STATE OF FLORIDA
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FLORIDA GEOLOGICAL SURVEY
Herman Gunter, Director

GEOLOGICAL BULLETIN NO. 35

EOCENE MOLLUSKS FROM CITRUS AND LEVY COUNTIES, FLORIDA

By

Horace G. Richards, Associate Curator
Department of Geology and Paleontology

Katherine V. W. Palmer, Director
Paleontological Research Institution

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Florida Geological Survey

Tallahassee

June 20, 1953

MR. CHARLIE BEVIS, *Supervisor*
FLORIDA STATE BOARD OF CONSERVATION
TALLAHASSEE, FLORIDA

SIR:

As part of the services rendered by the Florida Geological Survey to the stratigraphers and oil workers of the Gulf Coast States, a study of an unusual association of upper Eocene mollusk shells discovered in Citrus and Levy counties, Florida, was undertaken in 1948. The description of this fauna was made by Dr. Horace G. Richards, Associate Curator of the Academy of Natural Sciences, Philadelphia, Pennsylvania; Mrs. Katherine Van Winkle Palmer, Director, Paleontological Research Institution, Ithaca, New York; and by Henry B. Roberts of the staff of the Wagner Free Institute of Sciences, Philadelphia, Pennsylvania.

This study is of importance in the correlation of the Florida rocks with similar rocks of the remaining states of the Gulf coast. It is being published as Florida Geological Survey Bulletin No. 35.

Respectfully yours,

HERMAN GUNTER, *Director*

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EOCENE MOLLUSKS FROM CITRUS AND LEVY COUNTIES, FLORIDA

PART I—INTRODUCTION

by

HORACE G. RICHARDS

The Eocene of Florida.—Prior to 1944 the Ocala limestone was the only Eocene formation known from the state of Florida, and this was also regarded as the oldest outcropping formation within the state.

Although limestones in the vicinity of Ocala have been well known for many years, the first formal use of the term Ocala limestone was by Dall in 1892. For a while there was considerable confusion between these beds and the overlying "Orbitoides limestone," now known to be of Oligocene age. Cooke (1915) was the first to point out the true age of the Ocala limestone by showing a correlation between it and the deposits of Jackson age of Alabama and Mississippi. He, therefore, concluded that the formation was of late Eocene age.

The considerable amount of drilling and consequent study of the well samples including especially the microfossils, has led Cole (1944), Applin and Applin (1944) and others to recognize various formations of Eocene and Paleocene age older than the Ocala that underlie it in central and southern Florida. The following Table is based on the correlation of the Applins (1944, p. 1678).

Upper Eocene	Ocala ls.	Upper / Lower JACKSON
Late Middle Eocene	Avon Park ls.	CLAIBORNE
	Tallahassee ls.	
Early Middle Eocene	Lake City ls.	
Lower Eocene	Oldsmar ls.	WILCOX
Paleocene	Cedar Keys ls.	MIDWAY

In this work the Applins recognized an upper and lower member of the Ocala with differences both in lithology and in microfauna.

Ericson (1945) described beds of dolomite and dolomitic limestone that cropped out in the Gulf Hammock region in Levy and Citrus counties, and assigned them to the Gulf Hammock formation. This he thought was equivalent to the Avon Park formation as described by the Applins from the subsurface and dated as Claiborne in age. He proposed the abandonment of the term Avon Park in favor of Gulf Hammock since the latter was named from an outcrop area instead of from the subsurface.

A short time later the present writer (Richards, 1946) described a new species of gastropod of the genus *Velates* from excavations from the Withlacoochee River 1/8 to 1 mile below the Florida Power Corporation Plant in Citrus County. This was the first record of the genus from eastern North America, although it was widely distributed throughout the Eocene of other parts of the world. It was suggested that the *Velates* came from a different faunal assemblage than that of the Ocala limestone, but whether the bed be of lower Jackson or Claiborne age was not stated.

Vernon (1947) summarized the geology of the area and in his extensive report on the geology of Citrus and Levy counties Vernon (1951, p. 112) made the following subdivisions of the upper part of the Eocene section:

Beds of Jackson Age		Ocala limestone (restricted)
	Moodys Branch fm.	Williston member
		Inglis member
		Disconformity
Beds of Claiborne Age		Avon Park limestone
		Disconformity
		Lake City limestone

Vernon has retained the term Ocala limestone in a restricted sense (?= upper Ocala of the Applins) and has correlated the lower Ocala beds with the Moodys Branch formation, originally described from the vicinity of Jackson, Mississippi. He further subdivided the Moodys Branch formation into two members, the Williston and the Inglis. Beneath these there is another limestone which Vernon correlated with the Avon Park formation of Clai-

borne age. In a paper to be published by the Florida Geological Survey, H. S. Puri (personal communication) will call all upper Eocene beds, the Ocala group and may raise the Inglis and Williston members of "the Moodys Branch formation" to formational rank.

According to Vernon (1951, p. 104) Ericson's "Gulf Hammock" formation, as defined, includes the Inglis member of the Moodys Branch formation and the upper part of the Avon Park limestone. Because of the confusion and overlapping of terms, Vernon has suggested that the term "Gulf Hammock" be abandoned.

The Foraminifera from the Avon Park limestone and the Inglis member have been described by Cole (1942), Applin and Applin (1944), Applin and Jordan (1945), Vernon (1951) and others. The ostracodes were described in a recent bulletin by Howe (1951) and the echinoids by Fischer (1951). A preliminary list of the mollusks was submitted to the Florida Geological Survey by H. B. Stenzel (see Vernon, 1947, pp. 7, 12, 16, 17) and a list by the present writer was included in the main report on the two counties (Vernon, 1951, pp. 119-21). Harris (1951) described and figured many of the pelecypods from the Ocala limestone from Georgia and Florida. For further details on the stratigraphy of the region, the reader is referred to reports by Cooke (1945) and Vernon (1951).

Present Project.—The writer's attention was first called to the fauna by Dr. A. G. Fischer and Mr. Joseph Banks, then of the Stanolind Oil and Gas Company, who in September, 1945, showed him the specimens of *Velates* mentioned above. In February, 1948, he spent a few days visiting localities in Citrus and Levy counties in the company of Dr. Robert O. Vernon. Sometime after that field trip he was requested by the Florida Geological Survey to prepare a report on the mollusks from the Eocene outcrops that Dr. Vernon had collected in his studies of the area. The writer invited Dr. Katherine V. W. Palmer of the Paleontological Research Institution of Ithaca, N.Y., to collaborate with him in the study, and consequently the material thus far obtained was shipped from Tallahassee to Philadelphia and Ithaca for study.

Dr. Palmer had already visited localities of Ocala limestone in the region of Ocala and in March, 1952, stopped in Tallahassee to examine material in the collections of the Florida Geological Survey.

Material was received from both the Avon Park limestone and the Inglis member of the Moodys Branch formation. The most surprising feature of the two faunas was the meager specific similarity with the well-known Eocene faunas of the Mississippi em-

bayment. On the other hand there was a rather remarkable correlation of these Florida mollusks with Eocene faunas from other parts of the world, especially from the Paris Basin, England, and northern Italy. A preliminary report stressing this old world affinity was presented before the International Geological Congress in Algiers, in September, 1952 (Palmer and Richards, 1952).

Because of the necessity of comparing the Florida mollusks with material or descriptions from so many parts of the world, the work was considerably more difficult than anticipated, causing the consequent delay in the completion of this report.

Procedure and Acknowledgments.—Although the two authors have conferred at various times both in Ithaca and Philadelphia, it was decided that the present author (Richards) should be responsible for the pelecypods and Dr. Palmer, the gastropods. The discussions and conclusions were written jointly by the two authors.

The authors are indebted to Dr. Vernon, of the Florida Geological Survey, for the opportunity of studying this unique fauna and for providing funds for certain phases of the investigation. We are also indebted to the American Philosophical Society for additional funds to cover other expenses of the project including those of both authors to Washington, D.C., to compare specimens at the United States National Museum where the collections were made available through the courtesy of David Nicol. Others who have offered suggestions throughout the course of the study include: G. D. Harris, Axel Olsson and Charles Wurtz. James Dahlhausen assisted with the sorting and preparation of the fossils at the Academy of Natural Sciences.

Thanks are due to Mrs. Venia Phillips, Librarian, and her staff, of the Academy of Natural Sciences, for making available literature which was difficult to obtain elsewhere. We wish to acknowledge the courtesy of Dr. L. R. Cox, British Museum (Natural History) for the privilege by H. G. Richards of the examination of Italian Mont Postale and Ronca Eocene material in that museum.

The type and figured specimens are in the collections of the Florida Geological Survey in Tallahassee, Florida. A few duplicate specimens are in the collections of the Paleontological Research Institution at Ithaca, New York, and the Academy of Natural Sciences in Philadelphia, Pennsylvania.

List of Localities from R. O. Vernon, Florida Geological Survey

L-73 Avon Park limestone. On the dredged channel of the Waccassassa River in the southwest quarter of southwest quarter

of Section 8, Township 14 South, Range 16 East, below the bridge on State Road 55, Levy County, Florida. Tan to brown, fairly hard, porous, massive dolomite. The porosity is almost entirely molds of mollusks and foraminifers. The bed is 0.2 to 0.8 foot thick. Bed No. 2 of section described by Vernon (1951, pp. 102-103).

L-76 Avon Park limestone. Exposed as ledges in the timber road in the northwest corner of the southwest quarter of Section 14, Township 14 South, Range 15 East, Levy County, Florida. Hard, porous, cream to light gray-purple tinted, massive, miliolid, fragmental, marine limestone. Some of the miliolids are the size of buckshot and numerous undescribed mollusks are present. See Vernon (1951, p. 104).

L-92 Avon Park limestone. This, the thickest limestone section, can be reached by driving from the town of Gulf Hammock, leaving State Road 55, four-tenths mile southeast of the town, on a narrow pavement and driving two and one-quarter miles to the end of the pavement, and turning northwest on a dirt road to Sulphur Springs Landing on the left bank of Wekiva River in the southwest quarter, northwest quarter of Section 32, Township 14 South, Range 16 East. The fossils come from Bed 2 (Vernon, 1951, pp. 105-106) which is 1.5 feet of cream to white, mottled, hard ledge of dense, very fossiliferous, marine limestone, containing excellent specimens of Peneroplid sp. "X" (Gen. et. sp. nov.) and other Avon Park microfauna.

L-93 Inglis member—Moodys Branch formation. A road metal pit 2.9 miles south of the north limits of the town of Gulf Hammock just southwest of State Road 55 in the southwest quarter of Section 34, Township 14 South, Range 16 East. Boulders of very indurated, cream to tan, hard, dense limestone containing numerous *Periarchus lyelli floridanus* and well-preserved mollusks. A preliminary list has been published (Vernon, 1951, pp. 119-121, 126).

L-118 Avon Park limestone. The New Labanon dolomite pit located in the southwest quarter, northeast quarter of Section 12, Township 16 South, Range 16 East. The following section is reproduced from Vernon (1951, pp. 108-110) and was measured December 14, 1946:

Locality L-118

	Feet
Pleistocene series	
Pamlico formation	
8) White to gray, fine, argillaceous, quartz sand	1.5 to 4.0

Unconformity

Upper Eocene series

Moodys Branch formation

Inglis member

7) Tan, dense, hard, massive dolomite containing scattered molds of foraminifers and broken mollusks 2.35

6) Tan, very soft, friable, finely crystalline, porus to dense, thinly-bedded dolomite composed of silt-sized euhedral crystals. Grades laterally into large, massive, dolomite beds containing platy dolomite pebbles, apparently reworked from beds below. This bed is high and low along the quarry face and apparently has covered an erosional surface of relief up to 10 feet 9.75

Unconformity

	Feet
Middle Eocene series	
Avon Park limestone	
5) High areas extending into bed 6—Tan to brown, extremely platy and laminated by alternate layers of plant remains and silt-sized euhedral crystals of dolomite. The base is dark brown, heavily laminated and contains thin beds of peat and specimens of Peneroplid sp. "X (Gen. et. sp. nov.)," *Coskinolina*, *Dictyoconus* and *Lituonella*. Extensively exposed in the south side of the quarry	Variable to 3.0
4) Tan to brownish-gray, dense, fine-grained, fragmental dolomite cut by numerous long, narrow borings made by worms or boring mollusks. Many molds of *"Cerithium"* are present and the bed is absent at places	0.35 to 0.85
3) Brownish-gray, purple-tinted, very dense, fine grained, lithographic dolomite. Beds 3 and 4 grade laterally and vertically into bed 2 or where absent into bed 1	0.7 to 1.6
2) Brown to greenish-gray, very pure, thin-bedded, dense carbonate having the texture and consistency of clay when wet and analyzing 95 to 98 percent calcium-magnesium carbonate. Upon drying the material cements solidly. The bed is laminated by carbonized plant remains, thin peat beds in places, and a pavement-like bryozoa. It contains an abundant and beautifully preserved microfauna of the Avon Park limestone and includes *Elphidium* sp. "A," *Coskinolina floridana* and *Dictyoconus cookei* in great abundance, and an ostracod fauna that has been described by Dr. H. V. Howe and is published in Florida Geological Survey Bulletin 34	0.7 to 1.0
1) Brownish-gray to brown, purple-tinted, soft but tough, granular, massive, porous limestone containing an abundant Avon Park fauna. Peneroplid sp. "X," *Elphidium* sp. "A" are prominent. On November 15, 1947, and July 11, 1948, boulders of this limestone, completely dolomitized, were mined in the north side of the pit, and these contained the large Lucinia of L-123, a Manatee rib, and numerous dolomite casts of *"Cerithium"* n.sp.	3.0
Maximum cumulative thickness	25.55

Specimens labeled L-118A are from Bed 1, and those labeled L-118B are from Bed 4.

L-135 Inglis member—Moodys Branch formation. One of the type localities located about one-eighth mile below the Florida Power Corporation Plant at Inglis, Florida, on the right bank of of the Withlacoochee River in the southeast quarter of the northwest quarter of Section 3, Township 17 South, Range 16 East. Boulders of cream-colored, soft, granular, porous miliolid limestone. See Vernon (1951, p. 124, type 2).

L-139 Inglis member—Moodys Branch formation. An extensive exposure along the Withlacoochee River at the dam of the Florida Power Corporation in the southwest quarter, southwest quarter of Section 8, Township 17 South, Range 17 East. The fossils come from Bed 4 of the following section, reproduced from Vernon (1951, pp. 129-130) :

Locality L-139

	Feet
Upper Eocene series	
Moodys Branch formation	
Inglis member	
5) Tan, very soft, finely crystalline, massive dolomite containing abundant foraminifers, barnacle and mollusk molds, *Coskinolina* sections, shrimp claws, and *Periarchus lyelli floridanus*	1.0
4) Similar dolomite containing pebbles of laminated dolomite and abundant nodular concretions of hard, brown to gray, crystalline, dolomitic limestone. *Periarchus lyelli floridanus, Cassidulus cricsoni, C. globosus, Eupatagus mooreanus,* all dolomitized and deformed but beautifully preserved, sections of *Coskinolina, Dictyoconus* and *Lituonella,* impressions of Peneroplid sp. "X" and buckshot miliolids are present. Grades into bed 3	1.9
3) Tan, soft, finely crystalline, massive dolomite containing many molds of the mollusks above. The base contains boulders and pebbles of tan, laminated dolomite and many oxidized concretions. A reworked soil mantle developed on bed 2	2.15
Unconformity	
Middle Eocene series	
Avon Park limestone	
2) Soft, tan, finely crystalline, platy dolomite, laminated by differing colors and textures of dolomite and by carbon residues of eel(?) grass and other plant remains. The top has many brown to tan concretions that are more calcareous than the matrix and elongate, meandering tubes that appear to be animal borings. Molds of the Avon Park microfauna are numerous —to water level	1.4
1) Bed 2 visible below water	1.5
Total thickness	6.95

C-11 Inglis member—Moodys Branch formation. Boulders of crystalline, tan to brown, hard, fragmental marine limestone

thrown out of a pit of the Dunnellon Phosphate Mining Company located in the southwest quarter of the southeast quarter of Section 10, Township 18 South, Range 19 East. For further discussion see Vernon (1951, pp. 134-135).

VL-187 Inglis member—Moodys Branch formation. Boulders of hard, crystalline, tan, fragmental marine limestone, exposed in a road metal pit in the northeast quarter of the southwest quarter of Section 14, Township 15 South, Range 16 East. Not included by Vernon in Bulletin 33.

PART 2.—GASTROPODA

by

KATHERINE V. W. PALMER

INTRODUCTION

The collection of gastropods from the Avon Park limestone includes specimens from localities L-73, L-76 and L-118. The species identified are all new and represent such Eocene genera as *Tectariopsis, Bellatara, Hipponix, Pseudocrommium* and *Conomitra.* Of those genera *Tectariopsis* is a Lutetian genus from France. *Bellatara* previous to the record of this Floridian material was known only from the middle Eocene of Europe. *Pseudocrommium* occurs in the middle Eocene of Europe and in the upper Eocene of Colombia. The evidence of the identifiable gastropods corroborates a middle Eocene or Lutetian age of the Avon Park limestone as previously assigned by the members of the Florida Geological Survey.

The greater portion of the material submitted for study came from a horizon stratigraphically higher than the Avon Park limestone (see Bull. 33, Fla. Geol. Surv.), the Inglis member of the Moodys Branch formation which is lower than the Ocala limestone (restricted) (Jackson Eocene). Well-preserved gastropods were recovered from the Inglis member at localities L-93, L-139, L-135 and C-11, Levy and Citrus counties respectively. There was also a large number of fragments in the form of casts and impressions which would not warrant description but which do indicate that the fauna was more prolific than the listed species. Of the localities L-93 yielded the best preserved and most abundant specimens.

Of the genera identified from the Inglis member *Velates* (one species in the Cretaceous), *Bellatara, Pseudoaluca, Personella, Pseudocrommium, Papillina, Lapparia, Eovasum and Pseudotoma* and confined to the Paleocene and Eocene. *Seraphs* which is a predominantly Eocene subgenus does range into the Oligocene. *Batillaria, Hipponix, Agaronia, Olivella (Callianax), Conomitra, Athleta,* and *Lyria* though not limited to the Eocene are common during that period. *Laevella, Voluticella,* and *Sycospira* are new genera which are unique. *Caricella, Lapparia* and *Papillina* are genera which are typical of the Mississippi embayment area and except *Caricella* are confined to that region. Species of these genera predominate in the Floridian material and have associated with

them the Tethyan genus, *Velates*. Jamaica, B.W.I., California, and Panama, are the only other places in the Western Hemisphere at which *Velates* has been found. The Floridian species of *Bellatara* resemble forms from the lower Claiborne formations to the west as well as to species of Europe. Specifically the ubiquitous *Calyptraea aperta* (Solander), *Cypraedia fenestralis* Conrad and *Distorsio jacksonensis* (Meyer) make up the list common to the Floridian and Mississippian provinces. *Calyptraea aperta* is of no subdivisional value in the Eocene.

The presence of the above genera and species is weighed against that of *Velates, Eovasum,* and *Pseudoaluca. Seraphs* is abundant in the Floridian material while only meager specimens of *Terebellum, s.s.,* have been found in the Mississippi embayment Eocene fauna. The fauna presents a more striking resemblance to genera and species of the middle and upper Eocene of the Paris Basin, northern Italy and the Moquattam beds in Egypt. Certainly a portion of the gastropod fauna of the Florida Eocene, during the deposition of the Avon Park limestone and the Inglis member of the Moodys Branch formation, was supplied from the Tethyan source. Analysis of the fauna confirms that the Inglis is low in the upper Eocene.

