell 3.5; greatest width 5 mm.

Specimens of this species were described in 1892, but not named by Doctor Dall to whom the shell is now dedicated.

Chipola marls, Baileys Ferry, Florida.

Cornell University collection.—Maury, 1910.

Dimensions of figured specimen: Height, 3.8 millimeters; maximum diameter, 5.7 millimeters.

Figured specimen: U. S. Nat. Mus. No. 112995.

Locality of figured specimen: No. 2213, 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.

The protoconch of *A. dalli* is similar to that of *A. chipolana* Dall—twice coiled, both volutions flattened and wound in a single plane—but the conch of *A. chipolana* is more elevated than that of *A. dalli,* the sides more uniformly flattened, the peripheral spines more numerous and less produced, and the spiral sculpture sharper and moniliform.

Astraea dalli (Maury) from the Chipola formation has much the same general aspect as *Astralium sublongispinum* Maury from the possibly synchronous Cercado formation of the Dominican Republic. The Chipola species, however, is smaller and imperforate, with obliquely flattened whorls, whereas the species from the Dominican Republic is perforate, with broadly inflated volutions.

Occurrence: Chipola formation, locality 2213[c], Cornell University collection.

Subgenus LITHOPOMA J. E. Gray

1850. *Lithopoma* J. E. Gray. In M. E. Gray, Figures of molluscous animals, vol. 4, p. 88.

Type by monotypy: *Trochus tuber* Linnaeus. Recent in the West Indies.

Shell of moderate dimensions, broadly conical, with rounded or subacute periphery and flattened base; imperforate. Sculpture more or less nodose but not spinose. Operculum thickened, oval or ovate, the external surface granulated and commonly costate near the margin, inner face flattened and coiled about an eccentric submarginal nucleus.

The development of a crude cordate, strongly protractive axial sculpture at right angles to the direction of the growth lines is a characteristic feature of the subgenotype and many other species of the *Lithopoma* group. The subgenus was founded on the character of the operculum.

The Recent species are, for the most part, restricted to the Florida Keys and the West Indies.

Astraea (Lithopoma) chipolana (Dall)

Plate LX, figures 15, 16, 30

1892. *Astralium (Lithopoma) chipolanum* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 384, pl. 18, fig. 6a.

Shell small, elevated-trochiform, with flattened sides and base and seven or eight whorls; nucleus minute, the first two or three whorls flattened above, coiled in a single plane, then taking on the adult habit in the remainder of the shell; periphery keeled, the carina furnished with ten or twelve triangular, imbricate spinose projections, underneath which the suture is closely appressed; above, between the suture and the periphery, are five low spiral, beaded bands, between which are single smaller intercalary threads, all of which march straight around the whorl without fluctuation; on the base between the periphery and pillar are about eight beaded spirals, alternated in strength; across the spiral sculpture, obliquely, especially toward the apex, run well-marked but not lamellose incremental lines; pillar narrow, arched, with a faint groove behind it, terminating in one or two feeble tubercles; aperture rounded quadrate, outer lip thin, body with a wash of callus. Alt. 11.5; max. diam. 11.0 mm.

This interesting little shell is without doubt the forerunner of the following species [*Astralium (Lithopoma) precursor* Dall], but differs from it and from all the Recent forms in the low, rectilinear sculpture and the absence of any plications on the side of the whorl except at the periphery.—Dall, 1892.

Holotype: U. S. Nat. Mus. No. 112994.

Figured operculum: U. S. Nat. Mus. No. 114439.

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

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

The operculum is thick and slightly ovate, the inner face flattened and exhibiting 4 or 5 whorls coiled about an eccentric nucleus placed near the margin of the smaller end. The external surface is much thickened at the larger end near the pillar, thinning gradually away from it with the exception of a slight irregular deposit over the nucleus. The posterior margin of the operculum is pinched into a thin flange, the inner limit of the flange marked by an ill-defined arcuate rib subparallel to the outer margin. The surface is finely granulated except over the nucleus.

The species is known only from the type locality. The operculum has not been found in place, but as both the shells and the opercula are fairly common at the single locality at which they are represented and as no other *Lithopoma* has been recognized from the horizon except a very much smaller species, there seems to be little cause to doubt their identity.

Occurrence: Chipola formation, locality 2211[c].

Genus GELASINOSTOMA Gardner, n. gen.

Type by original designation: *Collonia elegantula* Dall. Caloosahatchee formation (Pliocene) of Florida and the Waccamaw formation (Pliocene) of North Carolina.

Shell small, rather thin, depressed, paucispiral; the early whorls in the genotype broadly shouldered, the later more evenly inflated. Protoconch minute, glassy, including a single loop, slightly tilted and enlarging. Conch with an occasional high light, which may be a touch of nacre; the beginnings of the shoulder and the spiral sculpture obscurely visible within the first half turn. Both coarse and fine spirals developed on the early whorls of the genotype; only the fine on the later. Aperture subcircular. Margin of outer lip crenate in the juveniles, thickened and rolled back slightly in the adult. Peristome depressed slightly at the posterior commissure, adnate to the body wall from the commissure to the umbilical pit, thickened in front of the umbilicus and dimpled at the extremity of the very heavy circumumbilical rib. Umbilical pit extremely small, bordered by the conspicuously elevated rib.

The depression of the peristome at the extremity of the umbilical keel is a distinctive character not shared by any other group that I know. In *Delphinula marginata* Lamarck, the genotype of *Collonia,* the protoconch is naticoid, and the umbilicus is not so small. The spiral within the umbilicus in typical *Collonia,* terminates in a marginal tubercle, but there is no nick at the extremity of the rib at the margin of the umbilicus. In *Delphinula striata* Lamarck, the genotype of *Cirsochilus* Cossmann, the character of the spiral sculpture is similar to that of *Gelasinostoma,* but the protoconch is naticoid, and the umbilicus larger; the marginal rib is crenate like that of *Delphinula marginata,* not conspicuously elevated and not nicked at its extremity. The characters of the umbilicus are similar, in a general way, in *Collonia* Gray, *Cirsochilus* Cossmann, and *Otollonia* Woodring and serve to separate these groups from *Gelasinostoma.*

Gelasinostoma has a meagre representation in the Gulf Tertiary possibly from the Eocene to the Pliocene, but it is restricted in its known distribution to the Gulf area and the Tertiary period. *Collonia claibornensis* Dall may be referable to *Gelasinostoma,* but the protoconch is lost, the rib at the margin of the umbilicus is less elevated than in the later Tertiary species, and the aperture is so imperfect that the characters of the inner lip are not definitely known.

Gelasinostoma chipolanum (Dall)

Plate LXII, figure 12

1892. *Collonia chipolana* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 387.

Shell small, resembling a young specimen of *C. elegantula,* but with much finer sculpture, rounder whorls, no tabulation at the shoulder, a less prominent projection where the umbilical rib impinges on the aperture, and a decidedly thinner and smaller shell. There are about four whorls, which do not complete the growth, as the unique specimen is immature; they are rounded, with a distinct suture and finely spirally striated; the aperture resembles in a general way that of a young *C. elegantula.* Alt. of shell 2.2 [1.9]; max. diam. 2.0 [1.9] mm.

The shell, though immature, is an unmistakable *Collonia,* and I have described it, lest it should be lost sight of, being the only representative of the group in the Chipola Miocene.—Dall, 1892.

Holotype: U. S. Nat. Mus. No. 113001.

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

No other representative of the species or of the genus has been found at any horizon in the Alum Bluff group.

Occurrence: Chopola formation, locality 2212^{r}.

Genus LIOTIA Gray

1842. *Liotia* Gray, Synopsis of the contents of the British Museum, 44th ed., p. 57 (genus without species). *Fide* Iredale, 1913.

1847. *Liotia* Gray, Zool. Soc. London Proc., pt. 15, p. 145.

Type by original designation: *Delphinula cancellata* Gray. Recent on the Pacific Coast from Peru to Chile.

Small, low, turbinate, thick-shelled, the inner layer subnacreous. Sculpture commonly spiral or reticulate, knotted at the intersections, the incrementals sharp, laminar, radial in arrangement on the base. Aperture obliquely subcircular. Peristome continuous, much thickened, simple within, adnate to the body wall only along its base. Umbilicus funicular, open to the apex, the keel crenate, but no spirals developed within the funnel. Operculum according to Pilsbry and Thiele, multispiral, horny, with a pearly inner layer of spirally disposed particles.

Liotia, s.s., is best characterized by the low, thick shell, crude but strong sculpture, thickened peristome, adnate only at the extreme base of the body, so that the last half turn of the body is thrown out of the plane in which the earlier whorls are coiled.

Liotia, s.s., is best developed in Pacific waters, for the most part in tropical and south-temperate seas.

Subgenus ARENE H. and A. Adams

1854. *Arene* H. and A. Adams, Genera of Recent Mollusca, vol. 1, p. 404.

Type by subsequent designation (Woodring, W. P., Carnegie Inst. Washington Pub. 385, p. 422, 1928): *Turbo cruentatus* Megerle von Mühlfeld. Recent in the West Indies.

Shell radiately painted with red; whorls muricated, the last stellate at the periphery, or angulated and keeled; peritreme more or less varicose.—H. and A. Adams, 1854.

The greater number of the West Atlantic *Liota,* both fossil and Recent, are referable to *Arene* rather than to *Liotia,* s.s. The shells referable to *Arene* are commonly smaller than those of *Liotia,* s.s. and less heavy. The sculpture is less crude, and is spiny rather than nodose. The peripheral spiral upon the body is commonly emphasized and in the genotype is corronated with flattened spines, giving the stellate aspect observed by the Adamses.

Liotia (Arene) agenea Dall

Plate LX, figure 32

1892. *Liotia (Arene) agenea* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 410, pl. 23, fig. 3.

Shell small, with four whorls, the whorls tricarinate, the umbilicus wide, rapidly narrowing, funicular, the outer margin bordered by a crenate rib; suture distinct; transverse sculpture of fine, elevated, close-set lines, which are usually a little gathered up, close to the suture, into short wrinkles; aperture nearly circular, slightly thickened, the outer margin angulate from the ends of the keels. Alt. 2.0; max. diam. 2.5 mm.

This little shell is the precursor of *L. gemma* of the Newer Miocene and the variety *tricarinata* Stearns of the Pliocene and recent faunas. From them it differs in its much smaller size and relatively much wider umbilicus. It seems to be very rare in the marl.—Dall, 1892.

Holotype: U. S. Nat. Mus. No. 113091.

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

The species has not been found in any of the later collections.

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

Genus DIDIANEMA Woodring

1928. *Didianema* Woodring, Carnegie Inst. Washington Pub. 385, p. 447.

Type by original designation: *Didianema tytha* Woodring. Miocene of Bowden, Jamaica.

Shell very small, polished, relatively thick, spire low, body

whorl strongly inflated, umbilical opening moderately wide. Aperture subcircular, peristome complete, expanded at contact with body whorl. Outer lip, as viewed from above, arched forward between suture and periphery. Basal lip almost straight. Within aperture and visible on inner lip and parietal wall lies a narrow shelf against which the operculum probably fitted. Basal lip excavated at junction with inner lip. At outer edge of umbilicus are two spiral threads disappearing upward into umbilicus, the inner one disappearing first.—Woodring, 1928.

Didianema recalls *Molleria* Jeffreys in the development of the small opercular shelf, and it may well be the southern representative of that genus. The northern form commonly exhibits a crude axial sculpture of which there is no trace in *Didianema,* and it is not carinate at the margin of the umbilicus. The type of *Molleria* is *Margarita? costulata* Möller, widespread in the North Atlantic and reported off Fernandina, Fla., in 294 fathoms. It is probable that a number of the Tertiary species from the South Atlantic now referred to *Molleria* are more properly referable to the southern genus, but the absence of the beading on the umbilical keel and of the spirals within the umbilical funnel may be of more than specific importance.

Didianema? waltonia Gardner, n. sp.

Plate LX, figure 7

Shell minute but rather solid, turbinate. Whorls between 3½ and 4, closely appressed, increasing regularly in size. Protoconch not well differentiated but probably including a little more than a single volution, distinguished only by its more highly polished surface and slightly greater inflation. Surface dull, unsculptured. Suture line distinct, feebly impressed, dropped forward a trifle at the aperture. Periphery of body broadly and smoothly rounded. Aperture semielliptical, feebly sulcate at the posterior commissure. Outer margin broadly and symmetrically arcuate, the inner feebly excavated, furnished with an inner rim for the support of the edge of the operculum. Parietal glaze heavy. Pillar free, slightly reverted. Umbilical area differentiated by a sort of basal disk extending from the inner wall of the umbilicus outward to the obtuse margin of the carina. Umbilical perforation small but probably deep.

Dimensions of holotype: Height, 1.3 millimeters; maximum diameter, 1.4 millimeters.

Holotype: U. S. Nat. Mus. No. 351638.

Type locality: No. 3732, Dave Adams Mill Creek, sec. 2, T. 3 N., R. 21 W., Walton County, Fla.

Molleria duplinensis Dall is less minute and has a roughened outer surface and an umbilical pit margined by an angulated carina. It should probably be referred to *Didianema,* though it lacks the beading on the keel and the spirals within the umbilical funnel. In *M. minuscula* Dall, from the St. Marys formation of Maryland, the base is smoothly rounded and the outline that of true *Molleria.*

Occurrence: Shoal River formation, locality 3732r.

Family SKENEIDAE

Genus TEINOSTOMA A. Adams

1853. *Teinostoma* A. Adams, Zool. Soc. London Proc., pt. 21, p. 183.

Type by monotypy: *Teinostoma politum* A. Adams. Recent off the coast of Ecuador.

The type of *Teinostoma* is a very solid lenticular little shell of auriculate outline. The periphery is sharply rounded, the surface highly polished and devoid of sculpture. The suture line may be faintly traced on the apical surface as a rapidly opening spiral. The basal disk is opaque, clearly defined, and evenly spread from the axis about halfway out to the periphery. The aperture is ovate trigonal, the outer lip and compressed periphery of the body forming roughly a straight line, the lip expanding and pulled out and sharply rounded at the periphery. The inner margin of the aperture is smoothly concave and calloused. There is no sulcus at the posterior commissure, and the parietal callus merges smoothly into the pad, which completely closes the umbilicus. The few specimens of *Teinostoma politum* examined run between 5 and 10 millimeters in their greatest dimension, a size appreciably larger than any of the Tertiary species considered.

The majority of the east coast Tertiary species are referable to *Idioraphe* Pilsbry.

The genus is known in the Tertiary beds of the east coast of North America and in the Paris Basin. The Recent forms occur most abundantly in the China and Japan Seas, although there are a few representatives in the tropical and subtropical waters of eastern America.

Surface sculptured with exceedingly fine spirals ..... *Teinostoma chipolanum* Dall.

Surface entirely smooth, polished:

Body obscurely shouldered ..... *Teinostoma nanum eonanum* Gardner, n. subsp.

Body not shouldered:

Apical surface smoothly but feebly arched; outer lip thin, sharp ... *Teinostoma phacoton* Gardner, n. sp.

Apical surface not arched; outer lip thickened slightly *Teinostoma mekon* Gardner, n. sp.

Section IDIORAPHE Pilsbry

1922. *Idioraphe* Pilsbry, Acad. Nat. Sci. Philadelphia Proc., vol. 73, pt. 2, p. 398.

Type by original designation: *Cyclops angulatus* Gabb. Miocene of the Dominican Republic.

The section is characterized "by having the whorls enveloping, the suture at first closely coiled, but in the last whorl deviating abruptly." The periphery on the first half of the body whorl in the type is distinctly carinate, and the apical surface is domed. These last

characters are apparently not essential, for *Teinostoma depressum,* the only other species referred to *Idioraphe* in the original description, is depressed and the periphery is rounded.

Teinostoma chipolanum Dall

Plate LXI, figures 12, 13

1892. *Teinostoma chipolanum* Dall. Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 413, pl. 23, figs. 6, 7.

Shell small, tumid, somewhat neritiform, three-whorled; surface polished with microscopic revolving striae; dome of the spire slightly gibbous; a little flattened between the suture and the periphery; base flattish, the spiral striae stronger below; aperture small, nearly circular, somewhat pointed at the upper commissure; umbilicus solidly filled with smooth callus, which extends across the body to the outer lip; inner lip at certain stages of growth separated from the callus by a small groove, at other times the surface is continuous and smooth. Alt. 1.0; max. diam. of base 2.3; min. diam. 1.8 mm.

This curious little shell is well distinguished by its gibbous form. The spirals are only visible in a good light and on a perfectly unworn specimen.—Dall, 1892.

Lectotype: U. S. Nat. Mus. 113101.

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

The individuals from Alum Bluff are less feebly striated than those from the Chipola River. *Teinostoma phacoton* from Alum Bluff is smaller, thinner, and destitute of spiral sculpture.

Occurrence: Chipola formation, localities 10609^{r}, 2212^{c}, 2213^{c}, 2211^{p}.

Teinostoma nanum eonanum Gardner, n. subsp.

Plate LXI, figures 8-10

Shell minute but solid, discoidal, lustrous, paucispiral. Outer margin of the body drawn up over the spire, almost entirely concealing it. Periphery sharply rounded. Body obliquely flattened behind the periphery. Base feebly convex, tending to develop an obtuse umbilical keel near the aperture. Surface smooth, highly polished, microscopically striated with incrementals. Aperture broken, probably transversely elongated. Outer lip thin, sharp. Peristome feebly sulcated at the commissure. Parietal wash rather thin, continuous with the umbilical and pillar callus. Inner margin of aperture sinuous, expanding a little along the body wall, constricted in the umbilical region. Umbilicus entirely filled with a smooth, flat pad of callus that anteriorly extends to the obscure carina, where it merges into the base without perceptible demarcation, although along the posterior margin it is clearly differentiated.

Dimensions of holotype: Height, 0.9 millimeters; maximum diameter, 1.7 millimeters.

Holotype: U. S. Nat. Mus. No. 351634.

Type locality: No. 3733, three quarters of a mile west of Shell Bluff, Shoal River, Walton County, Fla.

The subspecies *T. nanum eonanum* is, apparently the herald of a group that was widespread in the upper Miocene of the Atlantic seaboard. *Teinostoma nanum* Isaac Lea is recorded in the Yorktown formation of Virginia and North Carolina, in the Duplin marl of North and South Carolina, and in the Choctawhatchee formation (*Arca* zone) of Florida. The Walton County shell is less compressed than the later Miocene forms, and the doming of the apical surface, particularly toward the aperture, is more pronounced.

Teinostoma phacoton from Alum Bluff is more lentiform than *T. nanum eonanum* and is feebly but smoothly arched on the apical surface.

The species is known only from the type and one other individual.

Occurrence: Shoal River formation, locality 3733^{r}.

Teinostoma phacoton Gardner, n. sp.

Plate LXI, figures 19-21

Shell minute, lentiform, auriculate. Apical surface broadly and feebly arched. Base obliquely flattened. Periphery sharply rounded. Body whorl embracing and entirely concealing the spire in the adult. Sutures enameled. Protoconch not exposed. Surface smooth, the glaze scratched by microscopically fine incrementals. Aperture semielliptical, obtusely angulated at the posterior commissure, which falls a little behind the periphery. Outer lip slightly flexuous, semielliptical, a little broader than it is long. Inner lip feebly convex, adnate to the body wall. Parietal wash thin. Umbilical pad moderately thick, semielliptical, asymmetric in position.

Dimensions of holotype: Height, 0.7 millimeters; maximum diameter, 1.45 millimeters.

Holotype: U. S. Nat. Mus. No. 329124.

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

The coexistent *T. chipolanum* Dall is larger and not so compressed as *T. phacoton* and exhibits, furthermore, a feeble spiral sculpture. *T. nanum eonanum,* from the Shoal River formation, is less uniformly compressed than *T. phacoton* and is obscurely angulated at the shoulder. The species is known only from the type locality.

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

Teinostoma mekon Gardner, n. sp.

Plate LXI, figures 15-17

Shell minutely auriculate, rather thin for the group but not vitreous, highly polished. Shell of 2 conchal and 1½ protoconchal turns, the nuclear feebly inflated and partially immersed in the postnuclear whorls. Line between conch and protoconch indicated

by the slight flattening of the shell and by the higher luster of the postnuclear turns. On the first whorl of the conch only a narrow area of the flattened posterior portion exposed, the rest of the whorl concealed by the overlap of the body. Body well-rounded, not flattened posteriorly, evenly inflated from the appressed suture to the basal disc. Suture distinct, a faint striation directly in front of the suture limiting the appressed margin. Callus of basal disc extending about halfway from the umbilicus to the periphery. Umbilicus imperforate but indicated by a rather deep depression. Aperture subcircular, sinuous, the outer lip expanded behind the periphery, the inner lip contracted and reinforced at the margin of the basal callus. Margin of outer lip thickened slightly and pushed back across the appressed sutural margin. Parietal wash heavy, appearing as a linguiform process between the commissure and the basal disc; continuous with the callus of the outer lip and of the disc.

Dimensions of holotype: Height, 0.5 millimeters; maximum diameter, 1.4 millimeters.

Holotype: U. S. Nat. Mus. No. 498396.

Type locality: No. 14436, gully south of the road and east of the bridge over Whites Creek, on road from Eucheeanna to Knox Hill, 6.7 miles south of Argyle, 1.7 miles southeast of Eucheeanna, Walton County, Fla. Collection made by the Geological Survey of the State of Florida and presented to the U. S. Geological Survey.

Teinostoma mekon is the smallest recognized representative of this genus of minute shells. Its apparent maturity is indicated by the thickening of the outer lip, the relatively heavy parietal wash, and the callus of the umbilical area. The thickening of the outer lip is a character that sets this species apart from the other *Teinostoma* of the area, and the character of the coiling probably excludes it from the section *Idioraphe*.

Occurrence: Shoal River formation, locality 14436r.

Genus SOLARIORBIS Conrad

1865. *Solariorbis* Conrad, Am. Jour. Conchology, vol. 1, p. 30.

Type by subsequent designation (Dall, W. H., Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 414, 1892): *Delphinula depressa* Isaac Lea. Claiborne sand of Alabama.

Small, depressed, moderately thick-shelled. Nucleus small but fairly prominent, smooth, shining, paucispiral. Surface of conch finely punctate spirally. Aperture entire, subcircular. Peristome angulated and feebly sulcate at the commissure. Parietal wash heavy. Umbilical perforation small but deep, partially concealed by the thickening of the umbilical carina toward the aperture.

Conrad's genus includes a compact group of Tertiary forms characterized by the depressed apical surface, finely punctate spiral sculpture, and small umbilical pit.

Solariorbis is restricted in its known distribution to the Tertiary, and in the Alum Bluff group it is restricted to the Chipola formation and the Oak Grove sand.

Solariorbis microforatis Dall

Plate LXI, figures 11, 14

1892. *Teinostoma (Solariorbis) microforatis* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 415.

1898. *Teinostoma microforatis* Dall., idem, pt. 4, p. 918, pl. 23, figs. 9, 10.

Shell large for the genus, with four or five whorls; surface polished, sculptured; spire flattened; upper surface of the whorl with two spiral subequal ribs, one close to and in front of the suture, the other near the periphery and having the suture laid upon it; surface between these ribs slightly convex, sculptured with numerous fine sharp spiral grooves crossed by numerous rather distant impressed lines of growth, producing a punctate effect at the intersections; periphery rounded, base moderately convex, with a sculpture similar to that of the spire, but stronger, increasing in strength and in the width of the interspaces toward the umbilical area, which is nearly smooth and evenly rounded; aperture rounded, oblique, angulated at the upper commissure and by the rib; pillar thin and short, at its base supported by a triangular thickening due to a stout projecting umbilical rib which overhangs and screens the small perforate umbilicus. Alt. of shell 2.3; max. diam. 4.7; min. diam. 3.7. mm.

The nucleus of this handsome little shell is swollen and prominent, almost as if it might be sinistral, and immersed in the spire. There is no callus on the pillar or umbilicus, and, viewed vertically from below, the shell seems imperforate, but under the shadow of the thick rounded umbilical rib there is a small perforate umbilicus, essentially as in *Leucorhynchia*.

The species is nearest *T. quadrangulare* Meyer, but has no angle at the periphery of the base, the umbilical area is proportionately smaller, and the end of the rib less broad and prominent. Meyer's species seems also to be a much smaller shell, and has a conical, not flattened, spire.—Dall, 1892.

Holotype: U. S. Nat. Mus. No. 113108.

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

Both the genus and the species are exceptionally well characterized.

Occurrence: Chipola formation, 2212r, 2213p, 3419p, 2211r; Oak Grove sand, 2646r, 5632r.

Family TROCHIDAE
Subfamily MONODONTINAE
Genus CHLOROSTOMA Swainson

1840. *Chlorostoma* Swainson, Treatise on malacology, pp. 218, 350.

Type by subsequent desiguation (Herrmannsen, A. N., Indicis generum malacozoorum, vol. 1, p. 231, 1846): *Trochus argyrostomus* Gmelin. Recent in the Indo-Pacific.

The genotype is a moderately large, high conical shell of dark color, imperforate, and corrugated with protractive riblets. *Chlorostoma,* s.s. is not known in the East American faunas, either from the Tertiary deposits or in the Recent seas.

Subgenus OMPHALIUS Philippi

1847. *Omphalius* Philippi, Zeitschr. Malakozoologie, Jahrg. 4, p. 21.

Type by subsequent designation (Herrmannsen, A. N., Indicis generum malacozoorum, vol. 2, p. 146, 1847): *Trochus rusticus* Gmelin. Recent in the Sea of Japan.

Systematic recognition is grudgingly accorded this ill-defined group of usually perforate trochoid shells with a subdued spiral or granose sculpture and a denticle at the extremity of the circum-umbilical cord.

Surface threaded with raised lirae; periphery sharply rounded or obtusely carinate . . . . . *Chlorostoma (Omphalius) exolutum* (Conrad).

Surface threaded with spiral color bands but not with raised lirae; periphery acutely bicarinate . . . . . *Chlorostoma (Omphalius) exolutum limatum* Dall.

Chlorostoma (Omphalius) exolutum (Conrad)

Plate LX, figures 4, 12

1843. *Monodonta exoluta* Conrad, Acad. Nat. Sci. Philadelphia Proc., vol. 1, p. 309.

1856. *Monodonta kiawahensis* Tuomey and Holmes, Pliocene fossils of South Carolina, p. 116, pl. 26, fig. 1.

1863. *Monilia (Monodonta) exoluta* Conrad, Acad. Nat. Sci. Philadelphia Proc. for 1862, vol. 14, p. 569.

1887. *Turbo heliciformis* Heilprin, Wagner Free Inst. Sci. Trans., vol. 1, p. 113, pl. 16, fig. 55.

1892. *Chlorostoma (Omphalius) exoletum* Conrad. Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 388, pl. 17, figs. 4, 4a.

1903. *Chlorostoma exoletum* Conrad. Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 6, p. 1601. (Check list of species from "Duplin Miocene" of North Carolina.)

1915. *Tegula (Omphalius) exoleta* Conrad. Dall, U. S. Nat. Mus. Bull. 90, p. 111, pl. 16, figs. 15-16.

1919. *Chlorostoma (Omphalius) exoleta* Conrad. Gardner and Aldrich, Acad. Nat. Sci. Philadelphia Proc., vol. 71, p. 18. (Check list of species from Muldrow Place, 5 miles southeast of Mayesville, Sumter County, S. C.).

1929. *Tegula exoleta* (Conrad). Cooke and Mossom, Florida Geol. Survey 20th Ann. Rept., 1927-1928, p. 139, pl. 16, figs. 9a-9b.

1930. *Tegula (Omphalius) exoleta* (Conrad). Mansfield, Florida Geol. Survey Bull. 3, p. 131, pl. 17, figs. 9a-9b.

1937. *Tegula (Omphalius) exoleta* (Conrad). Mansfield, Florida Geol. Survey Bull. 15, p. 181.

Depressed; volutions slightly convex, with revolving lines, most prominent on the periphery and base; 7 or 8 lines on the base increasing in size towards the umbilicus, which is profound; labrum with a series of minute short prominent irregular lines on the inner submargin; tooth at base of columella small, transverse, somewhat compressed; beneath is a smaller pyramidal tooth; aperture round, more than half the length of the shell. Width nearly half inch.—Conrad, 1843.

Type locality not given.

Dimensions of figured specimen: Height, 12 millimeters; maximum diameter, 13 millimeters.

Figured specimen: U. S. Nat. Mus. No. 112572.

Locality of figured specimen: Orthaulax bed, Ballast Point, Tampa Bay, Fla.

Shell nacreous within, solid, depressed, more or less irregularly trochiform. Whorls approximately 4. Peripheral carina obscure, evanescent toward the aperture. Surface spirally threaded. Lirations simple, linear, separated by wider interspaces, 4 to 7 on the ultima behind the periphery, 7 or 8 on the base. Occasional fortuitous secondaries introduced. Incrementals commonly conspicuous, obliquely intersecting the spirals in a line approximately parallel to the margin of the outer lip. Suture distinct, not coincident with the peripheral angle of the preceding whorl in all individuals but in some a little in front of it. Aperture holostomous, subcircular. Labrum sharp, broadly arcuate. Labium solid, strongly concave, bidenticulate anteriorly, the posterior tooth the stronger. Parietal wall heavily glazed. Umbilicus persistent to the apex of the spire.