As yet the molluscan remains of the Ocala limestone have not been critically and thoroughly described. Field studies of the material definitely indicate that it also contains a majority of Old World and new elements. Lack of an identified list of the Ocala shells prevents a comparison with the earlier genera and species, but those studies are underway and the present paper will furnish a preliminary list as a basis of comparison.

LIST OF SPECIES

GASTROPODA

Name	Formation Avon Park limestone	Inglis member, Moodys
Tectariopsis (?) *avonensis*, n.sp.	L-73	
Astraea withlacoochensis, n.sp.		L-135
Velates floridanus Richards	L-73 (Vernon)	L-135
Turritella fischeri, n.sp.		L-135; L-93 (type)
Diastoma, sp.		L-139
Batillaria advena, n.sp.		L-93
Bellatara americana, n.sp.	L-76	L-135; L-93 (type)
Bellatara citrana, n.sp.	L-76; L-118	C-11 (type)
Bellatara floridana, n.sp.	L-118	L-135 (type)
Pseudoaluca clarki, n.sp.		L-93
Hipponix floridanus, n.sp.	L-73	L-93 (type)
Calyptraea aperta (Solander)		L-93
Xenophora, sp.		L-135
Tugurium grayi, n.sp.		C-11
Laevella floridana, n.g., n.sp.		C-11; L-93 (type)

Terebellum (Seraphs) belemnitum, n.sp.		L-93
Cypraedia fenestralis Conrad		L-93
Ampullinopsis citrinensis, n.sp.		C-11; L-139; L-93 (type)
Pseudocrommium brucei, n.sp.		L-135; L-139; L-93 (type); C-11
Pseudocrommium occiduum, n.sp.	L-76	
Distorsio (Personella) jacksonensis (Meyer)		L-93
Papillina gunteri, n.sp.		L-93
Agaronia inglisia, n.sp.		L-93
Olivella (Callianax) poinciana, n.sp.		L-93
Conomitra, sp.	L-73	L-93
Lapparia conradi, n.sp.		L-93
Eovasum vernoni, n.sp.		L-93
Athleta arangia, n.sp.		C-11; L-93 (type)
Sycospira cocenica, n.g., n.sp.		L-93
Caricella obsoleta, n.sp.		L-93
Voluticella levensis, n.g., n.sp.		L-93; VL-187
Lyria citrusensis, n.sp.		C-11
Lyria pycnopleura eocenia, n. subsp.		L-93
Pseudotoma floridana, n.sp.		L-93
Conus, sp. A		L-93
Conus, sp. B		L-93
Scaphander richardsi, n.sp.		L-93

Systematic Descriptions

Family Turbinidae

Genus Tectariopsis Cossmann, 1888

Tectariopsis (?) avonensis Palmer, n.sp.

Plate 1, figures 10, 11

Shell medium in size, turbiniform; spire small, elevated, pointed; postnuclear whorls of spire about two; nuclear whorls not well preserved; suture impressed with a strong sutural cord; body whorl with four strong muricated spiral ribs which form a shoulder above and a carinated base below; about three fine spiral threads between the primary ribs; two muricated secondary spiral ribs are present on the base next to the umbilical area with two, more or less, spiral threads just below the carination of the base and one between the shoulder margin and the sutural cord; finer threads occur between the secondary ribs. The primary ribs are well developed on young specimens but do not yield the murications, and the fine spiral threads are not apparent. The aperture and umbilical areas are unknown. Fragments of a larger specimen than the holotype has the murications less pronounced than that individual, but the spiral threads are more numerous.

This species is represented by four plastotypes with additional fragments. All are casts which were made in the field from original molds. They are from young, immature and adult shells. The species belongs in the Turbinidae but because the critical characters of the aperture and umbilical areas are not preserved the generic placement cannot be definite. The form is common at the type locality, and the specific features are distinct and different from any known form of the Gulf Coast Eocene, hence its definition as new is warranted. The species is placed temporarily in *Tectariopsis* Cossmann, 1888, a genus represented by several species in the Lutetian (middle Eocene) of France.

Dimensions.—Adult; height, 15 mm.; greatest diameter, 18 mm. young: height, 9 mm.; greatest diameter, 8 mm.

Types.—Holotype, No. I-7391; paratypes, Nos. I-7392-94, Fla. Geol. Surv.

Occurrence.—Avon Park limestone, loc. L-73, Fla. Geol. Surv.

Genus Astraea Roeding in Bolten, 1798

Astraea withlacoochensis Palmer, n.sp.

Plate 1, figure 12

Shell medium, pyramidal line of whorls continuous, concave above the flaring margin of the whorl just above the suture; apical

whorls destroyed, five remaining whorls; anterior margin of each whorl pinched into a slightly spreading irregular rim compressed over the suture below; surface with fine irregular spiral lines, some more pronounced than others; base unknown. This species is like *A. fimbriatum* (Lamarck) figured by Pilsbry (Man. Conch., X, 1888, pl. 54, figs. 46-54), Recent of Australia. The spiral lines in the Florida Eocene are fewer and more unequal in size than those of *A. fimbriatum*. The species belong in a subgroup which have been placed in *Cyclocantha* Swainson, 1840, or *Calcar* Montfort, 1810, the nomenclature of which is technically unsettled. There is a species in the Eocene of Australia, *A. flindersi* Tenison Woods which was placed in *Calcar* by Cossmann (Essais Paléonconch. comp., 11 liv., 1918, p. 145). Because the umbilical area and aperture is unknown the generic placement cannot be definite.

Clark in Clark and Durham (1946, p. 13) identified an *Astraea*, sp. from the upper Eocene of Colombia. It is not so well preserved as this Florida shell and is of a different shape.

The species is known by the holotype only but its distinctness in form and sculpture justifies its description.

Dimensions.—Height, 27+ mm.; greatest diameter, 29 mm.

Holotype.—No. I-7395, Fla. Geol. Surv.

Occurrence.—Inglis member, Moodys Branch formation, loc. L-135, Fla. Geol. Surv.

Family Neritidae
Genus Velates Montfort, 1810
Velates floridanus Richards
Plate 1, figures 6-9

Velates floridanus Richards, 1946, Acad. Nat. Sci., Philadelphia, Notulae Naturae, No. 177, p. 2, pls. 1, 2.

Three specimens of *Velates* were recovered from L-135 which is the type locality for *V. floridanus*. This locality is further discussed by Vernon (1951 p. 123, 124) and several sections are given. *V. floridanus* is mentioned in the fauna.

Velates is widely distributed in the Eocene of Europe, Africa, and Asia.

In the Western Hemisphere it is known from Jamaica, California, Panama, and Florida. The type species, *V. perversus* (Gmelin) from the Eocene of France ranges through the Eocene in Europe; in Africa and Asia it is known from lower through upper Eocene. In California and Jamaica it occurs in the middle Eocene. In Florida, *V. floridanus* is present in the lower upper Eocene.

Vernon (1951, p. 103) listed "*Velates*, sp. (juvenile?)" from L-73 in the Avon Park limestone, middle Eocene.

Cossmann and Pissarro (1909, p. 76) pointed out a basic criterium for differentiating specimens from the variable, widely distributed *V. perversus*. They noted a difference in the number of teeth on the inner lip. *V. perversus* has usually eight teeth while in other species such as *V. noetlingi* Cossmann and Pissarro, there are only six. Vokes (1935, pp. 381-389, pls. 25, 26) utilized this point in describing a species from California (*V. californicus* Vokes).

A large (90 mm., length) internal mold from L-135 has the impressions on the inner lip of seven (possibly six) large teeth more regular than as usual in *V. perversus* (Gmelin). This feature of the Florida shells suggests that the species is not of the typical *V. perversus* group. Differences in size and shape bear little weight in distinguishing the smooth specimens of *Velates* specifically. Because of the apparent difference from *V. perversus* in character of the teeth the Florida shells are retained in the distinct species. Specimens of *Velates* from Jamaica, B.W.I., in the senior author's collection measure 127 mm. in length. None of the Jamaican individuals has the teeth preserved.

Specimens figured.—Nos. I-7396, I-7397, I-7398, Fla. Geol. Surv.

Occurrence.—Inglis member, Moodys Branch formation, loc. L-135, Fla. Geol. Surv.

Family Turritellidae

Genus Turritella Lamarck, 1799

Turritella fischeri Palmer, n.sp.

Plate 1, figures 1-5

Shell medium in size (greatest diameter, 18 mm.); tapering; 17 whorls± (an immature specimen has 17 whorls); postnuclear whorls are tricarinate in sculpture, the middle rib the weaker; with age an additional spiral line develops which becomes stronger so that a whorl or two in the ontogeny of the shell has four primary spiral ribs (see Plate 1, figure 1). The adult sculpture consists of two strong spirals above the suture and two below the suture on the posterior part of the lower whorl; the basal ribs are the stronger of the two pairs; there are fine spiral striations on the medial region of the whorls; the middle of each whorl is close and slightly overhangs the suture.

The nuclear and postnuclear whorls of a *Turritella* are the key portions of the shell to determine the general groups to which the species may belong. A discussion of the types of apical carination

of the southern United States Eocene Turritellas has been presented by Palmer (1937), Bowles (1939), and Palmer (1947).

The collection of this species does not contain a specimen with the apical whorls preserved. However, several immature individuals, including the one figured herein (Plate 1, figure 1) present the early apical whorls in which the tricarination of the spiral ribbing is revealed. Such a primary factor places the species in the tricarinate group of which *T. ghigna* de Gregorio *(T. carinata* Lea) of the Claiborne group and *T. perdita* Conrad are representatives. Specimens of *T. fischeri* bear a superficial resemblance to shells of those species and in a preliminary survey of the material the shells were temporarily so assigned (see list, p. 119, Bull. 33, Fla. Geol. Surv.). On detailed examination and preparation of additional specimens the differences from the specimens mentioned seem to warrant a distinct separation.

The character of the closer overhanging basal spiral rib distinguishes *T. fischeri* from both *T. ghigna* and *T. perdita*. The specimen which had been thought to resemble *T. ghigna* apparently is of the same species as the remainder of the individuals. On the later part of the tricarinate stage of *T. fischeri,* the middle spiral is weaker than the posterior and the anterior two ribs are stronger than the third.

Named in honor of Dr. Alfred G. Fischer who studied the echinoids of these counties.

Types.—Holotype, No. I-7399; paratypes, Nos. I-7400-7403, Fla. Geol. Surv.

Occurrence.—Inglis member, Moodys Branch formation, loc. L-93 (type) and L-135, Fla. Geol. Surv.

Family Diastomatidae

Genus Diastoma Deshayes, 1850

Diastoma sp.

Plate 7, figure 8

A fragment of 10 whorls reveals well-preserved sculpture of spiral fine lines alternating in strength. Moderately strong longitudinal folds extend the length of each whorl. Varices are apparent on two whorls. The shell would have been slender.

Only one side of one specimen of this species is available. Hence the known characters are not enough for description. But the features are adequate to identify additional material of the same species. Future collections may contribute the data as to the present missing characters.

Specimen figured.—No. I-7404, Fla. Geol. Surv.

Occurrence.—Inglis member, Moodys Branch formation, loc. L-139, Fla. Geol. Surv.

Family Cerithiidae

Dall in 1892 (p. 277) remarked on the apparent scarcity of Cerithiidae in the American Eocene and thought that it was due in part to lack of material and poor preservation. Large collections of well-preserved specimens from formations of Claiborne and Jackson Eocene of the Gulf states have not yielded a noticeable representation of the family such as that from Eocene sediments of the Old World. In contrast the Eocene deposits of Citrus and Levy counties, Florida, contain fragments which indicate that there was a better representation of cerithiids in the Floridian Eocene than in the Mississippi Embayment area. Portions of specimens each with a different type of sculpture indicate that there would be at least four cerithiid species in the present small collection.

The name *"Cerithium"* has been used and continues to be used as a general term rather than as a generic name in the strict sense. The generic name *Cerithium* Bruguière is at present in a debatable nomenclatorial situation (see foot note under *Bellatara wechensensis.)*

Genus Batillaria Benson in Cantor 1842

Batillaria advena Palmer, n.sp.

Plate 2, figures 4, 5

Shell small; nine whorls; first nuclear whorl not known, last smooth; first two or three postnuclear whorls with three spiral ribs crossed by the longitudinal folds; the remainder of the whorls of the spire and the posterior portion of the body whorl have four coarse spiral ribs and stout longitudinal folds. The folds do not cross the revolving ribs over the basal portion of the body whorl; microscopic spiral threads are present between the axial ribs; the labrum is bounded by a varix; labium moderately thickened and reflected, spread to the posterior point and divided from the outer lip by a notch; short anterior notch or channel present. There are 8-10 longitudinal coarse folds which extend over all the whorls except the basal portion of the body whorl.

This species is representative of a genus not recorded previously from the United States. The genus extends from the Paleocene in India, through Eocene-Oligocene in Europe and Pliocene to Recent in the Indo-Pacific (Davies, 1935).

The species resembles the figure of *"Potamides transecta"* Dall (1890, pl. XI, fig. 7; Dall, 1915, pl. 14, fig. 3) in the coarse ribbing,

number of revolving ribs on the whorls of the spire and posterior notch. It differs from Dall's species in a larger number of spiral ribs on the base of the body whorl, fewer on the posterior portion, smaller number of longitudinal folds, less recurved anterior canal and less concave basal outline of the body whorl. *"Potamides" transecta* is from the lower Miocene Tampa limestone.

For generic relationship *B. advena* may be compared with the abundant western Atlantic Recent species *B. minima* (Gmelin) (Bequaert, 1942, p. 8, pl. 5). *B. minima* was placed in the subgenus *Lampanella* Mörch (1876) by Bequaert but he did not believe such a division was warranted. Dall (1890, p. 189; 1915, p. 91) placed *"Potamides" transecta* in *Lampanella.*

Cerithium (Bittium) plaga Oppenheim (1901, p. 266, pl. XV, figs. 10, 10a) from the Eocene of Dolnja Tuzla has a comparable general pattern of sculpture. The longitudinal folds die out on the posterior area of the body whorl in both species. The longitudinal ribs are stronger but fewer in the Florida species, and there are less spiral ribs on the whorls of the spire.

Types.—Holotype, No. I-7405; paratype, I-7406, Fla. Geol. Surv.

Occurrence.—Inglis member, Moodys Branch formation, loc. L-93, Fla. Geol. Surv.

Genus Bellatara Strand, 1928

(Bellardia Mayer-Eymar, 1870 not *Bellardia* Robineau-Desvoidy, 1863 or of Roudani, 1864, or of Bucquoy, Dautzenberg, and Dollfus, 1883).

Bellatara is a middle Eocene genus of northern Italy and the Balkan Peninsula. It was assigned to the marine family Cerithiidae by the early authorities but Davies (1935, p. 257) referred the forms to Melanopsidae, the fluviatile group. He briefed the description of the genus as with no posterior notch. However, the type species has a posterior notch. Cox (1931, p. 46) reiterated the cerithiid position of the genus. The association of the type species is marine. The discovery of specimens of *B. americana, B. citrana* and *B. floridana* extends the range of the genus into the lower upper Eocene in Florida.

The apparent abundance of this genus including specific differentiation in the Florida Eocene reveals a faunal element not heretofore noted in the southern American Eocene. The association bears a resemblance to that of the fauna of the middle Eocene beds of Mt. Postale, northern Italy. The Floridian species, however, range from the middle Eocene into the lower upper Eocene equally as well developed in each horizon.

Bellatara americana Palmer, n.sp.
Plate 2, figures 3, 9, 12

Shell large, robust, whorls narrow and broad in adults; suture sharp and impressed; canal short, reflected, concave behind; posterior notch present with lines of growth curved on the body whorl following the strong swing of the labrum into the short canal; a strong incised line is present on the whorls above the midline of the whorl and forming a broad well-marked area parallel with the suture. Apical whorls with fine spiral threads crossed by incipient longitudinal ribs. Both become obsolete on the adult whorls. Figure 12, Plate 2 is an immature shell showing primitive longitudinal striae. On the apical whorls of the holotype rudimentary varices are present. They are not noticeable beyond the sixth whorl. Probably the varix-like folds are what in *B. floridana* persist as strong nodes on the adult whorls. *B. americana* differs from *B. floridana* in the lack of nodes in the mature stage and in the presence of the subcentral incised line on *B. americana*.

The holotype of this species is complete except for the earlier apical whorls. The specimen bears a close resemblance to "*Cerithium gomphoceras* Bayan" figured by De Gregorio (Ann. Geol. Paleont., 14 liv., 1894, p. 19, pl. 3, figs. 77-87) from Mt. Postale, Italy.

Types.—Holotype, No. I-7407; paratypes, I-7408, 7409, 7410, Fla. Geol. Surv.

Occurrence.—Avon Park limestone. loc. L-76; Inglis member, Moodys Branch formation, loc. L-93 (type), L-135, Fla. Geol. Surv.

Bellatara citrana Palmer, n.sp.
Plate 2, figure 8

Shell large, robust, sides of whorls straight; suture sharp and impressed, whorl slightly raised at suture in the body whorl and penultimate whorl, thereafter on the whorls of the spire the upper margin of each whorl becomes increasingly enlarged until it forms a distinct rounded rib margin; on the young and probably corresponding apical whorls of the adult this is a large revolving swollen rib which is the most conspicuous feature of the shell. On the anterior portion of older whorls of the spire there are two minor revolving ribs, these are present in the young but on the postnuclear whorls there is only one spiral. The sutural rib may be finely nodose. There are inconspicuous nodes or tubercles just above the suture on the penultimate whorl. This character reveals generic affinity. The canal is short; aperture unknown.

This species differs from *B. floridana* and *B. americana* in the

presence of the revolving ribs on the lower portion of the whorls of the spire and the strong sutural rib just below the suture. It lacks the strong nodes of *B. floridana* and the revolving incised line of *B. americana*. The revolving ribs on the lower portion of the whorls including the body whorl suggest that of *Campanile*. In *Campanile* (see Favre, 1918, pl. 12, figs. 200-201 for one of the best illustrations of *C. giganteum* Lamarck) the nodes on all the whorls are near the upper margin of the whorl. In this species nodes are conspicuously absent except on the penultimate whorl. They occur just above the suture.

The author is aware of the wide variation in the ontogeny of cerithiid species. On that basis I have endeavored preliminarily to divide the specimens of *Bellatara* into three species.

Types.—Holotype, No. I-7412; paratypes, Nos. I-7411, 7413 (all plastotypes), Fla. Geol. Surv.

Occurrence.—Avon Park limestone, loc. L-76; L-118; Inglis member, Moodys Branch formation, loc. C-11 (type), Fla. Geol. Surv.

Bellatara floridana Palmer, n.sp.
Plate 2, figures 10, 11, 13

Shell large, robust, adult with more than nine whorls, line of whorls straight; suture impressed, sharp; surface of immature individuals and of the whorls of mature shells excluding the body whorl and penultimate whorl is smooth; on the penultimate whorl there are large nodes with the line of the base of each just above the center or about the center of the whorl; there are probably six or seven of the nodes; obscure revolving lines are present on the last two whorls mainly on the posterior area; faint curved longitudinal striae are seen on the body whorl of the holotype. Immature shells of 25+ mm. in length and of at least eight whorls are smooth. The canal is short; aperture not known.

This species is congeneric with *B. palaeochroma* (Bayan) from the middle Eocene (Lutetian) of Mt. Postale, northern Italy. The striking resemblance may be seen in Cossmann (Essais Paléoconch. comp., 7 liv., p. 70, 1906, pl. 2, figs. 6-8) and better because of the series of figures in De Gregorio (Ann. Geol. Paleont., 14 liv., 1894, pl. IV, figs. 88-93) as well as in Oppenheim (Palaeont., vol. XLIII, 1897, pl. XV, figs. 1-3). *B. floridana* differs from *B. palaeochroma* in that the nodes are smaller with a greater number, and they may also appear on other whorls of the spire and the body whorl. *B. palaeochroma* (Bayan) is the type species of *Bellardia* Mayer-Eymar, 1870=*Bellatara* Strand, 1928.

This species is represented in the material studied by three adult individuals and three immature specimens from locality L-135 and one immature shell from L-118. These specimens were part of a suite of what were preliminarily referred to as *Campanile,* n.sp. (see Fla. Geol. Sur., Bull. 33, p. 119). The form is fairly abundant. The genus, as yet known, is limited to the middle and lower upper Eocene.

Types.—Holotype, No. I-7414 (plastotype); paratypes, Nos. I-7415, 7416, 7417, Fla. Geol. Surv.

Occurrence.—Avon Park limestone, L-118; Inglis member, Moodys Branch formation, loc. L-135 (type), Fla. Geol. Surv.

Bellatara wechesensis (Stenzel in Renick and Stenzel)

Cerithium vinctum Dall, 1892, Wagner Free Inst. Sci., Philadelphia, vol. III, pt. II, p. 285, pl. 22, fig. 9 not *C. vinctum* Whitfield, 1865, p. 265, pl. 27, fig. 8.

Vertagus wechesensis Stenzel in Renick and Stenzel, 1931, Univ. Texas Pub., Bull., No. 3101, pl. VI, fig. 8.

Clava ("Ochetoclava") vincta Palmer, 1937, p. 217 in part, pl. 29, figs. 15, 16 not *C. vinctum* Whitfield, 1865.

Clava wechesensis (Stenzel), 1938, Univ. Texas Pub., Bull., No. 3818, p. 112 footnote.

This species and *B. vincta* (Whitfield) are not typical *Cerithium*[1] Bruguière, 1789, nor *Clava* Martyn,[2] 1784, type species *C. rugata* Martyn *(Vertagus* Schumacher, 1817, not Link, 1807) where they have been indefinitely assigned previously. Both species are represented in the lower Claiborne Eocene of the Mississippi Embayment area: *B. vincta* (see Palmer, 1937, pl. 29, figs. 10, 11; Gardner, 1945, pl. 14, figs. 3, 7) from the Lisbon formation[3] of Lisbon, Alabama, and *B. wechesensis* from the Weches formation of Texas (Stenzel, 1938). These forms exhibit relationships with *Bellatara* and particularly with pertinent similarities with the Florida species so classified. The incised line of *B. americana* suggests affinity. The longitudinal sculpture of the young shells and apical whorls of the adults is stronger in the species to the west

[1]The status of *Cerithium* rests upon the identification of "Le Cerite" Adanson, 1757. That shell has been regarded as *C. adansoni* Bruguière (Stewart, 1927, p. 355; fig'd by Cossmann, 1906, pl. 1, figs. 3-4). However, Piette-Fischer and Fischer (1940, pp. 116-118) have studied Adanson's type and believe it to be *C. erythraeonense* Lamarck, 1822, which may be a variety of *C. nodulosum* Bruguière, 1789. This is the type species used by Cossmann, 1906.

[2]There is adverse opinion as to using Martyn's names (Winckworth, 1929, pp. 228-229) in spite of Dall's (1905, 1907) recommendation that six of the generic names, including *Clava,* were on a binomial basis.

[3]Name preoccupied.

than in the Floridian, *B. americana*. The canal is longer in *B. wechesensis* than in the Floridian species.

Clark (in Clark and Durham, 1946) figured a large single poorly preserved specimen from Zone C, Carmen area, Department of Bolivar, Colombia, in which he pointed out an affinity with *B. vincta* (Whitfield). The illustration by Clark (pl. 24, fig 1) exhibits a specimen of the character of *B. americana,* n.sp. It certainly reveals the presence of this same group of gastropods such as the Floridian shells. Clark correlated Zone C with the Saman sandstone and the Chira shale of Peru. Olsson (1930-31) regarded the Saman sandstone as upper Eocene and the Chira shales as lower Oligocene. Clark included both formations in the upper Eocene.

Genus Pseudoaluca Clark, 1946

Pseudoaluca clarki Palmer, n.sp.

Plate 8, figures 5, 12

Shell medium in size, height probably up to 45 mm. (adult) and maximum diameter, 10 mm., apical whorls and complete aperture not known; whorls sculptured with conspicuous primary revolving ribs, about four on early whorls increasing to seven or eight on later whorls. Between the primaries are microscopic spiral striae, usually two; below the first and/or second primary there is a concave area constricting the ribs above the suture as a subsutural collar; longitudinal folds occur which are well developed on the early whorls and become obsolete on the body whorl; the spiral primaries are beaded where the longitudinals cross; irregular widely swollen varices, usually one to a whorl are conspicuous; sutural margin at the point of the labrum swings upward to take care of the extended posterior canal.

Bruce Clark in 1946 (Geol. Soc. Amer., Mem. 16, p. 28) described the new genus *Pseudoaluca* to accomodate shells he found in the upper Eocene of Colombia. He designated a Paris Basin Lutetian species *Cerithium jussieui* Mayer-Eymer as the type species. This species is expertly illustrated by Cossmann and Pissarro (Icon. comp. Coq. fos. l'Eocène Env. Paris, 1910-1913, pl. XXIV, fig. 137-23) so that details of the sculpture and aperture may be determined.

The present species is represented by 10 specimens besides the holotype. Although the apical whorls and complete aperture are destroyed, many pertinent characters are well preserved and show a close resemblance to the type species of *Pseudoaluco. P. clarki* has stronger varices than the type species and there are more striae between the primaries. The Florida species is congeneric with the

sculptured *forma* which De Gregorio (1896, pp. 135-137) grouped under *"Cerithium corvinum"* (Brongniart, 1823).

De Gregorio (1896, pl. 25, fig. 13-15 a, b) illustrated shells from the Eocene of Mt. Pulli, Italy, as *C. fontis felsinae* Oppenheim. Specimens of *P. clarki* resemble those figures more than they do the originals of Oppenheim (Deutsche Geol. Gesell., Zeit. 46, 1894, p. 396, pl. XXV, figs. 8-10). De Gregorio showed that sculpture and nonsculpture were transitional.

Named in honor of the late Dr. Bruce Clark who described the genus.

Types.—Holotype, No. I-7641, Fla. Geol. Surv.

Occurrence.—Inglis member, Moodys Branch formation, loc. L-93, C-11 Fla. Geol. Surv.

Family Hipponicidae

Genus Hipponix Defrance, 1819

Hipponix floridanus Palmer, n.sp.

Plate 3, figures 6-8

Shell large; convex; apex strongly curved; inner margin of the aperture wider across the area beneath the apex, narrowing on both sides to the sharp margin anteriorly; surface covered with coarse radiating ribs which have interspaces about equal in size. The ribs may die out with age but not with size. Some of the large individuals have the surface completely sculptured while smaller gerontic shells have the surface smooth. Usually in such individuals the umbonal area retains the spiral ribs.

This species differs from *H. pygmaeus* Lea (1833) of the Claiborne and Jackson Eocene of the Mississippi embayment area (Palmer, 1947, p. 265, pl. 32, figs. 1-3) in size and character of the radiating ribs. In size and ribbing this species falls in the category of *H. vagus* (Palmer, 1944, p. 6, pl. 2, figs. 1-3) from the Gosport sand of Claiborne Bluff. That species is known so far only from the well-preserved holotype. The present species represented by eight specimens are all strongly curved while *H. vagus* with age has the umbo elevated as in *H. cornucopiae* Lamarck of the Lutetian and Bartonian of the Paris Basin (Cossmann and Pissarro, 1913, t. 2, pl. XII, figs. 74-1).

The species is well represented in the Inglis member, loc. L-93. One specimen was collected from the Avon Park limestone.

Types.—Holotype, No. I-7418; paratypes, I-7419, 7420, 7421, Fla. Geol. Surv.

Occurrence.—Avon Park limestone, loc. L-73; Inglis member, Moodys Branch formation, loc. L-93 (type).

Family Calyptraeidae
Genus Calyptraea Lamarck, 1799
Calyptraea aperta (Solander)
Plate 2, figures 1, 2

Trochus aperta Solander in Brander, 1766, p. 9, pl. 1, figs. 1, 2.
For continued synonymy see Palmer, 1937, p. 145.

This species is known from the English, French, and American Eocene. In the southern states it occurs in the Sabine (Wilcox), Claiborne, and Jackson Eocene (Palmer, 1937, p. 145; Palmer, 1947, p. 261). Similar variations are exhibited in the different geographic and geologic locales.

Four specimens from the Inglis member at L-93, with shape and sculpture well preserved, are typical of the species.

Specimens.—No. I-7422, 7423 (figured), 7424, 7425, Fla. Geol. Surv.

Occurrence.—Inglis member, Moodys Branch formation, L-93, Fla. Geol. Surv.

Family Xenophoridae
Genus Xenophora Fischer de Waldheim, 1807
Xenophora, sp.
Plate 2, figure 6

The cast of this species resembles the usual specimens in the Eocene which have been identified as *X. trochiformis* (Born) (Palmer, 1947, pl. 30, figs. 15, 18). The specimen figured is from Levy County at L-135, Inglis member of the Moodys Branch formation. Another specimen (No. I-7427) from L-139, same formation, is not so well preserved.

Specimen figured.—No. I-7426, Fla. Geol. Surv.

Genus Tugurium Fischer, 1880
Tugurium grayi Palmer, n.sp.
Plate 2, figure 7

Shell high, moderately large; whorls six; fragments which were cemented to the whorls were coarse.

Although this species is represented in the collections by the holotype only, because of the high spire it is distinct from the other species of Xenophoridae so far described from the Eocene of the southern United States. Usually the Eocene specimens of *Xenophora* are not well preserved, and they have been compared to the Recent *X. trochiformis* (Born) (Palmer, 1937, p. 143; Clench and Aguayo, 1943, p. 2; Palmer, 1947, p. 258) or indicated merely as "species." Two such specimens in this material are so labelled

(Plate 2, figure 6, one figured). *T. grayi* differs from all such specimens in its elevated shape. In that respect it is conspicuously like *Xenophora delecta floridana* Mansfield (1930, p. 121) from the Choctawatchee Miocene of Florida. The size is about the same in both species. The whorls of *T. grayi* differ from *X. floridana* in having the point of greatest convexity below the midline of the whorl. In *X. floridana* that point is about at the central line of height of the whorl. The base of *T. grayi* is not available. The whorls apparently did not carry many objects as only about three impressions of such are noted but more may have been on the broken basal whorl. *Tugurium* differs in one respect from *Xenophora* in that only a few particles are cemented to the whorls. The other pertinent characters of each genus are not available in the holotype to identify the distinction with certainty.

Named in honor of Carlton Gray who prepared many of the specimens for this study.

Type.—Holotype, No. I-7428, Fla. Geol. Surv.

Occurrence.—Inglis member, Moodys Branch formation, loc. C-11, Fla. Geol. Surv.

Family Strombidae

Genus Laevella Palmer, n.genus

Type species, *L. floridana* Palmer, n.sp.

Shell medium in size; spire moderate; canal short, wide with a slight but definite notch bounded anteriorly by a thick margin; outer lip expanded, flaring and thickened; aperture narrow; posterior canal cuts obliquely and deeply across the thickened labrum; posterior canal extends narrowly but completely over the apex and down over the spire to the suture of the body whorl; shell smooth except for two or three sharp lines just over the anterior canal; on one adult shell obsolete longitudinal folds may be discerned over the body whorl.

The complete smoothness of the shell, the abbreviated but wide canal with slight notch and pointed margin of it, the wide calloused labrum, obliquely cut posterior canal characterize this genus as different from any rimellid so far known. It appears to be allied nearest to *Ectinochilus canalis* (Lamarck) type species of *Ectinochilus* Cossmann, 1889, but there are too many critical differences with that genus to include the Florida species in it. *Laevella* is like *Ectinochilus* in the abbreviated canal, but it does not have the two notches in the canal margin as in that genus. The spire is shorter in *Laevella,* the labrum is more extended and the surface is smooth.

Laevella floridana Palmer, n.sp.
Plate 3, figures 1-5

The description of the species has been presented in the characterization of the genus. The species is so far unique. It is abundant at the type locality.

Types.—Holotype, No. I-7436; paratypes, I-7437, 7438, Fla. Geol. Surv.

Occurrence.—Inglis member, Moodys Branch formation, loc. L-93 (type) and C-11, Fla. Geol. Surv.

Genus Terebellum Roeding in Bolten, 1798
Subgenus Seraphs Montfort, 1810
Terebellum (Seraphs) belemnitum Palmer, n.sp.
Plate 3, figures 9, 12

Shell large, cylindrical; the spire is enveloped and the aperture extends to about one millimeter from the apex of the spire. The aperture is linear for the upper third of the shell, appearing as a groove, anteriorly from above the midline the inner lip curves backward and the margin of the labrum projects outward thus widening the aperture two or three times the width of the posterior end; cross section of the shell is a regular wide spiral; sutures not discernible.

T. belemnitum resembles most *T. (Seraphs) californicum* Vokes (N.Y. Acad. Sci., Ann., vol. XXXVIII, 1939, p. 157, pl. 20, figs. 7, 8, 11) from the Domengine, lower upper Eocene of California.

This species is the first described *Terebellum* or *Seraphs* from the Eocene of the southern United States. "*T. fusiforme* Lamarck" (not Lamarck, Ann. du Mus., 1803, p. 390) mentioned by De Gregorio (Ann. de Geol. Pal., 1 liv., 1890, p. 116, pl. 10, figs. 7-10) is not a *Seraphs* but *Terebellum s.s.*, with well-marked sutures. The specimens did not come from the Gosport sand but probably from the Ocala "limestone" above "the sand." The report of "*Terebellum*, sp." listed by Kennedy (Acad. Nat. Sci., Proc., vol. 47, 1895, p. 114) from Alto, Cherokee County, Texas, was probably taken from labels which had been made by G. D. Harris or from Harris' Texas manuscript which was never published. The Harris drawing of a fragment, 14 mm. in length (plus 5 or 6 mm. destroyed) is of a *Terebellum* with a short spire and visible sutures, inflated medially. The species was never named.

Harris (Amer. Geol., vol. 5, 1890, p. 315) called attention to casts in the collection of the U.S. National Museum, Sta. No. 2056, Mt. Enterprise, southeastern Rusk County, Texas, Claiborne group,

Reklaw formation, middle Eocene, which he noted probably belonged to *Terebellum*.

Types.—Holotype, No. I-7642; paratype, No. I-7643, Fla. Geol. Surv.

Occurrence.—Inglis member, Moodys Branch formation, loc. L-93, Fla. Geol. Surv.

Family Cypraeidae
Genus Cypraedia Swainson, 1840
Cypraedia fenestralis Conrad
Plate 5, figures 2, 3

Cypraea (Cypraedia) fenestralis Conrad, 1854, Wailes, Rept. Agr. Geol. Mississippi, p. 289, pl. XVII, figs. 5a, 5b; Conrad, 1855, Acad. Nat. Sci. Philadelphia, Proc., vol. VII, p. 262; 1939, Reprint, Bull. Amer. Paleont., vol. XXIV, No. 86, pp. 8, 19, pl. 4, figs. 5a, 5b.

Cypraedia fenestralis Conrad, Ingram, 1942, Bull. Amer. Paleont., vol. XXVII, No. 104, p. 19, pl. 4, figs. 2, 3; Palmer, 1947, Bull. Amer. Paleont., vol. XXX, No. 117, pt. 2, p. 320, pl. 40, figs. 9, 10, 17, 18.

Two specimens, not complete, but exhibiting excellently preserved sculpture were recovered in the Inglis member sediments. They seem to be typical of the species from the Moodys Branch formation in the Mississippi embayment area.

Specimens figured.—Nos. I-7439, 7440, Fla. Geol. Surv.

Occurrence.—Inglis member, Moodys Branch formation, loc. No. L-93, Fla. Geol. Surv.

Family Ampullospiridae
Genus Ampullinopsis Conrad, 1865
(*Megatylotus* Fischer, 1887)
Ampullinopsis citrinensis Palmer, n.sp.
Plate 3, figures 10, 11

Shell large, spire elevated, body whorl globose, whorls five, apical whorls poorly preserved; suture conspicuously channelled; large and wide umbilical callus with faint groove centrally directed posteriorly from a rim of the exposed umbilical sheath; remainder of anterior tip of shell unknown. Even fragments of the spire of this species may be known by the channelled suture.

This species is related to the Vicksburg *A. mississippiensis* Conrad and *A. crassatina* (Lamarck), an important middle Oligocene (Rupelian) marker in Europe. The Florida Eocene species differs from *A. crassatina* in having a broader heavier callus and

a faint umbilical groove. *A. amphora* (Heilprin) (1887, p. 112, pl. 16, fig. 50; Dall, 1915, p. 108, pl. 11, fig. 5) from the Tampa, lower Miocene, Florida, has a wider shoulder to the whorls than *A. citrinensis* does. *A. citrinensis* has been compared with the holotype and five other Conradian specimens of *A. mississippiensis* Conrad from the Vicksburg at the Academy of Natural Sciences in Philadelphia. *A. citrinensis* is typical generically of those specimens with perhaps a slightly heavier callus. The additional specimens which Conrad had are larger and better preserved than his holotype.

A species which resembles the Florida shells in the feature of the heavy callus is "*Natica* (*Ampullina*) *incompleta* Zittel" in Oppenheim (1901, p. 153, pl. XL, figs. 9-11) upper Lutetian Eocene of Guttaring, Pusta Forna and Dabrica (Herzegowina). The whorls of that form are more sharply shouldered that those in *A. citrinensis*.

In the Nanggulan upper Eocene fauna of Java (Martin, 1914, p. 173, pl. VI, figs. 152-154), *A. ickei* Martin has a smaller spire, narrower whorls and more exposed umbilical sheath than *A. citrinensis* has.

Types.—Holotype, No. I-7434; paratype, No. I-7435, Fla. Geol. Surv.

Occurrence.—Inglis member, Moodys Branch formation, loc. C-11 (type); L-139, Fla. Geol. Surv.

Genus Pseudocrommium Clark, 1946

Pseudocrommium brucei Palmer, n.sp.

Plate 4, figures 2-8

Shell large; spire high and sharp; composed of about seven whorls; about one and one-half nuclear whorls, bulbous; body whorl globose; whorls broadly shouldered, concave at the suture sloping to a rounded shoulder margin; the surface of the shell has prominent regularly spaced enlarged longitudinal growth lines which give the appearance of fine sharp ribs. These are developed strongest on the concave area of the shoulder. Some shells, particularly a figured paratype, have the lines conspicuously developed over large portions of the whorls. Although microscopic on the young specimens they are intimated most strongly just below the suture. They are less well developed on the earlier whorls of the spire; umbilical area may be completely closed with callus or a slight narrow opening may be present; the callus may be broken back in adults revealing an irregular funicular ridge with a groove behind; margin of the callus recurved below and flaring.

This species resembles *P. occiduum,* n. sp. in the elevated spire, with about the same number of whorls, and by the shouldered whorls of the spire. *P. brucei* differs from the older species in being smaller, narrower, and by the less channelled sutural area.

This group of ampullinids is represented in the middle Eocene of the Paris Basin and English Basin and Italy. They have been designated as *Ampullaria, Ampullospira, Pachycrommium,* and *Ampullina.* (See Cox, 1931; Wrigley, 1946). In America, *P. perovatum* Conrad (Claiborne, Gosport sand and *P. jacksonense* (Harris)) (Jackson, Moodys Branch formation) are from the Eocene of the southern United States. The type species and another are from the upper Eocene of Colombia (Clark, 1946, p. 19).

This species was referred to in preliminary lists as *Crommium,* n.sp. (Fla. Geol. Sur., Bull. 33, p. 120).