The shells have a weathered appearance, as a rule, as though the spirals had once been granular and had since been eroded until almost smooth. This is due, in large part, to the preservation of the color pattern. The primaries are irregularly barred in alternating lighter and darker tones, thus lending to the spirals a slightly undulatory aspect, which at first glance is deceptive.

The Alum Bluff material, though meager and for the most part immature, indicates an interesting gradation between the typical and the varietal form. The specimens from Alum Bluff, Dall's locality for the subspecies, are most of them without any trace of a raised spiral liration. The single young individual from Oak Grove and those from Boynton Landing are strongly threaded and differ from the normal *C. exolutum* only in the more sharply angulated double keel. The Chipola River specimens are intermediate between these two.

Dall, 1892, considered the specific name of Conrad, *exoluta,* a typographical error. Doubtless Conrad had in mind the Latin word meaning old, an attribute suggested by the weathered appearance of the shell. But there is no evidence that he recognized his error, for 20 years after he published his original description he repeated, without comment in a check list, the name as originally printed. The rules of nomenclature do not permit the correction of the misspelled Latin adjective.

Occurrence: Chipola formation, localities 7893^{r}, 2211^{p}, 7183^{r}; Oak Grove sand, localities 3386^{r}, 2646^{r}, 9961^{r}.

Outside occurrence: "Silex beds" of Tampa limestone, Florida; Yorktown formation, North Carolina; Duplin marl, North Carolina-South Carolina; *Cancel-*

laria zone, Choctawhatchee formation, northern Florida.

The Recent species, for the most part, are warm water and intertidal.

Chlorostoma (Omphalius) exolutum limatum Dall

Plate LX, figures 9-10

1892. *Chlorostoma* (*exoletum* var. ?) *limatum* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 389.

This, which may prove with more material to be a distinct species, differs from *C. exoletum* by its nearly smooth surface, and, in the young, by having one or two keels near the periphery, which are the more prominent from the general smoothness of the shell; and a somewhat smaller umbilicus bounded by a strongly annulated or transversely wrinkled rib; the shell is on the whole more depressed than *exoletum*, but has similar, though fewer, lines, articulated with dark and light color. The most nearly adult specimen measures 7 mm. high by about 9.5 mm. in greatest diameter. It is a variation from *exoletum* in the direction of *C. fasciatum* Born.—Dall, 1892.

Dimensions of lectotype: Height, 5 millimeters; maximum diameter, 7.3 millimeters.

Lectotype: U. S. Nat. Mus. No. 329112.

Lectotype locality: No. 3419, 1 mile below Baileys Ferry, Calhoun County, Fla.

The majority of the forms from the Chipola River are nearer the type of the species than are those from Alum Bluff. They show at most only faint traces of spiral lirae, but they are less strongly bicarinate than the typical *limatum*. The umbilical characters—a relatively small pit margined by a transversely rugose rib—suggest the subspecies. The specimen chosen for figuring is from the Chipola River, for it is very much more perfect than any in the collections from Alum Bluff.

Occurrence: Chipola formation, localities 2213[p], 2564[r], 3419[p], 2211[p].

Chlorostoma (Omphalius) sp. indet.

An immature and imperfect *Chlorostoma* that does not seem to be referable to any described species was collected in the De Funiak *Cardium* beds. It suggests a young *Chlorostoma fasciatum* (Born) in its absence of spiral sculpture, but it is more depressed on the apical surface, and there are faint radial puckerings in front of the suture line which do not seem to be developed in the later form. The basal surface, however, is more strongly rounded, the umbilical keel acute and crenulate, and there is no suggestion of a concave depression just within the keel such as that in *Chlorostoma fasciatum*.

Occurrence: Shoal River formation, locality 7264[r].

Subfamily CALLIOSTOMATINAE

Genus CALLIOSTOMA Swainson

1840. *Calliostoma* Swainson, Treatise on malacology, pp. 218-219, 351.

Type by subsequent designation (Herrmannsen, A. N., Indicis generum malacozoorum, vol. 1, p. 154, 1846): *Trochus conulus* Linnaeus. Recent in the Mediterranean Sea.

Imperforate: spire elevated, acute; aperture broader than high, transversely ovate, hardly sinuated at the base, and slightly oblique; shells almost smooth, and often polished.—Swainson, 1840.

Shell nacreous within, imperforate, or more rarely perforate, rather solid, pyramidal in outline. Spire acute. Whorls numerous, usually more or less flattened laterally, smooth or exquisitely sculptured with simple or granular spirals. Body whorl angular or carinated. Base flattened or slightly convex. Aperture subquadrate. Outer lip sharp, retractive. Inner lip simple, thickened, dentate or subdentate anteriorly.

Calliostoma includes a large number of fossil species. The recognized Gulf species are all of them post-Eocene, but the genus is present in the upper Eocene of the Anglo-Parisian Basin. The number of Recent species is large and their distribution world-wide in waters ranging from a few feet to 500 fathoms in depth. The color and sculpture of the forms render them conspicuous for their beauty.

The perforate Calliostomas are entirely restricted to the Shoal River formation, and they are abundant within that limited area. The imperforate Calliostomas occur most commonly, though not abundantly, at Alum Bluff and along the Chipola River.

Umbilicus imperforate or narrowly perforate; outline moderately high, pyramidal:
- Surface of whorls spirally lirated:
  - Spirals simple ..... *Calliostoma grammaticum* Dall.
  - Spirals moniliform; sutures not overhung by periphery of preceding volution:
    - Spirals more than 3 to the whorl ..... *Calliostoma metrium* Dall.
    - Spirals 3 to the whorl ..... *Calliostoma rhombotoide* Gardner, n. sp.
  - Spirals articulated by the incrementals; sutures overhung by periphery of preceding volution ..... *Calliostoma ceramicum* Dall.
- Surface of whorls smooth except for 2 or 3 faintly incised lines in front of the anterior suture ..... *Calliostoma exile* Dall.

Umbilicus perforate; outline low, broad:
- Entire surface spirally lirate ..... *Calliostoma flumenvadum* Gardner, n. sp.
- Surface smooth except for the two earliest whorls and the umbilical region ..... *Calliostoma rugabasis* Gardner, n. sp.

Calliostoma grammaticum Dall

Plate LX, figure 35

1892. *Calliostoma grammaticum* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 397, pl. 18, fig. 2a.

Shell with seven whorls, the nucleus small and smooth, the remaining whorls strongly spirally sculptured; the periphery is smooth and rounded, overhanging like a broad rib the suture, which is closely appressed below it; between the suture and the peripheral rib are three to five strong, smooth spirals, disposed in scalar fashion like steps up the spire, with sharp-cut interspaces, the number increasing by intercalation, and the area they cover slightly impressed; there is no finer sculpture on the spire; the base is gently rounded, flattish, smooth except for wavy incremental lines and two or three strong spirals close to the umbilical region, which is bounded by a swollen rib and imperforate; pillar arched, a blunt tooth at the base; aperture ovate-quadrangular, smooth inside; the young have the base flatter, with obscure, impressed spiral lines and a single feeble thread near the periphery. Alt. and diameter, 13.5 mm.

This fine species, with its uniform smooth clean-cut spirals, is very distinctive and unlike any other in the American Tertiary.—Dall, 1892.

Cotypes: U. S. Nat. Mus. No. 113038.

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

The figure is a composite of the cotypes—the final 2¼ whorls of an adult and a juvenile of 6 whorls.

A few immature individuals from the Chipola beds suggest *C. grammaticum* in general contour, character of the nuclear whorls, and basal sculpture. The spiral sculpture on the sides of the whorls is restricted, however, to the strong peripheral rib directly behind the posterior suture, a sharply impressed line directly in front of the posterior suture, and occasional faintly impressed lines on the medial portion of the whorl. It is impossible without adult material to determine the relation of these forms to *C. grammaticum*.

Occurrence: Chipola formation, localities ?2213^{r}, 2564^{r}, 3419^{r}, 2211^{c}, 7183^{r}.

Calliostoma metrium Dall

Plate LX, figure 37

1892. *Calliostoma metrium* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 394, pl. 22, fig. 27.

1915. *Calliostoma metrium* Dall, U. S. Nat. Mus. Bull. 90, p. 111, pl. 15, fig. 8 (in part).

Shell large, extremely thin, conical, with the surface between the sutures flat or slightly concave, with seven or more whorls exclusive of the nucleus; spiral sculpture of subequal, close-set, flattened threads covering nearly all of the whorl, with narrower interspaces in which, on the later whorls, runs generally a much smaller, simple, elevated line; a few of the spirals on either side the suture are adjacent to one another, the peripheral spiral on which the suture is wound is simple, the others are obliquely articulated by impressed incremental lines; the suture is closely appressed and inconspicuous; the base appears to be imperforate, with the primary spirals becoming stronger toward the axis; pillar stout, with a moderate fasciole behind it; aperture not visible in the specimen. Alt. of shell, without the nucleus, 18 [20.5]; max. diam. of last whorl 20 [20.5]; min. diam. 18 mm. [18.5].

A single specimen of this well-marked species was obtained by Mr. Burns, but the shell is so thin that it is not practicable to remove the indurated matrix from the aperture. The species is not likely to be confounded with any other of our coast, either recent or fossil.—Dall, 1892.

Holotype: U. S. Nat. Mus. 113025.

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

The type is the only individual yet collected from the Alum Bluff group, and Mansfield has not recognized it in the Tampa limestone.

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

Calliostoma exile Dall

Plate LXII, figure 5

1892. *Calliostoma exile* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 397.

Shell acute-conical, with more than four whorls, the apex of the specimen decollated; whorls smooth except for lines of growth and two or three fine, incised spiral lines just above the periphery; periphery prominent, rounded, slightly overhanging the suture; base smooth or sparsely spirally striated, imperforate, impressed, so that the periphery when the shell is held base upward is elevated and forms a narrow, raised margin around the impressed area it encloses; aperture subquadrate, wider than high. Alt. of shell with the last whorl deficient about 7.0 [6]; max. diam. 5.5 mm.

Though represented by a very imperfect, single specimen, this shell is undoubtedly different from either fossil or recent forms from our coast yet known, and recalls the European *C. conulus*. I have delayed figuring it in the hope of securing a better specimen, but the characters are so distinct that it cannot be mistaken for any other American species.—Dall, 1892.

Holotype: U. S. Nat. Mus. No. 113041.

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

A single immature individual probably referable to this species was collected 1 mile below Baileys Ferry on the Chipola River. It is so young that it represents little more than the area covered by the decollated apex in the type. The nucleus is very small, moderately inflated, paucispiral, erect, acutely tapering. The first whorls of the conch are also broadly rounded, but the later whorls are trapezoidal. Traces may be discerned of a microscopically fine but crowded spiral threading, which evanesces about the beginning of the sixth whorl except for two or three faintly impressed lines in front of the anterior suture. The base is grooved with half a dozen feeble sulci; that nearest the periphery is the most deeply impressed.

Occurrence: Chipola formation, localities 2564^{r}, 2211^{r}.

Calliostoma rhombotoide Gardner, n. sp.

Plate LX, figures 21, 26-27

Shell small, thin, conic, higher than it is wide. Whorls 7 in all. Nucleus very small, smooth and shining, the first half turn bulbous and tilted toward the axis of the shell, the succeeding and final turn of the protoconch also small and not strongly inflated. Line between conch and protoconch sharp, indicated by a change in the texture of the shell and by the initiation of the sculpture. Whorls of conch flattened laterally, the apparent outline of the later whorls modified by the strong spirals. Sculpture plan of 3 symmetrically spaced spirals intercepted and beaded by the strong and regularly spaced retractive incrementals; a fourth spiral introduced on the last whorl of the spire, directly behind the posterior suture; decrease in prominence of the medial of the 3 spirals coincident with the increasing prominence of the fourth spiral, which on the body forms with the outer basal spiral a double keel. Base further sculptured with 4 moderately heavy threads, the second from the peripheral keel less elevated than the others, that nearest the umbilical keel obscurely beaded by the incrementals, which are curved forward toward the periphery. Spiral outlining the umbilicus strongly crenated by the alternate incrementals. Sutures obscure. Aperture rudely quadrate. Outer lip thin, sharp, obtusely angulated at the periphery. Inner lip strongly concave, turned outward and free in the umbilical area. Parietal wall thinly washed with callous. Umbilical pit small but apparently deep.

Dimensions of holotype: Height, 3.8 millimeters; maximum diameter, 3.5 millimeters.

Holotype: U. S. Nat. Mus. No. 498392.

Type locality: No. 10603, gully south of the road and east of the bridge over Whites Creek, on road from Eucheeanna to Knox Hill, 6.7 miles south of Argyle, 1.7 miles southeast of Eucheeanna, Walton County, Fla.

The unique type is probably a juvenile. The shell is delicate and the wash on the parietal wall so thin that the spirals may be traced through it. However, it indicates the presence of a group that is not otherwise represented in the Shoal River formation and is of further interest because of its apparent similarity to *Calliostoma rhombotum* Mansfield from the Brasso beds of Trinidad. The Trinidad species is broader relatively, and though the general sculpture plan is the same in both, the anterior spiral is relatively stronger and more finely and sharply beaded than it is in *C. rhombotoide,* and the basal spirals are finer and all 4 of them sharply beaded. The final whorl is incomplete, but, apparently, in *C. rhombotum* the umbilicus is closed. It is possible, too, that the adult shell of *C. rhombotoide* is imperforate.

Occurrence: Shoal River formation, locality 10603[r].

695462—47—9

Calliostoma ceramicum Dall

Plate LX, figure 34

1892. *Calliostoma (Eutrochus) ceramicum* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 404, pl. 18, fig. 10.

1910. *Calliostoma palmeri* Maury, Bull. Am. Paleontology, vol. 4, no. 21, p. 32, pl. 8, fig. 4.

Shell elevated-conic, strongly spirally sculptured with one small smooth nuclear and eight subsequent whorls; spiral sculpture of four strong, squarish, revolving ribs, with somewhat narrower channeled interspaces, crossed by numerous deeply-impressed, evenly-spaced, oblique lines, in harmony with the incremental lines, which produce an effect on the ribs between the intersections analogous to that of tiles on a roof; base with five or six strong spirals of the same sort and two or three smaller ones around the umbilicus; periphery with a single broad smooth spiral, not intersected by the transverse sculpture, and on which the suture is closely laid; umbilicus small, deep, subcylindrical, its marginating riblets forming a projection at the aperture; whorls and base slightly rounded, periphery moderately so; surface polished; aperture rounded-quadrate. Alt. of shell 15; max. diam. of base 14 [13.5] mm.

The characters of this fine shell are very distinctive, and it can readily be distinguished from any other of our Tertiary species.—Dall, 1892.

Holotype: U. S. Nat. Mus. 113065.

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

Miss Maury's *C. palmeri* is only half as large as *C. ceramicum* and seems to be the young of that species.

A single young specimen from Oak Grove differs from the Chipola forms in the less elevated spiral sculpture, particularly on the base, and in the less sharply incised axial sulci. It is impossible to determine the relations of this isolated immature individual until further and more mature material is available.

Occurrence: Chipola formation, localities 2212[r], 2564[r].

Section LEIOTROCHUS Conrad

1862. *Leiotrochus* Conrad, Acad. Nat. Sci. Philadelphia Proc. for 1862, p. 288.

Type by monotypy: *Leiotrochus distans* Conrad. Miocene of Maryland (St. Marys formation).

Shell perforate in normal adults.

The section is restricted in its distribution to the Shoal River beds.

Eutrochus A. Adams, 1863, has been commonly used for the umbilicated group of *Calliostoma,* but the type of *Eutrochus* is *E. perspectivus* A. Adams, a Tasmanian species, and, according to Dall, [46] it is synonymous with *Astele subcarinata* Swainson, 1855, also described from Tasmania. *Leiotrochus* Conrad from the St. Marys formation of Maryland is probably closer to the Floridian species than is the Tasmanian shell, but in *Calliostoma* the forms, separated on no grounds other than

[46] Dall, W. H., Contributions to the Tertiary paleontology of the Pacific coast, I, The Miocene of Astoria and Coos Bay, Oreg.: U. S. Geol. Survey Prof. Paper 59, p. 96, 1909.

the presence or absence of an umbilicus, do not seem to fall into natural divisions. The sculpture of the early whorls seems of greater importance than the umbilical characters in the separation of certain groups. Both *Calliostoma rhombotoide* and *ceramicum* are narrowly perforate, but in the ensemble of their characters they seem more closely allied to *Calliostoma* s. s. than to the section *Leiotrochus*.

Calliostoma flumenvadum Gardner, n. sp.

Plate LXII, figures 14, 24

Shell nacreous within, rather large, low-turbinate. Whorls 7, including the small, smooth, somewhat bulbous nucleus of only a little more than a single turn. Whorls of spire obliquely flattened laterally, increasing rather rapidly in size. Body whorl sharply rounded or obtusely carinate at the periphery, flattened or feebly convex on the base. Sculpture initiated in the form of 3 spiral lirae, the posterior moniliform and placed directly in front of the suture, the other two sharp and simple, symmetrically spaced between the posterior lira and the anterior suture; anterior and medial spirals becoming moniliform before the end of the second whorl; secondaries intercalated near the beginning of the fourth whorl between the first and second and the second and third primaries; a fourth primary introduced directly behind the anterior suture; anterior and medial spirals tending to become simple near the body, the 1 or 2 posterior spirals alone retaining their beading; spirals further increased in number by intercalation and reaching 6 or 7 on the final whorl of the spire. Sutures impressed, indistinct, outlined by the beaded posterior spiral. Body threaded behind the periphery with 10 or 11 lirae, the posterior 1 or 2 moniliform, those in front of them simple, tending to alternate in size, the peripheral spiral the heaviest; base of type sculptured with 2 flattened lirae immediately in front of the periphery, 6 broader, equisized and equispaced fillets between the peripheral and umbilical regions and 2 narrow, close-set lirae near the umbilicus. Aperture subquadrate to transversely elliptical. Outer lip heavy but sharp-edged, acutely rounded at the periphery. Parietal wall thinly glazed. Columella arched, reinforced, simple. Umbilicus rather large, open, persistent to the apex, scalariform within, margined by a heavy, rugose costa, dissected by the incrementals.

Dimensions of holotype: Height, 15.8 millimeters; maximum diameter, 22.3 millimeters.

Holotype: U. S. Nat. Mus. No. 351612.

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

Calliostoma flumenvadum is characterized by the low, turbinate outline, the sharp spiral threading, moniliform on the early whorls and directly in front of the suture and simple on the medial and anterior portions of the body and on the base. The species varies somewhat in the number and elevation of the lirae, but the general aspect of the shell is constant. It is prolific at the Shoal River horizon in Walton County, particularly at the type locality. It has not been recognized elsewhere, but the higher, more strongly sculptured *Calliostoma mancinella* Olsson from the Gatun formation of Costa Rica may be related.

Occurrence: Shoal River formation, localities 3856^{pr}, 3742^{a}, 3731^{r}, 5080^{r}, 5184^{r}, 5195^{r}, 3748^{r}.

Calliostoma rugabasis Gardner, n. sp.

Plate LXII, figures 28-30

Shell nacreous within, low, broad, shaped like a beehive, the profile of the spire scarcely interrupted at the sutures. Whorls 6 to 7, including the small, smooth, bulbous protoconch of approximately a turn and a half. Spiral sculpture initiated on the first whorl of the conch in the form of 3 sharply elevated, simple lirae, which soon become equal in size and symmetrical in spacing between the sutures but which persist for only a couple of turns, when they abruptly evanesce; remaining volutions smooth except for a faintly impressed line directly behind the periphery and faint incremental striae. Periphery bicarinate in the young, obtusely monocarinate in the adult forms. Suture lines distinct, feebly impressed. Base smooth near the periphery but sharply puckered or corrugated near the umbilical rib. Aperture subquadrate to transversely lenticular in outline. Outer lip sharp, strongly retractive, obtusely angulated at the periphery. Pillar strongly arched, heavily reinforced by the apertural face of the umbilical rib. Parietal wall thinly glazed. Umbilicus small but deep, margined by a very broad and very heavy, commonly rugose costal into which the base of the body is puckered; costa increasingly heavy toward the aperture and terminating in an obscurely defined tubercle.

Dimensions of holotype: Height, 12.6 millimeters; maximum diameter, 19.5 millimeters.

Holotype: U. S. Nat. Mus. No. 351620.

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

Calliostoma rugabasis is unique in the low, pyramidal outline, the trilirate sculpture of the two earliest whorls of the conch, the smooth, later volutions, the exceptionally heavy umbilical rib, and the rugose area that margins it.

However, *Calliostoma rugabasis* is similar in outline and in the sculptural detail of the early whorls to *C. humilis* Conrad of the later Chesapeake group (Miocene) of Maryland and Virginia. *C. labrosum* from the Chesapeake group of Virginia is a related species, though it is not umbilicate. The group of low, broad

Calliostoma with trapezoidal whorls, a sculpture which tends to become obsolete on the later volutions, and an umbilicus which may be open or closed is prominent in the Yorktown formation of Virginia and North Carolina. This group has not been recognized, however, in the Floridian or mid-American Tertiaries. The distribution of the group may be governed by temperature. Other cool-water elements in the Shoal River faunas, such as the *Ashtarotha* section of *Astarte,* are not represented in the Chipola fauna nor in the later Floridian and mid-American assemblies.

The species is restricted to the Shoal River formation, and although represented at three localities it is not abundant at any of them.

Occurrence: Shoal River formation, localities 3856^{r}, 3742^{p}, 5195^{r}.

Subfamily MARGARITINAE
Genus SOLARIELLA Searles Wood

1842. *Solariella* Searles Wood, Annals and Mag. Nat. History, vol. 9, p. 531.

Type by monotypy: *Solariella maculata* Searles Wood. Crag (Pliocene) of England.

Shell small, subnacreous, depressed turbinate. Volutions not numerous, inflated, commonly tubular. Sculpture dominantly spiral, more or less beaded by the incrementals. Aperture subcircular, the axis subparallel to the axis of the shell. Peristome adnate to the body wall between the peripheral and umbilical keels; outer margin of peristome sharp, commonly crenulated by the primary sculpture. Columellar margin strongly concave, simple. Umbilicus usually large and deeply perforate, outlined as a rule by an acute carina. Operculum horny, multispiral.

Liotia, which resembles *Solariella* in size, outline, and general sculpture plan, has a heavier shell than *Solariella,* and the operculum is calcareous rather than horny.

Solariella has been reported from all of seas except the Antarctic. A large number of the species are boreal and cool temperate.

Solariella turritella Dall

Plate LX, figure 31

1892. *Solariella turritella* Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 408, pl. 23, fig. 2.

Shell small, conical, with six whorls; nucleus small, inflated, smooth; next two whorls reticulated by about four spiral and numerous transverse elevated threads; subsequent whorls with an elevated thread a little in advance of the suture and two at the periphery, the posterior of these the stronger, beside several rather obscure smaller ones on the base, in addition to which the whole surface is minutely spirally striated; the transverse sculpture consists of numerous minute, narrow riblets, with wider interspaces, directed in harmony with the incremental lines, most elevated just in front of the suture, and by which the posterior primary spiral rib is crenulated, beyond which the riblets are not distinguishable from the lines of growth; the whorl between the suture and the first primary spiral is flattened; in front of the primary it is rounded, the base is swollen; the umbilicus is large and funicular; the umbilical carina strong and crenulated, separated from the base by a well-defined groove; the umbilical walls are coarsely sculptured by two or three strong and several feebler crenulated spirals separated by excavated sulci; the aperture is rounded, with a thin edge, crenulated by the exterior sculpture; color markings, in the shape of rather distant, small purplish spots, still appear on the primary spirals. Alt. of shell 5.6; max. diam. 6.0 mm.

A single specimen of this pretty and very distinct species was obtained by Mr. Burns.—Dall, 1892.

Holotype: U. S. Nat. Mus. No. 113081.

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

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

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

Solariella laqua Mansfield

Plate LX, figures 28, 29, 33, 36

1935. *Solariella laqua* Mansfield, Florida Dept. Cons., Geol. Bull. 12, p. 45, pl. 5, figs. 1-5.

Shell small, turreted, moderately high-spired for the genus and consisting in all of 5½ whorls. Earliest turn smooth and rounded with an immersed tip; following whorls nearly flat below the suture, very sharply angled at the posterior shoulder and sculptured with one weakly beaded spiral in front of the suture, a nearly smooth cord at the posterior shoulder, and 2 smooth cords below, the medial one being a little weaker and situated nearer the basal cord. Another weaker spiral is present above the medial one on some specimens. Base of body whorl with 5 to 7 rather weak and nearly smooth spiral cords. Umbilical cords weakly nodulated, coarser than the basal cords, and separated by rather wide intervals. Aside from the stronger spirals, the whole shell is overrun with microscopic spirals. Retractive axial growth structures ornament most of the shell, being more prominent on the tabulated area in front of the suture. Umbilicus large and scalariform. Aperture nearly round; inner lip thin and closely adhering to the body whorl.

The larger cotype (U.S.N.M. Cat. No. 373157) measures: Length, 5.5 mm.; diameter, 7 mm.

The following species, when compared with *S. laqua,* show the following differences: *S. vaughani* Mansfield, an upper Miocene species, has a larger shell and coarser ornamentation; *S. altiusulca* Guppy, a species from the Bowden marl of Jamaica, has a less tabulated area below the suture, more rounded whorls and more spirals on the base; *S. major* (Gardner and Aldrich), an upper Miocene species, though closely related, has more strongly nodulated spirals and weaker umbilical cords; *S. lacunella depressa* Dall, a living subspecies from Florida and the Antilles, has a lower spire and closer-spaced spirals.

Type locality: Station 12046, Vaughan Creek, upper locality, Walton County, Florida.

Occurrence: Upper middle Miocene, *Arca* zone. Type locality (quite common); Station 12044, Bell farm, upper locality, Walton County (rare).—Mansfield, 1935.

Two adolescent specimens from Whites Creek, are probably referable to this species. The less elaborate

sculpture of the Shoal River individuals is due to their immaturity.

Dimensions of figured specimens: U. S. Nat. Mus. No. 498394, height, 3.5 millimeters; maximum diameter, 4.0 millimeters. U. S. Nat. Mus. 498395, height, 3.4 millimeters; maximum diameter, 3.9 millimeters.

Locality of figured specimens: No. 14436, gully south of the road and east of the bridge over Whites Creek, on road from Eucheeanna to Knox Hill, 6.7 miles south of Argyle, 1.7 miles southeast of Eucheeanna, Walton County, Fla.

Occurrence: Shoal River formation, locality 14436[r].

Superfamily ZEUGOBRANCHIA
Family FISSURELLIDAE
Genus LUCAPINELLA Pilsbry

1890. *Lucapinella* Pilsbry, Manual Conchology, vol. 12, pp. 179, 195.

Type by original designation: *Clypidella callomarginata* Carpenter. Recent from Monterey to Magdalena Bay, Lower California.

Fissurellidae with an oblong shell, not sunken in or covered by the mantle, and about as long as the foot; its apex subcentral, wholly removed by a rather large oblong perforation, which is margined within by an entire (not truncated) callus; edge of shell blunt, scarcely crenulated in adults except in front and behind; sculptured with scaly riblets; front and side margins level, posterior margin a little elevated.—Pilsbry. 1890.

The genus is restricted in its geologic distribution to the Tertiary and Quaternary and in its geographic distribution to the American shores.

In the Alum Bluff group the family is recorded only in the Chipola formation.

Lucapinella limatula (Reeve)

Plate LXII, figure 15

1850. *Fissurella limatula* Reeve, Conchologia Iconica, vol. 6, *Fissurella;* sp. and fig. 115.
1889. *Fissurellidea limatula* Reeve. Dall, Harvard Coll. Mus. Comp. Zool. Bull. 18, p. 409.
1890. *Lucapinella limatula* Reeve. Pilsbry, Manual of conchology, vol. 12, p. 198, pl. 36, fig. 13, pl. 61, figs. 6-9.
1892. *Lucapinella limatula* Reeve. Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 423.
1910. *Lucapinella Cornelliana* Maury, Bull. Am. Paleontology, vol. 4, no. 21, p. 32, pl. 8, fig. 5.

Shell oblong-ovate, somewhat attenuated anteriorly, sides a little compressed, radiately finely and closely prickly striated, orifice large, ovate; white, stained and variegated with pale black.

Hab—?

A depressed shell, finely prickly striated over its surface.—Reeve, 1850.