The incised longitudinal lines are suggestive of *Pseudomaura* Fischer (1885) of the Rauracian (Jurassic) through Neocomian according to Cossmann (1925, pp. 22-24). Wenz, however, extends the genus from the middle Triassic through the Miocene (Wenz 1941, p. 1021, fig. 2927 *P. bulbiformis* (Sowerby), type species). Although the incised lines are more continuous and frequent than shown on the illustration of a paratype of *Pseudocrommium brucei,* they do not completely cover all of the whorls as in the type species of *Pseudomaura.*

Amaurellina (*Euspirocrommium*) *clarki* Stewart (see Weaver, Univ. Washington Publ. Geol., vol. 5, pt. II, 1943, p. 345, pl. 70, figs. 10, 18) may be a related species which existed in the middle Eocene (Domengine) of California and upper Eocene (Cowlitz) of Washington.

Types.—Holotype, No. I-7429; paratypes, I-7430-32, I-7640 Fla. Geol. Surv.

Occurrence.—Inglis member, Moodys Branch formation, loc. L-93 (type), loc. L-139, L-135, C-11, Fla. Geol. Surv.

Pseudocrommium occiduum Palmer, n.sp.
Plate 4, figure 1

Shell large, broad, spire high and pointed, seven whorls broadly shouldered with a concave channel at the sutures. No impressions of pronounced growth stages as in *P. brucei* where the longitudinal lines are coarse at regular intervals.

This species is known by the holotype only which consists of the external impression of the spire and upper body whorl and the internal mold of the same which includes the complete body whorl.

This species attains a size about twice that of *P. brucei.* The

shoulders are concave at the suture and flatter at the periphery of the shoulder than in *P. brucei*. *P. occiduum* also lacks the conspicuously marked growth stages of *P. brucei*. The photographs of the holotypes of each species are deceiving as to size if taken as illustrated. That of *P. occiduum* is reduced in size.

P. occiduum approaches in size *P. scalariformis* (Deshayes) (1837, pl. 16, figs. 8, 9; Cossmann and Pissarro, 1910-1913, Pl. XI, fig. 64 bis 3) from the Paris Basin and English Lutetian. Where the holotype of *P. occiduum* is about 110 mm. (est.), the height of *P. scalariformis* is about 130 mm. The spire is more elongate, 50 mm., length to 45 mm., width, while in *P. occiduum* the ratio between the same areas is 1:1. The character of the shouldered whorls are similar in the two species and is closer than that of American ampullinid species are to *P. occiduum*. Both species are from the middle Eocene.

Type.—Holotype, No. I-7433, Fla. Geol. Surv.

Occurrence.—Avon Park limestone, loc. L-76, Fla. Geol. Surv.

Family Cymatiidae
Genus Distorsio Roeding in Bolten, 1798
Subgenus Personella Conrad, 1865
Distorsio (Personella) jacksonensis (Meyer)
Plate 7, figures 10, 11

Distortrix Jacksonensis Meyer, 1885, Am. Jour. Sci., vol. XXIX, 3d ser., pp. 464, 468; Meyer and Aldrich, 1886, Cincinnati Soc. Nat. Hist., Jour., vol. IX, No. 2, p. 50.

Distorsio (Personella) septemdentata jacksonensis (Meyer), Palmer, 1947, Bull. Amer. Paleont., vol. 30, No. 117, pt. 2, p. 336, pl. 44, figs. 7-9.

One medium-sized specimen of *Personella* was recovered from the material at locality L-93, Levy County. The shell is well preserved. Even though compared to *P. jacksonensis* (Meyer) from Jackson, Mississippi, by means of a single shell it adheres to the specific characters of *P. jacksonensis* rather than to those of *P. septemdentata* Gabb (1860, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., IV, p. 380, pl. 67, fig. 21; Palmer, 1937, p. 260, pl. 34, figs. 10, 11 in formations and members of the lower Claiborne of Texas, Louisiana and Mississippi). This influenced me to recognize a specific differentiation, as Meyer originally did, between the lower Claiborne form and the Jackson species.

The Florida specimen is intermediate in age (14 mm., height) between adult individuals of *P. septemdentata* of 22 mm., height and specimens of *P. jacksonensis* of 9 mm. in height. It has two

large teeth on the posterior area of the interior of the labrum with four minor ones anteriorly to the brink of the canal. This is similar to the condition in *P. jacksonensis* while in *P. septemdentata* there are seven robust teeth, but about uniform in size, on the same region. In the Florida and Jackson forms the teeth on the inner lip are larger and fewer, three in number, than on *P. septemdentata*. The Florida shell, like *P. jacksonensis*, is less distorted than *P. septemdentata*. It has the revolving ribs closer with a microscopic spiral thread in the interspaces as in *P. jacksonensis*. *P. septemdentata* has wide interspaces. Of two small Jackson specimens examined one has a short blunt canal, the other sharper and more elongate. The Florida shell has the blunt canal.

Specimen figured.—No. I-7644, Fla. Geol. Surv.

Occurrence.—Inglis member, Moodys Branch formation, loc. L-93, Fla. Geol. Surv.

Family Fasciolariidae

Genus Papillina Conrad, 1855

Papillina gunteri Palmer, n.sp.

Plate 8, figures 1-4

Shell large with huge spines in adult. Nuclear whorls smooth, about four and one-half; apical whorl minute, flattened; postnuclear whorls begin abruptly with spiral ribs and obscure longitudinal folds. A suite of three immature individuals reveal the *Papillina* nucleus of this species. The youthful stage of sculpture identifies the species as distinct from *P. dumosa* (Conrad) (Wailes, Rept. Agr. Geol. Mississippi, 1854, p. 289, pl. XVII, figs. 10a, 10b see Palmer, 1947, p. 389 for further reference and figures) of the Jackson Eocene.

The immature shells have coarse spiral lines and wide longitudinal folds which extend obliquely across the whorls. With maturity the longitudinal ridges become pinched into large sharp spines. On a gerontic specimen such as the holotype the spiral lines are obsolete except obscurely on the midportion of the body whorl. As illustrated the canal is long and straight. The specimen of middle age as of figure 2, plate 8, has the spiral ribs still conspicuous. Specimens of this age could be confused with *P. dumosa* (Conrad). The spinous character of the longitudinal folds of *P. dumosa* develop before maturity and the young shells do not have the longitudinal ridges the length of the whorl as in *P. gunteri*.

The extreme size of this shell is remarkable, approaching 200 mm. in length. This surpasses the size of *P. dumosa* Conrad or

Levifusus branneri Harris of the Jackson (Moodys Branch formation) Eocene of the Mississippi embayment area.

Named in honor of Dr. Herman Gunter, State Geologist of Florida.

Types.—Holotype, No. I-7645; paratypes, I-7646-49, Fla. Geol. Surv. (I-7649 unfigured.)

Occurrence.—Inglis member, Moodys Branch formation, loc. L-93, Fla. Geol. Surv.

Family Olividae

Genus Agaronia Gray, 1839

Agaronia inglisia Palmer, n.sp.

Plate 6, figures 5, 8, 13

Shell large, composed of four whorls; nuclear whorls bulbous, of about 1½ whorls; suture deeply grooved; anterior marginal callus cut by three prominent grooves, first marking the posterior edge, second anteriorly placed, and the third is about in the midportion; the callus is strongly plicate in the columellar area.

The holotype is like specimens from the Moodys Branch formation at Montgomery, Louisiana, which I identified (1947, p. 410) as *A. mississippiensis* Conrad (1847, p. 289). The latter is a Vicksburg Oligocene species. The types of this species were compared with the holotype and five topotypes of *A. mississippiensis* in the Conrad collection at the Academy of Natural Sciences at Philadelphia, as well as with topotypes from Vicksburg localities. The similarity is close but the difference in shape seems to warrant separation.

The shape in *A. inglisia* is more slender and the spire more elevated. A large specimen (apical whorls gone) of 37 mm. was recovered. This indicates that the species probably attained a larger size than *A. mississippiensis.*

Types.—Holotype, No. I-7604; paratypes, Nos. I-7605, I-7606, Fla. Geol. Surv. (I-7606 unfigured.)

Occurrence.—Inglis member, Moodys Branch formation, loc. L-93, Fla. Geol. Surv.

Genus Olivella Swainson, 1831

Subgenus Callianax H. and A. Adams, 1853

Olivella (Callianax) poinciana Palmer, n.sp.

Plate 6, figures 7, 10

Shell small, broad, stout; moderate spire; whorls four, nuclear whorl large, bulbous, tip minute; sutures channelled, deepened by erosion; inner lip with short callus, one deep groove and a smaller,

fainter one anteriorly; siphonal fasciole bordered above by spiral groove; anterior emargination wide.

This species is suggestive of *C. ventricosa* (Defrance) (Cossmann and Pissarro, 1910-1913, pl. XLVI, fig. 210-1) from the Bartonian of France. It is stouter than that species. *Callianax branderi* (Sowerby) occurs in the Barton of England. *C. lata* (Dall) from the Tampa lower Miocene beds is lower spired and less grooved on the columellar callus.

The type species of *Callianax* is a common Recent species, *Olivella biplicata* (Sowerby) of the Pacific Coast. The subgenus extends from the Paleocene but was widely distributed in the Eocene from Asia, Europe to the Americas.

O. poinciana is represented in the collection by nine specimens, two of which are figured herein.

Types.—Holotype, No. I-7607; paratype, I-7608, Fla. Geol. Surv.

Occurrence.— Inglis member, Moodys Branch formation, loc. L-93, Fla. Geol. Surv.

Family Mitridae

Genus Conomitra Conrad, 1865

Conomitra sp.

Plate 6, figures 9, 14

A poorly preserved specimen (plastotype) of a *Conomitra* was found in the Avon Park limestone (L-73, Bed No. 2). Its generic characters are available which reveal that the shell was a smooth *Conomitra*. It is like the smooth form of *C. lepa, C. fusoides* (Lea) (Palmer, 1937, pl. 66, figs. 23-28) the Claiborne species, except that it is about 4-5 mm. taller with a higher spire. There are no visible longitudinal striations on the apical whorls of this individual. They may or may not be present in *C. fusoides lepa*. Three plications are preserved on the columella, there probably were four.

A single better preserved shell of the same species was recovered from the Inglis member at L-93. This specimen has microscopic spiral striations preserved on the basal area of the body whorl. No striations are visible on the apical whorls.

Specimens figured.—Nos. I-7609, I-7610, Fla. Geol. Surv.

Occurrence.—Avon Park limestone, loc. L-73, Bed No. 2; Inglis member, Moodys Branch formation, loc. L-93, Fla. Geol. Surv.

Genus Lapparia Conrad, 1855

Lapparia conradi Palmer, n.sp.

Plate 8, figures 9-11

Shell elongate, spire 4 or 5 mm. shorter than the length of the

body whorl; nuclear whorls smooth, broadly ovate, consists of about 2½ whorls; postnuclear whorls begin with spiral lines crossed by longitudinal ribs; below the suture there is a concave area in which the spiral lines are stronger than over the middle area of the shell. There are about 16 longitudinal folds which are obsolete in the spiral furrow and increase in strength below; subdued nodes are formed at the margin of the furrow. The spiral lines are coarse on the anterior portion of the body whorl; the fasciole is strong and curved; canal short; four plications on the columella; outer lip thin at the posterior end but thickened from the midline anteriorly by the combination of the last longitudinal rib and the margin of the shell.

The similarity between characters of *Mitreola* Swainson, 1833, of the Paris Basin Eocene and *Lapparia* Conrad has been considered. The resemblance between *L. pactilis* (Con.) has been reiterated by Stenzel and Turner (Type Invert. Fos. N. Amer., [1942], card No. 40) but because of apertural differences the species were retained as belonging to distinct genera. In some species of *Mitreola* there is a tooth on the inner margin of the labrum. The thickened outer lip of *L. conradi* is like *Mitreola* but in the other features the shell is more like *Lapparia*. There is no species of either genus to which this Florida form is related specifically. It lacks the spines of the Claiborne and Jackson species and is more nodose than the smoothest *Lapparia, L. pactilis*.

It resembles most *L. dumosa exigua* Palmer (1937) of the Moodys Branch marl of Mississippi and Louisiana but differs from that subspecies in the longitudinal folds.

Types.—Holotype, No. I-7611; paratypes, Nos. I-7612, 13, Fla. Geol. Surv. (I-7613 unfigured.)

Occurrence.—Inglis member, Moodys Branch formation, Loc. L-93, Fla. Geol. Surv.

Family Vasidae

Genus Eovasum Douville, 1920

Eovasum vernoni Palmer, n.sp.

Plate 7, figures 4-7

Shell large; spire short, narrow, pointed, whorls not convex, crowded; suture appressed; body whorl with row of 11 or 12 strong spines at the shoulder and another about halfway between the posterior row of spines and the basal notch; the lines of growth are convex from the posterior spines to the suture; strong fasciole with probably a large notch; surface of the body whorl covered with spiral ribs with wide interspaces, less developed on the shoulder

and obsolete on the obscure whorls of the spire; spines tubular; aperture tapering not so wide as typical of the genus. There are four columellar folds which become large and prominent with age; callus is wide and thick spreading posteriorly over the spines. The spines appear like nodes on the upper whorls of the spire.

In the character of the spire, position of rows of nodes and number of nodes this shell bears a striking resemblance to *Galeodes millsapsi* Sullivan and Gardner (in Gardner, 1939). The character of the spire, position of the nodes or spines are different in the two forms. The presence of the fasciole in *G. vernoni* places it in the genus which has a basal notch instead of the elongated curved canal.

This species is congeneric with *Eovasum frequens* (Mayer-Eymer) (1895; Oppenheim, 1906) of the middle and upper Eocene of the Moqattam (Mokattam) beds in Egypt. That species is the type species of *Eovasum* Douville. The strong generic features of the four robust columellar plications, the short canal, short spire, nodose shoulder and row of nodes on the lower body whorl are common in both species.

E. vernoni differs from the Egyptian form in less mammiform apical whorls, higher nodose apical whorls, in more sloping spire and convex instead of concave outline of the body whorl. For illustrations of *E. frequens* see Oppenheim, 1906 (Palaeontographica, Bd. XXX, Abt. 111, p. 318, pl. XXIV, figs. 1-7)

The Florida species also resembles *E. douvillei* Olsson (1930, p. 49, pl. 8, figs. 4, 6) from the Restin formation, upper middle Eocene, north of Negritos, Peru. *E. douvillei* has a broader spire than *E. vernoni.*

Named in honor of Dr. Robert O. Vernon, Associate State Geologist of Florida.

Types.—Holotype, No. I-7614; paratypes, Nos. I-7615, 16, Fla. Geol. Surv.

Occurrence.—Inglis member, Moodys Branch formation, loc. L-93, Fla. Geol. Surv.

Family Volutidae

Genus Athleta Conrad, 1853

Athleta arangia Palmer, n.sp.

Plate 8, figures 6, 8

Shell medium in size, spire moderate, nuclear whorls worn; whorls four, those of the spire without spiral threads; longitudinal folds are pronounced and are abrupt and sharp just below a concave groove below the suture; the longitudinal ridges extend an-

teriorly below the midline of the body whorl; the entire surface of the body whorl is covered with conspicuous spiral threads.

This species bears a relationship with the *A. petrosa* (Conrad) stock (Palmer, 1937, pl. 58) which is a variable species from the Sabine (Wilcox) through Jackson Eocene. *A. arangia* resembles *A. ficulina* Lamarck (Palmer, 1937, pl. 57, fig. 4) from the Burdigalian Miocene of France, except that the spire of the Florida species lacks the spiral lines and the body whorl is more elongate. *A. ficulina* Lamarck is the normal stage of *A. varispina* Lamarck which is the type species of *Athleta* Conrad. Of the *A. petrosa* group, *A. arangia* falls in the category of such forms as *A. petrosa indenta* Conrad in the Crockett formation, middle Eocene of Texas. It differs from *A. indenta* in having the longitudinal ribs much stronger over the body whorl and a more elongate body whorl.

Types.—Holotype, No. I-7617; paratypes, I-7618, I-7619, Fla. Geol. Surv. (I-7619 unfigured.)

Occurrence.—Inglis member, Moodys Branch formation, loc. L-93 (type, and C-11, Fla. Geol. Surv.

Genus Sycospira Palmer, new genus

Type species, *Sycospira eocenica* Palmer, n.sp.

Shell large, smooth, whorls four, sutures appressed; shell thin; young shell, 28 mm. in height, bulbous with immense nucleus (15 mm., greatest diameter); sutural line of nuclear whorls deep and curved vertically; columellar callus thin; two columellar plications, not visible from front view of shell; plications well developed on the young of above dimension.

This genus is known by two specimens, an adult and a juvenile. The nuclear whorls of the young specimen are as broad as the body whorl and half as high as the whorl. The immense inflated nucleus is similar to that of *Pterospira* and was tentatively placed there. *Pterospira* G. F. Harris (Cat. Tert. Moll. Brit. Mus., pt. 1, 1897, p. 100) was described from the Eocene of Australia. That genus has three plications and a winglike expansion of the labrum. The whorls are nodose. Therefore, *S. eocenica* does not belong in *Pterospira.*

The adult shell of this genus has a nearly straight canal and lower columellar area and is not congeneric in shape and aperture with *Mamillana* Crosse (Jour. de Conchyliol., 19, 1871, p. 308) which also has a huge type of nucleus. *Mamillana* is Recent in the Australasia region.

An association of the specimens included under this genus and species was made in the first examination. But apparent lack of

plications on the large specimens and its close resemblance to species of *Sycostoma* in the English and Paris basins Eocene led to the identification under *Sycostoma* and it was so reported in the abstract of the work (Palmer and Richards, 1952).

On deeper excavation of the columellar area two large plications were revealed. These would place the species in the Volutidae and indicate that the two specimens, young and adult, do belong to the same species. The young shell also has two large plications deeply placed.

Sycospira eocenica Palmer, n.sp.
Plate 7, figures 1-3, 9

Description of the species same as for the genus. So far as is known the species is unique.

Types.—Holotype, No. I-7620; paratype, I-7621, Fla. Geol. Surv.

Occurrence.—Inglis member, Moodys Branch marl, loc. L-93, Fla. Geol. Surv.

Genus Caricella Conrad, 1835
Caricella obsoleta Palmer, n.sp.
Plate 5, figures 9-13

Shell elongate; nuclear whorls bulbous, smooth, about two whorls the first large, the second narrow in height; postnuclear whorls begin with about six or seven coarse spiral ribs which cover the entire whorl; on the remaining whorls of the spire on adult shells, the spiral ribs are present only on the upper portion of the whorl, between the suture and the shoulder in a concave area; the spiral ribs are present on the lower portion of the body whorl from about the midline of the columella anteriorly. The basal revolving ribs may have interspaces equal to the width of the rib or they may have fine intervening threads; four or five columellar plications.

This species is like *C. pyruloides* (Conrad) of the Gosport sand and *C. polita* Conrad from the Jackson Eocene in the presence of the spiral threads or fine ribs over the whorls of the spire and upper and lower portion of the body whorl on the adult. The spiral sculpture in this species differs from those two forms in that the young and immature specimens of *C. obsoleta* do not have spiral lines over the entire shell (Pl. 12, figs. 12, 13). The three species are similar in general shape. Of the group *C. pyruloides* has the finest spiral threads or ribs and *C. obsoleta,* the coarsest.

The largest specimen of *C. obsoleta* found measures approximately 55 mm. in height and 32 mm., greatest diameter.

Types.—Holotype, I-7622; paratypes, I-7623, 7624, Fla. Geol. Surv.

Occurrence.—Inglis member, Moodys Branch formation, loc. L-93, Fla. Geol. Surv.

Genus Voluticella Palmer, new genus

Type species, *Voluticella levensis* Palmer n.sp.

Shell medium in size; body whorl enlarged, pyriform, forming practically all of the shell; nuclear whorls smooth, flattened, the initial point is a low elongated knob, about 1 mm. in length, the first and second whorls are broad, narrow in height and flattened; the last half whorl of the nucleus is smooth and narrow, ¾ mm. in height; postnuclear portion of the spire is coarsely sculptured, first with longitudinal ribs with spirals becoming conspicuous thereafter; sutures impressed, border of the lower whorl is constricted with a groove below; the shoulder of the body whorl is rounded. The whole surface of the shell is covered with coarse spiral ribs; longitudinal lines cross the spiral ribs and give the surface of medium-sized shells a reticulate appearance; the intersections of the two lines develop granular threads or small nodes, which are more crowded toward the sutures; aperture narrow, elongate, canal short; five plications present on the columellar callus with several small ones posteriorly on some specimens; callus thin.

The type species is abundant at the type locality with young, medium and adult shells present. Individuals have been recovered from two different localities.

The genus appears superficially like a reticulately sculptured *Caricella* but differs from *Caricella* in the increased number of columellar plications. The highly ornamented Caricellas known in the American Eocene and Oligocene, *C. reticulata* Aldrich, *C. reticulata stenzeli* Palmer and *C. turneri* Palmer have an elevated spire. The nuclear whorls of *Voluticella* are flatter than those of *Caricella*.

The species, which illustration and description suggest that it belongs to this genus, is a form from the uppermost Ranikot (Paleocene) of Jhirak, in India which Cossmann and Pissarro (1909, p. 27, pl. III, figs. 10-12) tentatively placed in *Volutoconus* Crosse, 1871. However, *Volutoconus,* typified by *V. coniformis* (Cox), living in Australia, is smooth with four columellar plications. The resemblance between *V. levensis* and *V. funiculifer* (Cossmann and Pissarro) is striking. *V. funiculifer* has 10 columellar plications which decrease in size posteriorly, the anterior four or five are strong and the posterior weak as in *V. levensis.*

Caricella praetenuis Conrad of the Gosport sand may have five plications. They are situated on the columellar area. Additional

plications other than the five, in *V. levensis* are irregular in size and occur in the parietal area. The labial callus is thin and on some specimens the coarse spiral ribs protrude through the callus like small plications. In such cases in the parietal area the protruded ribs may suggest low plications for they are extended obliquely to the direction of the ribs.

Low-spired and broad-shouldered Claiborne Caricellas, such as *C. praetenuis* Conrad and *C. doliata* Conrad (Palmer, 1937, pl. 64) are the nearest approach in shape to *Voluticella levensis*. The apical whorls of the spire of those species are more elevated than in *Voluticella*.

Voluticella levensis Palmer, n.sp.
Plate 5, figures 4-8

Description as for the genus.

Types.—Holotype, No. I-7625; paratypes, Nos. I-7626-7628, Fla. Geol. Surv.

Occurrence.—Inglis member, Moodys Branch formation, loc. L-93 (type) and VL-187.

Genus Lyria, Gray, 1847
Lyria citrusensis Palmer, n.sp.
Plate 8, figure 7

Shell medium in size, robust; spire short; whorls about four; nuclear whorls worn; whorls with strong longitudinal ribs, about nine or ten ribs on the body whorl, the last enlarged fold forming a strong varix on the margin of the labrum; concave groove below the suture developing a shoulder to the ribs; about 10 plications on columella, the anterior ones are larger and more regular.

The species is represented by the holotype only which is a plastotype.

This species differs from the common form *L. pycnopleura eocenia* in the Inglis member by the shorter spire, the plumper shape, and lack of spiral threads in *L. citrusensis*. Possibly it has more longitudinal ribs than *L. eocenia* has.

Holotype.—No. I-7629 (plastotype), Fla. Geol. Surv.

Occurrence.—Inglis member, Moodys Branch formation, loc. C-11, Fla. Geol. Surv.

Lyria pycnopleura eocenia Palmer, n.subsp.
Plate 5, figures 1, 14

Shell medium in size, solid, spire elevated; postnuclear whorls five; nuclear whorls smooth, of about 2 or 2½ whorls; whorls with

eight or nine large coarse longitudinal lirae, those over the body whorl somewhat irregular in size and position; the lirae crossed by fine spiral striations, most conspicuous on the body whorl; below the suture there is a concave appressed area which causes the lirae to be nodose between it and the suture and the lirae slightly nodose just below it; anterior notch recurved, short in length but deep with coarse spiral lines above it; columellar callus thick; plications medium in size.

This species is related to *L. pycnopleura* Gardner (1937, p. 404, pl. XLVIII, figs. 1, 2) from the Chipola Miocene of Florida. That Miocene species was earlier figured by Dall (1915, pl. 9, figs. 1, 4) as *L. musicina* Heilprin from the lower Miocene of Ballast Point, Florida. Dr. Gardner differentiated the two forms specifically but intimated their relationship, as well as with *L. costata* ("Sowerby") (Solander in Brander, 1766, pl. III, fig. 45) of the Barton, upper Eocene of England.

The present Eocene species is allied to *L. pycnopleura* and not to *L. musicina* Heilprin (Mansfield, 1937, p. 106, pl. 3, figs. 1, 4) or *L. costata* (Solander).

The general shape, character of the longitudinal costae and slight groove below the suture with nodose costae between it and the suture are similar in *L. pycnopleura* and *L. eocenia*. *L. eocenia* has eight longitudinal costae and the spiral lines seem more prominent than on the Miocene species.

Gardner had enough material of her species to evaluate a range in size. Unfortunately this form is known only by the holotype and one paratype which are smaller than the holotype of *L. pycnopleura*. That species ranged to an altitude of 63 mm.

Dimensions.—Height, 21+ mm.; greatest diameter, 11 mm. (holotype).

Types.—Holotype, No. I-7630; paratype, No. I-7631, Fla. Geol. Surv.

Occurrence.—Inglis member, Moodys Branch formation, loc. L-93, Fla. Geol. Surv.

Family Turridae

Genus Pseudotoma Bellardi, 1875

Pseudotoma floridana Palmer, n.sp.

Plate 6, figures 6, 11

Shell stout, thick; whorls six; nuclear whorls about two, worn; nine longitudinal folds which form nodes on the whorls of the spire and obscure ones on the shoulder of the body whorl; two coarse spiral ribs on the whorls of the spire on the lower half and

over the body whorl; microscopic spirals are present between the ribs and the suture and lines of nodes; there is a tendency for a third spiral rib to appear above the suture. It appears in two of 18 specimens. Typically the concave area just below the suture is smooth. One individual has four microscopic revolving striae in that area; retral sinus deep, wide and margin thickened; labrum thick; labial callus well-developed bearing three plications.

This species differs from *P. heilprini* (Aldrich) and subspecies (Aldrich, 1885, p. 146, pl. 3, fig. 15; 1886, p. 29, pl. 1, fig. 15; Harris 1937, p. 81, pl. 13, figs. 32a, b; 1947, p. 434, pl. 60, figs. 6, 7) of the Moodys Branch formation of the Mississippi embayment area by having two stout revolving ribs on the whorls of the spire. *P. heilprini* has at least seven finer spiral ribs on the penultimate whorls and following whorls of the spire accordingly. The longitudinal folds on *P. floridana* are more pronounced than on *P. heilprini*.

The species is abundant at the type locality.

Types.— Holotype, No. I-7632; paratype, No. I-7633 (unfigured), Fla. Geol. Surv.

Occurrence.—Inglis member, Moodys Branch formation, loc. L-93, Fla. Geol. Surv.

Family Conidae
Genus Conus Linnaeus, 1758
Conus, spp. A and B

Two specimens of *Conus*, each representing a different species were found at L-93. One, species A, is a broad (21 mm.), low-spired (7 mm.) shell with sharp angulation of the shoulder of the whorls; the surface was apparently smooth. The specimen is a fragment, 25 mm. high.

The shell of species B, Plate 2, figure 14, is small, about seven whorls, narrow with a high spire, equal to half the height of the body whorl; dimensions, 23 mm., height and 12 mm., greatest diameter. The specimen is figured herein (I-7634, Fla. Geol. Surv.).

Neither of the above shells is adequate to describe the species of *Conus*.

Family Scaphandridae
Genus Scaphander Montfort, 1810
Scaphander richardsi Palmer, n.sp.
Plate 6, figures 1-4, 12

Shell large, elongate, sides nearly parallel, body whorl width nearly equidistant except at the tapered posterior end and constricted posterior; surface entirely covered with conspicuous spiral

flat ribs with linear interspaces; microscopic longitudinal lines are present in the interspaces, these may be lost with erosion. The spiral ribs are narrower in width anteriorly.

The species is abundant at the type locality. The largest specimen measures 40 mm. in height and 18 mm., greatest width.

S. richardsi differs from *S. jacksonensis* Palmer (in Harris and Palmer, 1946-1947, p. 449, pl. 64, figs. 6, 7) in the narrower and more elongate body whorl. The posterior area of the aperture is narrower and the labrum is less oblique and more nearly parallel with the sides of the shell in *S. richardsi* than in *S. jacksonensis*. The revolving ribs tend to be wider in *S. jacksonensis* than in the Florida species. Type material of both species has been compared.

S. cossmanni Oppenheim (Palaeontographica, 1906, pl. XXVI, figs. 14, a, b; 17a, 17b, 22, 23) from the Mokattam beds of Egypt appears to be of the same group of *Scaphander* as *S. richardsi*.

Named in honor of Dr. Horace G. Richards.

Types.—Holotype, No. I-7635; paratypes, I-7636-39, Fla. Geol. Surv.

Occurrence.—Inglis member, Moodys Branch formation, loc. L-93, Fla. Geol. Surv.

PART 3—PELECYPODA

by

HORACE G. RICHARDS

INTRODUCTION

Twenty-six species of pelecypods have been recognized in the collections submitted from the Avon Park limestone and the Inglis member of the Moodys Branch formation. Of these eleven are described as new, four merely identified as to genus, and eleven referred to previously described species. Omitting those merely identified as to genus they are distributed as follows:

Avon Park limestone	10
Inglis member	19
Restricted to Avon Park	3
Restricted to Inglis	12
Both formations	6

It is noted that there were fewer species of pelecypods than gastropods, and that a higher percentage were identifiable only as to genus. The state of preservation, while fairly good, was not satisfactory for complete descriptions, since frequently only one side of the shell could be seen. In some cases, descriptions are based on plastocasts prepared by Robert O. Vernon of the Florida Geological Survey. The collections of the Survey contain additional pelecypod material not sufficiently well preserved for identification at this time.

As in the case of the gastropods, the dimensions of the type and figured specimens are given under the description of plates.

A discussion of the age and correlation of the pelecypod fauna is given in Part 4 of this report.

LIST OF SPECIES

	Avon Park	Inglis
Barbatia palmerae Richards, n.sp.		L-93
Barbatia ? inglisia Richards, n.sp.		L-93
Glycymeris lisbonensis Harris		L-93; L-139
Ostrea falco Dall		L-135
Ostrea sp.		L-93
Anomia cf. *lisbonensis* Aldrich	L-76	
Volsella sp.		L-93
Crassatella inglisia Richards, n.sp	L-92	L-93; L-135; VL-187
Crassatella entawacolens Harris		L-93
Crassatella sp.		C-11
Venericardia scabricostata Guppy	L-73; L-118A	L-93; L-139
Venericardia withlacoochensis		

Richards, n.sp.		L-93
Pseudomiltha megameris Dall	L-76	C-11
Here cf. *wacissana* Dall		C-11
Here sp.	L-118A	
Divaricella robertsi Richards, n.sp.		L-93
Fimbria vernoni Richards, n.sp.		L-93; L-139
Fimbria olssoni Richards, n.sp.	L-118A	
Cardium (Dinocardium) levyi Richards, n.sp.		L-93
Cardium (Trigoniocardium) protoaliculum Richards, n.sp.	L-92	L-93
Cardium (Trachycardium) cf. *claibornense* Aldrich	L-73	L-93
Cardium (Anthocardia) avonum Richards, n.sp.	L-76	
Gari jacksonense Harris		L-139
Macrocallista annexa Conrad	L-118	L-93
Blagraveia ? gunteri Richards, n.sp.	L-118	L-93; C-11?
Corbula densata Conrad		L-93; L-135 VL-187

Systematic Descriptions

Family Arcidae

Genus Barbatia Gray, 1847

Barbatia palmerae Richards, n.sp.

Plate 9, figure 1.

Shell elliptical in lateral view as illustrated, with beak slightly elevated and with a posterior alation. Sculpture of radiating ribs which are wider than their interspaces and with each rib bearing a series of nodes. On the beak the ribs are very faint and without nodes (or with nodes worn off), the interspaces appearing as striae. On both the anterior and posterior slopes the ribs and their interspaces are broader and the nodes are more pronounced. The medial ribs of the ventral margin are narrowest. There are a few (3 to 4) irregularly spaced concentric growth lines.

B. palmerae is slightly larger, has coarser nodes and more ribs than *B. ludoviciana* Harris to which it is closely related. *B. ludoviciana* occurs in formations of both the Claiborne and Jackson stages of the Mississippi embayment (See Harris, 1919, p. 54, pl. 22, figs. 8-16; Harris, 1946, p. 46, pl. 11, figs. 6-8). It is also related to the Claiborne *B. rhomboidella* Lea.

Named in honor of Dr. Katherine V. W. Palmer.

Type—Holotype No. I-7551, Fla. Geol. Surv.

Occurrence.—Inglis member of Moodys Branch formation, Loc. L-93.

Barbatia ? inglisia Richards, n.sp.

Plate 9, figure 2

Shell equilateral in lateral view as illustrated, with beaks slightly elevated; no alation; sculpture of radiating ribs bearing nodes formed by incised, concentric grooves which are deeper than the rib interspaces. The sculpture has a shingled appearance. The ribs and interspaces are of equal width, both widening on the anterior and posterior slopes. A few (3 or 4) concentric growth lines present on the holotype.

Differs from *B. palmerae* by being equilateral, the lack of alation and by having the grooves deeper than the rib interspaces.

Type.—Holotype: No. I-7550, Fla. Geol. Surv.

Occurrence.—Inglis member of the Moodys Branch formation, Loc. L-93.

Genus Glycymeris Da Costa, 1778

Glycymeris lisbonensis Harris

Glycymeris lisbonensis Harris, 1919, Bull. Amer. Paleont., vol. 6, No. 31, p. 48, pl. 20, figs. 12-15

This species is especially common at locality L-93. The Florida specimens are slightly smaller than the type of *G. lisbonensis*, but agree with it in general appearance and sculpture. They can be separated from *G. idonea* Conrad by their more rounded shape.

G. lisbonensis is known from the Claiborne (Lisbon and Cook Mountain formations) Eocene of Alabama and Mississippi.

Specimens figured.—Nos. I-7552, I-7553, Fla. Geol. Surv.

Occurrence.—Inglis member, Moodys Branch formation, loc. L-93, L-139.

Family Ostreidae

Genus Ostrea Linne, 1758

Ostrea falco Dall

Ostrea falco Dall, 1895, U.S. Nat. Mus. Proc., vol. 18, p. 22; Dall, 1898, Wagner Free Inst. Sci., Phila., Trans. vol. 3, p. 682, p. 30, figs. 4-11; Harris, 1947, Bull. Amer. Paleont., vol. 30, No. 117, p. 20, pl. 3, figs. 1-9.

One shell is very similar to some of the specimens of this species figured by Harris (1947) from Jackson deposits, was found in the Inglis limestone at locality L-135. (Fla. Geol. Surv. I-7586).

Ostrea spp.

Plate 9, figure 6.

Several unidentifiable specimens of *Ostrea* occur at various localities. One broken shell from locality L-93 is figured in this report (I-7595).

Family Anomiidae

Genus Anomia Linne, 1758

Anomia cf. A. lisbonensis Aldrich

Plate 9, figure 5

Anomia ephippioides var. *lisbonensis* Aldrich, 1886, Geol. Surv. Ala., p. 41, pl. 4, fig. 6.

Anomia lisbonensis Dall, 1889, Wagner Free Inst. Sci., Phila., Trans. vol. 3, p. 781; Harris, 1919, Bull. Amer. Paleont., vol. 6, No. 31, p. 17, pl. 11, figs. 6-10.

One imperfect specimen is tentatively referred to this species which is known from the Claiborne of Alabama and Texas. However, because the Florida shell is incomplete, it is impossible to determine it completely as to species.

Specimen figured.—No. I-7531, Fla. Geol. Surv.
Occurrence.—Avon Park limestone: L-76.

Family Mytilidae
Genus Volsella Scopoli, 1777 (=Modiolus Lamarck, 1799)
Volsella sp.
Plate 9, figure 8

One large, but incomplete, example of this genus was taken from locality L-93. The concentric marks are well developed and on the margin can be seen a series of radial markings. The broken specimen measures 50.7 mm. by 35.8 mm.

Specimen figured.—No. I-7560.
Occurrence.—Inglis member, Moodys Branch formation: L-93.

Family Crassatellidae
Genus Crassatella Lamarck, 1801
Crassatella inglisia Richards n. sp.
Plate 9, figures 9, 10

Shell trapezoidal in lateral view as illustrated. Posterior ridge obtusely keeled and slightly elevated. Nearly equidistant, pronounced, concentric ridges with interspaces wider than the ridges. Interspaces become narrower in passing from the margin to the beak but this sculpture is still distinct on the beak.

This species is related to *C. flexura* Conrad (see Harris, 1946, p. 81, pl. 18, figs. 22-29, 35038; Plate 19, figs. 1-4) which is known from the Jackson deposits of Alabama, Mississippi, and Louisiana, and is differentiated from this species by having the beak more centered and by being less elongate.

Types.—Holotype No. I-7541, paratype No. I-7542, Fla. Geol. Surv.

Occurrence.—Inglis member of Moodys Branch formation, Loc. L-93, L-135, VL-187, Avon Park limestone: Loc. L-92.

Crassatella eutawacolens (Harris) 1919
Plate 10, figure 4.

Crassatellites entawacolens Harris in Van Winkle and Harris, 1919, Bull. Amer. Paleont., vol. 8, No. 33, p. 14, pl. 2, fig. 4.

One internal cast from L-93 is very similar, although somewhat larger than *C. eutawacolens* which Harris described from Eutaw Springs, South Carolina, which locality has been referred to the Santee limestone, of probable Jackson age.[1] Differs from the other

[1]In a recent paper Cooke and MacNeil (1952) regard the Cooper marl as Oligocene.

specimens of *Crassatella* in the Florida collection by its conspicuous marginal crenulations, conspicuous muscle scars, and general proportions as shown in the figure.

Specimen figured.—No. I-7548

Occurrence.—Inglis member, Moodys Branch formation, Loc. L-93.

Crassatella sp.

Plate 10, figure 3.

Various unidentifiable specimens of *Crassatella* have been found in the Inglis member of the Moodys Branch formation. One of these, from Locality C-11, is figured.

Specimen figured.—No. I-7549

Occurrence.—Inglis member, Moodys Branch formation Loc. C-11.

Family Carditidae

Genus Venericardia Lamarck, 1801

Venericardia scabricostata Guppy

Plate 10, figures 1, 2.

Venericardia scabricostata Guppy, 1866, Quat. Jour. Geol. Soc. London, vol. 22, p. 292, pl. 18, fig. 10; Maury, 1919, Bull. Amer. Paleont., vol. 5, No. 29, p. 362, pl. 33, fig. 1.

This species is common at several localities in the Inglis member. It resembles *V. diversidentata* Meyer from the Jackson of the Mississippi embayment but differs from it by having fewer ribs (about 18 instead of about 28 as in *diversidentata)* and by having the nodes on the ribs less conspicuous.

V. scabricostata was first described from Jamaica and later redescribed and refigured by Maury (1919) from the Dominican Republic from the middle Miocene. The Florida shells are generally smaller than those from Jamaica and the Dominican Republic, but agree in other details.