The species is characterized by its depressed, more or less spatulate shell, suggesting in outline a duck's bill, its foramen elongated in some individuals to almost one-third the total height, and the prominent concentric lamellae with their free edges minutely spinose at the intersection with the radials. The primary radials are 16 in number on the figured specimen; secondaries and tertiaries are intercalated. The sculpture, both the concentric and radial, is less prominent laterally than it is toward the anterior and, particularly, toward the posterior extremity. The radials are less crowded, too, on the sides of the shell than they are toward the ends. The inner margin of the foraminal opening is rather broadly banded with a heavy callus that conforms in outline to the opening.

Dimensions of figured specimen: Height, 3.0 millimeters; length, 14.0 millimeters; maximum width, 8.0 millimeters; length of foramen, 3.0 millimeters.

Figured specimen: U. S. Nat. Mus. No. 53881.

Locality of figured specimen: Recent off Key West on grass at low water.

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

Outside occurrence: Pliocene—Waccamaw formation, North Carolina; Caloosahatchee formation, Florida. Recent: Cape Fear, N. C., to the Barbadoes in 15 to 20 fathoms.

Genus DIODORA Gray

1821. *Diodora* Gray, London Medical Repository Monthly Jour. and Rev., vol. 15, p. 233.
1915. *Diodora* Gray. Iredale, Malac. Soc. London Proc., vol. 11, p. 331.

Type by monotypy: *Patella apertura* Mont[agu]= *Patella graeca* Linnaeus *juvenis* (Fide Iredale). Recent off the coast of southern England and the Channel Islands, and, according to some authors, south into the Mediterranean and Adriatic Seas.

Ovate conic limpetlike shells, the base level or slightly raised laterally. Basal outline ovate or ellipsoidal. Nucleus spiral, present only in the juveniles, in which it caps the imperforate subcentral apex; later absorbed and succeeded by an ovate or keyhole perforation which migrates a part of the distance down the anterior slope. Sculpture radial or reticulate. Inner margins crenate in the type, reflecting the radial sculpture. Apical perforation set high on anterior slope, rather narrow and not conspicuously elongated, reinforced within and banded with a heavy but rather narrow callus truncate posteriorly; shell depressed behind the truncated callus. Muscle scar horseshoe-shaped, confined to posterior and lateral portions of shell.

The group is prominent in the Tertiary and Recent faunas.

Radials alternating in size in the adult, rarely exceeding 50 in number:
  Sculpture relatively strong..... *Diodora chipolana* (Dall).
  Sculpture rather low and flat..... *Diodora daidala* Gardner, n. sp.
Radials alternating in size in the young, subequal in the adult, usually exceeding 50 in number..... *Diodora pumpellyi* Gardner, n. sp.

Diodora chipolana (Dall)

Plate LXII, figure 13

1892. *Fissuridea chipolana* Dall, Wagner Free Inst. Sci. Trans. vol. 3, pt. 2, p. 426.
1898. *Fissuridea chipolana* Dall, idem, pt. 4, p. 918, pl. 23, fig. 21.
1915. *Fissuridea chipolana* Dall, U. S. Nat. Mus. Bull. 90, p. 114.
1937. *Diodora chipolana* (Dall). Mansfield, Florida Dept. Cons., Geol. Bull. 15, p. 186.

Shell ovate, slightly wider behind the foramen, with rather straight sides, slightly concave anterior and convex posterior slope; foramen oval or a little keyhole-shaped, sloping forward; sculpture of narrow, prominent, radiating rounded ribs, with wider interspaces and alternately smaller intercalary riblets, crossed by distant, regularly spaced, elevated concentric threads, which form nodules at the intersections; these nodules toward the periphery tend to become transversely flattened or pear-shaped, and in large specimens near the margin may assume an imbricated form; interior smooth, the margin crenulate in the young, in the full-grown rather sharply and coarsely denticulate radially; foraminal callus spade-shaped, slightly dinted behind.—Alt. 7; lon. 15; diam. 9.5 mm.

This species much resembles *F. alternata* Say, but seems more depressed and elongated, and has the foramen habitually more anterior. It does not seem to attain so large a size as the recent specimens of *alternata*. It is undoubtedly the forerunner of that species.—Dall, 1892.

Holotype: U. S. Nat. Mus. No. 112699.

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

Diodora daidala Gardner from the Shoal River formation, is more finely sculptured and both the radials and the concentric lirae are more flat than they are in *D. chipolana*.

Diodora pumpellyi is relatively higher than the Chipola species; the radials are subequal in the adult, linearly spaced, and may be as many as 80; the foraminal opening is smaller.

Occurrence: Chipola formation, localities 10609[r], 7257[r], 2213[c], 2564[r], 2211[p]; Oak Grove sand, locality 2646[r].

Outside occurrence: Miocene—Tampa silex beds at Ballast Point; Yorktown formation, Rock Landing?, Craven County, N. C.; Duplin marl, Natural Well?, Duplin County, N. C.

Diodora daidala Gardner, new species

Plate LXII, figure 26

Shell rather thin, of moderate dimensions, not very high. Basal outline ovate, broadening posteriorly, slightly upcurved laterally. Apical perforation elliptical, relatively broad, set obliquely on the anterior slope; its posterior rim nearly central. Rim reinforced, narrowly banded within by a heavy callus, uniform in width and following the outline of the perforation anteriorly and laterally but truncate behind. Shell depressed behind the truncation. Radial sculpture dominant, the radials crowded, separated by linear interspaces, arranged in a series of not very sharply defined primaries, secondaries and tertiaries, the primaries and secondaries, originating at the foramen, the tertiaries commonly introduced a little later. Radials overridden by crowded concentric lirae, regular in size and spacing, not spinose nor scaly but rather flat. Inner margins feebly crenate in harmony with the radials. Muscle scar obscure, taking the form of a narrow band about midway between the apical opening and the basal margin, confined to the posterior and medial portions of the shell, the extremities apparently in line with the foraminal callus.

Dimensions of holotype: Height, 7.9 millimeters; length, 18 millimeters; width, 12 millimeters.

Holotype and 1 paratype: U. S. Nat. Mus. No. 498397.

Type locality: No. 14436. Gully south of the road and east of the bridge over Whites Creek on road from Eucheeanna to Knox Hill, 6.7 miles south of Argyle, 1.7 miles southeast of Eucheeanna, Walton County, Fla. Collection made by the Geological Survey of the State of Florida and presented to the United States Geological Survey.

Diodora daidala is related closely to *Diodora chipolana* Dall. The shell seems to run larger, and the primary sculpture does not stand out above the secondary as it does in *D. chipolana*. The concentric lirae, too, are more crowded in *D. daidala* and are not spinose or scaly at the intersections with the overridden radials. The sculpture plan in *D. daidala* is similar to that of the Recent *D. alternata* (Say), but *alternata* is a larger, coarser, and more elevated shell, with a stronger concentric sculpture. *Diodora redimicula* (Say) and *D. catilliformis* (Rogers), widespread in the upper Miocene of the middle Atlantic seaboard are also similar in general sculpture but they, too, are much larger and coarser than *D. daidala*.

Occurrence: Shoal River formation, locality 14436[r].

Diodora pumpellyi Gardner, new species

Plate LXII, figures 25, 27

Shell rather small for the group, moderately elevated, conic; the posterior slope a little more produced and consequently not so steep as the anterior; lateral slopes oblique, steeper than the anterior. Base ovate, little or not at all upcurved medially. Radials well elevated, well-rounded cords, alternating in size in the young, subequal in the adults, separated by linear interspaces, not far from 80 in number. Concentric sculpture finely laminar, closely spaced, overriding the radials; the interspaces between the radials and concentric laminae appearing, especially in the worn shells, as a series of minute pits. Foramen rather small, elongate, oval, slightly oblique to the axis. Interior concealed by the matrix.

Dimensions of holotype: Height, 7.4 millimeters;

length of base, 12.5 millimeters; maximum width of base, 8.8 millimeters.

Holotype: U. S. Nat. Mus. No. 371889.

Type locality: No. 7148, Gastropod Gulch, 5½ miles southeast of Bainbridge, Decatur County, Ga.

Diodora pumpellyi is higher relatively than *D. chipolana* Dall, and the sides are less inclined to be upcurved. The radials are more numerous and more closely spaced than in the Chipola species; they are more nearly equal than in either *D. chipolana* or *D. daidala.*

Diodora pumpellyi is not uncommon in the Alum Bluff group of Decatur County, Ga., an area which Raphael Pumpelly was among the first to critically investigate.

Occurrence: Oak Grove sand, localities 3386^{r}, 3385^{p}, 7148^{r}, 3396^{r}.

Genus RIMULA Defrance

1827. *Rimula* Defrance, Dictionnaire des Sciences naturelles, vol. 45, p. 471.

Type by subsequent designation (Gray, Zool. Soc. London Proc., pt. 15, p. 147, 1847): *Rimula blainvillii* Defrance. "Calcaire grossier de Hauteville, département de la Manche," France.—Defrance, 1827.

Shell small, thin, ovate-conic. Apex imperforate, usually within the posterior third; posteriorly directed, incurved. Nucleus small, smooth, paucispiral. Anal opening a slit on the median line of the anterior slope, enclosed within the basal margin, migrating with the growth of the shell, the traces of the successive openings clearly retained on the sinus, which is continuous from the apex to the slit. Surface cancellate.

Rimula woodringi Gardner, n. sp.

Plate LXII, figures 16, 17

1928. *Rimula* species, Woodring, Carnegie Inst. Washington Pub. 385, p. 456.

Shell very small and delicate, semielliptical. Basal margin elliptical, level. Apex directed backward and within the posterior fourth. Posterior slope consequently very short, concave. Anterior slope broadly and smoothly convex. Sides oblique, evenly diverging toward the base. Protoconch minute, smooth, shining, curved backward; coiled in a single plane, the 1½ volutions visible on the right side when the anterior extremity is faced away from the observer. Close of protoconch indicated by a change in the texture of the shell and by the appearance of a feeble radial sculpture. Surface of conch finely cancellated; the interspaces between the radials and the concentric sculpture appearing as minute, squarish pits, which give a slightly punctate aspect to the sculpture. About 40 rather low, broadly rounded radials, a little wider and less closely spaced anteriorly. Concentric lirae not quite so wide as the radials, equal and regularly spaced, more crowded in the apical region than they are toward the base. Margin finely serrate in harmony with the radials. Foraminal groove gracefully contoured, broadly arched, regularly corrugated from the apex to the slit, each lamina indicating a former posterior extremity of the foramen. Slit as wide as the groove and about one-third its length. Distance from the anterior extremity of the foramen to the basal margin not so long as the foramen. Opening feebly reinforced within.

Dimensions of holotype: Height, 1.3 millimeters; length of base, 2.7 millimeters; maximum width of base, 1.9 millimeters.

Holotype: In the collection made by T. H. Aldrich and later acquired by Johns Hopkins University, Baltimore. Deposited, at present, in the U. S. National Museum.

Woodring referred to this species in a discussion of *Rimula pilsbryi* Woodring from the Bowden of Jamaica and noted that the Bowden species was larger and more heavily sculptured than the Chipola form.

Rimula woodringi is the possible ancestor of *Rimula caroliniana* Dall of the Pliocene of North Carolina. The Waccamaw species is not so flattened dorsally as the species from the Chipola formation, and the sculpture is sharper and more open. The foraminal opening is not so near the anterior margin in *R. caroliniana,* nor is the foraminal groove so closely and so regularly laminated. I have the pleasure of naming this unusually interesting species in honor of Dr. Wendell P. Woodring, whose work on the Bowden fauna in the late 1920's is still the latest and finest.

Occurrence: Chipola formation, locality 10288^{r}, Aldrich collection, Johns Hopkins University.

Class SCAPHOPODA

Family DENTALIIDAE

Genus DENTALIUM Linnaeus

1758. *Dentalium* Linnaeus, Systema Naturae, 10th ed., p. 785.
1897. *Dentalium* Linnaeus. Pilsbry and Sharp, Manual of conchology, vol. 17, p. xxix.
1920. *Dentalium* Linnaeus. Henderson, U. S. Nat. Mus. Bull. 111, p. 8.

Type by subsequent designation (Schmidt, Chr. Fr., Versuch über die beste Einrichtung zur Aufstellung, Behandlung u. Aufbewahrung der verschiedene Naturkörper u. Gegenstände der Kunst, vorzüglich der Conchyliensammlungen; nebst kurzer Beurtheilung der conchyliologischen Systeme u. Schriften, u. einer tabellarische Zusammenstellung u. Vergleichung der sechs besten u. neuesten conchyliologischen Systeme; nebst einem Verzeichniss der am meisten bekannten Conchylien, wie solche nach dem Lamarkschen Systeme geordnet werden können, pp. 151, 178, 181, 1818):

Dentalium elephantinum Linnaeus. Recent off Amboyna and the Philippine Islands.

Shell a curved and tapering tube, the diameter greatest at the aperture. Embryonic whorls minute, fragile, and lost at an early growth stage. A longitudinal sculpture usually developed, at least near the posterior extremity; shell smooth or merely annulated in a few of the smaller subgenera. Apical opening usually modified by a slit or notch due to absorption and in no way analogous to similar modifications in the gastropod apertures. Anterior opening circular or oblique, commonly modified by the longitudinal ribbing.

The shell varies in size from minute needlelike forms to those of 4 or 5 inches in length, in thickness from fragile to heavy and solid; in texture from soft and chalky to hard porcellanous or glassy; in color from occasional greenish, reddish, or yellowish species to pure white, the latter greatly predominating. The shells may be transparent, translucent to opaque, dull lusterless to the most highly polished and glistening surface.—Henderson, 1920.

Dentalium has been adequately monographed both by Pilsbry and Sharp and by Henderson, and their classifications are followed in this report.

The distribution of *Dentalium* in the Alum Bluff group is interesting in that out of the six species listed all but one occurs in the Chipola formation. *Dentalium chipolanum* and *D. schumoi*, the two most abundant species in the Chipola, are apparently restricted to it.

Axial sculpture developed at least on the posterior part of the shell; evanescent medially or anteriorly:
- Axials sharply defined though not conspicuously elevated ..... *Dentalium (Antalis) chipolanum* Gardner, n. sp.
- Axials threadlike, irregular in arrangement ..... *Dentalium (Antalis) diopon* Gardner, n. sp.
- Axial sculpture developed only at the extreme tip, exceedingly fine ..... *Dentalium (Graptacme) eboreum* Conrad.

Axial sculpture not developed even on the posterior part of the shell:
- Shell laterally compressed, minutely annulated posteriorly ..... *Dentalium (Episiphon) schumoi* (Pilsbry).
- Shell cylindrical, not annulated ..... *Dentalium (Laevidentalium) santarosanum* Maury.

Subgenus ANTALIS H. and A. Adams

1854. *Antalis* H. and A. Adams, Genera of Recent Mollusca, vol. 1, p. 457.
1897. *Antalis* H. and A. Adams. Pilsbry and Sharp, Manual of Conchology, vol. 17, p. 37.
1920. *Antalis* H. and A. Adams. Henderson, U. S. Nat. Mus. Bull. 111, p. 34.

Type by subsequent designation (Pilsbry and Sharp, idem, 1897): *Dentalium entalis* Linnaeus. Recent in the North Atlantic and south to Spain.

Tip prismatic or round, with primary riblets ranging from 6 to 18, which are less strongly developed and prominent than in *Dentalium* s. s. and generally disappear in the senescent stages of the shell if not earlier. The apical characters consist of a notch on the convex side or may be lacking. Transverse sculpture is variable or absent.

As already noted, the differences between this and the preceding subgenus [*Dentalium s. s.*] are not very sharply drawn. * * * The American species referred here are all less strongly ribbed than are those included under *Dentalium* s. s.—Henderson, 1920.

Dentalium (Antalis) chipolanum Gardner, n. sp.

Plate LXII, figures 18, 18a

1892. *Dentalium disparile* D'Orbigny. Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 440 (in part).

Not *Dentalium disparile* D'Orbigny, 1853.

Shell polished but not highly, moderately long but very slender, gently arched medially, less feebly so posteriorly. Young acicular and rather strongly arcuate. Axial sculpture at the posterior extremity of the slightly imperfect holotype of 12 (6 in the earliest growth stage) equisized, narrow, costae a little more closely spaced on the ventral surface than on the dorsal; intercalaries admitted midway between the primaries at a distance varying greatly with the individual; secondaries rapidly increasing in prominence until they equal the primaries; sculpture on the medial portion of the tube consisting of approximately 24 subequal lirae separated by linear interspaces. Axials abruptly evanescent anteriorly, leaving the tube destitute of ornamentation. Intercostal areas on the posterior portion of the shell finely striated by the growth lines. Posterior orifice slightly oval due to the greater thickening of the shell on the dorsal and lateral surfaces. Medial section subcircular, finely stellated externally by the axials. Peristome circular, very thin, and slightly oblique to the axis of the shell.

Dimensions of holotype: Length, 40 millimeters; maximum diameter, 3.3 millimeters.

Holotype: U. S. Nat. Mus. No. 329137.

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

Dentalium chipolanum seems to be a forerunner in the group of the Recent *D. disparile* D'Orbigny, and probably the references of Chipola species in the various check lists to *D. disparile* should be transferred to *D. chipolanum*. The curvature toward the apical extremity is higher and the lag in the change in sculpture pattern greater in the Recent species. In *D. chipolanum*, the hexagonal sculpture is confined to the extreme tip and the longitudinal cording evanesces in many individuals midway from the apex. In *D. disparile*, the hexagonal sculpture commonly persists through the posterior fourth or third of the entire length and the longitudinal cording to the peristome. In *D. texasianum* Philippi, the secondary sculpture is absent or fortuitous, and the hexagonal sculpture

fades directly into the simple, incrementally roughened tube; only at the extremities is there any close resemblance to *D. chipolanum.*

A few tips from the marls of the Shoal River formation south of De Funiak Springs exhibit the characteristic hexagonal outline of *D. disparile.*

D. chipolanum is represented in the Chipola by abundant but fragmentary material. It shows wide variation in the prominence of the axials and in the time of appearance of the secondaries.

Occurrence: Chipola formation, localities 10609^{r}, 2213^{a}, 2564^{a}, 3419^{a}, 2211^{p}, 7183^{r}.

Dentalium (Antalis) diopon Gardner, n. sp.

Plate LXII, figures 23, 23a

Tube rather highly polished, thin, of moderate diameter; curvature very low. Earliest growth stages probably not preserved. Ten threadlike ribs at tip of incomplete figured specimen, the number, however, apparently inconstant; number increased by intercalaries, but all axial sculpture becoming obsolete in fully adult and senescent stages. Growth sculpture strong, in some individuals sufficiently strong to cancellate the axial filaments. Characters of apical extremity not preserved. Peristome circular.

Dimensions of cotypes: Length, estimated from broken specimens, 45 to 50 millimeters; diameter of posterior extremity of incomplete adolescent, 1.1 millimeters; diameter of anterior extremity of short length of adult, 3.3 millimeters.

Cotypes, an incomplete adolescent and an incomplete adult: U. S. Nat. Mus. No. 498398.

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

Dentalium diopon is a larger, thicker, more gently arcuate shell than *D. chipolanum.* It is more finely sculptured posteriorly and the sculpture is more rapidly evanescent. The relationship between the two species is probably not close. In its thickness and low curvature *D. diopon* recalls *D. dissimile* Guppy of the Bowden fauna, but the initial primaries of the Jamaican species number only 4, and the quadrate outline is retained into the adolescent stage.

Occurrence: Shoal River formation, localities 3856^{a}, 3742^{c}, 3748^{p}.

Subgenus GRAPTACME Pilsbry and Sharp

1897. *Graptacme* Pilsbry and Sharp, Manual of conchology, vol. 17, p. 85.

Type by subsequent designation (Woodring, Carnegie Inst. Washington, Pub. 366, p. 201, 1925): *Dentalium eboreum* Conrad. Cape Hatteras to Sarasota, Fla.

Surface sculptured with close, fine, deeply engraved longitudinal striae near the apex, the remainder smooth; or rarely the striae persist half or all the length. Moderate sized or small species, cylindrical in section, and white or nearly so.

Distribution: Antillean and Panamic regions; Indo-Pacific; mainly living in quite moderate depths.

There is remarkable diversity in the characters of the apices in this apparently very natural group.—Pilsbry and Sharp, 1897.

Dentalium (Graptacme) eboreum Conrad

1846. *Dentalium eboreum* Conrad, Acad. Nat. Sci. Philadelphia Proc., vol. 3, p. 27.
1885. *Dentalium leptum* Bush, Connecticut Acad. Arts and Sci. Trans., vol. 6, p. 470, pl. 45, figs. 18, 18a.
1889. *Dentalium matara* Dall, Harvard Coll. Mus. Comp. Zoology Bull., vol. 18, p. 420.
1892. *Dentalium leptum* Bush. Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 440.
1897. *Dentalium eboreum* Conrad. Pilsbry and Sharp, Manual of Conchology, vol. 17, p. 89, pl. 16, figs. 47-49, 55, 56.
1897. *Dentalium leptum* Bush. Pilsbry and Sharp, Manual of Conchology, vol. 17, p. 89, pl. 16, fig. 50.
1897. *Dentalium matara* Dall. Pilsbry and Sharp, Manual of Conchology, vol. 17, p. 105, pl. 18, figs. 14-18.
1920. *Dentalium (Graptacme) eboreum* Conrad. Henderson, U. S. Nat. Mus. Bull. 111, p. 66, pl. 10, figs. 3-5, 8, 9; pl. 11, fig. 6.

The shell is regularly, moderately curved, slender, thin but strong, with a long, slightly arched tip. The color is a salmon pink, sometimes yellowish, generally fading to white, first on the anterior portion, then finally over the entire shell in all but fresh specimens. The surface is highly polished, shining and vitreous, though often variegated with milky, less translucent patches. The sculpture is confined to the tip only and consists of about 20 very fine raised longitudinal lines, visible only under a lens; all the balance of the shell is perfectly smooth save for slight growth irregularities. There is a rather deep, narrow apical notch on the convex side. In old specimens where the tip has been lost a projecting thin sheath of the inner shell layer from the posterior aperture is frequently developed, and in this case the apical slit is preserved and reproduced in the protruding sheath, and it is sometimes even repeated, though in lesser degree, on the concave side as well. Average specimens measure—length, from 25 to 35 mm.; diameter, 2.5 mm.; with an arc of 2. An adult specimen of large size with tip intact would measure about—length, 62-65 mm.; diameter, 3 mm.; with an arc of 3.5 to 4.

The type of *Dentalium eboreum* is in the collection of the Philadelphia Academy of Sciences; topotypes in museum collection, Cat. No. 152957, U.S.N.M., are from Sarasota Pass, Florida.

The type of *Dentalium leptum*, Cat. No. 41562, U.S.N.M., are from off Hatteras, in 16 fathoms, from the U. S. B. F. Station 2276; bottom of gray sand and broken shells.

The type of *Dentalium matara*, Cat. No. 95363, U.S.N.M., off Cape Lookout, in 31 fathoms, bottom of black sand and broken shells, from the U. S. B. F. Station 2611.

In the National Museum collection are many lots from off Cape Hatteras, Beaufort, Cape Lookout, from the Florida east-coast region in shallow water, 6 to 49 fathoms; from the Florida Keys region, 18 to 50 fathoms; west coast of Florida shore stations to 111 fathoms; also from San Juan, Porto Rico, and Barbados.

A lot from Samana Bay, consisting mostly of fragments, are not typical, being more strongly curved.

Conrad's *Dentalium eboreum* seems to have been overlooked until redescribed by Pilsbry and Sharp in 1897. Conrad's speci-

mens showed no notch. We now know the absence of apical characters to be of frequent occurrence in many of the *Dentalia*. On account of its insufficient description, Miss Bush evidently discarded Conrad's species when determining the status of her own *D. leptum*.

Practically all large, fully adult or senile specimens lose the entire tip, leaving a perfectly smooth, highly polished sculptureless shell. This is Dall's *Dentalium matara*. I have only been willing to unite these three species after a most critical examination of many lots, and I do not believe them to be separable even subspecifically.—Henderson, 1920.

The species is well characterized by the exceedingly fine axial sculpture restricted to the posterior portion of the shell. *Dentalium chipolanum*, the only other Alum Bluff form in which the sculpture evanesces before reaching the aperture, is much larger and stouter and more coarsely sculptured.

It is difficult to discriminate the short lengths of the anterior portions of the tubes of *Dentalium eboeum, D. santarosanum* and *D. schumoi*. None of them are axially sculptured near the anterior extremity of the adult shell. In general, *Dentalium eboreum* is a thicker, less polished shell than either of the other two, *D. santarosanum* is less slender in outline than *D. schumoi*, but very thin, polished, and commonly with obscure growth wrinkles. *Dentalium schumoi* is exceedingly slender and needlelike, more minute than either of the other two and more highly polished.

D. eboreum has been recognized both in the Chipola and the Oak Grove but is not abundant in either formation.

Occurrence: Chipola formation, localities 2213^{p}, 7151^{r}; Oak Grove sand, locality 2646^{p}.

Subgenus EPISIPHON Pilsbry and Sharp

1897. *Episiphon* Pilsbry and Sharp, Manual of conchology, vol. 17, p. 117.

Type by subsequent designation (Suter, Manual of New Zealand Mollusca, p. 821, 1913): *Dentalium sowerbyi* Guilding. Recent from Cape Hatteras to the Gulf of Mexico and the West Indies, 8 to 124 fathoms (fide Johnson).

Small, very slender, rather straight shells, needle-shaped or truncated, slightly tapering, thin and fragile, glossy and smooth or at least without longitudinal sculpture; apex with a projecting pipe or a simple orifice; no slit, rarely a notch.

Inhabitants of moderately or very deep water in the Mediterranean, Atlantic, Gulf of Mexico, and Pacific.—Pilsbry and Sharp, 1897.

Dentalium (Episiphon) schumoi Pilsbry

1892. *Dentalium filum* Sowerby. Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 441 (in part).
Not *Dentalium filum* Sowerby, 1860.
1911. *Dentalium (Episiphon) schumoi* Pilsbry, Acad. Nat. Sci. Philadelphia Proc., p. 167, text fig. 5.
1925. *Dentalium (Episiphon) schumoi* Pilsbry. Woodring, Carnegie Inst. Washington Pub. 366, p. 203, pl. 27, figs. 21-23.

Shell small, slightly curved, excessively slender, the adults but slightly tapering, young shells acicular; rather thin; surface finely striated circularly, becoming on the posterior half strongly annulated by rather regularly spaced, close grooves, slightly oblique, and cutting the surface into narrow segments much as in *D. (Fustiaria) circinatum*. Tube strongly compressed laterally throughout; apex simple or with a short projecting pipe or tube.

Length 8.2, antero-posterior diameter at aperture 0.78, at apex 0.56 mm.; lateral diam. at aperture 0.6, at apex 0.46 mm. The specimen has evidently lost in length by breakage.

Bowden bed, not uncommon.

Strongly compressed laterally, and readily distinguished by the circular sculpture. It is named in honor of Mr. Silas L. Schumo, who collected the material.—Pilsbry, 1911.

Type locality: Bowden, Jamaica.

The characteristic annulations of the Florida and West Indian species and the conspicuous lateral compression are wanting on the recent *D. filum* of Sowerby, which is a very slender and fragile little tube, circular in cross section and smooth except for exceedingly faint growth lines. Sowerby's figured specimen, presumably the type, is from Gibralter. The recent Caribbean species, *D. sowerbyi* Guilding, is also similar to *D. schumoi* but less uniformly annulated posteriorly.

The small, highly polished *Dentalium schumoi* is far from rare in the Chipola fauna, and on a few of the specimens, the diagnostic pipe has been preserved. The species has not been reported from either of the other two Alum Bluff horizons.

Occurrence: Chipola formation, localities 10609^{r}, 7257^{r}, 2213^{a}, 2564^{p}, 3419^{p}, 7151^{c}.

Outside occurrence: Bowden formation of Jamaica.

Subgenus LAEVIDENTALIUM Cossmann

1888. *Laevidentalium* Cossmann, Catalogue illustré des Coquilles fossiles de l'Éocène des environs de Paris, fasc. 3, p. 11.
1897. *Laevidentalium* Cossmann, s. lat. Pilsbry and Sharp, Manual of conchology, vol. 17, p. 97.

Type by original designation: *Dentalium incertum* Deshayes. Calcaire grossier of the Paris Basin.

Cossmann cited as diagnostic characters of the subgenus the oval cross section of the shell, the absence of longitudinal sculpture, and the truncated, unnotched apical opening.

Pilsbry and Sharp extended the limits imposed by Cossmann to include some forms with a circular cross section and some notched at the apical opening.

Dentalium (Laevidentalium) santarosanum Maury

1873. *Dentalium Haytensis?* Gabb, Am. Philos. Soc. Trans., vol. 15, p. 244.
1897. *Dentalium haytense?* Gabb. Pilsbry and Sharp, Acad. Nat. Sci. Philadelphia Proc., p. 471, pl. 11, figs. 8, 9.
1910. *Dentalium santarosanum* Maury, Bull. Am. Paleontology, vol. 4, no. 21, p. 33, pl. 8, fig. 6.

Shell small, nearly straight, increasing very gradually in size, surface polished.—Gabb, 1873.

Type locality: Santo Domingo.