Specimens figured.—Nos. I-7533, I-7534.

Occurrence.—Avon Park limestone.—L-73, L-118 A; Inglis member, Moodys Branch formation, loc. L-93, L-139.

Venericardia withlacoochensis Richards, n.sp.

Plate 10, figure 5

Shell small, circular in lateral view as illustrated and with beak obliquely elevated. No posterior ridge. Sculpture of a few (about 12 to 15) prominent ribs separated by equally wide grooves and bearing broad nodules. The rib nodules anastomose on the beak and lose their identity.

Distinguished from *V. scabricostata* Guppy by its slightly more prominent and smaller number of ribs. Differs from *V. diversidentata* Meyer by its considerably smaller number of ribs and its generally smaller size.

This species is apparently more closely related to *V. scabricostata* of Jamaica and the Dominican Republic than to the Florida *V. diversidentata*. Known from three specimens.

Type.—Holotype, No. I-7539 Fla. Geol. Surv.

Occurrence.—Inglis member of Moodys Branch formation, Loc. L-93.

Family Lucinidae

Genus Pseudomiltha Fischer, 1885

Pseudomiltha megameris Dall

Plate 10, figure 6

Lucina megameris Dall, 1901, Nautilus, vol. 15, p. 41; Dall, 1901, U.S. Nat. Mus., Proc., vol. 23, No. 1237, p. 806.

This largest of all lucinoids was described by Dall from the Montpelier White limestone at Clairemont, St. Ann's Parish, Jamaica of "Upper Eocene or Oligocene age." The formation is now thought to be of late Eocene age. The species was described from internal casts which measured 235 by 230 mm. *P.* cf. *megameris* is reported from the Eocene of Panama (Woodring and Thompson, 1949, p. 228).

The Florida specimens from the Avon Park limestone (Locality L-76) and the Inglis member of the Moodys Branch formation (Locality C-11). The figured specimen is from the Inglis member (Locality C-11) and measures 175 mm. by 100 mm. Larger, although imperfect, specimens were obtained from the Avon Park limestone (Locality L-76). The two largest measured 240 mm. by 215 mm. and 245 mm. by 220 mm. respectively (estimated).

The species is related to *P. gigantea* Deshayes from the Eocene of the Paris Basin, but this attains a maximum length of only 98 mm. The occurrence of large lucinoids in the Eocene of Florida is highly interesting. No representatives of *Pseudomiltha* have been reported from the Eocene of the Mississippi embayment.

Specimen figured.—No. I-7562, Fla. Geol. Surv.

Occurrence.—Avon Park limestone, Locality L-76; Inglis member, Moodys Branch formation, Loc. C-11.

Genus Here Gabb, 1866

Here cf. H. wacissana Dall

Plate 10, figure 9

Phacoides (Here) wacissanus Dall, Wagner Free Inst. Sci. Phila.

Trans., vol. 3, p. 1365, pl. 50, fig. 15.

Here cf. *wacissana* Harris, 1951, Bull. Amer. Paleont., vol. 33, No. 138, pl. 10, fig. 6.

Shell somewhat longer than high with conspicuous concentric growth lines. These are very similar to the shell from the Ocala limestone near Albany, Georgia, figured by Harris. The species was originally described from the Tampa limestone (lower Miocene) of Florida. Both the specimen from the Ocala limestone and the one figured in this report are somewhat larger than the type specimen figured by Dall.

Specimen figured.—I-7563, Fla. Geol. Surv.

Occurrence.—Inglis member, Moodys Branch formation, loc. C-11.

Here sp.

Plate 10, figure 8

One plastocast resembles *H. wacissana* Dall but is more slender and has considerably fainter concentric lines of growth.

Specimen figured.—I-7564, Fla. Geol. Surv.

Occurrence.—Avon Park limestone, loc. L-118A.

Genus Divaricella von Martens, 1880

Divaricella robertsi Richards n.sp.

Plate 9, figure 7

Shell small, circular, equilateral in lateral view as illustrated; beaks elevated. Sculpture of irregularly spaced concentric scarps with uneven edges. A trace of radial grooves on the beak.

This species can be compared with *D. prevaricata* Guppy from the middle Miocene of Jamaica and the Dominican Republic (see Maury 1919, p. 207, pl. 35, fig. 10) but is more narrow and has fainter concentric lines. It may also be compared with *D. ermenovillensis* (d'Orbigny) from the upper Eocene of the Paris Basin. As far as is known, there are no other representatives of *Divaricella* from the Eocene of eastern North America.

Named in honor of Henry B. Roberts of the Wagner Free Institute of Science who is reporting on the crab claws of the Inglis member.

Type.—Holotype, No. I-7567, Fla. Geol. Surv.

Occurrence.—Inglis member of Moodys Branch formation, loc. L-93.

"Lucinoids"

Plate 10, figure 7

Various other unidentifiable specimens of lucinoids have been

found at various localities in the Inglis member. The figured specimen is from locality L-139. (No. I-7587, Fla. Geol. Sur.)

Family Fimbriidae
(Corbidae)
Genus Fimbria Megerle von Mühlfelt, 1811
Fimbria vernoni Richards, n. sp.
Plate 11, figures 2-4

Shell broadly elliptical in lateral view with beaks elevated as illustrated; ventricose; index of height over length is approximately 82%. Anterior slope abrupt. Inner margin with heavy crenulations. Raised concentric ridges and radial ribs produce a cancellate pattern of rectangles having their longer axes parallel to the radial ribs. These rectangles are narrower and proportionately more elongate on the beak. The concentric ridges of the beak are more pronounced than the radial ribs, but this difference fades on the slope and at the margin the radial ribs are more pronounced. Several (8) impressed growth lines are present on the holotype. Inner margin crenulate.

Differs from *F. claibornensis* (Dall) by having the concentric ribs less prominent and closer together; also the radial ribs are more conspicuous than in *F. claibornensis* and *F. lamellosa*. Furthermore, *F. vernoni* is more rounded than the Claiborne form.

The Claiborne specimen of *Fimbria (Corbis)* was originally referred to *C. lamellosa* Lamarck from the Eocene of the Paris Basin, but the American form was later shown to be distinct. (See Harris, 1919, p. 123, pl. 40, fig. 3, 4). *F. claibornensis* is apparently rare and is known only from the type specimen in the collections of the Academy of Natural Sciences (A.N.S.P. 19684) from Claiborne, Alabama. *F. vernoni* is related to both the Alabama and French forms, but is distinct from each, although a little closer to the French form.

F. vernoni is also related to *F. furoni* Cox from the Eocene of the Gold Coast of Africa (Cox, 1952, p. 43, pl. 4, fig. 16), but the concentric ribs are more widely spaced.

Named in honor of Dr. Robert O. Vernon, of the Florida Geological Survey.

Nicol (1950) has pointed out the reasons for substituting the generic name *Fimbria* for the more widely used name *Corbis*.

Types.—Holotype, No. I-7556; paratype, I-7557, Fla. Geol. Surv.

Occurrence.—Inglis member of Moodys Branch formation, loc. L-93, L-139.

Fimbria olssoni Richards, n. sp.
Plate 11, figure 1

Shell elliptical in lateral view with beaks elevated as illustrated. Index of height over length is approximately 70%. Not ventricose as in *F. vernoni.* Anterior slope less abrupt than in *F. vernoni.* Inner margin not visible. Sculpture a cancellate pattern of elongate rectangles similar to *F. vernoni;* radial ribs narrower and more numerous than in that species and being the dominant sculptural feature over the whole of the shell. The concentric ridges are narrower, fewer, and more irregular than in *F. vernoni.*

F. olssoni is larger and more elongate than *F. jamaicensis* Trechmann. It does not have the prominent concentric ridges of *F. claibornensis.*

F. olssoni is known only by two plastotypes. It is apparently related to both the Florida *F. vernoni* Richards and the Jamaican *F. jamaicensis* Trechmann (1923, p. 364, pl. 18, fig. 5), of late Eocene age.

Named in honor of Axel Olsson.

Type.—Holotype, No. I-7558, Fla. Geol. Surv. (plastotype).

Occurrence.—Avon Park limestone: loc. L-118A.

Family Cardiidae
Genus Cardium Linne, 1758
Cardium (Dinocardium) levyi Richards, n. sp.
Plate 11, figure 7

Shell nearly equilateral, in lateral view circular with tangential slopes leading to the beak as illustrated. No posterior ridge. Sculpture of broad, flat, radial ribs separated by narrow, impressed grooves which are wider, deeper, and more pronounced on the posterior slope. Seven ribs in about ten millimeters at the mid-ventral margin. Approximately 31 ribs in the type specimen. Traces of prominent spines on the ribs. Interior of shell not exposed.

Very closely resembles the shell which Harris (1951, p. 23, pl. 12, fig. 3, 4) figured from the Ocala limestone near Kendrick, Florida, which he referred to *C.* cf. *cabezai* Gardner, but clearly shows the spines which Harris's specimen lacks. It differs from Gardner's description of *C. cabezai* (1945, p. 102, pl. 4, figs. 7, 8, 10) by the presence of the spines, as well as by having the anterior margin less rounded.

Dinocardium cabezai Gardner is known from the Shoal River formation (Miocene) of Walton County, Florida, as well as from the Guajalote formation (lower Miocene) of northeastern Mexico.

Type.—Holotype, No. I-7568, Fla. Geol. Surv.

Occurrence.—Inglis member of Moodys Branch formation, loc. L-93.

Cardium (Trigoniocardium) protoaliculum Richards, n. sp.
Plate 12, figures 1-3

Shell obliquely subtriangular in lateral view with truncate posterior end as illustrated and being nearly half again as high as long. A strongly keeled posterior ridge. Pronounced ribs, twelve anterior and ten posterior to the posterior ridge. Two ribs on the posterior ridge are twice as heavy as the others. The ribs bear strongly elevated nodes which decrease in elevation from the margin toward the umbo becoming obsolete on the beak. Ribs and interspaces crossed by fine, closely-spaced, concentric lines which do not appear on the nodes.

The species is close to *C. alicula* Dall (1900, p. 1103, pl. 40, fig. 12, pl. 48, fig. 5) from the Chipola formation (Miocene) of Florida and *C. berberum* Dall from the Tampa limestone (lower Miocene) of Florida. (See Mansfield, 1937, p. 249, pl. 18, fig. 2, 3). Differs by the presence of the slightly higher ribs at the keel and by its more conspicuous nodes. Fairly common.

Types.—Holotype, No. I-7572; paratypes, Nos. I-7571, I-7573, Fla. Geol. Surv.

Occurrence.—Inglis member of Moodys Branch formation, loc. L-93. Avon Park L-92.

Cardium (Trachycardium) cf. C. claibornense Aldrich
Plate 11, figures 5, 6

Cardium (Trachycardium) claibornensis Aldrich, 1911, Bull. Amer. Paleont., vol. 5, No. 22, p. 3, pl. 1, fig. 4; Harris, 1919, Bull. Amer. Paleont., vol. 6, No. 31, p. 132, pl. 41, figs. 8, 9.

Several incomplete specimens are close to *C. claibornense* and are tentatively referred to that species. They have a greater length and somewhat less conspicuous spines than *C. levyi,* but because of the incompleteness of the specimens it is impossible to identify them completely. They have been compared with the type of *C. claibornense* which was loaned through the cooperation of the Department of Geology of Johns Hopkins University, Baltimore, Maryland.

Specimens figured.—Nos. I-7569; I-7570, Fla. Geol. Surv.

Occurrence.—Inglis member of Moodys Branch formation, loc. L-93. Avon Park limestone, loc. L-73.

Cardium (Anthocardia?) avonum Richards, n. sp.
Plate 11, figure 9

Shell inequilateral; umbonal area moderately high. Anterior and posterior slides sloping away from central area. Sculptured most conspicuously on anterior slope where nodes are present. There are approximately 5 ribs with conspicuous nodes. The central region contains about 7 ribs which are less conspicuous than those on the anterior slope. Posterior slope contains about 5 moderately conspicuous ribs without presence of nodes. Concentric growth lines are very faint.

This is an unusual species of *Cardium* and is only tentatively assigned to the subgenus *Anthocardia.* It bears some resemblance to *Cardium (Anthocardium?) suwannense* Mansfield (1937, p. 248, pl. 18, figs. 4, 6, 8) from the Suwannee limestone (Oligocene) of Florida. However, it differs in proportion, the presence of the anterior spines and in the number of ribs.

Known only from several plastocasts from locality L-76.

Type.—Holotype (plastocast), No. I-7575, Fla. Geol. Surv.

Occurrence.—Avon Park limestone, loc. L-76.

Genus Gari Schumacher, 1817
Gari jacksonense Harris
Plate 12, figure 4

Gari jacksonense Harris, 1946, Bull. Amer. Paleont. vol. 30, No. 117, p. 97, pl. 21, figs. 12, 14.

One plastocast is very similar to the type of this species in the Paleontological Research Institution in Ithaca. *G. jacksonense* is known from the Jackson deposits in Alabama, Mississippi, and Louisiana.

Specimen figured.—No. I-7561, Fla. Geol. Surv.

Occurrence.—Inglis member, Moodys Branch formation, loc. L-139.

Family Veneridae
Macrocallista Meek, 1876
Macrocallista annexa (Conrad)
Plate 12, figure 5

Dione annexa Conrad, 1865, Amer. Jour. Conch., vol. 1, p. 137, pl. 10, fig. 5.

Callista annexa Palmer, 1929, Paleont. Amer. vol. 1, p. 283, pl. 45, figs. 17, 20; Harris, Bull. Amer. Paleont. vol. 30, No. 117, p. 95, pl. 21, figs. 6-9.

This species is common at several localities. The shells are

ovate, posteriorly cuneate and abruptly rounded at the extremity. They have been compared with material in the Paleontological Research Institution. It is known from Jackson deposits in Mississippi and Louisiana.

Dimensions.—Length 21.1 mm.; width 28.0 mm. (figured).

Specimens figured.—No. I-7578, Fla. Geol. Surv.

Occurrence.—Avon Park limestone: loc. L-118. Inglis member, Moodys Branch formation, loc. L-93.

Genus Blagraveia Cox, 1931

Blagraveia ? gunteri Richards, n. sp.

Plate 12, figures 6, 7(?)

Shell subovate in lateral view with concave anterior slope and elevated beak as illustrated. Pronounced concentric grooves with interspaces nearly equidistant but decreasing toward the beak and being closely spaced there. Interspaces between grooves flatly convex.

It resembles *B. corrugata* Cox (1931, p. 184, pl. 21, figs. 5, 8, 9) from the Lutetian of Baluchistan and British Somaliland but is smoother and less circular in shape. Since the interior of the shell is not exposed, it is impossible to determine for certain whether this species belongs in Cox's genus. It differs from *Macrocallista annexa* (Conrad), the only other venerid found in the Inglis member, by being rounder and by the presence of the prominent concentric lines.

Known from the type lot and several others questionably referred to this species (I-7580).

Type.—Holotype, No. I-7579, Fla. Geol. Surv.

Occurrence.—Inglis member of Moodys Branch formation, loc. L-93; C-11. Avon Park limestone, loc. L-118.

Family Corbulidae

Genus Corbula Bruguière, 1797

Corbula densata Conrad

Plate 12, figures 8, 9

Corbula densata Conrad, 1854, in Wailes, Rept. Geol. and Agric. Miss., p. 289, pl. 14, fig. 9; Harris, 1946, Bull. Amer. Paleont. vol. 30, No. 117, p. 115, pl. 24, figs. 11-15, 17-21.

This species is very common at locality L-135. It is sometimes confused with *C. alabamiensis* Lea of Claiborne age, but in general the Jackson *C. densata* Conrad is larger and has a more rounded base than *C. alabamiensis;* also in many of the examples of the Claiborne form the ribs are slightly more conspicuous.

The Florida specimens have been compared with typical Jackson and Claiborne examples and appear to more closely resemble shells of *C. densata* from the Jackson deposits of Alabama, Mississippi, and Louisiana.

Specimens figured.—Nos. I-7582; I-7583, Fla. Geol. Surv.

Occurrence.—Inglis member, Moodys Branch formation, loc. L-135, VL-187, L-93.

Other Specimens

The collections examined by the present authors included various specimens of echinoids and corals and an unidentified species of the scaphopod *Dentalium*. This latter is figured on Plate 11, figure 8.

Miller (1947, p. 83) records the nautiloid *Aturia alabamensis* (Morton) from the Avon Park formation, one eighth of a mile below the Florida Power Corporation plant on the Withlacoochee River in Citrus County.

PART 4—DISCUSSION

by

KATHERINE V. W. PALMER

and

HORACE G. RICHARDS

Avon Park Fauna.—The molluscan fauna of the Avon Park limestone is somewhat limited and includes specimens from localities L-73, L-76 and L-118. As pointed out earlier (p. ....), all the gastropods from this formation are new species and fall in such genera as *Tectariopsis, Bellatara, Hipponix, Pseudocrommium* and *Conomitra.* The gastropods suggest a correlation with the middle Eocene (Lutetian), a dating previously assigned by Vernon (1951). The genus *Tectariopsis* has hitherto been known only from the Lutetian of France.

The pelecypod fauna from the Avon Park limestone is limited to seven identified species. The affinity seems closest to the Claiborne deposits (middle Eocene). The European affinity shown by the gastropods is less apparent in the case of the pelecypods.

Inglis Fauna.—The fauna of the Inglis member is by far the richer and includes 30 species of gastropods and 18 species of pelecypods plus others identified only as to genus. The best localities for fossils are L-93, L-135, L-139 and C-11.

A brief discussion of the gastropod fauna has already been given (pp. 9-11). The most striking feature is the lack of close relationship with material from the well-known Eocene deposits of the Mississippi embayment, together with the rather surprising relationship of the Inglis fauna with material from Eocene deposits of the Paris Basin, northern Italy, the Moquattam beds of Egypt, and other deposits in the Old World. The species best showing this Old World affinity are:

Species	*Formation*	*Notes*
Astraea withlacoochensis n.sp	I	Species in same group in Eocene of Colombia and Australia as well as a Recent species from Australia.
Velates floridana Richards	A(?)/I	Genus widespread in Eocene of Europe, Asia and Africa; only other American records are from California, Panama and the West Indies.
Batillaria advena, n.sp.	I	Genus not hitherto known from Eocene of North America.
Bellatara (3 spp.)	I	Genus characteristic of northern Italy and the Balkans.

Pseudoaluca clarki, n.sp.	I	Genus known from Eocene of Colombia, Paris Basin and Italy.
Laevella floridana, n.sp.	I	New genus; nearest relations are European forms; unique.
Terebellum (Seraphs) belemnitum, n.sp.	I	Subgenus; Eocene - Oligocene.
Ampullinopsis citrinensis, n.sp.	I	Genus known from upper Eocene of Java, Hungary and Oligocene of North America, Europe, Asia, South America, and West Indies.
Pseudocrommium brucei, n.sp.	I	Genus of middle Eocene of France,
Pseudocrommium occiduum, n.sp.	I	England and Italy; some close relatives in Eocene of North and South America.
Eovasum vernoni, n.sp.	I	Genus known from Paleocene of India, the Eocene of Egypt, Senegal and Peru.

A = Avon Park limestone; I = Inglis member.

Other gastropod genera represented in the Inglis formation which are more characteristic of the Eastern Hemisphere, although known from North America, include *Diastoma, Callianax* (subgenus of *Olivella), Athleta, Conomitra, Agaronia, Lyria* and *Calyptraea.*

Only three gastropods are identical with species known from the Eocene of the Mississippi embayment. These are:

Name	*Distribution*
Calyptraea aperta (Solander)	Wilcox, Claiborne, and Jackson
Cypraedia fenestralis Conrad	Jackson
Distorsio jacksonensis Meyer	Jackson

Other members of the Inglis fauna related to species in the Mississippi embayment are in the following genera: *Papillina, Turritella, Xenophora, Conus* and *"Cerithium."*

For further analysis of gastropod genera see the introduction of Part 2.