Known only by fragments, the largest of which is probably one-half the original length. These indicate an almost straight, rather rapidly tapering but slender shell, circular or nearly so in section, with smooth, polished surface; growth-wrinkles light, rather irregular, running somewhat obliquely around the tube; and there is an occasional constriction so slight as to be hardly mentionable. No trace of longitudinal sculpture. Shell moderately thick (as shown by the section, fig. 8), but becoming very thin at the aperture. Apex unknown.

Length of type (broken at both ends), 9.4 diam. at larger end 1.28 × 1.35, at smaller end 0.68 mm.—Pilsbry and Sharp, 1897.

Shell rather thin, small, so slightly curved as to appear at first sight straight; smooth; more or less shining; without sculpture; lines of growth very faintly visible, cross section of shell circular.

Length of largest specimen 7; greatest diameter 1.5 mm.

Oak Grove, Santa Rosa County, Fla.

Mr. Aldrich's collection.—Maury, 1910.

Rather abundant fragments have been found of a species that resembles *haytense* in the smooth, highly polished external surface, the very gradually tapering outline, circular or nearly circular cross section, and the somewhat oblique incremental striae. It also exhibits a feeble and obscure concentric undulation, due doubtless to irregularities of growth and suggested in the description of *haytense* by Pilsbry and Sharp. The fragment described by Miss Maury under the name of *santarosanum* seems to present no characters specifically distinct from those of the Haitian species.

Dentalium sanatarosanum is less minute and less slender than *Dentalium eboreum* and lacks the fine posterior annulation.

Occurrence: Chipola formation, localities, 10609[r], 2213[p], 2564[r], 3419[r]; Oak Grove sand, locality 2646[c].

Family SIPHONODENTALIIDAE
Genus CADULUS Philippi

1844. *Cadulus* Philippi, Enumeratio Molluscorum Siciliae, vol. 2, p. 209.

Type by monotypy: *Dentalium ovulum* Philippi. Recent in the Mediterranean.

Shell tubular, more or less inflated medially or anteriorly and contracted near the aperture. Maximum diameter may be sharply defined by the so-called cingulum. Outline somewhat arcuate, especially along the outer, convex, or ventral margin and toward the posterior extremity. External surface without color in the Recent shells, usually polished; smooth or faintly scratched incrementally. Posterior orifice simple or cut into 2 or 4 lobes. Anterior orifice circular, oval, or ovate, usually oblique to the axis.

The genotype and the other members of *Cadulus* s. s. are stout, bulging, cask-shaped little tubes, as the name *Cadulus* indicates. The restricted genus has been recognized in the mid-Americas but not in the Alum Bluff group of Florida.

The genus, though of more modern origin than *Dentalium* s. lat., is recorded in the Cretaceous. The Recent species number about 70 and are rather abundantly represented in the warmer waters.

Subgenus POLYSCHIDES Pilsbry and Sharp

1898. *Polyschides* Pilsbry and Sharp, Manual of conchology, vol. 17, p. 146.

Type by original designation: *Siphodentalium tetraschistum* Watson. Off Fernando Noronha in 25 fathoms (Challenger Expedition).

Shell inflated above the middle or not much bulging; apex cut into a number of lobes, generally four, by as many slits.—Pilsbry and Sharp, 1898.

Cadulus (Polyschides) lobion Gardner, n. sp.

Plate LXII, figure 21

1892. *Cadulus vicksburgensis* Meyer. Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 444 (partim).

Not *Cadulus vicksburgensis* Meyer, 1886.

Shell very small, rather thin, lustrous, the dorsal margin nearly straight medially and anteriorly, feebly arcuate posteriorly; the ventral margin more strongly arcuate, the maximum curvature a little in front of the middle. No defined cingulum. Posterior extremity 4-lobed, the nicks shallow and V-shaped, evenly scalloping the small circular aperture. Anterior extremity slightly compressed dorsoventrally, oblique, the dorsal margin produced slightly beyond the ventral.

Dimensions of holotype: Length, 4.8 millimeters; maximum diameter, 0.9 millimeters.

Holotype: U. S. Nat. Mus. No. 498411.

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

Cadulus lobion appears in many of the collections and check lists under the name of *Cadulus vicksburgensis* Meyer. In the Oligocene species the cingulum is much more sharply defined, and the posterior slits apparently deeper. The curvature of *C. lobion* is very gentle and uniform, more so than in either *C. vicksburgensis* or in the Oak Grove species *C. clarae*. In well-preserved material, *C. clarae* Maury may be discriminated not only by the cingulum but, more significantly, by the nondentate posterior opening.

Cadulus portoricensis Henderson is a somewhat similar shell and 4-lobed, but tapers more gradually than the Chipola species. *Cadulus tetrodon* Pilsbry and Sharp, Recent from Frying Pan Shoals to the Bahamas in 2 to 85 fathoms (fide Johnson), is also similar in form, but it is a thinner, more delicate shell than the Chipola species and apparently is more deeply dentate posteriorly. *Cadulus carolinensis* Bush, also 4-lobed posteriorly and common in the Recent seas from Hatteras to the Keys and the Gulf of Mexico in 3 to 63 fathoms, is larger and more bulging anteriorly.

Occurrence: Chipola formation, localities 10609[r], 7257[p], 2213[a], 2564[c], 3419[p], 7151[p], 2211[c].

Subgenus GADILA Gray

1847. *Gadila* Gray, Zool. Soc. London, Proc., pt. 15, p. 159.

Type by original designation: *Dentalium gadus* Montagu. "In many parts of the British Channel" (Montagu).

Gadila exhibits the toothlike outline of many of the species of *Polyschides,* but the margin of the apical orifice is simple and unslit.

Cadulus (Gadila) clarae Maury

Plate LXII, figure 20

1910. *Cadulus clarae* Maury, Bull. Am. Paleontology, vol. 4, no. 21, p. 33, pl. 8, fig. 7.

Shell slender, small, curved; cingulum more or less differentiated, varying with individuals; cross section of shell elliptical.

Length of shell 5; greatest diameter 1 mm.
Oak Grove, Florida.
Mr. Aldrich's collection.—Maury, 1910.

Shell small, smooth, highly polished, gently arched, feebly compressed dorsoventrally, moderately inflated, the cingulum rather well differentiated and placed a little in front of the median line. Tube very gradually tapering behind the cingulum until it approaches the posterior extremity, where both the contraction and the arching are higher. Anterior contraction gradual and not very great. Posterior orifice simple, circular in outline. Anterior, ovate and slightly oblique to the axis of the shell, the dorsal margin a little more produced than the ventral.

Dimensions of figured topotype: Height, 4.9 millimeters; maximum diameter, 0.9 millimeters; minimum diameter, 0.3 millimeters; maximum diameter of aperture, 0.7 millimeters; minimum diameter of aperture, 0.5 millimeters.

Figured topotype: U. S. Nat. Mus. No. 350513.

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

Cadulus clarae suggests the Vicksburg species *C. quadriturritus* Meyer, but it has a more pronounced cingulum and is more arculate posteriorly. The posterior orifice is apparently simple, for out of a very large number of species none has been observed which shows any trace of denticulation. *Cadulus lobion* from the same locality is much more slender and more attentuated posteriorly.

It is the only *Cadulus* reported from the Oak Grove sand and is restricted in its known distribution to that formation.

Occurrences: Oak grove sand, localities 2646^{pr}, 5632^{a}, 5631^{p}, 5633^{p}, 7054^{c}, 10659^{r}.

Cadulus (Gadila?) volvulus Gardner, n. sp.

Plate LXII, figure 22

1892. *Cadulus newtonensis* Meyer and Aldrich. Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, p. 444 (in part).

Not *Cadulus newtonensis* Meyer and Aldrich, 1886.

Shell small, slender, polished, well-rounded, less gently curved near the posterior end than medially or anteriorly. Inner surface almost straight except in the posterior third. Cingulum not defined. Anterior half of tube approximately uniform in diameter except for the dorsoventral compression near the aperture. Posterior orifice circular, the characters obscure, the margin possibly cut into four subequal, exceedingly shallow lobes. Margin of aperture very thin, nearly circular, set at a low angle to the axis of the shell, the dorsal surface a little more produced than the ventral.

Dimensions of holotype: Height, 8.6 millimeters; maximum diameter, 1.1 millimeters.

Holotype: U. S. Nat. Mus. No. 112754.

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

Cadulus volvulus runs rather consistently smaller than *C. jacksonensis* Meyer of the upper Eocene and is a little less compressed dorsoventrally. It may also be related to the Recent species *C. quadridentatus* Dall, which occurs in the North Atlantic in 2 to 52 fathoms from Cape Hatteras to the Florida Keys and the Gulf, but it is a little more slender, less compressed at the aperture, and less deeply or not at all dentate posteriorly. From the coexistent species *C. lobion* it is separated by its greater height, more slender outline, and more attenuated posterior portion. *C. spiniformis* is more attenuated posteriorly and has a better defined and more anterior equator.

Cadulus phenax Pilsbry and Sharp, from the Cercado formation of the Dominican Republic has a somewhat similar aspect, but it is smaller and more slender posteriorly. The apical extremity of *C. phenax* is simple, but on some specimens of *C. volvulus* it seems to be lobed. Unfortunately this characteristic part is commonly lost, and the apparent scalloping of the orifice may possibly be due to breakage.

A similar but not identical species was recorded by Mansfield in 1930 from the Choctawhatchee formation in the uppermost bed at Jackson Bluff, Leon County, Fla. Mansfield's specimens, which he calls *Cadulus* aff. *C. (Polyschides) quadridentatus* Dall, are distinctly dentate. One individual, however, which has an incomplete apical extremity, exhibits the oblique annulation of *Gadila (Gadilopsis)* Woodring. The same obscure striation seems to be developed fortuitously on the Chipola examples.

Cadulus volvulus may be referable to the subgenus *Platyschides* Henderson, 1920. The shallow apical slits separate *Platyschides* from *Polyschides,* a difference, apparently of degree rather than kind. The type of *Platyschides* is *grandis* Verrill, a northern species ranging from Georges Bank to Hatteras and reaching a length of 15 millimeters or more. The subgeneric groupings in the fossil species are far from satisfactory, for the character on which they are primarily based—the outline of the margin of the apical extremity—is commonly lost.

Occurrence: Chipola formation, localities 2213^{c}, 7183^{p}.

Section GADILOPSIS Woodring

1925. *Gadilopsis* Woodring, Carnegie Inst. Washington Pub. 366, p. 206.

Type by original designation: *Ditrupa dentalina* Guppy. Miocene of the Bowden beds, Jamaica.

Shell moderately small, very slender, needle-shaped, slightly swollen very near aperture; sculpture consisting of oblique growth rings on posterior part of shell; apical opening small, unslit.

The geologic history and present distribution of this section, as traced by Pilsbry and Sharp, seem to fully justify their suggestion that the group of *C. dentalinus* should probably form a separate section. The needle-shape, slight swelling very near the aperture, and sculpture separate *Gadilopsis* from *Gadila s. s.* The living species of sculptured *Gadilopsis* are confined to the West Indian and adjoining waters, the Pacific coast of Central America and Mexico, and the East Indies. Pilsbry and Sharp expand the group to include similarly shaped smooth species.—Woodring, 1925.

This mid-American group is apparently already established in the lower Miocene of Florida. The oblique annulation of the whorls seems, in the Alum Bluff species, to be a fortuitous character observed on several individuals but not all of any single species.

Cadulus (Gadila) spiniformis Gardner, n. sp.

Plate LXII, figure 19

Shell a smooth, highly polished, slender tube. Posterior half gently arcuate and tapering gradually to an exceedingly small, circular orifice. Anterior portion nearly straight, varying but slightly in diameter. Maximum diameter within the anterior sixth. Cingulum ill-defined. Shell rather abruptly but feebly constricted in front of the cingulum in a manner suggesting the attached end of some of the echinoid spines. Cross section of cingulum circular, very slightly compressed dorsoventrally on either side of the equator. Margin of aperture thin, broadly oval in outline. Posterior orifice circular, apparently nondentate.

Dimensions of holotype: Height, 8.5 millimeters; maximum diameter, 1.2 millimeters.

Holotype: U. S. Nat. Mus. No. 351645.

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

Cadulus spiniformis is the largest of any of the Alum Bluff species. It is nearest to *Cadulus volvulus* of the Chipola fauna, but is more attentuated posteriorly, less uniform in diameter, and has a better defined and more anterior equator. The species is restricted to the Shoal River formation and is, furthermore, the only determinable member of the genus at that horizon. *Cadulus abruptus* Meyer and Aldrich, so prolific at the Woods Bluff horizon, is similar in general contour, but larger and less slender posteriorly.

Cadulus blountensis Mansfield, from a slightly higher horizon on Vaughan Creek in Walton County, has a somewhat similar outline but lacks the cingulum. *Cadulus phenax* Pilsbry and Sharp from the Cercado formation of the Dominican Republic is relatively shorter and more gently curved posteriorly.

Occurrence: Shoal River formation, localities 3856^{r}, 2645^{r}, 3732^{r}, 3742^{p}, 5079^{r}, 9960^{r}.

ADDENDA TO STENOGLOSSA

ADDENDA TO STENOGLOSSA

Exceptionally well preserved shells of Shoal River age are exposed at Whites Creek on the Eucheeanna-Knox Hill road, 6.7 miles south of Argyle, Walton County, Fla. A large collection was sent in after the publication of the earlier parts of this Professional Paper. The species included in the addenda belong to families described in Part VI.

Family TEREBRIDAE

Terebra (Strioterebrum) psesta Gardner, n. sp.

Plate LII, figures ?33, 34

Shell slender, acutely tapering, the whorls tightly wound, minutely tabulated, the axial sculpture not sufficiently strong to break the even profile. Body whorl rather high for the genus, abruptly constricted into the short canal. Whorls 15 in the holotype, the initial turn apparently lost and the apical portion so worn that the line between the nuclear and postnuclear turns can not be traced. Nucleus certainly small, slender, and acutely tapering. Postnuclear whorls increasing in diameter slowly and with regularity. Sutures impressed. Presutural band occupying, with the sulcus, more than a third of the whorl; not conspicuously distinct; the sculpture on it similar in general pattern to that in front of the sulcus. Sulcus extremely shallow and relatively broad. Axial sculpture feeble and irregular; the ribs running about 19 on the early whorls of the holotype but increasing to 25 on the later, persistent to the posterior suture but more feeble on the band and nearly obsolete on the sulcus; the axials on the second figured specimen, little more than exaggerated resting stages. Spirals low and flat, 9 in front of the sulcus on the later whorls of the spire of the holotype, and 4, more obscure, lirae on the presutural band. Spirals on the base of the body and the canal finer and more closely spaced than on the medial portion of the body. Aperture broken in all specimens, probably rather narrow. Outer lip sharply constricted at the canal. Parietal wall thinly glazed, the wash not sufficient to entirely conceal the feeble sculpture. Margin of pillar twisted but no true fold developed. Anterior fasciole cut off from the base of the body by a smoothly concave area; the posterior margin of the fasciole sharply raised; the anterior, the continuation of the pillar margin; fasciole strongly corrugated by the incrementals and broadly notched at its extremity.

Dimensions of holotype: Height, 28.7 millimeters; diameter, 7 millimeters. Second figured specimen: Height, 30 millimeters; diameter, 6.9 millimeters.

Holotype: U. S. Nat. Mus. No. 497664; second figured specimen, U. S. Nat. Mus. No. 497665.

Type locality: No. 14436, gully south of the road and east of the bridge over Whites Creek on road from Eucheeanna to Knox Hill, 6.7 miles south of Argyle, 1.7 miles southeast of Eucheeanna, Walton County, Fla. Locality of second figured specimen: No. 10608, Whites Creek, half a mile below bridge on road between Eucheeanna and Knox Hill, 6.7 miles south of Argyle, Walton County, Fla.

Terebra psesta is another of a large group in the Whites Creek fauna which, though closely related to the Shell Bluff species, seem taxonomically distinct. In the relatively high whorls and in the characters of the aperture and anterior canal, pillar, and fasciole, *T. psesta* closely resembles *T. waltonensis* from Shell Bluff, and, less closely *T. gatunensis* Toula from the Isthmus of Panama. The sculpture pattern of the Whites Creek species, however, is more subdued in every detail than that of either *T. waltonensis* or *T. gatunensis*. This tendency toward an evanescent sculpture is indicated perhaps in the subspecies *T. waltonensis tribaka,* in which the spirals are almost obsolete although the axials are relatively strong and regular. It is possible that the shell represented in figure 33 should be referred to a distinct species. The sculpture, both axial and spiral is further reduced, and—probably a factor of greater importance—the apical angle is perceptibly smaller. However the group exhibits such a wide range of variation that the two forms from Whites Creek will be included under a single name until further material proves that more than one species is involved.

Occurrence: Shoal River formation, localities 14436^{r}, ?10608^{r}.

Family TURRITIDAE

Crassispira loxa Gardner, n. sp.

Plate LXII, figure 1

Shell large, not very heavy, the whorls compressed, and the spire acutely tapering. Body and canal more then half the height of the entire shell, rather strongly constricted at the base for a *Crassispira;* the anterior canal moderately long and broad. Apex decorticated and protoconch lost. At least 10 whorls in the

conch, the early whorls badly rubbed; the early as well as the later whorls of the spire minutely tabulated and trapezoidal in outline, differing from the later whorls in the stronger definition of the anal fasciole. Whorls obliquely rippled with rounded axials, strongly protractive and evenly alined at the sutures, the series performing a half turn in passing from the apex to the body; axials uniformly strong from the fasciole to the suture but obsolete on the fasciole and dying out on the base of the body. Spiral lirae low, flat, and worn-looking; 4 primaries on each of the later whorls of the spire and more than double that number on the body, a single intercalary faintly visible between each pair of primaries and similar threads closely spaced on the fasciole. Base of the body and the anterior fasciole girded with less feeble threadlets. Suture distinct, undulated by the axials of the preceding whorl, a well-defined cord outlining the narrow tabulation in front of the suture, and, on the final whorl, a feeble thread between the sutural cord and the suture. Aperture obliquely lobate, the outer lip broadly arcuate, broken, unfortunately, in the unique type; the scar of the anal notch U-shaped and set squarely on the anal fasciole. Inner wall of aperture thinly glazed. Pillar moderately long and straight, reinforced. Canal with parallel margins; obscurely notched at the extremity.

Dimensions of imperfect holotype: Height, 33 millimeters; diameter, 9.5 millimeters.

Holotype: U. S. Nat. Mus. No. 497671.

Type locality: No. 14436, gully south of the road and east of the bridge over Whites Creek on road from Eucheeanna to Knox Hill, 6.7 miles south of Argyle, 1.7 miles southeast of Eucheeanna, Walton County, Fla.

Crassispira loxa is remarkable for its compressed, evenly tapering spire and the oblique axial rippling that adorns it. The sculpture of most of the *Crassispira* is more decided and the axials are narrower, more elevated, and less strongly protractive than they are in *C. loxa*. Nothing closely comparable is known. The type is unique.

Occurrence: Shoal River formation, locality 14436[r].

Crassispira laurentii Gardner, n. sp.

Plate LV, figure 24

Shell of average dimensions for the group, moderately heavy, rather slender. Apex lost in the unique type. Remaining whorls 5; the body and anterior canal probably as high as half the entire shell when perfect. Sutural band and fasciole sharply defined, occupying on the early whorls more than half the entire volution; relatively narrower toward the aperture. Sculpture in front of the fasciole strongly reticulate, the protractive axials sharply elevated and uniformly strong from the fasciole to the anterior suture and, on the body, almost to the anterior sinus; increasing in number from slightly more than 20 on the earliest retained whorl to more than 30 on the body and the final whorl of the spire. Spirals flattened, 4 in front of the fasciole on the whorls of the spire, subnodular at the intersection with the axials and overridden by them; separated by narrower interspiral areas, with or without intercalated secondaries; number of lirae increased on the body whorl to about a dozen, those on the base of the body and the canal narrower and more widely spaced than those on the spire. Whorls narrowly tabulated. Sutural collar is smooth except for incrementals, exceedingly fine and obscure lirae, and the sharply elevated anterior cord. Fasciole concave, sharply delimited both anteriorly and posteriorly, threaded with 2 or 3 low lirae and deeply insinuated by a broad, U-shaped siphonal scar; axis of sinus slightly closer to the anterior than to the posterior margin of the fasciole. Body merging with no distinct break into the rather broad anterior canal. Aperture narrow, linear-lanceolate. Outer lip broken, doubtless feebly arcuate and apparently smooth within. Posterior commissure grooved, the shallow channel persistent within the aperture. Inner wall of aperture heavily glazed, the margin of the glaze sharp and extending in a broad curve from the commissure to the anterior fasciole; callus so thick that the sculpture is completely hidden. A narrow umbilical chink visible between the reverted callus and the anterior fasciole. Fasciole heavily corrugated by the incrementals, spirally lirate. Anterior extremity slightly damaged, but the shallow terminal notch traceable in the corrugations.

Dimensions of incomplete holotype: Height, 27 millimeters; maximum diameter, 8.5 millimeters.

Holotype: U. S. Nat. Mus. No. 497661.

Type locality: No. 9957, gully south of the road and east of the bridge over Whites Creek, on road from Eucheeanna to Knox Hill, 6.7 miles south of Argyle, 1.7 miles southeast of Eucheeanna, Walton County, Fla.

Crassispira laurentii is one of a small group of species that flourished in the Floridian and West Indian waters during the late lower and middle Miocene. The most closely related forms are perhaps *C. calligonoides* Gardner from the Shoal River, *C. blountensis* Mansfield from the slightly younger beds on Vaughan Creek in Walton County, and *C. consors* (Sowerby) of the West Indian and Gatun faunas. These species differ chiefly in outline and in the detail of the sculpture pattern. The type is unique.

Occurrence: Shoal River formation, locality 9957[r].

Clavatula gunteri Gardner, n. sp.

Plate LV, figure 25

Shell rather small, moderately heavy, the spire about double the height of the aperture, tapering rather rapidly to an acute apex. Whorls of conch a little less than 10, those of the protoconch 3. Apex badly rubbed; the initial turn of the protoconch minute and partially immersed, the two succeeding turns increasing rather rapidly in diameter; faint traces of an anterior keel and arcuate riblets on the final nuclear whorl. Early whorls of conch trapezoidal; the sutural collar not prominent; the axials relatively few and rippling. Adult axials narrow, strongly protractive, obtuse, increasing from less than 10 on the earliest conchal whorl to about 23 on the body; uniform in prominence between the fasciole and the anterior suture, irregular in spacing and elevation on the final half whorl; posterior termination of ribs at margin of fasciole abrupt. Spiral sculpture less prominent than the axial; spirals low, flattened lirae, restricted largely to the interaxial areas; 4 or 5 primaries on the whorls of the spire and about a dozen on the body; a secondary threadlet between the anterior pairs on the whorls of the spire and commonly with 2 or even 3 secondaries on the base of the body. Whorls narrowly tabulated in front of the impressed suture; the sutural collar well developed and distinct; the sutural cord rather broad with a few threadlets in front of it but none behind. Scar of anal opening strong and U-shaped, contained between the sutural cord and the terminals of the axials. Body short, rather abruptly constricted into the short broad canal. Aperture narrow, the margins nearly parallel. Outer lip dragged backward slightly on the preceding whorl and possibly subvaricose at certain stages; the notch for the protrusion of the eyestalks feebly indicated. Margin of labial callus sharp, reverted. No umbilical chink. Anterior fasciole rather narrow, lirate; the posterior margin of the fasciole forming one arm of the broad and rather deep, obliquely directed U-shaped terminal notch.

Dimensions of holotype: Height, 18.1 millimeters; diameter, 6.2 millimeters.

Holotype: U. S. Nat. Mus. No. 497662.

Type locality: No. 9957, gully south of the road and east of the bridge over Whites Creek, on road from Eucheeanna to Knox Hill, 6.7 miles south of Argyle, 1.7 miles southeast of Eucheeanna, Walton County, Fla.

I have the pleasure of naming the species in honour of Herman Gunter, State Geologist of Florida, to whom we are indebted for some of the best of our material from Whites Creek.

Clavatula gunteri is not far removed from *C. proebenina,* which is also from the Shoal River formation but comes from Shell Bluff, possibly a little lower in the section than the outcrop at Whites Creek. The Shell Bluff species is shorter and stouter, but perhaps the most obvious difference is in the axial ribbing. The axials in *C. proebenina* are distinctly broader and more widely spaced, running 15 to the body whorl in *C. proebenina* as compared to 23 in *C. gunteri.* The axials are more numerous, too, than in *C. ebenina* Dall, from the Caloosahatchee and Recent faunas, and the backward drag of the outer lip at the aperture is less pronounced than in the later species. The type is unique.

Occurrence: Shoal River formation, locality 9957r.

"Drillia" haraldi Gardner, n. sp.

Plate LXII, figures 2, 3

Shell small, slender, acutely tapering, the body approximately half as high as the entire shell. Whorls probably between 10 and 11 in all. Protoconch small and paucispiral, badly worn; probably similar to that of *"Drillia" centrodes* Gardner, which includes a broad flat initial turn and half of another, succeeded by a broadly inflated and axially ribbed whorl with spiral lirae on the final half turn. Whorls of conch slender, increasing slowly in diameter, and the shoulder becoming increasingly broader and well-defined. Axial sculpture moderately strong and regular on the early whorls, tending to become feeble and irregular on the later; the axials rounded and nearly vertical, evanescent posteriorly; 8 or 9 on the early whorls of the spire, more strongly protractive, more numerous and not continued behind the periphery on the later whorls. Spirals, like the axials, largely restricted to the area in front of the fasciole, equally low and flat on the costals and intercostals; three primary threadlets to each of the early whorls of the spire, the posterior outlining the shoulder, the middle and anterior evenly spaced between the shoulder and the anterior suture; a fourth primary lira coming into view behind the anterior suture on the final whorl of the spire, and 2 more added on the medial portion of the body; scarcely perceptible secondary threadlets intercalated between the primaries. Base of body finely threaded, separated from the closely lirate anterior canal by a slightly less crowded area. Shoulder closely appressed posteriorly, feebly concave on the later whorls, free from sculpture except for the U-shaped anal notch symmetrically disposed upon it and a few microscopically fine spiral scratches. Aperture obliquely lenticular, a little more than a third the height of the shell. Outer lip thin-edged, broadly arcuate and flaring forward, deeply notched for the extrusion of the siphonal fasciole, and nicked probably for the eyestalks. Inner wall of aperture rather abruptly constricted at the smoothly glazed base of the body. Anterior canal short, straight, open, obscurely emarginate terminally.

Dimensions of holotype: Height, 12.6 millimeters; maximum diameter, 4.3 millimeters.

695462—47—10

Holotype: U. S. Nat. Mus. No. 497670.

Type locality: No. 14436, gully south of the road and east of the bridge over Whites Creek, on road from Eucheeanna to Knox Hill, 6.7 miles south of Argyle, 1.7 miles southeast of Eucheeanna, Walton County, Fla. This collection was made by the Florida Geological Survey from the same locality as that indicated by No. 10603 of the U. S. Geological Survey.

I have the pleasure of naming this species in honor of Dr. Harald Rehder, the Acting Curator of Mollusca in the United States National Museum, upon whose generous and understanding assistance I can always rely.

"Drillia" haraldi is the possible descendant of the slightly older *"Drillia" centrodes* Gardner from Shell Bluff. The Shell Bluff species is less slender than *haraldi,* includes fewer whorls, commonly bears 2 instead of 3 primary lirae upon the medial portion of the shell and—possibly the most obvious distinction—is more definitely shouldered and is corded directly in front of the suture.

The type is unique.

Occurrence: Shoal River formation, locality 14436[r].

Agladrillia agla Gardner, n. sp.

Plate LV, figure 23

Shell small, shining, the body whorl about half as high as the entire shell, its diameter increased by the terminal varix. Spire acutely tapering, the apex lost. Protoconch not known. Remaining whorls of conch constricted and slightly concave at the fasciole, expanding in front of the fasciole with the axial ribbing. Axials pinched, protractive, uniform in strength from the fasciole to the anterior suture and to the base of the body, 12 or 13 on the earliest retained whorls, the number increasing to 15; a faint suggestion of axial noding also evident on the compressed sutural band of the later whorls. Spiral sculpture restricted to 3 or 4 barely perceptible scratches on the axially ribbed portion of the whorls of the spire and the medial portion of the body with a further irregular scratching on the fasciole and sutural band; the base of the body and the canal regularly grooved, the degree of incision increasing anteriorly. Sutural band compressed, the incrementals retractive and fairly strong. Fasciole together with the band occupying more than half the width on the adolescent shell but less than half on the later whorls; the fasciole slightly concave and scarred with the broad U-shaped growth lines which are symmetrically disposed upon it. Body abruptly constricted into the short, broad canal. Aperture moderately wide for the group, lobate. Outer lip broken at the lower margin, flaring forward in front of the fasciole, sharp-edged, smooth within. A small pad of callus directly in front of the commissure on the parietal wall; parietal and pillar callus heavy, the margin of the callus sharp. Canal short, defined by the constriction of the whorl and by the disappearance of the axial ribs. Anterior fasciole slightly swollen, finely lirate, broadly U-shaped terminally, the upper arm of the obliquely directed U-notch coincident with the posterior margin of the fasciole.

Dimensions of imperfect holotype: 16.3 millimeters; maximum diameter, 6.5 millimeters; diameter at right angles to maximum diameter, 5.0 millimeters.

Holotype: U. S. Nat. Mus. No. 497663.

Type locality: No. 14436, gully south of the road and east of the bridge over Whites Creek on road from Eucheeanna to Knox Hill, 6.7 miles south of Argyle, 1.7 miles southeast of Eucheeanna, Walton County, Fla.

Agladrillia agla differs from *A. empera* from the Shoal River formation at Shell Bluff in the less elevated, more strongly protractive, and less numerous axials and in the more feeble spirals.

We are indebted to Herman Gunter of the Florida State Geological Survey for this interesting specimen.

The type is unique.

Occurrence: Shoal River formation, locality 14436[r].

Family CANCELLARIDAE

Cancellaria eucheea Gardner, n. sp.

Plate LII, figure 43

Shell large for the group, squat in outline. Whorls broadly rounded, narrowly tabulate, rapidly enlarging; 6 in the unique type, the first whorl and a half included in the naticoid nucleus. Extreme tip possibly lost and the earliest remaining whorls rather badly rubbed. Both the axial and spiral sculpture probably initiated with the conch; sculpture on the whorls of the spire reticulate, the axials retractive, their outline less sharply defined than that of the 5 or 6 spirals that override them; interstices squarish and the intersections nodose. Body whorl inflated; axial ribbing stronger and more widely spaced relatively as well as absolutely, overridden by regularly spaced spiral fillets separated by interspaces of slightly more than their own width; a single secondary introduced midway between each pair of primaries; two finer lirae revolving on the narrow shoulder. Suture feebly channeled. Aperture auriculate, moderately broad. Outer lip expanding with the curvature of the whorl, thickened and lirate within; the lirae not produced within the throat; margin possibly crenate in the young. Body abruptly constricted at the base. Parietal wall heavily washed, the margin of the callus sharply defined; deposit especially heavy at the commissure, a ridge developed opposite the posterior of the labral lirae and produced far within the throat. Columellar folds strong, the posterior shelflike and nearly horizontal, the less prominent anterior fold probably parallel to it within the aperture but deflected slightly forward at

the mouth; an incipient tubercle on the margin of the pillar simulating a fold but probably not produced within the aperture. Anterior fasciole closely lirate, arching away from the margin of the pillar and so leaving an open umbilical chink between them.

Dimensions of holotype: Height, 33.5 millimeters; diameter, 21.5 millimeters.

Holotype: U. S. Nat. Mus. No. 497450.

Type locality: No. 14436, gully south of the road and east of the bridge over Whites Creek on road from Eucheeanna to Knox Hill, 6.7 miles south of Argyle, 1.7 miles southeast of Eucheeanna, Walton County, Fla. Collected by the Geological Survey of Florida and presented to the United States Geological Survey.

Cancellaria eucheea is double the size of *Cancellaria druidarum* Gardner, the species which superficially it resembles. The pillar of *druidarum,* however, is triplicate rather than biplicate. *Cancellaria cossmanni* Olsson from the Gatun of Costa Rica is a smaller shell of similar outline and with a biplicate pillar, but the axial ribbing, particularly on the spire, is more elevated and more widely spaced than it is in *C. eucheea* and there are no secondary spirals on the body. *Cancellaria alternata* Conrad from the Choptank of Maryland is rather more elevated relatively and the whorls are more inflated medially. The characters of the aperture and the pillar folding, however, are strikingly similar. The mid-Tertiary members of the group of *reticulata,* the genotype, seem to have been numerous and diversified and *C. eucheea* is possibly an offshoot from that group.

Occurrence: Shoal River formation, locality 14436[r].

Family MARGINELLIDAE

Marginella (Volvarina) eobella Gardner, n. sp.

Plate LV, figure 22

Shell of moderate dimensions for the genus, highly polished, unsculptured, ovate. Spire only about one-fifth the height of the entire shell; the apical angle obtuse and about 90 degrees. Whorls probably about 4, the outlines and the sutures obscured by the surface glaze. Body obtusely shouldered, tapering smoothly to the rather wide anterior extremity. Aperture narrow, oblique, the margins subparallel. Outer lip slightly inwarped medially after the manner of *M. bella* Conrad; feebly varicose, produced backward across the preceding whorl. Margin of the narrow terminal varix defined externally by a shallow groove that becomes obsolete with the flattening of the varix both posteriorly and anteriorly. A few incipient rugae on the inner margin of the varix but no defined serration. Inner wall of aperture without reinforcing callus. Pillar quadruplicate; the posterior of the 4 delicate folds about midway between the extremities of the aperture and, like the fold in front of it, not far from normal to the axis of the shell; the anterior pair of folds oblique and parallel to each other; the foremost of the folds marginal and twisted, fusing with the labral callus around the truncate anterior extremity.

Dimensions of holotype: Height, 11.9 millimeters; greatest diameter, 6.0 millimeters.

Holotype: U. S. Nat. Mus. No. 496284.

Type locality: No. 14436, gully south of the road and east of the bridge over Whites Creek, on road from Eucheeanna to Knox Hill, 6.7 miles south of Argyle, 1.7 miles southeast of Eucheeanna, Walton County, Fla.

Marginella eobella is larger than *M. bella* s. s. or than any of the Floridian subspecies, but it is allied with that group by the inward bend of the medial portion of the outer lip, the absence of wash on the parietal wall, and in the number and disposition of the slender pillar folds.

The type is unique.

Occurrence: Shoal River formation, locality 14436[r].

Family VOLUTIDAE

Caricella (Atraktus) florea Gardner, n. sp.

Plate LII, figure 31

Shell of moderate dimensions for the group but more than usually heavy. Probably slender, the anterior canal lost so that the relative proportions are not known. Apex eroded and characters obscured. Protoconch apparently coiled between 1½ and 2 times, the conch a little more than 4 times. Initial nuclear spur worn down, the succeeding whorl broadly rounded. First whorl of conch laterally compressed, the succeeding volutions obliquely flattened posteriorly, expanded slightly anteriorly; body obscurely shouldered, not inflated medially, probably produced into a fairly long and slender anterior canal. Much of the sculpture lost through abrasion. Axial sculpture strongest at the opening of the conch, the axials narrow, uniform in strength between the sutures, evanescent before the close of the final whorl of the spire. Spiral lirae fine, crowded, overriding the axials on the earliest whorls of the spire, feeble on the later whorls, and on the body restricted to the shoulder and the canal. Sutures distinct, impressed slightly. Aperture narrow, lenticular, the outer lip broadly arcuate. Body very slightly constricted, the inner wall of the aperture descending almost obliquely from the commissure to the anterior canal. Parietal wash thin, extending only a little beyond the terminations of the pillar folds. Plications 4, the two posterior set well back and nearly normal to the axis of the shell; third fold equal to and probably parallel with the two behind it within the aperture, but its extremity bent forward at the mouth; anterior fold decidedly more feeble than the 3 behind it and, at the mouth, more oblique. Outer surface of

canal finely and obscurely lirate. Other characteristic features lost.

Dimensions of incomplete holotype: Height, 42 millimeters; diameter, 21.5 millimeters.

Holotype: U. S. Nat. Mus. No. 497667.

Type locality: No. 14436, gully south of the road and east of the bridge over Whites Creek on road from Eucheeanna to Knox Hill, 6.7 miles south of Argyle, 1.7 miles southeast of Eucheeanna, Walton County, Fla.

The *Caricella* from Whites Creek may be closely related to *Caricella (Atraktus) pycnoplecta* described from Shell Bluff. The Shell Bluff species was described from an adolescent in an almost perfect state of preservation, so that the reticulate sculpture is excellently displayed. The weakness of the sculpture of the Whites Creek individual is exaggerated by abrasion. The relative proportions of the two species are probably similar, and the number and disposition of the columellar folds are identical. The species is known only from the holotype.

Occurrence: Shoal River formation, locality 14436[r].

Family MITRIDAE

Vexillum (Uromitra) triptum? Gardner

Plate LII, figure 32

A small delicate individual, more slender than the usual *V. triptum* from the Shoal River, was collected by Mr. Gunter, State Geologist of Florida, from Whites Creek, 6.7 miles south of Argyle, Walton County, and presented by him to the United States Geological Survey. It may represent a distinct species or subspecies, but the individual variation in *V. triptum* is great and the Whites Creek specimen is unique. The Whites Creek individual differs further in the lower and more closely spaced axials, the earlier evanescence of the axials, and the absence of a spiral sculpture. The degree of development of the spirals is a variable character throughout the species, but in the Shoal River individuals, even if absent upon the rest of the shell, they are almost always clearly present on the anterior fasciole. In the Whites Creek specimen, however, only the faintest trace of a liration on the fasciole can be detected.

Height of the figured specimen, 6.9 millimeters; diameter, 2.3 millimeters.

The figured specimen is U. S. Nat. Mus. No. 497666.

PLATES LII-LXII

PLATE LII

FIGURE 1. *Mitrella perfervida* (Dall) (p. 510). Apertural view of holotype (U. S. Nat. Mus. No. 107387), from Oak Grove, Okaloosa County, Fla.; height, 18.6 mm.; diameter, including terminal varix, 7.3 mm. (After Dall.)

FIGURE 2. *Mitrella phagon* Gardner, n. sp. (p. 507). Apertural view of holotype (U. S. Nat. Mus. No. 371836), from Oak Grove, Yellow River, Okaloosa County, Fla.; height, 8.3 mm.; maximum diameter, 3.8 mm.

FIGURE 3. *Mitrella trajectionis* (Maury) (p. 508). Apertural view of topotype? (U. S. Nat. Mus. No. 371864), from the Chipola River 1 mile below Baileys Ferry, Calhoun County, Fla; height, 6.4 mm.; maximum diameter, 2.5 mm.

FIGURE 4. *Mitrella dallina* Gardner, n. sp. (p. 509). Apertural view of holotype (U. S. Nat. Mus. No. 371837), from 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 6.0 mm.; maximum diameter, 2.3 mm.

FIGURE 5. *Mitrella alumen* Gardner, n. sp. (p. 508). Apertural view of holotype (U. S. Nat. Mus. No. 114218), from the lower bed at Alum Bluff, Liberty County, Fla.; height, 10.1 mm.; maximum diameter, 4.2 mm.

FIGURE 6. *Mitrella asema* Gardner, n. sp. (p. 509). Apertural view of holotype (U. S. Nat. Mus. No. 371834), from 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 11.0 mm.; maximum diameter, 4.0 mm.

FIGURE 7. *Mitrella ischna* Gardner, n. sp. (p. 511). Apertural view of holotype (U. S. Nat. Mus. No. 371832), from 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 15.5 mm.; maximum diameter, 5.6 mm.

FIGURE 8. *Mitrella ischna mitrodita* Gardner, n. subsp. (p. 512). Apertural view of holotype (U. S. Nat. Mus. No. 371833), from Tenmile Creek, Calhoun County, Fla.; height, 16.0 mm.; maximum diameter, 6.3 mm.

FIGURE 9. *Mitrella pedana* Gardner, n. sp. (p. 501). Apertural view of holotype (U. S. Nat. Mus. No. 371840), from the lower bed at Alum Bluff, Liberty County, Fla.; height, 4.7 mm.; maximum diameter, 2.0 mm.

FIGURE 10. *Mitrella sima* Gardner, n. sp. (p. 505). Apertural view of holotype (U. S. Nat. Mus. No. 371839), from 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 4.2 mm.; maximum diameter 1.8 mm.

FIGURE 11. *Mitrella belonis* Gardner, n. sp. (p. 506). Apertural view of holotype (U. S. Nat. Mus. No. 371838), from Boynton Landing, Choctawhatchee River, Washington County, Fla.; height, 6.3 mm.; maximum diameter, 2.5 mm.

FIGURE 12. *Mitrella blastos* Gardner, n. sp. (p. 506). Apertural view of holotype (U. S. Nat. Mus. No. 371865), from 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 5.0 mm.; maximum diameter, 2.5 mm.

FIGURE 13. *Strombina lampra* Gardner, n. sp. (p. 515). Apertural view of holotype (U. S. Nat. Mus. No. 371849), from 3½ miles southwest of De Funiak Springs, Walton County, Fla.; height, 8.7 mm.; maximum diameter, 4.0 mm.

FIGURES 14, 15. *Strombina lissa* Gardner, n. sp. (p. 514).

14. Apertural view of paratype (U. S. Nat. Mus. No. 371869), figured to show nuclear whorls, × 10.
15. Apertural view of holotype (U. S. Nat. Mus. No. 371869), from Shell Bluff, Shoal River, Walton County, Fla.; height, 10.8 mm.; maximum diameter, 5 mm.

FIGURE 16. *Strombina ceryx* Gardner, n. sp. (p. 515). Apertural view of holotype (U. S. Nat. Mus. No. 371850), from Shell Bluff, Shoal River, Walton County, Fla.; height, 8.5 mm.; maximum diameter, 4.3 mm.

FIGURE 17. *Mitrella juncea* Gardner, n. sp. (p. 502). Apertural view of holotype (U. S. Nat. Mus. No. 371842), from Shell Bluff, Shoal River, Walton County, Fla.; height, 6.0 mm.; maximum diameter, 2.1 mm.

FIGURE 18. *Mitrella oxia* Gardner, n. sp. (p. 507). Apertural view of holotype (U. S. Nat. Mus. No. 371835), from 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 7.2 mm.; maximum diameter, 3.0 mm.

FIGURE 19. *Mitrella oryzoides* Gardner, n. sp. (p. 504). Apertural view of holotype (U. S. Nat. Mus. No. 371845), from 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 3.8 mm.; maximum diameter, 1.5 mm.

FIGURE 20. *Mitrella mikra* Gardner, n. sp. (p. 503). Apertural view of holotype (U. S. Nat. Mus. 371846), from Oak Grove, Yellow River, Okaloosa County, Fla.; height, 3.5 mm.; maximum diameter, 1.7 mm.

FIGURE 21. *Mitrella perfervida megala* Gardner, n. subsp. (p. 511). Apertural view of holotype (U. S. Nat. Mus. No. 371881), from 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 22.8 mm.; maximum diameter, 10.8 mm.

FIGURE 22. *Mitrella nanna* Gardner, n. sp. (p. 505). Apertural view of holotype (U. S. Nat. Mus. No. 371847), from 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 4.0 mm.; maximum diameter, 1.6 mm.

FIGURE 23. *Mitrella stikta* Gardner, n. sp. (p. 505). Apertural view of holotype (U. S. Nat. Mus. No. 371841), from 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.; height 5.5 mm.; maximum diameter, 2.1 mm.

FIGURE 24. *Mitrella tytha* Gardner, n. sp. (p. 502). Apertural view of holotype (U. S. Nat. Mus. No. 371843), from one-half mile below Shell Bluff, Shoal River, Walton County, Fla.; height 5.0 mm.; maximum diameter, 2.0 mm.

FIGURE 25. *Mitrella photeina* Gardner, n. sp. (p. 503). Apertural view of holotype (U. S. Nat. Mus. No. 371844), from 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 5.5 mm.; maximum diameter, 2.1 mm.

FIGURES 26–28. *Strombina waltonia* Gardner, n. sp. (p. 513).

26. Apertural view of immature paratype (U. S. Nat. Mus. No. 371848), from Shell Bluff, Shoal River, Walton County, Fla.; height, 14.3 mm.; maximum diameter, 4.7 mm.
27. Rear view of incomplete holotype (U. S. Nat. Mus. No. 371848); height, 23 mm.; maximum diameter, 8.5 mm.
28. Apertural view of incomplete holotype.

FIGURE 29. *Strombina aldrichi* (Maury) (p. 514). Apertural view of incomplete specimen (U. S. Nat. Mus. No. 371883), from Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 16.5 mm.; maximum diameter, 5.7 mm.

FIGURE 30. *Strombina aldrichi nemoralis* (Maury) (p. 514). Apertural view of topotype (U. S. Nat. Mus. 371868), from Oak Grove, Okaloosa County, Fla.; height, 12.5 mm.; maximum diameter, 4.6 mm.

FIGURE 31. *Caricella (Atraktus) florea* Gardner, n. sp. (p. 637). Apertural view of incomplete holotype (U. S. Nat. Mus. No. 497667), from Whites Creek, 6.7 miles south of Argyle, Walton County, Fla.; height, 42 mm.; diameter, 21.5 mm.

FIGURE 32. *Vexillum (Uromitra) triptum*? Gardner (p. 638). Apertural view of specimen (U. S. Nat. Mus. No. 497666), from Whites Creek, 6.7 miles south of Argyle, Walton County, Fla.; height, 6.9 mm.; diameter, 2.3 mm.

FIGURE 33. *Terebra (Strioterebrum) psesta*? Gardner, n. sp. (p. 633). Apertural view of specimen (U. S. Nat. Mus. No. 497665), from Whites Creek, 6.7 miles south of Argyle, Walton County, Fla.; height, 30 mm.; diameter, 6.9 mm.

FIGURE 34. *Terebra (Strioterebrum) psesta* Gardner, n. sp. (p. 633). Apertural view of holotype (U. S. Nat. Mus. 497664), from Whites Creek, 6.7 miles south of Argyle, Walton County, Fla.; height, 28.7 mm.; diameter, 7 mm.

FIGURE 35. *Urosalpinx tribaka* Gardner, n. sp. (p. 531). Apertural view of paratype (U. S. Nat. Mus. No. 371857), from Shell Bluff, Shoal River, Walton County, Fla.; height, 10.9 mm.; diameter, 6.2 mm.

FIGURES 36, 37. *Urosalpinx phagon* Gardner, n. sp. (p. 530).

36. Apertural view of paratype (U. S. Nat. Mus. No. 371856), from Oak Grove, Okaloosa County, Fla.; height, 7.4 mm.; maximum diameter, 4.6 mm.
37. Apertural view of holotype (U. S. Nat. Mus. No. 371856), height, 16.5 mm.; maximum diameter, 9.2 mm.

FIGURE 38. *Strombina walli* Mansfield (p. 516). Apertural view of holotype (U. S. Nat. Mus. No. 352671), from flood wash, Caroni County, Montserrat Ward, 1 mile south of Brasso, Trinidad, British West Indies; height, 6 mm.; maximum diameter, 3.4 mm. (After Mansfield.)

FIGURE 39. *Paziella (Dallimurex) fusinoides* Gardner, n. sp. (p. 524). Apertural view of paratype (U. S. Nat. Mus. No. 371854), from 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 14 mm.; maximum diameter, 7.5 mm.

FIGURES 40, 41. *Muricopsis laccopoia* Gardner, n. sp. (p. 529).

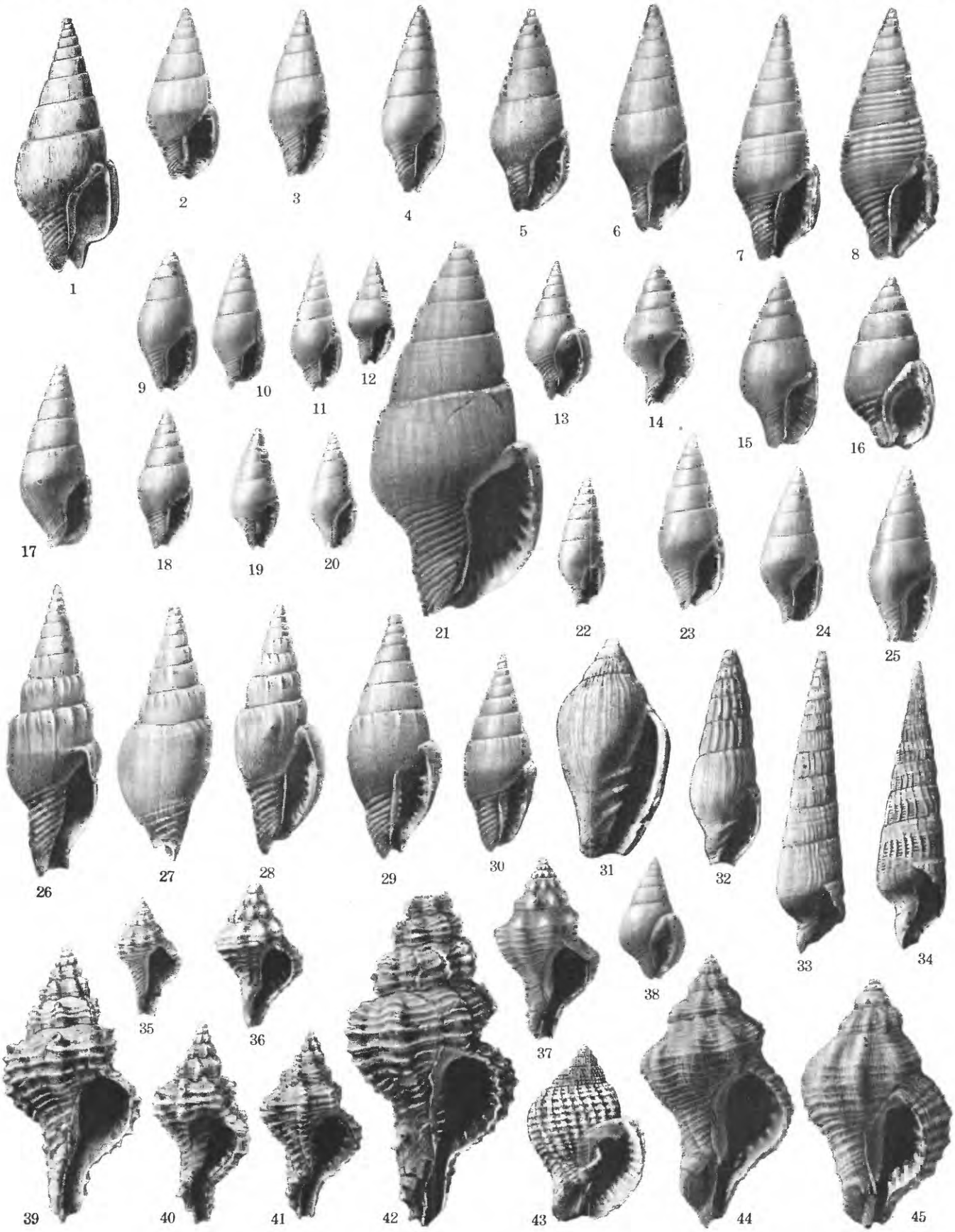
40. Apertural view of paratype (U. S. Nat. Mus. No. 371880), from 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 9.8 mm.; maximum diameter, 5.3 mm.
41. Apertural view of holotype (U. S. Nat. Mus. No. 371880); height, 18 mm.; maximum diameter, 9.8 mm.

FIGURE 42. *Paziella (Dallimurex) fusinoides* Gardner, n. sp. (p. 524). Apertural view of incomplete holotype (U. S. Nat. Mus. No. 371854), from 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 36.7 mm.; maximum diameter, 16.5 mm.

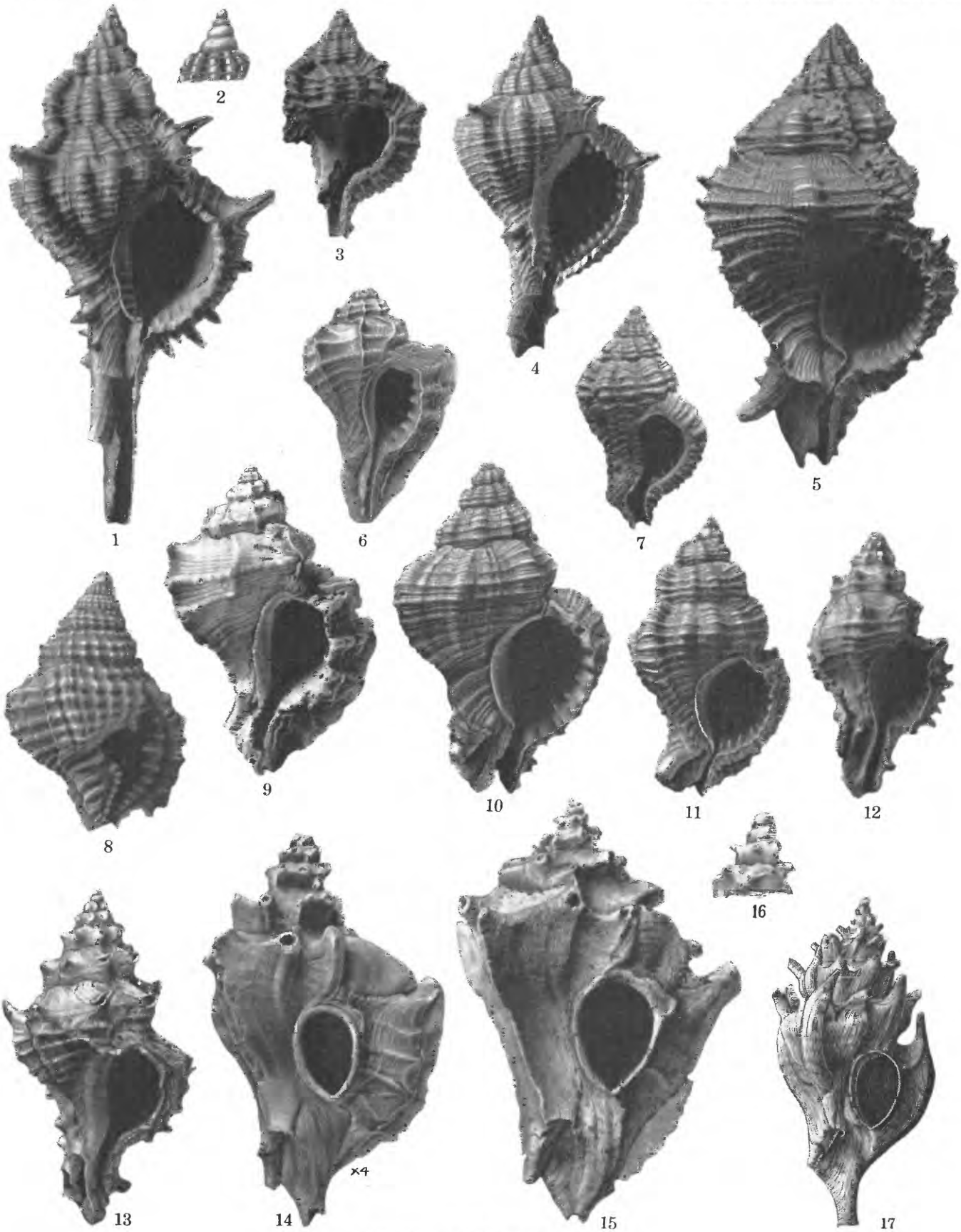
FIGURE 43. *Cancellaria eucheea* Gardner, n. sp. (p. 636). Apertural view of holotype (U. S. Nat. Mus. No. 497450), from Whites Creek, 6.7 miles south of Argyle, Walton County, Fla.; height, 33.5 mm.; maximum diameter, 21.5 mm.

FIGURE 44. *Urosalpinx xustris* Gardner, n. sp. (p. 531). Apertural view of holotype (U. S. Nat. Mus. No. 371858), from Oak Grove, Okaloosa County, Fla.; height, 25 mm.; maximum diameter, 14.5 mm.

FIGURE 45. *Ursalpinx tribaka* Gardner, n. sp. (p. 531). Apertural view of incomplete holotype (U. S. Nat. Mus. No. 371857), from Shell Bluff, Shoal River, Walton County, Fla.; height, 22.5 mm.; maximum diameter, 13.5 mm.



GASTROPODA OF ALUM BLUFF GROUP.



GASTROPODA OF ALUM BLUFF GROUP.

PLATE LIII

FIGURE 1, 2. *Murex (Murex) chipolanus* Dall (p. 517).
1. Apertural view of lectotype (U. S. Nat. Mus. No. 371885), from 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 49 mm.; diameter, including varices, 26 mm.
2. Tip of juvenile topotype (U. S. Nat. Mus. No. 371885), × 10.

FIGURE 3. *Murex (Murex) nicholsi* Gardner, n. sp. (p. 519). Apertural view of holotype (U. S. Nat. Mus. No. 371851), from 5 to 6 miles west-northwest of Mossyhead, Walton County, Fla.; height, 25 mm.; diameter, including varices, 14.5 mm.

FIGURE 4. *Murex (Murex) dasus* Gardner, n. sp. (p. 518). Apertural view of slightly imperfect holotype (U. S. Nat. Mus. No. 112057), from 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 33.4 mm.; diameter, including spines, 20.5 mm.

FIGURE 5. *Murex (Chicoreus) folidodes* Gardner, n. sp. (p. 520). Apertural view of holotype (U. S. Nat. Mus. No. 371852), from 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 43.3 mm.; diameter, including varices, 25 mm.