The pelecypod fauna shows less Old World affinity than the gastropods. However, several of the species herein recorded show closer affinities to species of the Eocene of the Paris Basin, the West Indies or elsewhere than to the Mississippi embayment. These are:

Inglis species	*Related form*
Divaricella robertsi, n. sp.	*D. ermenovillensis* (Paris Basin)
Fimbria vernoni, n. sp.	*F. lamellosa* (Paris Basin)
Fimbria olssoni, n. sp.	*F. jamaicensis* Trechmann (Jamaica)
Pseudomiltha megameris Dall	*P. megameris* Dall (Jamaica)
Blagraveia ? gunteri, n. sp.	*B. corrugata* Cox (Somaliland)

Nine species are identical or closely related to species from the Eocene of the Mississippi embayment.

Inglis species	*Related form*
Barbatia palmerae, n. sp.	*B. ludoviciana* Harris (Claiborne and Jackson)
Ostrea falco Dall	*O. falco* (Jackson)

Crassatella inglisia, n.sp.	*C. flexura* Conrad (Jackson)
Crassatella cutawacolens (Harris)	*C. cutawacolens* (Santee, South Carolina)
Here cf. *wacissana* Dall	*H. wacissana* (Ocala of Florida; also Miocene)
Cardium cf. *claibornense* Aldrich	*C. claibornense* (Claiborne)
Gari jacksonense Harris	*G. jacksonense* (Jackson)
Macrocallista annexa Conrad	*M. annexa* (Jackson)
Corbula densata Conrad	*C. densata* (Jackson)

Correlation with Oligocene and Miocene.—Another interesting feature of some species of the Inglis and Avon Park formations is the resemblance to Oligocene and Miocene forms in Florida, the West Indies and elsewhere. The following show this affinity better than to any Eocene species:

Inglis species	*Related form*
GASTROPODA	
Ampullinopsis citrinensis, n. sp.	*A. mississippiensis* Conrad; (Oligocene, Vicksburg)
Agaronia inglisia, n. sp.	*A. mississippiensis* Conrad; (Oligocene, Vicksburg)
Lyria pycnopleura eocenia, n. subsp.	*L. pycnopleura* Gardner; (Miocene, Florida)
PELECYPODA	
Venericardia scabricostata Guppy	*V. scabricostata* (Middle Miocene of Jamaica and Dominican Rep.)
V. withlachoochensis, n. sp.	*V. scabricostata*
Divaricella robertsi, n. sp.	*D. pervaricata* Guppy (Middle Miocene of Jamaica and Dominican Republic; also related to *D. ermenovillensis* from Eocene of France)
Cardium levyi, n. sp.	*C. cabezai* Gardner (Miocene of Florida and Mexico)
Here cf. *wacissana* Dall	*H. wacissana* (Ocala and Miocene, Fla.)
Cardium protoaliculum, n. sp.	*C. alicula* Dall (Middle Miocene, Fla.)
	C. berberum Dall (lower Miocene, Fla.)
Cardium avonum, n. sp.	*C. suwannense* Mansfield (Oligocene, Fla.)

Tethyan Fauna.—A distinctive molluscan assembledge, known as the Tethyan Fauna is widely distributed throughout the Eocene in various parts of the world. It stretches from Indonesia through India to the Mediterranean region, especially Egypt, northern Italy, parts of the Balkans, France (Paris Basin) and an extension into England. It then extends across the Atlantic to the West Indies (especially Jamaica and St. Bartholemew), Colombia, Peru, Mexico and southern California. This fauna probably did not occupy this large area continuously during Eocene time, although aspects of the Tethyan fauna are known from the various subdivisions of that epoch. The Tethyan Eocene fauna is regarded as being ancestral to the modern Indo-Pacific fauna. (See Davies, 1934, p. 104, etc.; Cox, 1931, p. 177).

Cole (1942, p. 13) pointed out that the foraminiferal fauna of

the middle Eocene in certain Florida wells was more related to the West Indies and Mexico than to the Gulf Coast of the United States. The discovery of the unusual Avon Park and Inglis faunas in Florida strongly suggest an extension of the Tethyan fauna from the West Indies to Florida.

No satisfactory explanation has ever been given to explain this widespread distribution of the Tethyan fauna during Eocene time, especially to explain the trans-Atlantic migration of this relatively shallow water fauna. Possibly this migration took place during one or more low sea levels of Eocene time.

An even greater problem is presented to explain the absence of the Tethyan fauna from the Eocene of the Mississippi embayment, separated by such a short distance from the outcrops of the Inglis and Avon Park formations in Florida.

Some barrier must have existed to prevent the spread of this Tethyan fauna northward from Florida. It is possible that the Peninsular arch (Applin. 1951) was high as late as Eocene time and may have produced such a barrier in northern Florida. However, further information on the geological history of Florida will be required before a satisfactory answer to this question can be given.

Age of the Avon Park and Inglis Faunas.

1. The study of the gastropods and pelecypods from the Avon Park limestone supports the view that this formation is of middle Eocene (Lutetian) age.

2. The fauna from the Inglis member of the Moodys Branch formation shows a strong affinity with the middle Eocene (Lutetian =Claiborne), as well as with the upper Eocene (Jackson). It is probable that the age of the Inglis is lower Jackson, as suggested by Vernon (1951, p. 112).

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APPENDIX

A New Species of Decapod Crustacean from the Inglis Member

by

Henry B. Roberts

Wagner Free Institute of Science

Philadelphia, Pa.

Among the specimens collected from the Inglis member of the Moodys Branch formation by the Florida Geological Survey were eighteen claws of a decapod crustacean which were turned over to the writer for study.

Family Callianassidae
Genus Callianassa Leach 1814
Callianassa inglisestris Roberts, n.sp.
Plate 13, figures 1-12

Diagnosis.—Hinge area* strongly produced, meeting the adjacent portion of the hand in a step-like ridge, and with a broad flattened tubercle at the lower distal angle of the outer face. A tubercle obliquely above and behind the articular node on both inner and outer surfaces. Interdigital sinus gaping; an acute tooth and a broad prominence just below the dactylar orifice. Fixed finger slightly deflected; slender; not more than one-quarter as high as the distal height of the hand.

Distribution.—Upper (Jackson stage) Eocene: Moodys Branch formation, Inglis member; near Inglis, Levy county, Florida. Florida Geological Survey Locality L-93.

Types.—Holotype is Florida Geological Survey No. I-7590. Paratypes a, c, d, and e are Florida Geological Survey Nos. I-7591 to 7594, respectively. Paratype b is Wagner Free Institute of Science No. 17231.

Material.—Eighteen hands of the first pair were studied (11

*This term is proposed for the lateral surfaces of the manus anterior to a line drawn between the articular node and the proximal edge of the interdigital sinus.

right, 7 left), of which two retain a portion of the fixed finger. As interpreted here, these specimens represent: major hands of males,—3 right; major hands of females,—6 right, 6 left; and minor hands,—2 right, 1 left.

Description of holotype.—A left major manus of the female. Hand slightly longer than high.** Upper and lower margins converge distally; the upper sinuous in profile, bluntly angled transversely, except on the distal third, where it is broadly rounded; the lower shallowly excavated behind the fixed finger, acute in cross-section. Anterior margin produced; curved toward and downward below the articular node. Above the node the margin is broken. The distance from the lower angle of the hinge area to the proximal limit of the interdigital sinus is slightly greater than the basal height of the fixed finger. Posterior margin concave, the lower angle rounded, cristate, extended beyond the upper angle. Outer surface more concave than the inner, which is concave along the lower third. Five indistinct sockets within, and parallel to, the upper margin; nine minute sockets on the inner side of the worn lower margin.

A broad sulcus ascends both outer and inner hinge areas and meets the adjacent portion of the hand in low, step-like ridge. On the outer hinge there is a flattened shelf-like tubercle near the lower angle. On both inner and outer surfaces, about half way between the upper margin and the articuler node, and slightly behind the latter, there is a worn tubercle. On the inner face, vertically above this tubercle, a granule near the upper margin.

Fixed finger slightly deflexed, slender, its basal height little greater than the gape of the interdigital sinus. Roof of interdigital sinus with a low prominence and a blunt tooth beneath the dactylar orifice; the tooth inserted slightly anterior to the shelf-like tubercle on the hinge; dactylar orifice large.

Distal arch of upper margin with a patch of elongated rugae; hinge area unornamented; except where worn, inner and outer surfaces of palm marked with small polygonal areas enclosed by raised lines.

Description of paratypes.—Paratypes a, b, and c are hands of females and are larger than the holotype. Paratype a retains a portion of the fixed finger, which is slightly deflexed, triangular in sec-

**As defined here, the length of the hand is the distance from the proximal limit of the interdigital sinus to the posterior margin, measured along an imaginary median line on the outer surface. Height is the greatest height,—thickness, the greatest thickness—unless stated otherwise.

tion with the exterior leg the longest. In the depression behind the interdigital sinus, there is a patch of worn granules. The upper margin of a and c are gently arched, that of b slightly concave. On the outer surface of b, just above and parallel to the lower margin, there is a row of 4 granules of which the submedian pair are widely spaced. This specimen shows a small tubercle near the lower angle of the inner hinge. A raised crenulated line, which is deflected inward, follows the crest of the lower margins of b and c. This line is not preserved in the holotype.

Paratype d,—the right hand of the male—, is one and a half times longer than high. Upper and lower margins are parallel; the upper straight in profile, narrow and bluntly rounded transversely, bowed outward as seen from above. Within the upper margin there is a longitudinal row of minute granules; parallel to this row, and below it, a shallow sulcus. Posterior margin is concave.

Paratype e is a right, minor hand of the first pair, with the lower margin broken. Upper margin with a strong distal slope; horizontal at the anterior corner, behind which it curves abruptly upward to a broad arch above the body of the hand.

Measurements.	L.	H.	T.
Holotype (left, female)	6.6	6.5	2.7mm.
Paratype a (left, female)	8.8	8.6	3.8
Paratype b (left, female)	8.2	7.8	3.4
Paratype c (right, female)	7.6 (est.)	7.7	3.2
Paratype d (right, male)	11.5 (est.)	7.7	3.7
Paratype e (right, minor)	4.8	5.0 (est.)	1.6

Relations.—The female hand of this species is closely related to *Callianassa beta* Stenzel,[1] from the Claiborne Eocene Winona formation of Mississippi. In the latter, there is no tubercle at the angle of the hinge, nor obliquely above the articular node, and the interdigital sinus is narrower. *Callianassa gamma* Stenzel,[2] from the Winona formation of Mississippi, differs from the male hand of our species in lacking tubercles on the distal inner and outer surfaces, and in having the groove leading to the interdigital sinus strongly tuberculated. Both *Callianassa americana* Woods,[3] from

(1) STENZEL, H. B., 1935. Middle Eocene and Oligocene Decapod Crustaceous from Texas, Louisiana, and Mississippi: Amer. Midl. Naturalist, vol. 16, pp. 389, 392, pl. 15, figs. 3, 4.

(2) STENZEL, H. B., 1935. Op. cit., pp. 389, 393, pl. 15, figs. 5, 6; pl. 16, fig. 5.

(3) WOODS, H. in T. O. BOSWORTH, 1922. Geology of the Tertiary and Quaternary Periods in the Northwest Port of Peru: p. 115, pl. XVII, figs. 5a-b, 6a-b.

the Eocene Negritos formation of Peru, and *Callianassa subplana* Withers,[4] from the Lutetian Eocene of Jamaica, are larger than the species described here. *C. americana* differs mainly in the sharp upper edge of the hand, and the straight, oblique distal margin of the hinge. *C. subplana* has a row of three or more prominent pits near the middle of the inner surface, and on the outer, a row of three small tubercles descend from the hinge tubercle.

Remarks.—This is the first Eocene *Callianassa* to be described from Florida. Apparently it is the species referred to by Vernon,[6] as follows:

"Some portions of the Inglis member are characterized by abundant fragments of a mud shrimp, *Callianassa* n.sp., claws of which are so common and prominent that this particular facies was called 'the shrimp claw limestone' in the process of mapping."

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(4) WITHERS, T., 1924. Some Cretaceous and Tertiary Decapod Crustaceous from Jamaica: Ann. and Mag. Nat. Hist., ser. 9, vol. XIII, p. 85, pl. II, figs. 9-12.

(6) VERNON, ROBERT O., 1951. Geology of Citrus and Levy counties, Florida: Fla. Geol. Survey Bull. 33, p. 117.

PLATES 1-13

PLATE 1

Figures

1-5. *Turritella fischeri* Palmer, n. sp. 1, paratype, No. I-7400, 23 mm. height, 7 mm., greatest diameter. 2, paratype, No. I-7401, 32 mm., height, 8 mm., greatest diameter. 3, paratype, No. I-7402, 60 mm., height, 10 mm., greatest diameter. 4, holotype, No. I-7399, 40 mm., height, 12 mm., greatest diameter. 5, paratype, No. I-7403, 38 mm., height, 16 mm., greatest diameter. Loc. L-93.

6-9. *Velates floridanus* Richards. 6, 7, No. I-7396, 52 mm., height, 67 mm., width, 90 mm.± length. 8, No. I-7398, 17 mm., height, 24 mm., width, 33 mm., length. 9, No. I-7397 (plastotype), 9 mm., height, 20 mm., width, 27 mm., length. Loc. L-135.

10, 11. *Tectariopsis? avonensis* Palmer, n. sp. 10, 11. Same specimen, holotype (plastotype), No. I-7391, 18 mm., height, 19 mm., greatest diameter. Loc. L-73.

12. *Astraea withlacoochensis* Palmer, n. sp. Holotype (plastotype), No. I-7395, 25 mm., height, 39 mm., greatest diameter. Loc. L-135.

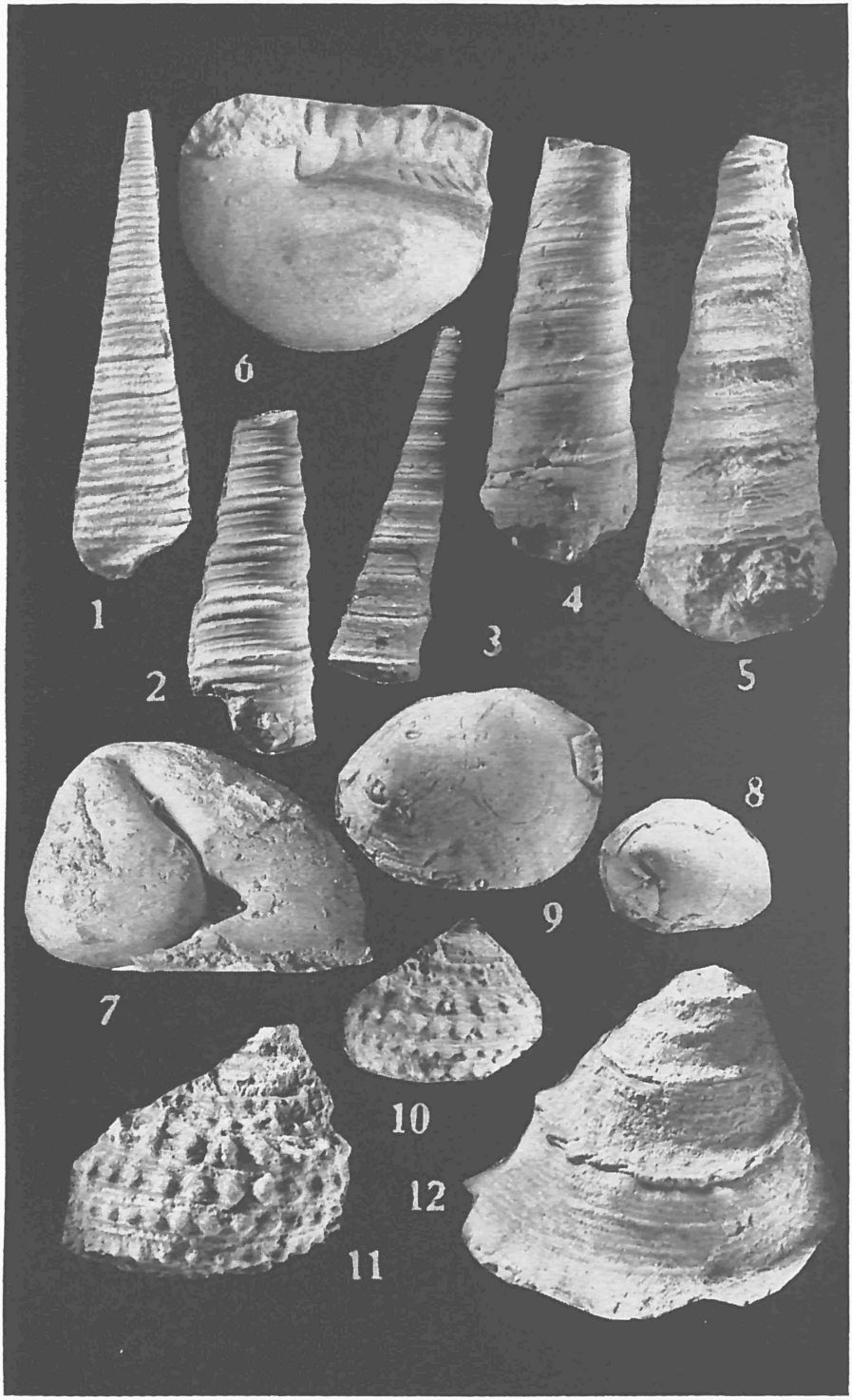
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PLATE 2

Figures

1, 2. *Calyptraea aperta* (Solander). 1, No. I-7422, 5 mm., height, 12 mm., greatest diameter. Loc. L-93. 2, No. I-7423, 15 mm., height, 15 mm., greatest diameter. Loc. L-93.

3, 9, 12. *Bellatara americana* Palmer, n. sp. 3, paratype, No. I-7408, 32 mm., height, 26 mm., greatest diameter, Loc. L-93. 9, holotype, No. I-7407, 90 mm., height, 37 mm., greatest diameter. Loc. L-93. 12, paratype (plastotype), No. I-7410, 28 mm., height; 16 mm., greatest diameter. Loc. L-135.

4, 5. *Batillaria advena* Palmer, n. sp. 4, paratype, No. I-7406, 15 mm., height, 6 mm., greatest diameter. 5, holotype, No. I-7405, 15 mm., height, 6 mm., greatest diameter.

6. *Xenophora* sp. Plastotype, No. I-7426, 10 mm., height, 20 mm., greatest diameter. Loc. L-135.

7. *Tugurium grayi* Palmer, n. sp. Holotype, No. I-7428, 25 mm., height, 31 mm., greatest diameter. Loc. C-11.

8. *Bellatara citrana* Palmer, n. sp. Holotype (plastotype), No. I-7412, 44 mm., height, 38 mm., greatest diameter. Loc. C-11.

10, 11, 13. *Bellatara floridana* Palmer, n. sp. 10, paratype (plastotype), No. I-7415, 26 mm., height, 15 mm., greatest diameter. 11, holotype (plastotype), No. I-7414, 70 mm., height, 30 mm., greatest diameter. 13, paratype, No. I-7416, 60+ mm., height, 24 mm., greatest diameter. Loc. L-135.

14. *Conus* sp. B. No. I-7634, 23 mm., height, 12 mm., greatest diameter. L-93.