FIGURE 6. *Eupleura pterina* Gardner, n. sp. (p. 532). Apertural view of imperfect holotype (U. S. Nat. Mus. No. 371882), from 6 miles west-northwest of Mossyhead, Walton County, Fla.; height, 15.3 mm.; diameter, including varices, 9.6 mm.

FIGURE 7. Incertae sedis (p. 522). Apertural view of specimen (U. S. Nat. Mus. No. 371878), from the lower bed at Alum Bluff, Liberty County, Fla.; height, 14.5 mm.; diameter, including varices, 8.3 mm.

FIGURE 8. *Personella floridana* Gardner, n. sp. (p. 535). Apertural view of holotype (U. S. Nat. Mus. No. 371879), from Shell Bluff, Shoal River, Walton County, Fla.; height, 24 mm.; diameter, including varices, 17 mm.

FIGURE 9. *Pteropurpura dryas* Gardner, n. sp. (p. 525). Apertural view of holotype (U. S. Nat. Mus. No. 371855), from 100 yards below Oak Grove bridge, Oak Grove, Okaloosa County, Fla.; height, 29 mm.; diameter, including varices, 20 mm.

FIGURE 10. *Murex (Chicoreus?) pyknos* Gardner, n. sp. (p. 522). Apertural view of holotype (U. S. Nat. Mus. No. 115771), from 5 miles west of Mossyhead, Walton County, Fla.; height, 32 mm.; diameter, including varices, 20 8 mm.

FIGURE 11. *Murex (Chicoreus) aldrichi* Gardner, n. sp. (p. 521). Apertural view of holotype (Johns Hopkins Univ. collection), from Shell Bluff, Shoal River, Walton County, Fla.; height, 53.5 mm.; diameter, including varices, 31.5 mm.

FIGURES 12, 13. *Paziella (Dallimurex) lychnia* Gardner, n. sp. (p. 523). Holotype and paratype (U. S. Nat. Mus. No. 371853), from 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.
12. Apertural view of imperfect holotype; height, 25.5 mm.; diameter, including varices, 15 mm.
13. Apertural view of paratype; height, 16.9 mm.; diameter, including varices, 9.6 mm.

FIGURE 14. *Typhis (Talityphis) pterinus* Gardner (p. 528). Apertural view of holotype (U. S. Nat. Mus. No. 371860), from Shell Bluff, Shoal River, Walton County, Fla.; height, 20 mm.; diameter, including varices, 13 mm.

FIGURES 15, 16. *Typhis (Talityphis) alatus obesus* Gabb (p. 527).
15. Apertural view of specimen (U. S. Nat. Mus. No. 371859), from 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 21 mm.; diameter, including varices, 14 mm.
16. Tip of a second individual, also U. S. Nat. Mus. No. 371859, × 10.

FIGURE 17. *Typhis linguiferus* Dall (p. 527). Apertural view of holotype (U. S. Nat. Mus. No. 112183), from Tenmile Creek, Chipola River, Calhoun County, Fla.; height, 15 mm.; diameter, including varices, 7.2 mm. (After Dall.)

PLATE LIV

FIGURES 1–3. *Ficus eopapyratia* Gardner, n. sp. (p. 539).

1. Apertural view of holotype (U. S. Nat. Mus. No. 114097), from 1 mile west of Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 46.5 mm.; maximum diameter, 22.5 mm.
2. Early whorls of holotype.
3. Rear view of holotype.

FIGURES 4, 5. *Cypraea* (*Cypraeorbis*) *chilona* Dall (p. 541).

4. Apertural view of paratype (U. S. Nat. Mus. No. 497120), from the lower bed at Alum Bluff, Liberty County, Fla.; length, 51 mm. (After Dall.)
5. Dorsal view of lectotype (U. S. Nat. Mus. No. 498388), from the lower bed at Alum Bluff, Liberty County, Fla.; length, 45.0 mm.; lateral diameter, 36.5 mm. (After Dall.)

FIGURE 6. *Semicassis* (*Tylocassis*) *aldrichi* (Dall) (p. 536). Apertural view of holotype (U. S. Nat. Mus. No. 112207), from Tenmile Creek, Chipola River, Calhoun County, Fla.; height, 26.0 mm.; maximum diameter, 19.0 mm. (After Dall.)

FIGURES 7, 8. *Cypraea* (*Cypraeorbis*) *tapeina* Gardner, n. sp. (p. 541).

7. Apertural view of holotype (U. S. Nat. Mus. No. 497854), from Whites Creek, 6.7 miles south of Argyle, Walton County, Fla.; length, 33 mm.; lateral diameter, 24 mm.; dorsoventral diameter, 19 mm.
8. Apical view of holotype.

FIGURES 9, 10. *Trivia vaughani* Gardner, n. sp. (p. 542).

9. Apertural view of holotype (U. S. Nat. Mus. No. 371861), from Shell Bluff, Shoal River, Walton County, Fla.; length along axis, 8.0 mm.; dorsoventral diameter, 5.5 mm.
10. Dorsal view of holotype.

FIGURE 11. *Sconsia paralaevigata* Gardner, n. sp. (p. 537). Apertural view of holotype (U. S. Nat. Mus. No. 371888), from 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 36 mm.; maximum diameter, 25 mm.

FIGURES 12, 13. *Cypraea* (*Cypraeorbis*) *heilprinii* Dall (p. 540).

12. Apertural view of holotype (U. S. Nat. Mus. No. 114103), from Tenmile Creek, 1 mile west of Baileys Ferry, Chipola River, Calhoun County, Fla.; length along apertural axis, 29 mm.; dorsoventral diameter, 15 mm.
13. Dorsal view of holotype.

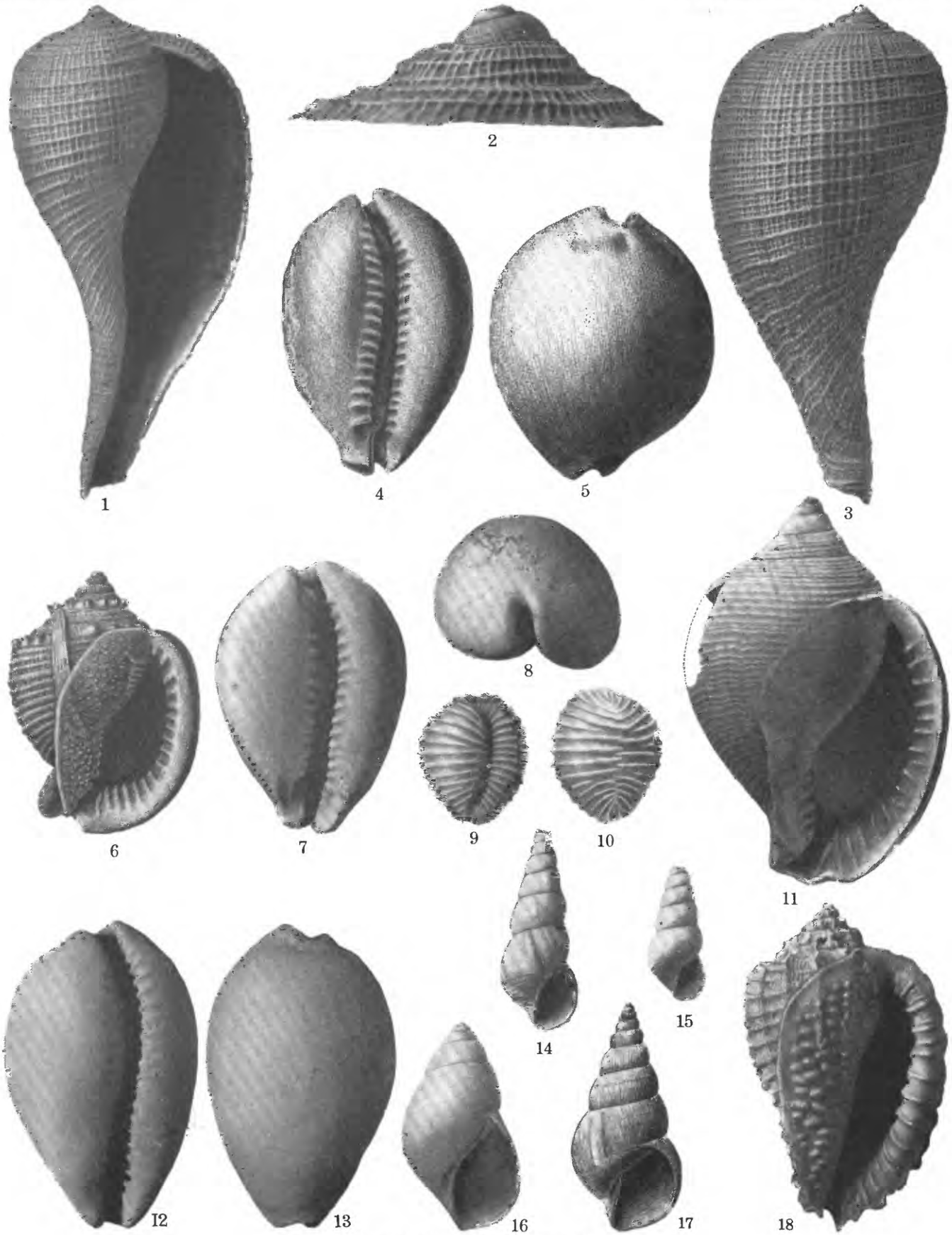
FIGURES 14, 15. *Alaba dodona* Gardner, n. sp. (p. 580).

14. Apertural view of holotype (U. S. Nat. Mus. No. 350405), from Oak Grove, Yellow River, Okaloosa County, Fla.; height, 4.5± mm.; maximum diameter, 1.4 mm.
15. Apertural view of incomplete paratype (U. S. Nat. Mus. No. 136045), from Oak Grove, Yellow River, Okaloosa County, Fla.; height, 2.6 mm.; maximum diameter, 1.2 mm.

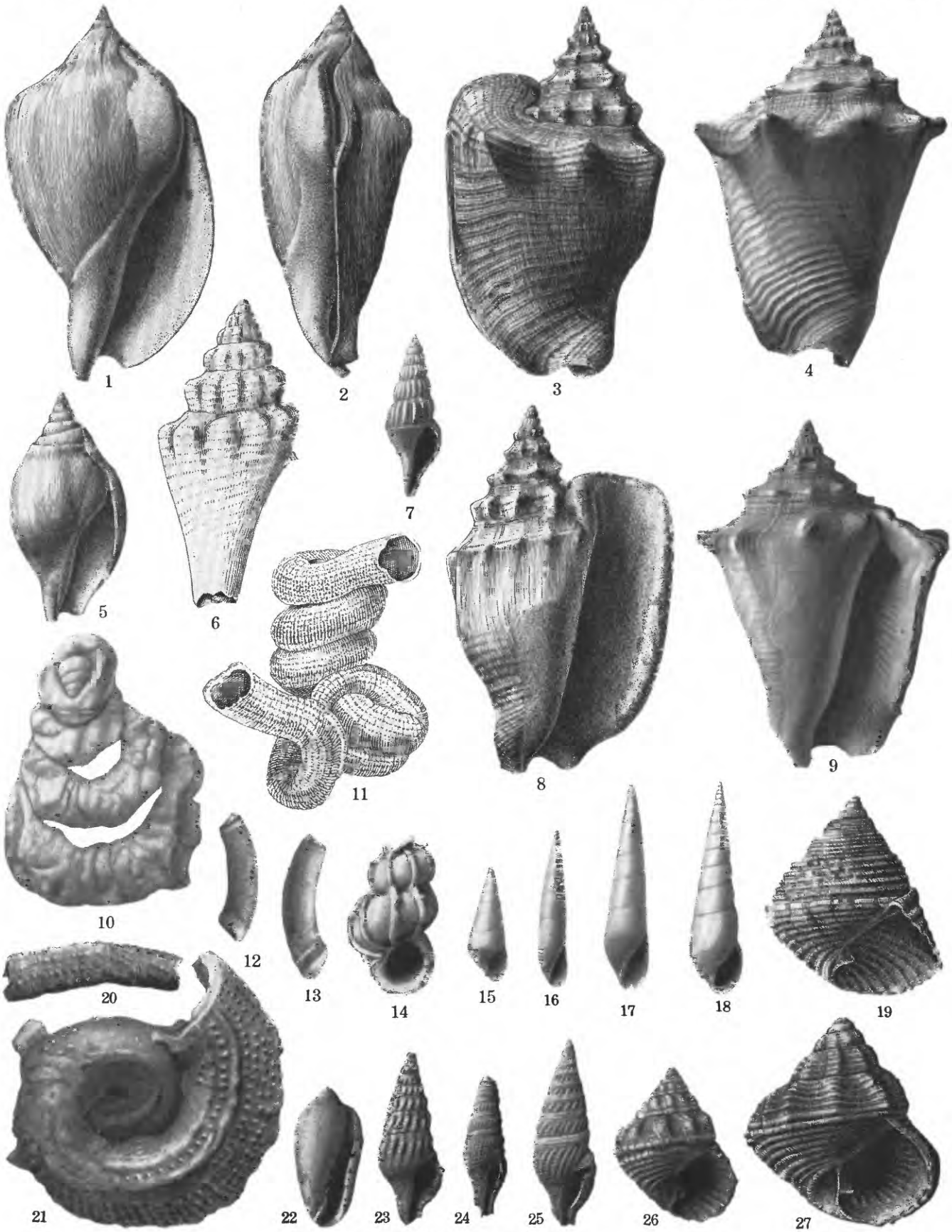
FIGURE 16. *Litiopa palaeosargassina* Maury (p. 579). Apertural view of topotype (U. S. Nat. Mus. No. 350402), from Oak Grove, Yellow River, Okaloosa County, Fla.; height, 3.8 mm.; maximum diameter, 2 mm.

FIGURE 17. *Alaba chipolana* Dall (p. 580). Apertural view of holotype (U. S. Nat. Mus. No. 113384), from 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 6.0 mm.; maximum diameter, 2.75 mm. (After Dall.)

FIGURE 18. *Morum* (*Oniscidia*) *chipolanum* (Dall ms.) Gardner, n. sp. (p. 538). Apertural view of holotype (U. S. Nat. Mus. No. 114095), from 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 32 mm.; maximum diameter, 20 mm.



GASTROPODA OF ALUM BLUFF GROUP.



GASTROPODA OF ALUM BLUFF GROUP.

PLATE LV

FIGURES 1, 2. *Orthaulax gabbi* Dall (p. 560).

1. Apertural view of cotype (U. S. Nat. Mus. No. 112218), from Tenmile Creek, 1 mile west of Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 65.5 mm.; maximum diameter, 35.0 mm. (After Dall.)
2. Profile of cotype shown in figure 1. (After Dall.)

FIGURE 3. *Strombus aldrichi* Dall (p. 558). Rear view of holotype (U. S. Nat. Mus. No. 112226), from Tenmile Creek, 1 mile west of Baileys Ferry, Chipola River, Calhoun County, Fla.; height 59 [62] mm.; maximum diameter, 36 mm. (After Dall.)

FIGURE 4. *Strombus dodoneus* Gardner, n. sp. (p. 559). Rear view of holotype (U. S. Nat. Mus. No. 350381), from Oak Grove, Okaloosa County, Fla.; height, 69 mm.; maximum diameter including tubercles, 51 mm.

FIGURE 5. *Orthaulax gabbi* Dall (p. 560). Apertural view of second cotype (U. S. Nat. Mus. No. 112218), from Tenmile Creek, 1 mile west of Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 35.7 mm.; maximum diameter, 17.5 mm. (After Dall.)

FIGURE 6. *Strombus chipolanus* Dall (p. 558). Incomplete specimen showing adolescent sculpture (U. S. Nat. Mus. No. 112224?), from Tenmile Creek, 1 mile west of Baileys Ferry, Chipola River, Calhoun County, Fla.; diameter, 22.0 mm. (After Dall.)

FIGURE 7. *Strombus dodoneus* Gardner, n. sp. (p. 559). Apertural view of juvenile paratype (U. S. Nat. Mus. No. 371867), from Oak Grove, Okaloosa County, Fla.; height, 9.7 mm.; diameter, 3.4 mm.

FIGURE 8. *Strombus aldrichi* Dall (p. 558). Apertural view of holotype shown in figure 3. (After Dall.)

FIGURE 9. *Strombus dodoneus* Gardner, n. sp. (p. 559). Apertural view of holotype shown in figure 4.

FIGURE 10. *Petalochonchus sculpturatus* H. C. Lea (p. 585). Early coils of specimen (U. S. Nat. Mus. No. 350411), from Oak Grove, Yellow River, Okaloosa County, Fla., × 15.

FIGURE 11. *Lemintina granifera* (Say) (p. 584). Holotype from "Maryland." (After Say.)

FIGURE 12. *Caecum pararegulare* Gardner, n. sp. (p. 583). Lateral view of holotype (U. S. Nat. Mus. No. 351485), from ¾ mile west of Shell Bluff, Shoal River, Walton County, Fla.; height, 2.3 mm.; maximum diameter, 0.6 mm.

FIGURE 13. *Caecum chipolanum* Gardner, n. sp. (p. 583). Lateral view of holotype (U. S. Nat. Mus. No. 329000), from 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 2.6 mm.; maximum diameter, 0.6 mm.

FIGURE 14. *Epitonium* (*Clathrus*) *alaçuaënse* Mansfield (p. 577). Apertural view of incomplete specimen (U. S. Nat. Mus. No. 498013), from 6.7 miles south of Argyle, Walton County, Fla.; height, 7 mm.; maximum diameter, 4 mm.

FIGURE 15. *Strombiformis* (*Polygireulima*) *defuniak* Gardner, n. sp. (p. 574). Apertural view of holotype (U. S. Nat. Mus. No. 498018), from 3½ miles southwest of De Funiak Springs, Walton County, Fla.; height, 4.5 mm.; maximum diameter, 1.6 mm.

FIGURE 16. *Strombiformis ischna* Gardner, n. sp. (p. 573). Apertural view of holotype (U. S. Nat. Mus. No. 498019), from one-half mile below Shell Bluff, Shoal River, Walton County, Fla.; height, 7.5 mm.; maximum diameter, 1.6 mm.

FIGURE 17. *Strombiformis scotti* (Maury) (p. 573). Apertural view of specimen (U. S. Nat. Mus. No. 498017), from 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 7.6 mm.; maximum diameter, 1.7 mm.

FIGURE 18. *Strombiformis* (*Polygireulima?*) *chipolana* (Maury) (p. 573). Apertural view of specimen (U. S. Nat. Mus. No. 498016), from 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 8 mm.; maximum diameter, 2 mm.

FIGURE 19. *Modulus willcoxii* Dall (p. 582). Apertural view of holotype (U. S. Nat. Mus. No. 113386), from Tenmile Creek, 1 mile west of Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 20 mm.; maximum diameter, 17.8 mm. (After Dall.)

FIGURE 20. *Lemintina papulosa* (Guppy) (p. 585). Tube (U. S. Nat. Mus. No. 498201), from Whites Creek, 6.7 miles south of Argyle, Walton County, Fla.; diameter of tube, 9 mm.

FIGURE 21. *Petaloconchus sculpturatus* H. C. Lea (p. 585). Holotype? (Acad. Nat. Sci. Philadelphia 1575), from Petersburg, Va., × 8.

FIGURE 22. *Marginella* (*Volvarina*) *eobella* Gardner, n. sp. (p. 637). Apertural view of holotype (U. S. Nat. Mus. No. 496284), from Whites Creek, 6.7 miles south of Argyle, Walton County, Fla.; height, 11.9 mm.; maximum diameter, 6.0 mm.

FIGURE 23. *Agladrillia agla* Gardner, n. sp. (p. 636). Apertural view of holotype (U. S. Nat. Mus. No. 497663), from Whites Creek, 6.7 miles south of Argyle, Walton County, Fla.; height, 16.3 mm.; maximum diameter, 6.5 mm.

FIGURE 24. *Crassispira laurentii* Gardner, n. sp. (p. 634). Apertural view of incomplete holotype (U. S. Nat. Mus. No. 497661), from Whites Creek, 6.7 miles south of Argyle, Walton County, Fla.; height, 27 mm.; maximum diameter, 8.5 mm.

FIGURE 25. *Clavatula gunteri* Gardner, n. sp. (p. 634). Apertural view of holotype (U. S. Nat. Mus. No. 497662), from Whites Creek, 6.7 miles south of Argyle, Walton County, Fla.; height, 18.1 mm.; maximum diameter, 6.2 mm.

FIGURE 26. *Modulus biconicus* Gardner, n. sp. (p. 581). Apertural view of holotype (U. S. Nat. Mus. No. 114117), from 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 9.5 mm.; maximum diameter, 7.8 mm.

FIGURE 27. *Modulus compactus* Dall (p. 581). Apertural view of holotype (U. S. Nat. Mus. No. 113387), from the lower bed at Alum Bluff, Liberty County, Fla.; height, 9.0 mm.; maximum diameter, 8.0 mm. (After Dall.)

PLATE LVI

FIGURES 1, 2. *Calyptraea crenata* Gardner, n. sp. (p. 562).
1. Dorsal view of holotype (U. S. Nat. Mus. No. 136053), from Oak Grove, Yellow River, Okaloosa County, Fla.; height, 6.5 mm.; maximum diameter, 14.8 mm.; diameter at right angles to maximum diameter, 13.7 mm.
2. Ventral view of holotype.

FIGURES 3–5. *Calyptraea centralis* (Conrad) (p. 562).
3. Lateral view of specimen in collection of Johns Hopkins University from St. Marys River, Md.; height, 10 mm.; diameter, 18 mm. (After Martin.)
4. Ventral view of specimen. (After Martin.)
5. Dorsal view of specimen. (After Martin.)

FIGURES 6, 7. *Crucibulum multilineatum* (Conrad) (p. 569).
6. Dorsal view of specimen in collection of Johns Hopkins University from Jones Wharf, St. Marys County, Md.; Choptank formation; height, 7 mm.; maximum diameter, 30 mm. (After Martin.)
7. Ventral view of specimen. (After Martin.)

FIGURES 8, 9. *Crucibulum constrictum* (Conrad) (p. 568).
8. Dorsal view of specimen (U. S. Nat. Mus. No. 325458) from Yorktown, Va.; height, 11.5 mm.; maximum diameter, 33 mm.
9. Ventral view of same specimen.

FIGURES 10, 11. *Crucibulum chipolanum* Dall (p. 567).
10. Lateral view of specimen (U. S. Nat. Mus. No. 112783), from Tenmile Creek, 1 mile west of Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 14.5 mm.; maximum diameter, 24.5 mm.
11. Ventral view of specimen shown in figure 10.

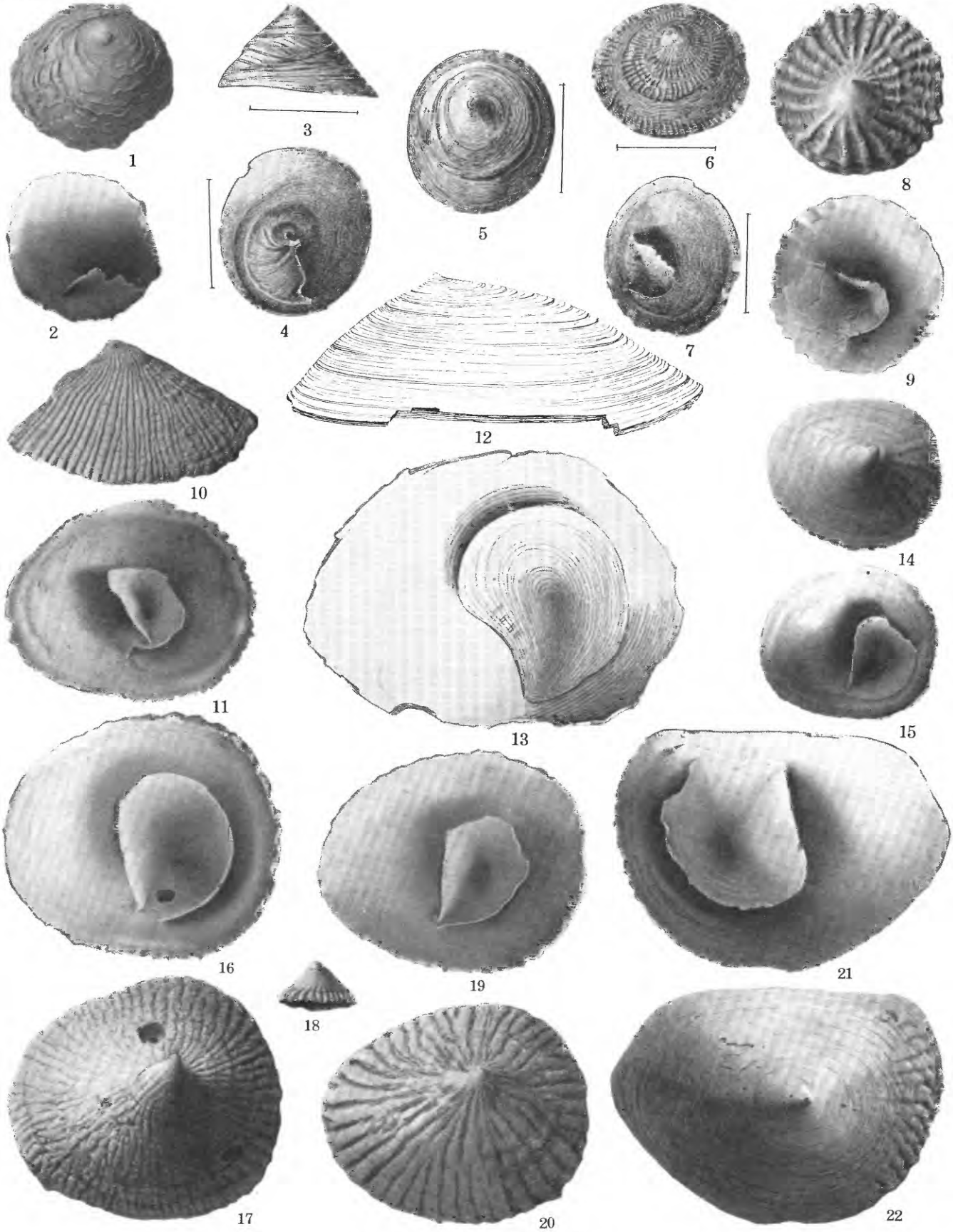
FIGURES 12, 13. *Crucibulum grande* (Say) (p. 569).
12. Lateral view of holotype, a×1(?). (After Say.)
13. Ventral view of holotype, a×1(?). (After Say.)

FIGURES 14, 15. *Crucibulum constrictum conjuge* Gardner, n. subsp. (p. 568).
14. Dorsal view of holotype (U. S. Nat. Mus. No. 371874), from near Shell Bluff, Shoal River, Walton County, Fla.; height, 9.2 mm.; maximum diameter, 16.7 mm.
15. Ventral view of holotype.

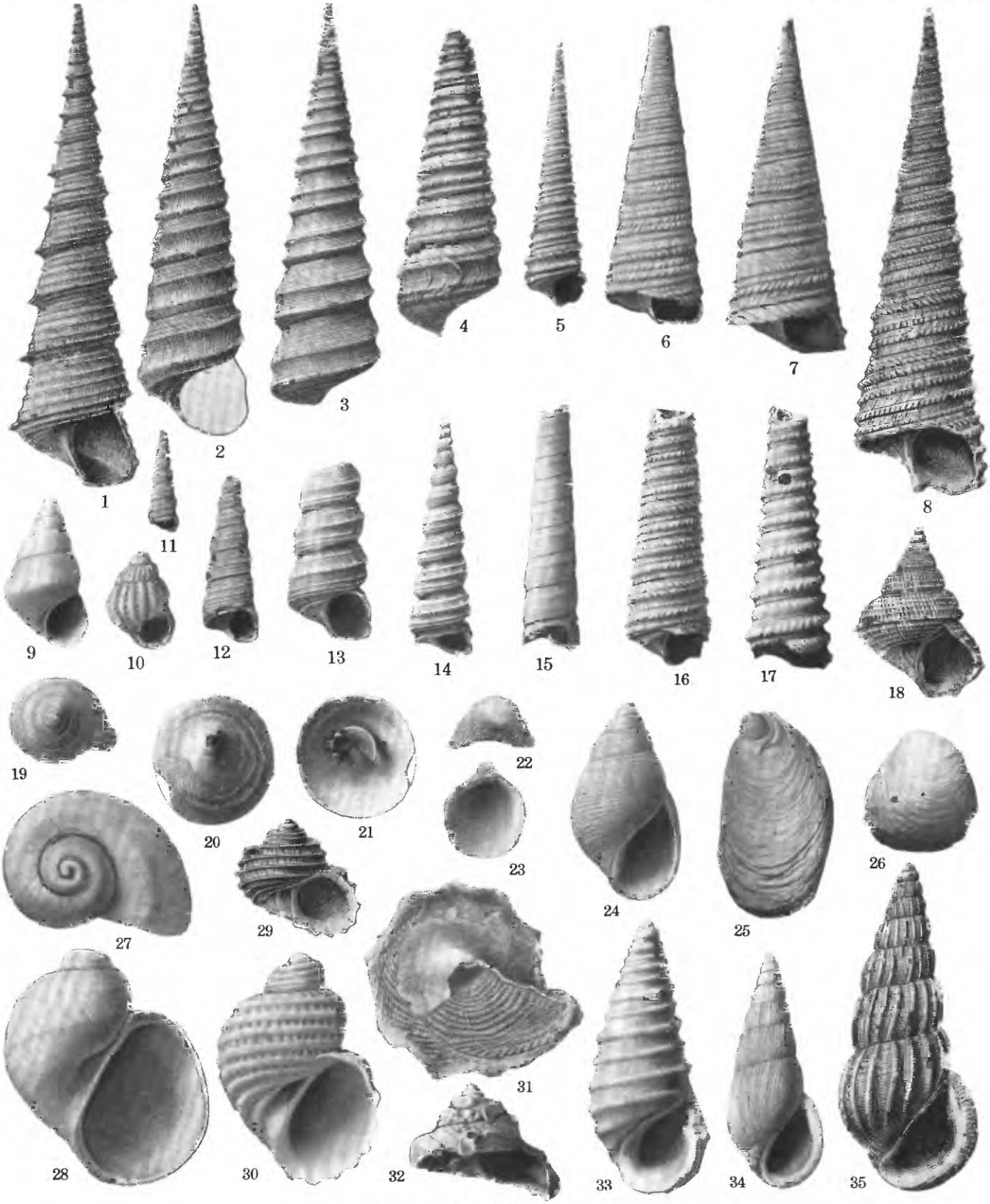
FIGURES 16, 17. *Crucibulum waltonense* Gardner, n. sp. (p. 568).
16. Ventral view of holotype (U. S. Nat. Mus. No. 371873), from Shell Bluff, Shoal River, Walton County, Fla.; height, 14 mm.; maximum diameter, 25.5 mm.
17. Dorsal view of holotype.

FIGURES 18–20. *Crucibulum chipolanum dodoneum* Gardner, n. subsp. (p. 567). Holotype and paratype (U. S. Nat. Mus. No. 350451), from Oak Grove, Yellow River, Okaloosa County, Fla.
18. Lateral view of juvenile paratype showing nuclear coil, ×4.
19. Ventral view of holotype; height, 13 mm.; maximum diameter, 25 mm.
20. Dorsal view of holotype.

FIGURES 21, 22. *Crucibulum constrictum* (Conrad) (p. 568).
21. Ventral view of specimen (U. S. Nat. Mus. No. 325459) from locality 1½ miles north of Suffolk, Va.; height, 27 mm.; maximum diameter, 64 mm.
22. Dorsal view of same specimen.



GASTROPODA OF ALUM BLUFF GROUP.



GASTROPODA OF ALUM BLUFF GROUP.

PLATE LVII

FIGURE 1. *Turritella subgrundifera* Dall (p. 590). Apertural view of holotype (U. S. Nat. Mus. No. 113440), from Tenmile Creek, 1 mile west of Baileys Ferry, Chipola River, Calhoun County, Fla.; height, in present state, 61 mm.; maximum diameter, 17 mm. (After Dall.)

FIGURE 2. *Turritella alcida* Dall (p. 591). Apertural view of holotype (U. S. Nat. Mus. No. 135054), from Oak Grove, Yellow River, Okaloosa County, Fla.; height (estimated), 85 mm.; maximum diameter, 21.5 mm. (After Dall.)

FIGURE 3. *Turritella alcida bicarinata* Gardner, n. subsp. (p. 592). Rear view of holotype (U. S. Nat. Mus. No. 350427), from Oak Grove, Yellow River, Okaloosa County, Fla.; height 73 mm.; maximum diameter, 19.5 mm.

FIGURES 4, 5. *Turritella (Torcula) dalli* Gardner, n. sp. (p. 594).

4. Rear view of incomplete holotype (U. S. Nat. Mus. No. 329008), from the lower bed at Alum Bluff, Liberty County, Fla.; height of incomplete specimen, 55.5 mm.; maximum diameter, 19.0 mm.
5. Apertural view of immature paratype (U. S. Nat. Mus. No. 329008); height, 47.5 mm.; maximum diameter, 11.0 mm.

FIGURE 6. *Turritella (Torcula?) jacula* Gardner, n. sp. (p. 596). Apertural view of imperfect holotype (U. S. Nat. Mus. No. 498021), from Whites Creek, 6.7 miles south of Argyle, Walton County, Fla.; height, 36 mm.; maximum diameter, 12 mm.

FIGURE 7. *Turritella (Torcula?) mixta* Dall (p. 596). Apertural view of incomplete topotype (U. S. Nat. Mus. No. 113476), from 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.; height of incomplete specimen, 62 mm.; maximum diameter, 22 mm.

FIGURE 8. *Turritella (Torcula?) chipolana* Dall (p. 597). Apertural view of holotype (U. S. Nat. Mus. No. 113442), from 1 mile west of Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 68 mm.; maximum diameter, 18 mm. (After Dall.)

FIGURE 9. *Syncera microgaza* Gardner, n. sp. (p. 602). Apertural view of holotype (U. S. Nat. Mus. No. 329042), from 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 3.0 mm.; diameter, 1.5 mm.

FIGURE 10. *Rissoa phagon* Gardner, n. sp. (p. 606). Apertural view of holotype (U. S. Nat. Mus. No. 136051), from Oak Grove, Yellow River, Okaloosa County, Fla.; height, 1.25 mm.; diameter, 0.9 mm.

FIGURES 11, 12. *Turritella gatunensis blountensis*? Mansfield (p. 592).

11. Apertural view of juvenile (U. S. Nat. Mus. No. 498024), from Whites Creek, 6.7 miles south of Argyle, Walton County, Fla.; height, 9.3 mm.; diameter, 2.8 mm.
12. Apertural view of older individual (U. S. Nat. Mus. No. 498024); height, 15.5 mm.; diameter, 5.1 mm.

FIGURES 13, 14. *Turritella segmenta* Gardner, n. sp. (p. 593).

13. Apertural view of three later whorls of incomplete cotype (U. S. Nat. Mus. No. 371863), from Shell Bluff, Shoal River, Walton County, Fla.; height, 16 mm.; diameter, 7.5 mm.
14. Apertural view of early and middle whorls of another incomplete cotype (possibly representing same individual as figure 13); height, 20.5 mm.; diameter, 5.7 mm.

FIGURE 15. *Turritella (Torcula?)* sp.(p. 595). Apertural view of incomplete specimen (U. S. Nat. Mus. No. 498025), from Whites Creek, 6.7 miles south of Argyle, Walton County, Fla.; height, 23 mm.; diameter, 5.6 mm.

FIGURE 16. *Turritella (Torcula) waltonensis* Gardner, n. sp. (p. 594). Apertural view of incomplete holotype (U. S. Nat. Mus. No. 371862), from Shell Bluff, Shoal River, Walton County, Fla.; height of incomplete shell, 46 mm.; diameter, 15.6 mm.

FIGURE 17. *Turritella (Torcula)* sp. cf. *T. (T.) altilira* Conrad (p. 595). Incomplete specimen (U. S. Nat. Mus. No. 498023), from Whites Creek, 6.7 miles south of Argyle, Walton County, Fla.; height, 24 mm.; diameter, 8 mm.

FIGURE 18. *Gegania acutissima* (Dall) (p. 579). Apertural view of holotype (U. S. Nat. Mus. No. 113472), from the lower bed at Alum Bluff, Liberty County, Fla.; height, 7.5 mm.; diameter, 5 mm. (After Dall.)

FIGURE 19. *Rissoa litiopaopsis* Gardner, n. sp. (p. 607). Apical view of holotype (U. S. Nat. Mus. No. 329036), from 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 3.4 mm.; diameter, 1.9 mm.

FIGURES 20, 21. *Cheilea dryas* (Dall ms.) Gardner, n. sp. (p. 570).

20. Dorsal view of holotype (U. S. Nat. Mus. No. 371877), from Shell Bluff, Shoal River, Walton County, Fla.; height, 6 mm.; maximum diameter along axis of shell, 11 mm.
21. Apertural view of holotype.

FIGURES 22, 23. *Capulus chipolanus* Gardner, n. sp. (p. 570).

22. Apical view of paratype (U. S. Nat. Mus. No. 329059), from 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 3.2 mm.; diameter, 2.6 mm.
23. Ventral view of holotype (U. S. Nat. Mus. No. 329059); height, 4.5 mm.; diameter, 3.7 mm.

FIGURE 24. *Rissoa litiopaopsis* Gardner, n. sp. (p. 607). Apertural view of holotype shown in figure 19.

FIGURE 25. *Crepidula plana* Say (p. 565). Dorsal view of specimen (U. S. Nat. Mus. No. 136061), from Oak Grove, Yellow River, Okaloosa County, Fla.; length, 37.5 mm.; width, 20.5 mm.

FIGURE 26. *Crepidula plana* Say? (p. 565). Dorsal view of specimen (U. S. Nat. Mus. No. 350470), from Oak Grove, Yellow River, Okaloosa County, Fla.; length (a warped individual), 22 mm.; width, 20 mm.; exterior, × 1.

FIGURES 27, 28. *Iselica psila* Gardner, n. sp. (p. 572).

27. Apical view of holotype (U. S. Nat. Mus. No. 329026), from 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 3.0 mm.; diameter, 2.5 mm.
28. Apertural view of holotype.

FIGURE 29. *Fossarus chipolanus* (Dall) (p. 571). Apertural view of holotype (U. S. Nat. Mus. No. 112660), from Tenmile Creek, 1 mile west of Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 2.25 mm.; diameter, 2.3 mm. (After Dall.)

FIGURE 30. *Fossarus florius* Gardner, n. sp. (p. 571). Apertural view of holotype (U. S. Nat. Mus. No. 371866), from Shell Bluff, Shoal River, Walton County, Fla.; height, 2.8 mm.; diameter, 2.0 mm.

FIGURES 31, 32. *Xenophora textilina* Dall (p. 561).

31. Basal view of larger of two cotypes (U. S. Nat. Mus. No. 112831), from 1 mile below Baileys Ferry, Chipola River, Calhoun, County, Fla.; maximum diameter, 41 mm.
32. Apertural view of smaller cotype; height, 20 mm.; maximum diameter, 25 mm.

FIGURE 33. *Rissoina vittata* Gardner, n. sp. (p. 605). Apertural view of holotype (U. S. Nat. Mus. No. 114359), from the lower bed at Alum Bluff, Liberty County, Fla.; height, 3.6 mm.; diameter, 1.5 mm.

FIGURE 34. *Rissoina (Mirarissoina) juncea* Gardner, n. sp. (p. 603). Apertural view of holotype (U. S. Nat. Mus. No. 329041), from 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 3.1 mm.; diameter, 1.2 mm.

FIGURE 35. *Rissoina (Zebinella) chipolana* Dall, n. sp. (p. 604). Apertural view of holotype (U. S. Nat. Mus. No. 113582), from 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 6 mm.; diameter, 2.5 mm. (After Dall.)

PLATE LVIII

FIGURES 1, 2. *Architectonica chipolana* (Dall) (p. 587).

1. Apertural view of holotype (U. S. Nat. Mus. No. 329031), from 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 7.5 mm.; diameter, 1.5 mm.
2. Basal view of holotype.

FIGURES 3–5. *Architectonica verecunda* Gardner (p. 589).

3. Apertural view of holotype (U. S. Nat. Mus. No. 352117), from 3½ miles southwest of De Funiak Springs, Walton County, Fla.; height, 4 mm.; maximum diameter, 6.5 mm.
4. Apical view of holotype.
5. Basal view of holotype.

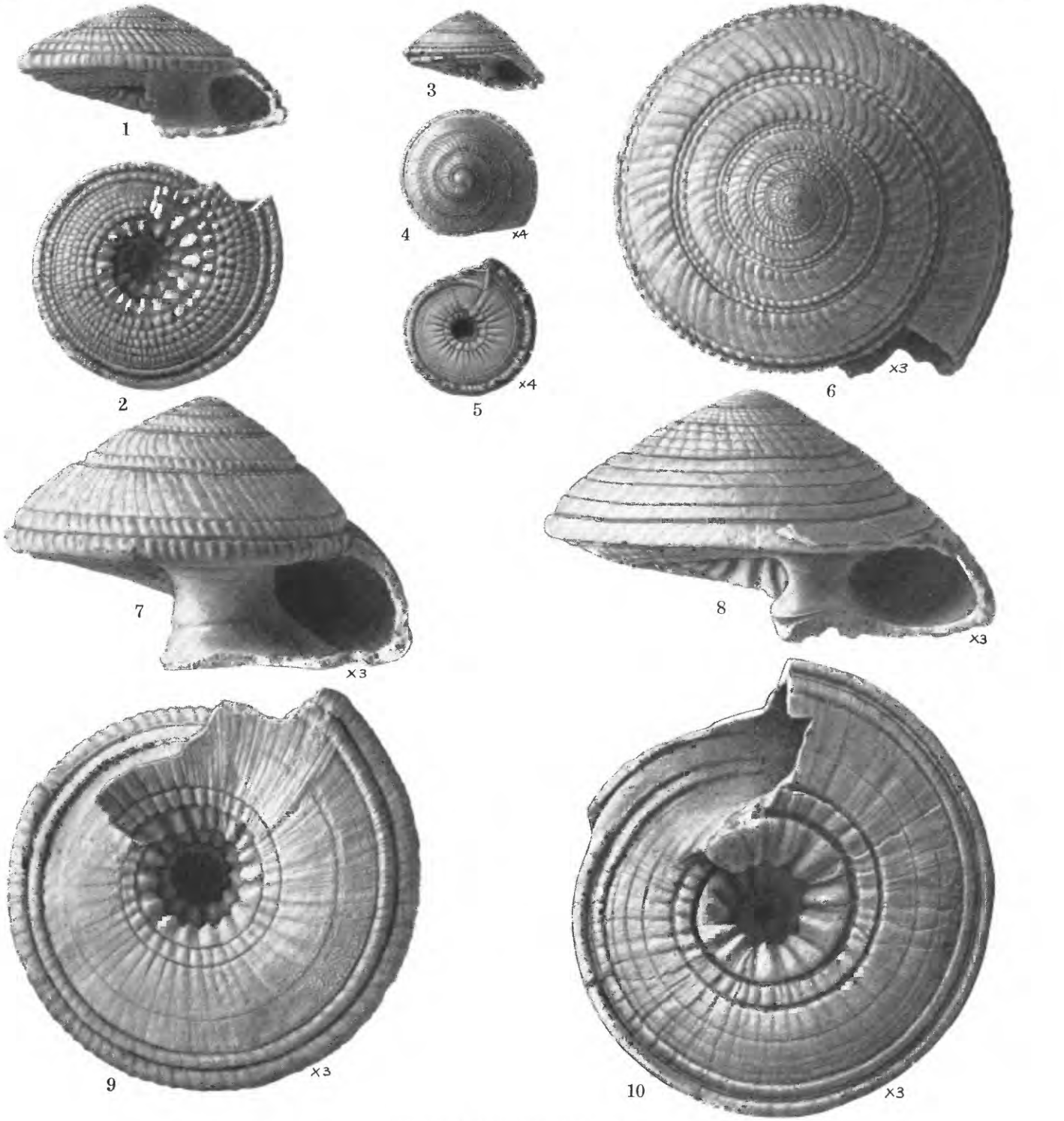
FIGURES 6, 7. *Architectonica alvear* Gardner (p. 588).

6. Apical view of holotype (U. S. Nat. Mus. No. 350446), from Oak Grove, Yellow River, Okaloosa County, Fla.; height, 17 mm.; maximum diameter, 25 mm.
7. Apertural view of holotype.

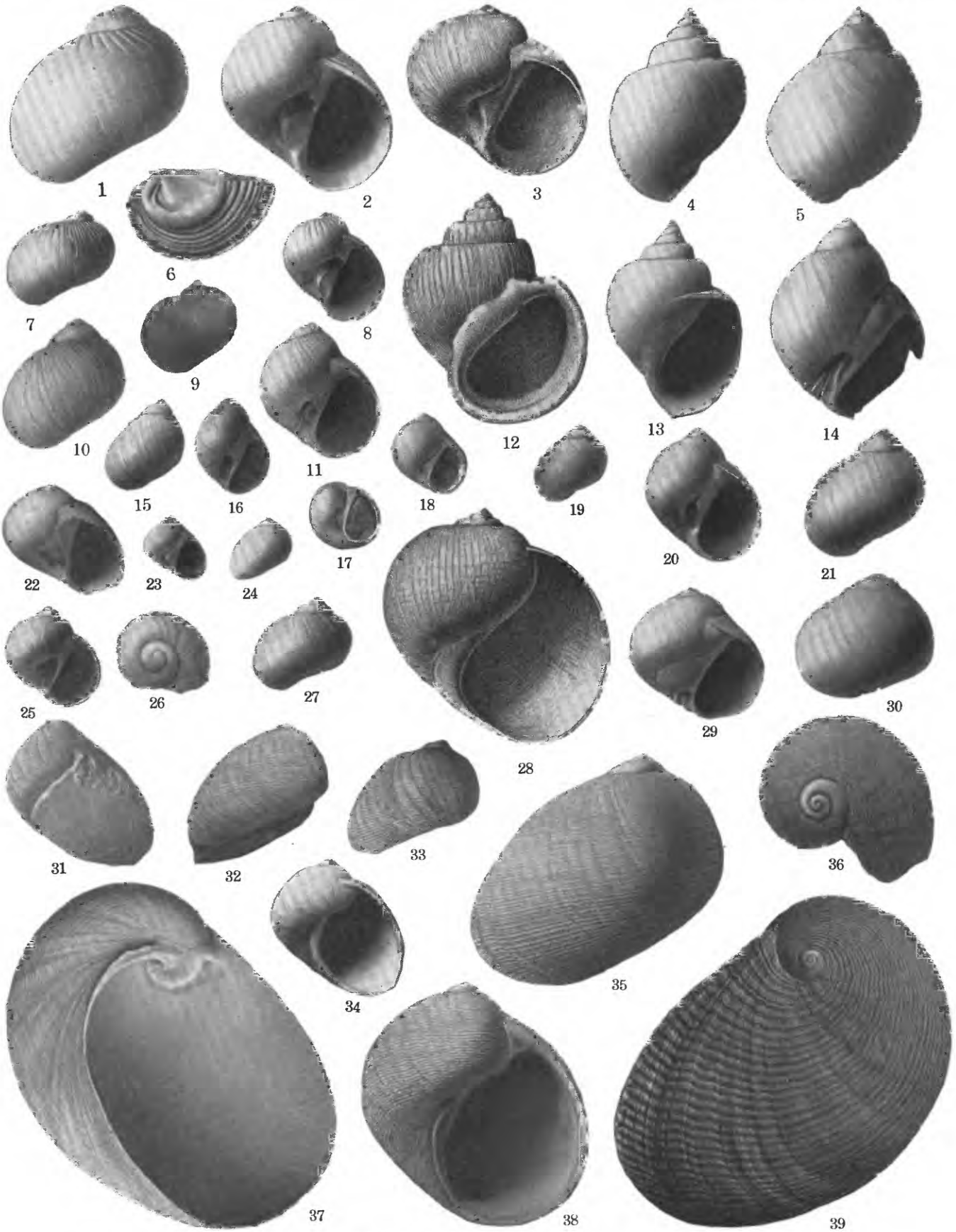
FIGURE 8. *Architectonica quadriseriata waltonensis* Gardner (p. 588). Apertural view of holotype (U. S. Nat. Mus. No. 351515), from Shell Bluff, Shoal River, Walton County, Fla.; height, 14 mm.; maximum diameter, 26 mm.

FIGURE 9. *Architectonica alvear* Gardner (p. 588). Basal view of holotype shown in figures 6 and 7.

FIGURE 10. *Architectonica quadriseriata waltonensis* Gardner (p. 588). Basal view of holotype shown in figure 8.



GASTROPODA OF ALUM BLUFF GROUP.



GASTROPODA OF ALUM BLUFF GROUP.

PLATE LIX

FIGURES 1, 2. *Natica (Naticarius) precursor* Gardner, n. sp. (p. 545).
1. Rear view of holotype (U. S. Nat. Mus. No. 329061), from 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 11.5 mm.; maximum diameter, 10 mm.
2. Apertural view of holotype.

FIGURE 3. *Natica (Natica) alticallosa* Dall (p. 545). Apertural view of holotype (U. S. Nat. Mus. No. 112841), from Tenmile Creek, 1 mile west of Baileys Ferry, Calhoun County, Fla.: height, 18 mm.; maximum diameter, 18 mm. (After Dall.)

FIGURE 4. *Pachycrommium dodonum* Gardner, n. sp. (p. 557). Rear view of holotype (U. S. Nat. Mus. No. 136073), from Oak Grove, Yellow River, Okaloosa County, Fla.; height, 37.5 mm.; diameter (outer lip lost), 25± mm.

FIGURE 5. *Polinices robustus* Gardner, n. sp. (p. 550). Rear view of holotype (U. S. Nat. Mus. No. 351586), from the first ravine below Shell Bluff, Shoal River, Walton County, Fla.; height, 39± mm.; diameter (outer lip lost), 29± mm.

FIGURE 6. *Natica (Naticarius) precursor* Gardner, n. sp. (p. 545). Outer surface of operculum (U. S. Nat. Mus. No. 329062), from 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla., ×3.

FIGURES 7, 8. *Natica (Stigmaulax) guppiana toulana* Gardner, n. subsp. (p. 547).
7. Rear view of holotype (U. S. Nat. Mus. No. 351564), from Shell Bluff, Shoal River, Walton County, Fla.; height, 20 mm.; maximum diameter, 20 mm.
8. Apertural view of holotype.

FIGURE 9. *Natica (Stigmaulax) guppiana* Toula (p. 546). Rear view of holotype, from the cut at the Gatun Locks, Panama Canal; height, 18 mm.; maximum diameter, 18 mm. (After Toula.)

FIGURES 10, 11. *Natica (Tectonatica) mino* Gardner, n. sp. (p. 547).
10. Rear view of holotype (U. S. Nat. Mus. No. 351571), from Shell Bluff, Shoal River, Walton County, Fla.; height, 6.4 mm; maximum diameter, 6 mm.
11. Apertural view of holotype.

FIGURE 12. *Pachycrommium burnsii* (Dall) (p. 557). Apertural view of holotype (U. S. Nat. Mus. No. 112954), from Tenmile Creek, Calhoun County, Fla.; height, 18 mm.; maximum diameter, 15 mm. (After Dall.)

FIGURE 13. *Pachycrommium dodonum* Gardner, n. sp. (p. 557). Apertural view of holotype shown in figure 4.

FIGURE 14. *Polinices robustus* Gardner, n. sp. (p. 550). Apertural view of holotype shown in figure 5.

FIGURES 15, 16. *Polinices judsoni* (Maury) (p. 549).
15. Rear view of specimen (U. S. Nat. Mus. No. 351575), from 6 miles west-northwest of Mossyhead, Walton County, Fla.; height, 18.3 mm.; maximum diameter, 13.5 mm.
16. Apertural view of same specimen.

FIGURES 17–19. *Natica (Tectonatica) semen* Gardner, n. sp. (p. 547). Holotype (U. S. Nat. Mus. No. 371876), from Oak Grove, Yellow River, Okaloosa County, Fla.; height, 2.6 mm.; maximum diameter, 2.4 mm.
17. View of holotype with operculum still in position.
18. Apertural view of holotype.
19. Rear view of holotype.

FIGURES 20, 21. *Polinices? demicryptus* Gardner, n. sp. (p. 550).
20. Apertural view of holotype (U. S. Nat. Mus. No. 112926), from Tenmile Creek, 1 mile west of Baileys Ferry, Calhoun County, Fla.; height, 7.5 mm.; maximum diameter, 6.0 mm.
21. Rear view of holotype.

FIGURE 22. *Polinices (Neverita) chipolanus* Dall (p. 551). Apertural view of holotype (U. S. Nat. Mus. No. 112870), from Tenmile Creek, Calhoun County, Fla.; height, 21.5 mm.; maximum diameter, 22 mm.

FIGURES 23, 24. *Natica (Tectonatica?) platabasis* Gardner, n. sp. (p. 548).
23. Apertural view of holotype (U. S. Nat. Mus. No. 371875), from 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 12.5 mm.; maximum diameter, 11.5 mm.
24. Rear view of holotype.

FIGURES 25–27. *Euspira rotunda* Gardner, n. sp. (p. 552).
25. Apertural view of holotype (U. S. Nat. Mus. No. 351597), from 6 miles west-northwest of Mossyhead, Walton County, Fla.; height, 9.5 mm.; maximum diameter, 9.0 mm.
26. Apical view of juvenile paratype (U. S. Nat. Mus. No. 497119), from 6 miles west-northwest of Mossyhead, Walton County, Fla., × 8.
27. Rear view of holotype.

FIGURE 28. *Globularia fischeri* (Dall) (p. 556). Apertural view of holotype (U. S. Nat. Mus. No. 112934?), from Tenmile Creek, Calhoun County, Fla.; height, 33 mm.; maximum diameter, 38 mm. (After Dall.)

FIGURES 29, 30. *Polinices (Neverita) eucallosus* Gardner, n. sp. (p. 551).
29. Apertural view of holotype (U. S. Nat. Mus. No. 350487), from Oak Grove, Okaloosa County, Fla.; height, 24.7 mm.; maximum diameter, 26.5 mm.
30. Rear view of holotype.

FIGURES 31, 32. *Sinum chipolanum* Dall (p. 553).
31. Apertural view of holotype (U. S. Nat. Mus. No. 112967), from 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 31 mm.; maximum diameter, 31 mm.
32. Rear view of holotype.

FIGURES 33, 34. *Sinum waltonense* Gardner?, n. sp. (p. 553).
33. Rear view of large adult (U. S. Nat. Mus. No. 498393), from Whites Creek, 6.7 miles south of Argyle, Walton County, Fla.; height, 27 mm.; maximum diameter, 27 mm.
34. Apertural view.

FIGURES 35, 36. *Sinum waltonense* Gardner, n. sp. (p. 553).
35. Rear view of holotype (U. S. Nat. Mus. No. 371887), from 6 miles west-northwest of Mossyhead, Walton County, Fla.; height, 15.5 mm.; maximum diameter, 13.5 mm.
36. Apical view of juvenile topotype (U. S. Nat. Mus. No. 371887), × 8.

FIGURE 37. *Sinum dodoneum* Gardner, n. sp. (p. 554). Apertural view of holotype (U. S. Nat. Mus. No. 136075), from Oak Grove, Okaloosa County, Fla.; height 7 mm.; maximum diameter, 23 mm.

FIGURE 38. *Sinum waltonense* Gardner, n. sp. (p. 553). Apertural view of holotype shown in figure 35.

FIGURE 39. *Sinum dodoneum* Gardner, n. sp. (p. 554). Rear view of holotype shown in figure 37.

695462—47——13

PLATE LX

FIGURE 1. *Sigatica euglypta* Gardner, n. sp. (p. 555). Apertural view of holotype (U. S. Nat. Mus. No. 371886), from Boynton Landing, Choctawhatchee River, Washington County, Fla.; height, 19.5 mm.; maximum diameter, 16.5 mm.

FIGURE 2. *Sigatica caractica* (Dall) (p. 555). Apertural view of holotype (U. S. Nat. Mus. No. 107379), from Oak Grove, Okaloosa County, Fla.; height, 8 mm.; maximum diameter, 6.6 mm. (After Dall.)

FIGURE 3. *Astraea dalli* (Maury) (p. 610). Apertural view of specimen (U. S. Nat. Mus. No. 112995), from 1 mile below Baileys Ferry, Calhoun County, Fla.; height, 3.8 mm.; maximum diameter, 5.7 mm.

FIGURE 4. *Chlorostoma (Omphalius) exolutum* (Conrad) (p. 616). Apertural view of specimen (U. S. Nat. Mus. No. 112572), from Ballast Point, Fla.; height, 12 mm.; maximum diameter, 13 mm. (After Dall.)

FIGURE 5. *Sigatica euglypta* Gardner, n. sp. (p. 555). Rear view of holotype shown in figure 1.

FIGURE 6. *Tricolia affinis chipolana* Gardner, n. subsp. (p. 609). Apertural view of holotype (U. S. Nat. Mus. No. 329107), from 1 mile below Baileys Ferry, Calhoun County, Fla.; height, 8.6 mm.; maximum diameter, 4.2 mm.

FIGURE 7. *Didianema? waltonia* Gardner, n. sp. (p. 613). Apertural view of holotype (U. S. Nat. Mus. No. 351638), from near Shell Bluff, Shoal River, Walton County, Fla.; height, 1.3 mm.; maximum diameter, 1.4 mm.

FIGURE 8. *Tricolia probrevis* Gardner, n. sp. (p. 609). Apertural view of holotype (U. S. Nat. Mus. No. 114434), from 1 mile below Baileys Ferry, Calhoun County, Fla.; height, 2.0 mm.; maximum diameter, 1.8 mm.

FIGURES 9, 10. *Chlorostoma (Omphalius) exolutum limatum* Dall (p. 617).

9. Apertural view of lectotype (U. S. Nat. Mus. No. 329112), from 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 5 mm.; maximum diameter, 7.3 mm.
10. Basal view of lectotype shown in figure 9.

FIGURE 11. *Astraea dalli* (Maury) (p. 610). Basal view of specimen shown in figure 3.

FIGURE 12. *Chlorostoma (Omphalius) exolutum* (Conrad) (p. 616). Basal view of specimen shown in figure 4. (After Dall.)

FIGURE 13. *Tricolia affinis chipolana* Gardner, n. subsp. (p. 609). Apertural view of paratype (U. S. Nat. Mus. No. 114369), from the lower bed at Alum Bluff, Liberty County, Fla.; height, 8.5 mm.; maximum diameter, 5.0 mm.

FIGURE 14. *"Vitrinella" excavata* Gardner, n. sp. (p. 598). Apertural view of holotype (U. S. Nat. Mus. No. 351628), from Shell Bluff, Shoal River, Walton County, Fla.; height, 1.1 mm.; maximum diameter, 3.0 mm.

FIGURES 15, 16. *Astraea (Lithopoma) chipolana* (Dall) (p. 611).

15. Outer surface of operculum (U. S. Nat. Mus. No. 114439), from the lower bed at Alum Bluff, Liberty County, Fla., × 4.
16. Surface of attachment of operculum shown in figure 15, × 4.

FIGURE 17. *"Vitrinella" waltonia* Gardner, n. sp. (p. 598). Apertural view of holotype (U. S. Nat. Mus. No. 351626), from Shell Bluff, Shoal River, Walton County, Fla.; height, 1.0 mm.; maximum diameter, 2.0 mm.

FIGURES 18–20. *"Vitrinella" seminola* Gardner, n. sp. (p. 597).

18. Apertural view of holotype (U. S. Nat. Mus. No. 351624), from Summerville mill, 1 mile east of Argyle, Walton County, Fla.; height, 1.5 mm.; maximum diameter, 2.7 mm.
19. Basal view of holotype.
20. Apical view of holotype.

FIGURE 21. *Calliostoma rhombotoide* Gardner, n. sp. (p. 619). Apical view of holotype (U. S. Nat. Mus. No. 498392), from Whites Creek, 6.7 miles south of Argyle, Walton County, Fla.; height, 3.8 mm.; maximum diameter, 3.5 mm.

FIGURE 22. *"Vitrinella" excavata* Gardner, n. sp. (p. 598). Basal view of holotype shown in figure 14.

FIGURES 23, 24. *"Vitrinella" waltonia* Gardner, n. sp. (p. 598).

23. Basal view of holotype shown in figure 17.
24. Apical view of holotype shown in figure 17.

FIGURE 25. *"Vitrinella" excavata* Gardner, n. sp. (p. 598). Apical view of holotype shown in figure 22.

FIGURES 26, 27. *Calliostoma rhombotoide* Gardner, n. sp. (p. 619).

26. Apertural view of holotype shown in figure 21.
27. Basal view of holotype shown in figure 21.

FIGURES 28, 29. *Solariella laqua* Mansfield (p. 621).

28. Apical view of specimen (U. S. Nat. Mus. No. 498394), from Whites Creek, 6.7 miles south of Argyle, Walton County, Fla.; height, 3.5 mm.; maximum diameter, 4.0 mm.
29. Apical view of specimen (U. S. Nat. Mus. No. 498395), from Whites Creek, 6.7 miles south of Argyle, Walton County, Fla.; height, 3.4 mm.; maximum diameter, 3.9 mm.

FIGURE 30. *Astraea (Lithopoma) chipolana* (Dall) (p. 611). Apertural view of holotype (U. S. Nat. Mus. No. 112994), from the lower bed at Alum Bluff, Liberty County, Fla.; height, 11.5 mm.; maximum diameter, 11.0 mm. (After Dall.)

FIGURE 31. *Solariella turritella* Dall (p. 621). Apertural view of holotype (U. S. Nat. Mus. No. 113081), from 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 5.6 mm.; maximum diameter, 6.0 mm. (After Dall.)

FIGURE 32. *Liotia (Arene) agenea* Dall (p. 612). Apertural view of holotype (U. S. Nat. Mus. No. 113091), from 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 2.0 mm.; maximum diameter, 2.5 mm. (After Dall.)

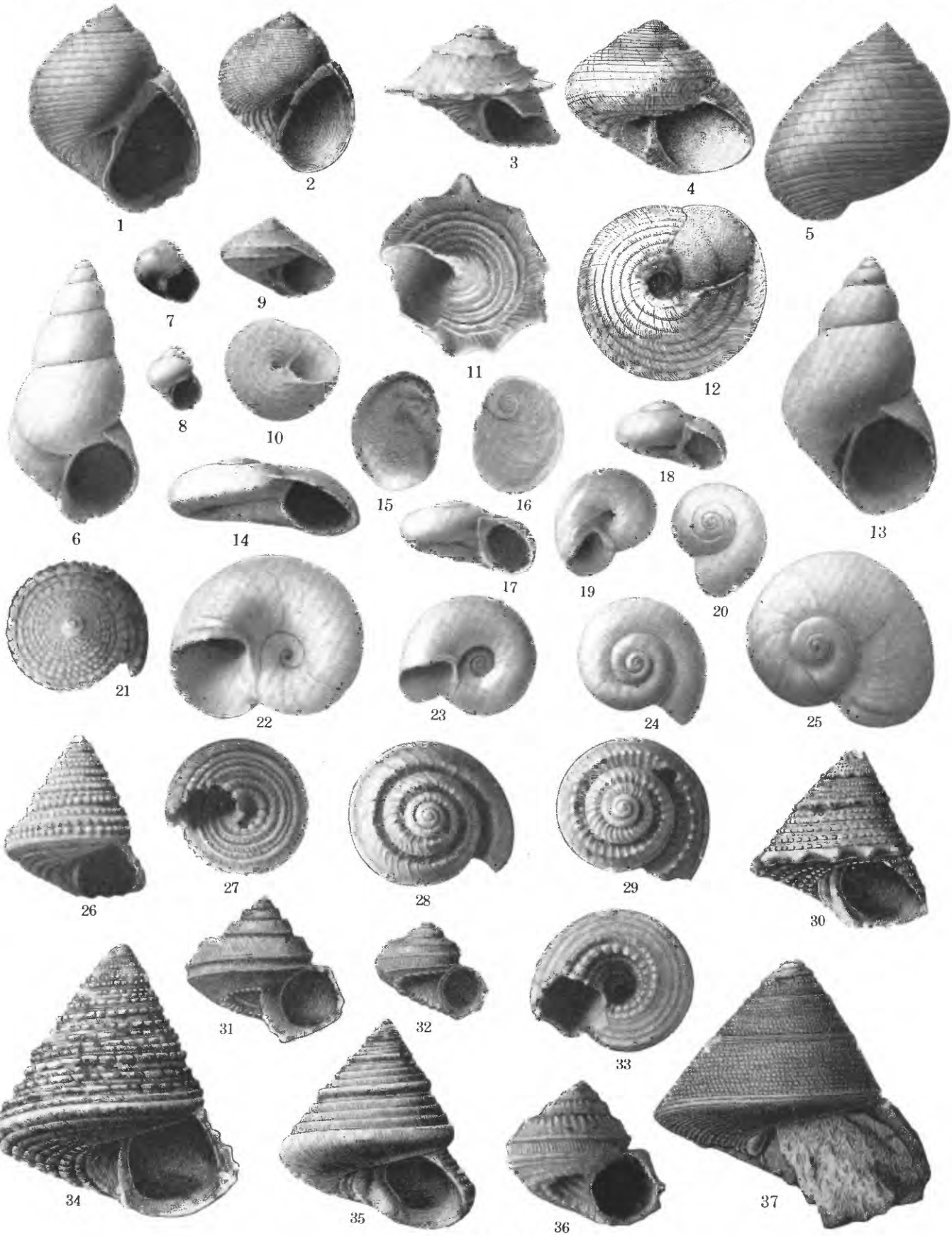
FIGURE 33. *Solariella laqua* Mansfield (p. 621). Basal view of specimen shown in figure 29.

FIGURE 34. *Calliostoma ceramicum* Dall (p. 619). Apertural view of holotype (U. S. Nat. Mus. No. 113065), from Tenmile Creek, 1 mile west of Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 15 mm.; maximum diameter, 13.5 mm. (After Dall.)

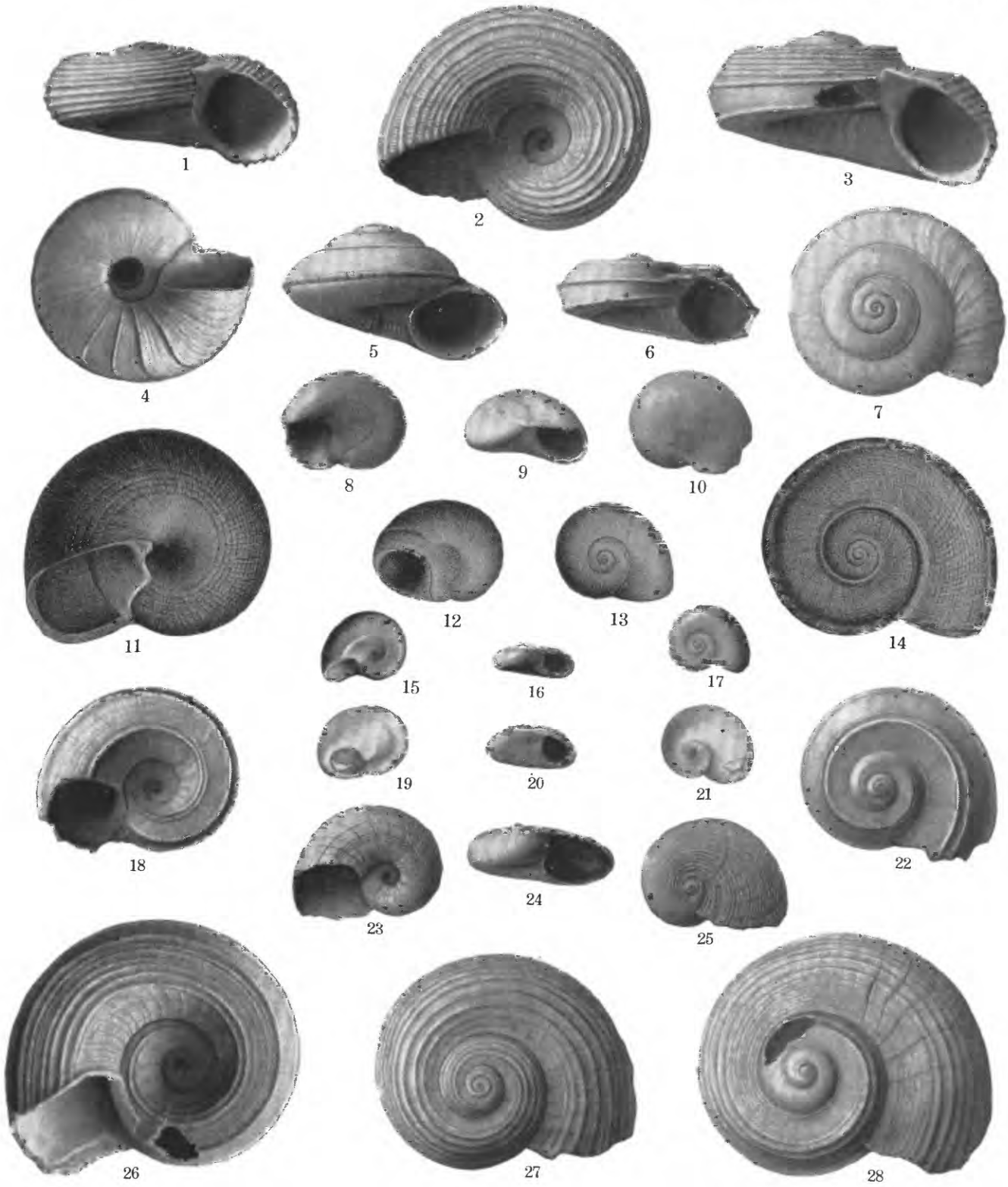
FIGURE 35. *Calliostoma grammaticum* Dall (p. 618). Apertural view of composite of the final 2¼ whorls of an adult cotype and a juvenile of 6 whorls (U. S. Nat. Mus. No. 113038), from the lower bed at Alum Bluff, Liberty County, Fla.; height, 13.5 mm.; maximum diameter, 13.5 mm. (After Dall.)

FIGURE 36. *Solariella laqua* Mansfield (p. 621). Apertural view of specimen shown in figure 29.

FIGURE 37. *Calliostoma metrium* Dall (p. 618). Apertural view of holotype (U. S. Nat. Mus. No. 113025), from 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 20.5 mm.; maximum diameter, 20.5 mm. (After Dall.)



GASTROPODA OF ALUM BLUFF GROUP.



GASTROPODA OF ALUM BLUFF GROUP.

PLATE LXI

FIGURES 1, 2. *"Circulus" mitorraphes* Gardner, n. sp. (p. 599).
1. Apertural view of holotype (U. S. Nat. Mus. No. 350505), from Oak Grove, Yellow River, Okaloosa County, Fla.; height, 1.6 mm.; maximum diameter, 3.4 mm.
2. Basal view of holotype.

FIGURE 3. *"Circulus" anthera* Gardner, n. sp. (p. 599). Apertural view of holotype (U. S. Nat. Mus. No. 351632), from Shell Bluff, Shoal River, Walton County, Fla.; height, 1.8 mm.; maximum diameter, 3.8 mm.

FIGURES 4, 5. *Episcynia mauryi* Gardner, n. sp. (p. 601).
4. Basal view of holotype (U. S. Nat. Mus. No. 350510), from Oak Grove, Yellow River, Okaloosa County, Fla.; height, 2.5 mm.; maximum diameter, 4.4 mm.
5. Apertural view of holotype.

FIGURE 6. *"Circulus" anthera* Gardner, n. sp. (p. 599). Apertural view of paratype (U. S. Nat. Mus. No. 498022), from Shell Bluff, Shoal River, Walton County, Fla.; height, 1.3 mm.; maximum diameter, 2.6 mm.

FIGURE 7. *Episcynia mauryi* Gardner, n. sp. (p. 601). Apical view of holotype shown in figure 4.

FIGURES 8–10. *Teinostoma nanum eonanum* Gardner, n. subsp. (p. 614).
8. Basal view of holotype (U. S. Nat. Mus. No. 351634), from three-fourths mile west of Shell Bluff, Shoal River, Walton County, Fla.; height, 0.9 mm.; maximum diameter, 1.7 mm.
9. Apertural view of holotype.
10. Apical view of holotype.

FIGURE 11. *Solariorbis microforatis* Dall (p. 615). Basal view of holotype (U. S. Nat. Mus. No. 113108), from 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 2.3 mm.; maximum diameter, 4.7 mm. (After Dall.)

FIGURES 12, 13. *Teinostoma chipolanum* Dall (p. 614).
12. Basal view of lectotype (U. S. Nat. Mus. No. 113101), from Tenmile Creek, 1 mile west of Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 1.0 mm.; maximum diameter, 2.3 mm. (After Dall.)
13. Apical view of lectotype. (After Dall.)

FIGURE 14. *Solariorbis microforatis* Dall (p. 615). Apical view of holotype shown in figure 11. (After Dall.)

FIGURES 15–17. *Teinostoma mekon* Gardner, n. sp. (p. 614).
15. Basal view of holotype (U. S. Nat. Mus. No. 498396), from Whites Creek, 6.7 miles south of Argyle, Walton County, Fla.; height, 0.5 mm.; maximum diameter, 1.4 mm.
16. Apertural view of holotype.
17. Apical view of holotype.

FIGURE 18. *"Circulus" anthera* Gardner, n. sp. (p. 599). Basal view of paratype shown in figure 6.

FIGURES 19–21. *Teinostoma phacoton* Gardner, n. sp. (p. 614).
19. Basal view of holotype (U. S. Nat. Mus. No. 329124), from the lower bed at Alum Bluff, Liberty County, Fla.; height, 0.7 mm.; maximum diameter, 1.45 mm.
20. Apertural view of holotype.
21. Apical view of holotype.

FIGURE 22. *"Circulus" anthera* Gardner, n. sp. (p. 599). Apical view of paratype shown in figure 6.

FIGURES 23–25. *Cochliolepis arietina* Gardner, n. sp. (p. 600).
23. Basal view of holotype (U. S. Nat. Mus. No. 136081), from Oak Grove, Yellow River, Okaloosa County, Fla.; height, 1.2 mm. maximum diameter, 3.2 mm.
24. Apertural view of holotype.
25. Apical view of holotype.

FIGURE 26. *"Circulus" anthera* Gardner, n. sp. (p. 599). Basal view of holotype shown in figure 3.

FIGURE 27. *"Circulus" mitorraphes* Gardner, n. sp. (p. 599). Apical view of holotype shown in figure 1.

FIGURE 28. *"Circulus" anthera* Gardner, n. sp. (p. 599). Apical view of holotype shown in figure 3.

PLATE LXII

FIGURE 1. *Crassispira loxa* Gardner, n. sp. (p. 633). Apertural view of holotype (U. S. Nat. Mus. No. 497671), from Whites Creek, 6.7 miles south of Argyle, Walton County, Fla.; height, 33 mm.; maximum diameter, 9.5 mm.

FIGURES 2, 3. *"Drillia" haraldi* Gardner, n. sp. (p. 635).

2. Apertural view of holotype (U. S. Nat. Mus. No. 497670), from Whites Creek, 6.7 miles south of Argyle, Walton County, Fla.; height, 12.6 mm.; maximum diameter, 4.3 mm.
3. Rear view of holotype.

FIGURE 4. *Epitonium* (*Clathrus*) *alaquaënse* Mansfield (p. 577). Apertural view of holotype (U. S. Nat. Mus. No. 373149), from U. S. Geol. Survey Sta. 12046, Vaughan Creek, Walton County, Fla.; height, 7.5 mm.; maximum diameter, 3 mm. (After Mansfield.)

FIGURE 5. *Calliostoma exile* Dall (p. 618). Apertural view of holotype (U. S. Nat. Mus. No. 113041), from the lower bed at Alum Bluff, Liberty County, Fla.; height, 6 mm.; maximum diameter, 5.5 mm.

FIGURES 6–8. *Strombiformis* (*Polygireulima*) *makista* Gardner (p. 574).

6. Apertural view of juvenile paratype (U. S. Nat. Mus. No. 483782), from 6 miles west-northwest of Mossyhead, Walton County, Fla.; height, 7.8 mm.; maximum diameter, 2.7 mm.
7. Apertural view of a specimen showing an unusually well-rounded body whorl (U. S. Nat. Mus. No. 483782); height, 20 mm.; maximum diameter, 6.0 mm.
8. Apertural view of holotype (U. S. Nat. Mus. 483782); height (estimated), 23 mm.; maximum diameter, 6.4 mm.

FIGURE 9. *Smaragdia grammica* Gardner, n. sp. (p. 607). Apertural view of holotype (U. S. Nat. Mus. No. 351640), from Shoal River, half a mile below Shell Bluff, Walton County, Fla.; height, 1.7 mm.; maximum diameter, 1.8 mm.

FIGURE 10. *Natica* (*Natica*) *alticallosa* Dall (p. 545). Apertural view of holotype (U. S. Nat. Mus. No. 112841), from Tenmile Creek, 1 mile west of Baileys Ferry, Calhoun County, Fla.; height, 18 mm.; maximum diameter, 18 mm.

FIGURE 11. *Smaragdia chipolana* (Dall) (p. 608). Apertural view of holotype (U. S. Nat. Mus. No. 112664), from Chipola River, 1 mile below Baileys Ferry, Calhoun County, Fla.; height, 5.0 mm.; maximum diameter, 5.3 mm. (After Dall.)

FIGURE 12. *Gelasinostoma chipolanum* (Dall) (p. 612). Apertural view of holotype (U. S. Nat. Mus. No. 113001), from Tenmile Creek, 1 mile west of Baileys Ferry, Calhoun County, Fla.; height, 1.9 mm.; maximum diameter, 1.9 mm.

FIGURE 13. *Diodora chipolana* (Dall) (p. 623). Apical view of holotype (U. S. Nat. Mus. No. 112699), from 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.; height, 7 mm.; length, 15 mm.; maximum width, 9.5 mm. (After Dall.)

FIGURE 14. *Calliostoma flumenvadum* Gardner, n. sp. (p. 620). Apertural view of holotype (U. S. Nat. Mus. No. 351612), from 5 to 6 miles west-northwest of Mossyhead, Walton County, Fla.; height, 15.8 mm.; maximum diameter, 22.3 mm.

FIGURE 15. *Lucapinella limatula* (Reeve) (p. 622). Apical view of specimen (U. S. Nat. Mus. No. 53881), from low water at Key West, Fla.; height, 3.0 mm.; length, 14.0 mm.; maximum width, 8.0 mm.

FIGURES 16, 17. *Rimula woodringi* Gardner, n. sp. (p. 624).

16. Apical view of holotype (Aldrich collection, Johns Hopkins University, from the lower bed at Alum Bluff, Liberty County, Fla.; height, 1.3 mm.; length, 2.7 mm.; maximum width, 1.9 mm.
17. Lateral view of holotype.

FIGURES 18, 18a. *Dentalium* (*Antalis*) *chipolanum* Gardner, n. sp. (p. 625).

18. Profile of holotype (U. S. Nat. Mus. No. 329137), from 1 mile below Baileys Ferry, Calhoun County, Fla.; length, 40 mm.; diameter at anterior extremity, 3.3 mm.
18a. Cross section of posterior extremity of holotype, ×6.

FIGURE 19. *Cadulus* (*Gadila*) *spiniformis* Gardner, n. sp. (p. 630). Profile of holotype (U. S. Nat. Mus. No. 351645), from half a mile below Shell Bluff, Shoal River, Walton County, Fla.; length, 8.5 mm.; maximum diameter, 1.2 mm.

FIGURE 20. *Cadulus* (*Gadila*) *clarae* Maury (p. 629). Profile of topotype (U. S. Nat. Mus. No. 350513), from Oak Grove, Yellow River, Okaloosa County, Fla.; length, 4.9 mm.; maximum diameter, 0.9 mm.

FIGURE 21. *Cadulus* (*Polyschides*) *lobion* Gardner, n. sp. (p. 628). Profile of holotype (U. S. Nat. Mus. No. 498411), from 1 mile below Baileys Ferry, Chipola River, Calhoun County, Fla.; length, 4.8 mm.; maximum diameter, 0.9 mm.

FIGURE 22. *Cadulus* (*Gadila?*) *volvulus* Gardner, n. sp. (p. 629). Profile of holotype (U. S. Nat. Mus. No. 112754), from Chipola River, 1 mile below Baileys Ferry, Calhoun County, Fla.; length, 8.6 mm.; maximum diameter, 1.1 mm.

FIGURES 23, 23a. *Dentalium* (*Antalis*) *diopon* Gardner, n. sp. (p. 626). Cotypes (U. S. Nat. Mus. No. 498398), from 5 to 6 miles west-northwest of Mossyhead, Walton County, Fla.; including the posterior extremity of an adolescent and the anterior extremity of an adult; length of adult, estimated from broken specimens, 45 to 50 mm.

23. Profile of posterior extremity of adolescent cotype; diameter, 1.1 mm.
23a. Profile of anterior extremity of adult cotype; diameter, 3.3 mm.

FIGURE 24. *Calliostoma flumenvadum* Gardner, n. sp. (p. 620). Basal view of holotype in figure 14.

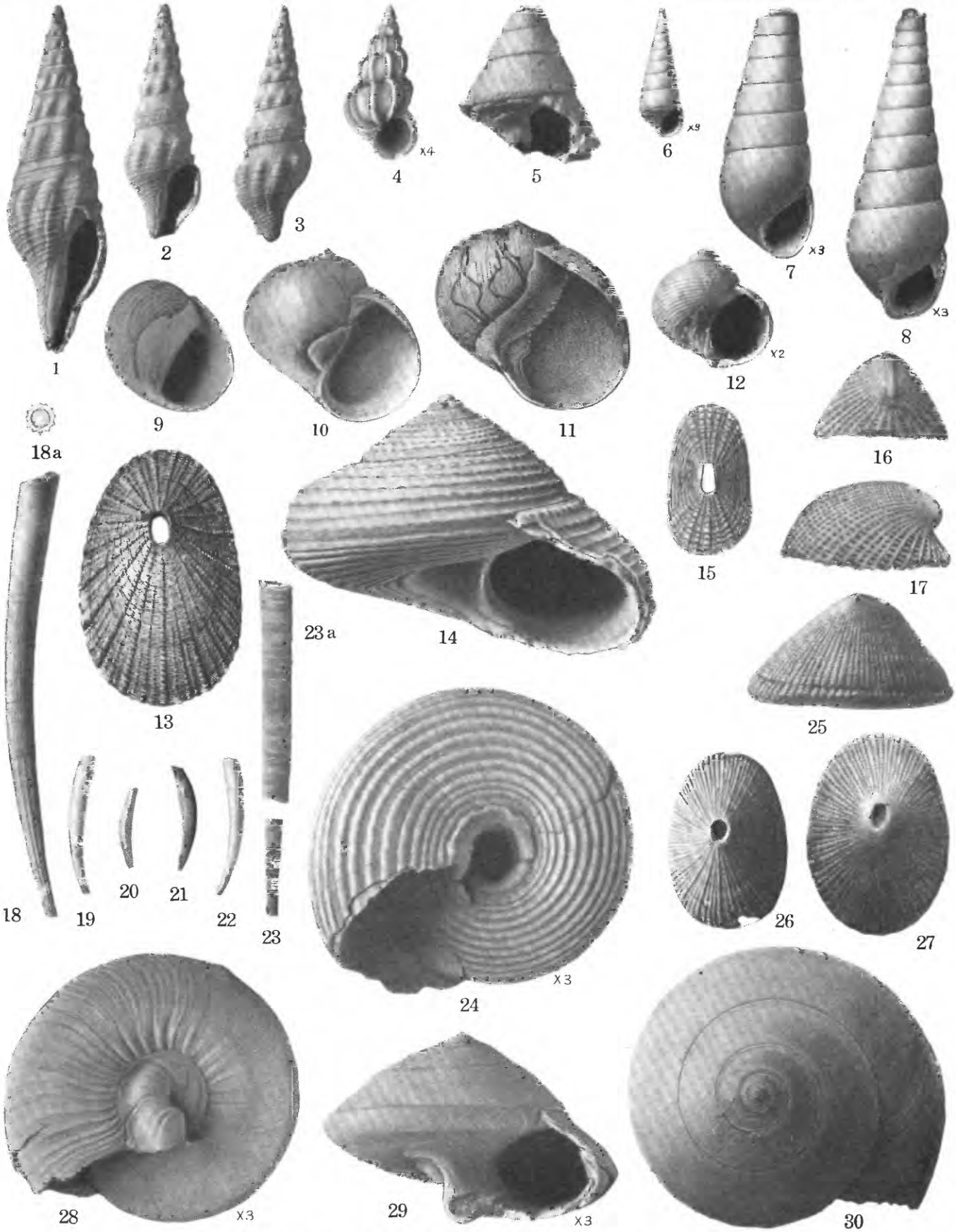
FIGURE 25. *Diodora pumpellyi* Gardner, n. sp. (p. 623). Profile of holotype (U. S. Nat. Mus. No. 371889), from Gastropod Gully, 5½ miles southeast of Bainbridge, Decatur County, Ga.; height, 7.4 mm.; length, 12.5 mm.; maximum width, 8.8 mm.

FIGURE 26. *Diodora daidala* Gardner, n. sp. (p. 623). Apical view of holotype (U. S. Nat. Mus. No. 498397), from Whites Creek, 6.7 miles south of Argyle, Walton County, Fla.; height, 7.9 mm.; length, 18 mm.; width, 12 mm.

FIGURE 27. *Diodora pumpellyi* Gardner, n. sp. (p. 623). Apical view of holotype shown in figure 25.

FIGURES 28–30. *Calliostoma rugabasis* Gardner, n. sp. (p. 620).

28. Basal view of holotype (U. S. Nat. Mus. No. 351620), from 5 to 6 miles west-northwest of Mossyhead, Walton County, Fla.; height, 12.6 mm.; maximum diameter, 19.5 mm.
29. Apertural view of holotype.
30. Apical view of holotype.



GASTROPODA AND SCAPHOPODA OF ALUM BLUFF GROUP.

INDEX

695462—47—14

UNITED STATES DEPARTMENT OF THE INTERIOR
J. A. Krug, Secretary

GEOLOGICAL SURVEY
W. E. Wrather, Director

Professional Paper 142

THE MOLLUSCAN FAUNA OF THE ALUM BLUFF GROUP OF FLORIDA

By
Julia Gardner

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1947

CONTENTS

ILLUSTRATIONS

U. S. GOVERNMENT PRINTING OFFICE: 1947—695462