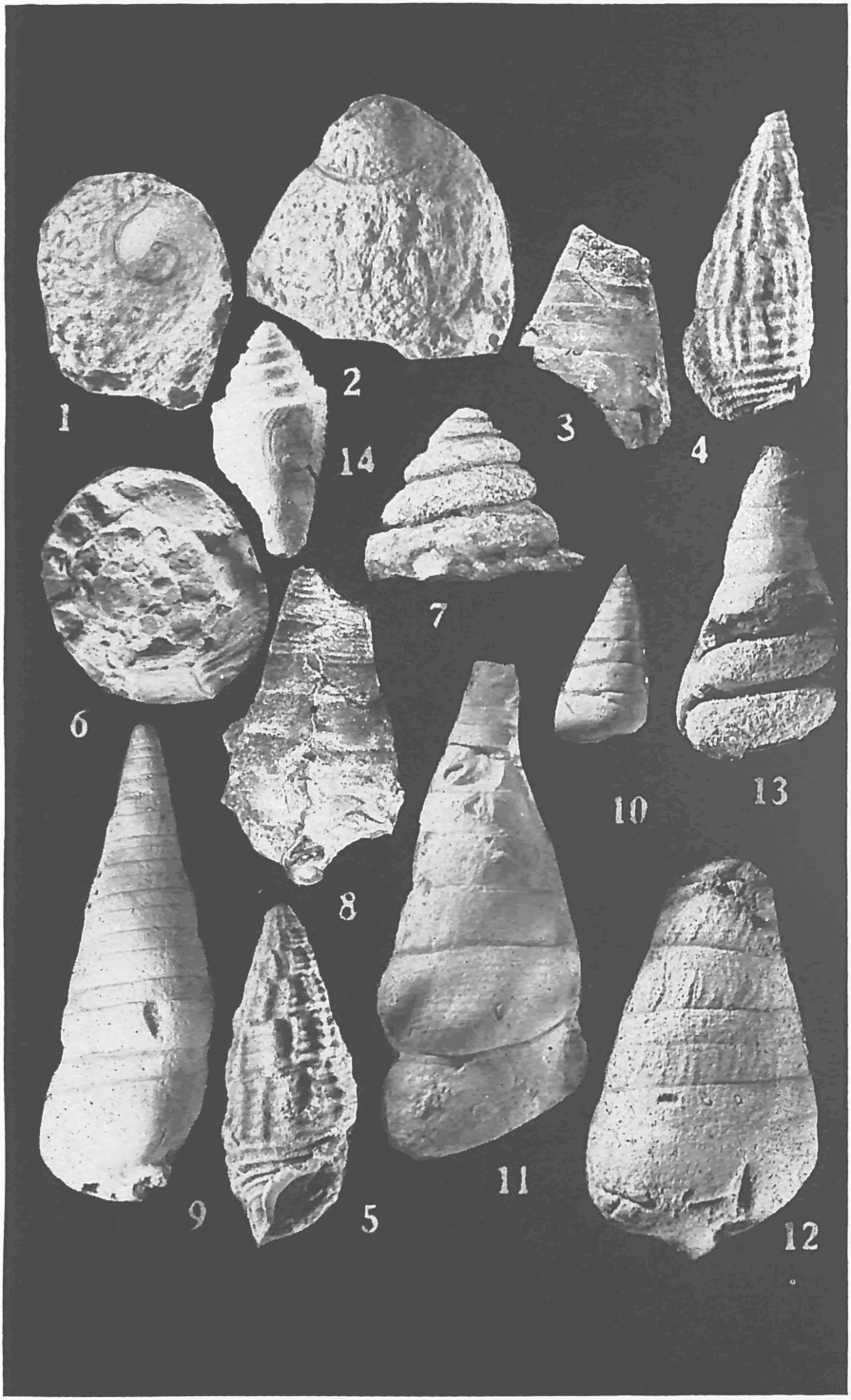
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PLATE 3

Figures

1-5. *Lacvella floridana* Palmer, n. sp. 1, 5, paratype, No. I-7437, 23 mm., height, 12 mm., greatest diameter. 2, 3, paratype, No. I-7438, 32 mm., height, 19 mm., greatest diameter. 4, holotype, No. I-7436, 30 mm., height, 20 mm., greatest diameter. Loc. L-93.

6-8. *Hipponix floridanus* Palmer, n. sp. 6, paratype, No. I-7419, 10 mm., height, 26 mm., greatest diameter. 7, holotype, No. I-7418, 17 mm., height, 27 mm., greatest diameter. Loc. L-93. 8, paratype (plastotype), 10 mm., height, 18 mm.±, greatest diameter. Loc. L-73.

9, 12. *Terebellum (Seraphs) belemnitum* Palmer, n. sp. 9, holotype, No. I-7642, 49 mm., height, 15 mm., greatest diameter. 12, paratype, No. I-7643, 27 mm., height, 10 mm., greatest diameter. Loc. L-93.

10, 11. *Ampullinopsis citrinensis* Palmer, n. sp. 10, paratype (plastotype), No. I-7435, 42 mm., height, 35 mm., greatest diameter. 11, holotype (plastotype), No. I-7434, 47 mm., height, 47 mm., greatest diameter. Loc. C-11.

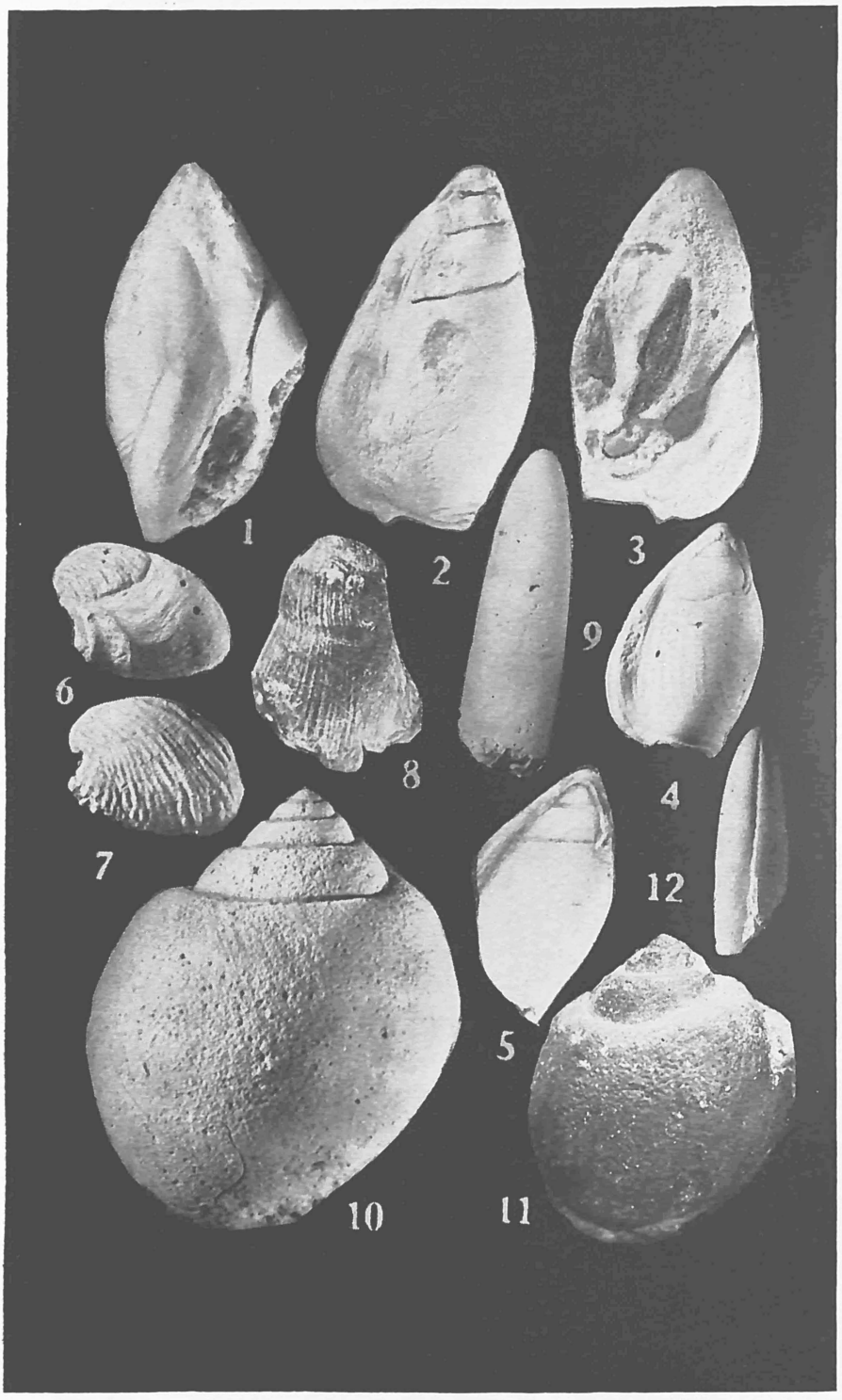
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PLATE 4

Figures

1. *Pseudocrommium occiduum* Palmer, n. sp. Holotype, No. I-7433, 80 mm., height of fragment, 63 mm., greatest diameter. Loc. L-76.

2-8. *Pseudocrommium brucei* Palmer, n. sp. 2, 3, holotype, No. I-7429, 50 mm., height, 35 mm., greatest diameter. 4, paratype, No. I-7430, 65 mm., height, 45 mm., greatest diameter. Loc. L-93. 5, paratype (plastotype), No. I-7640, 70 mm., height, 42 mm., greatest diameter. Loc. L-93. 6, 7, paratype (young), No. I-7431, 18 mm., height, 13 mm., greatest diameter. Loc. L-135. 8, paratype, No. I-7432, 15 mm., height, 16 mm., greatest diameter. Loc. L-93.

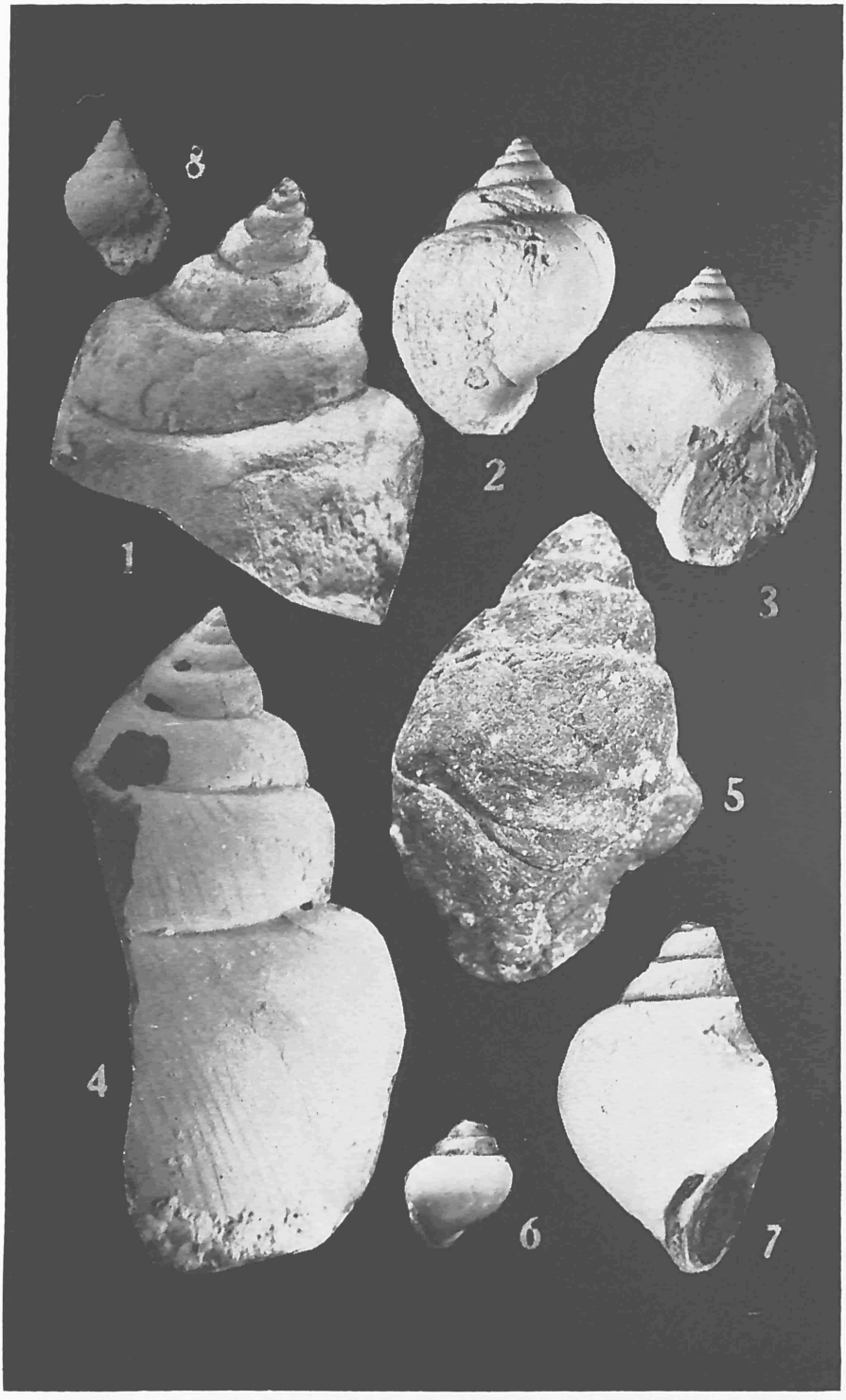
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PLATE 5

Figures

1, 14. *Lyria pycnopleura cocenia* Palmer, n. sp. 1, holotype, No. I-7630, 21+ mm., height, 11 mm., greatest diameter. 14, paratype, No. I-7631, 22 mm., height, 10 mm., greatest diameter. Loc. L-93.

2, 3. *Cypraedia fenestralis* Conrad. 2, No. I-7439, 19 mm., height, 18 mm., greatest diameter. 3, No. I-7440, 37 mm., height, 22 mm., greatest diameter. Loc. L-93.

4-8. *Voluticella levensis* Palmer, n. sp. 4, paratype, No. I-7626, 27 mm., height, 20 mm., greatest diameter. 5, holotype, No. I-7625, 35 mm., height, 21 mm., greatest diameter. 6, 8, paratype, No. I-7621, 19 mm., height, 11 mm., greatest diameter. 7, paratype, No. I-7628, 35 mm., height, 26 mm., greatest diameter. Loc. L-93.

9-13. *Caricella obsoleta* Palmer, n. sp. 9, 11, holotype, No. I-7622, 37 mm., height, 19 mm., greatest diameter. 10, 12, paratype (young), No. I-7623, 19 mm., 10 mm., greatest diameter. 13, paratype, No. I-7624, 35 mm., height, 21 mm., greatest diameter. Loc. L-93.

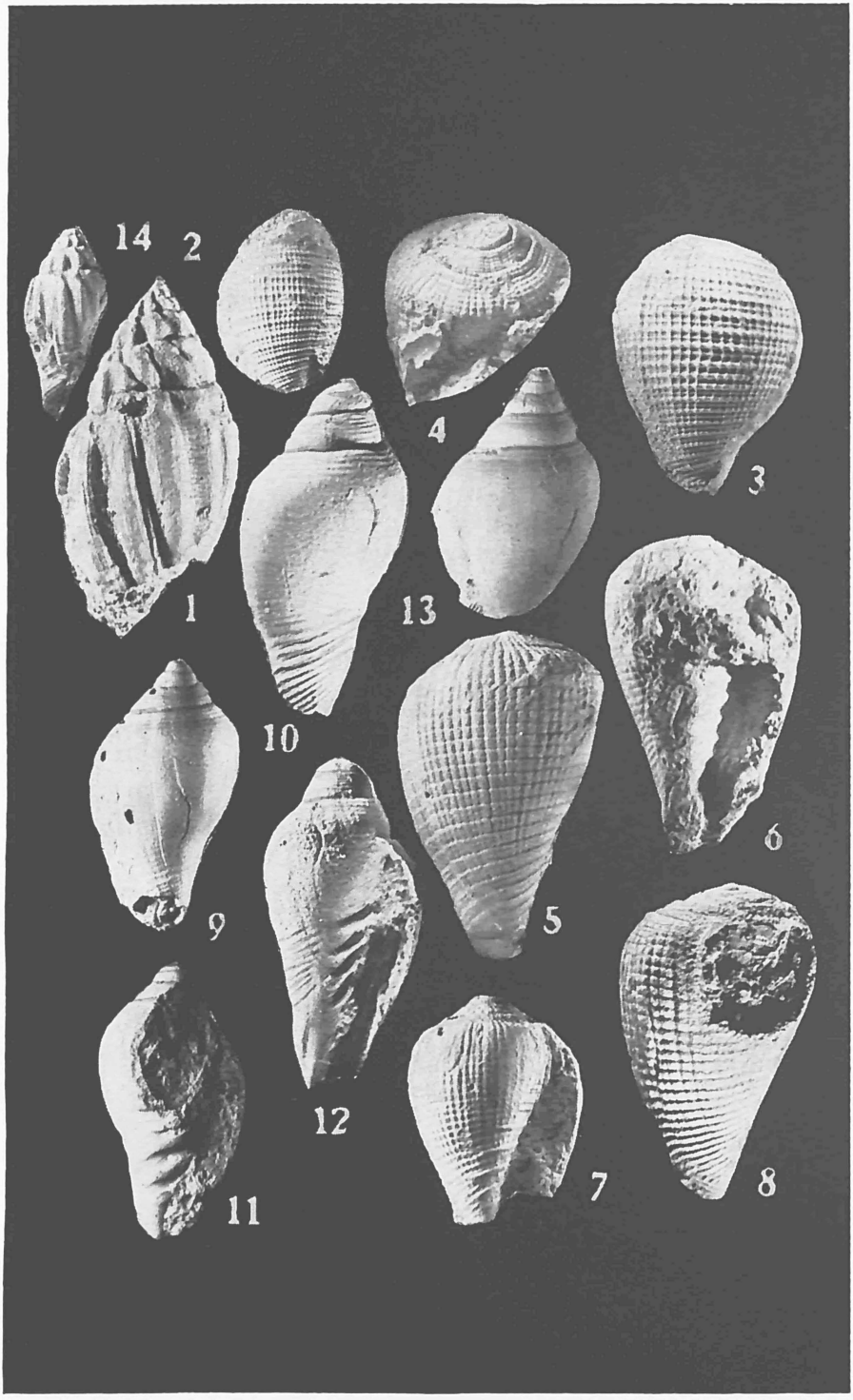
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PLATE 6

Figures

1-4, 12. *Scaphander richardsi* Palmer, n. sp. 1, holotype, No. I-7635, 40 mm., height, 17 mm., greatest diameter. 2, paratype, No. I-7636, 17 mm., height, 18 mm., greatest diameter. 3, paratype, No. I-7637, 20 mm., height, 9 mm., greatest diameter. 4, paratype, No. I-7638, 25 mm., height, 15 mm., greatest diameter. 12, No. I-7639, 21 mm., height, 10 mm., greatest diameter. Loc. L-93.

5, 8, 13. *Agaronia inglisia* Palmer, n. sp. 5, paratype, No. I-7605, 13 mm., height, 5 mm., greatest diameter. 8, 13, holotype, No. I-7604, 30 mm., height, 11 mm., greatest diameter. Loc. L-93.

6, 11. *Pseudotoma floridana* Palmer, n. sp. Holotype, No. I-7632, 19 mm., height, 10 mm., greatest diameter. Loc. L-93.

9, 14. *Concinitra* sp. 9, No. I-7610, 14 mm., height, 6 mm., greatest diameter. Loc. L-93. 14, No. I-7609, (plastotype), 15 mm., height, 5 mm., greatest diameter. Loc. L-73.

7, 10. *Olivella (Callianax) poinciana* Palmer, n. sp. 7, holotype, No. I-7609, 15 mm., height, 8 mm., greatest diameter. 10, paratype, No. I-7608, 11 mm., height, 6 mm., greatest diameter. Loc. L-93.

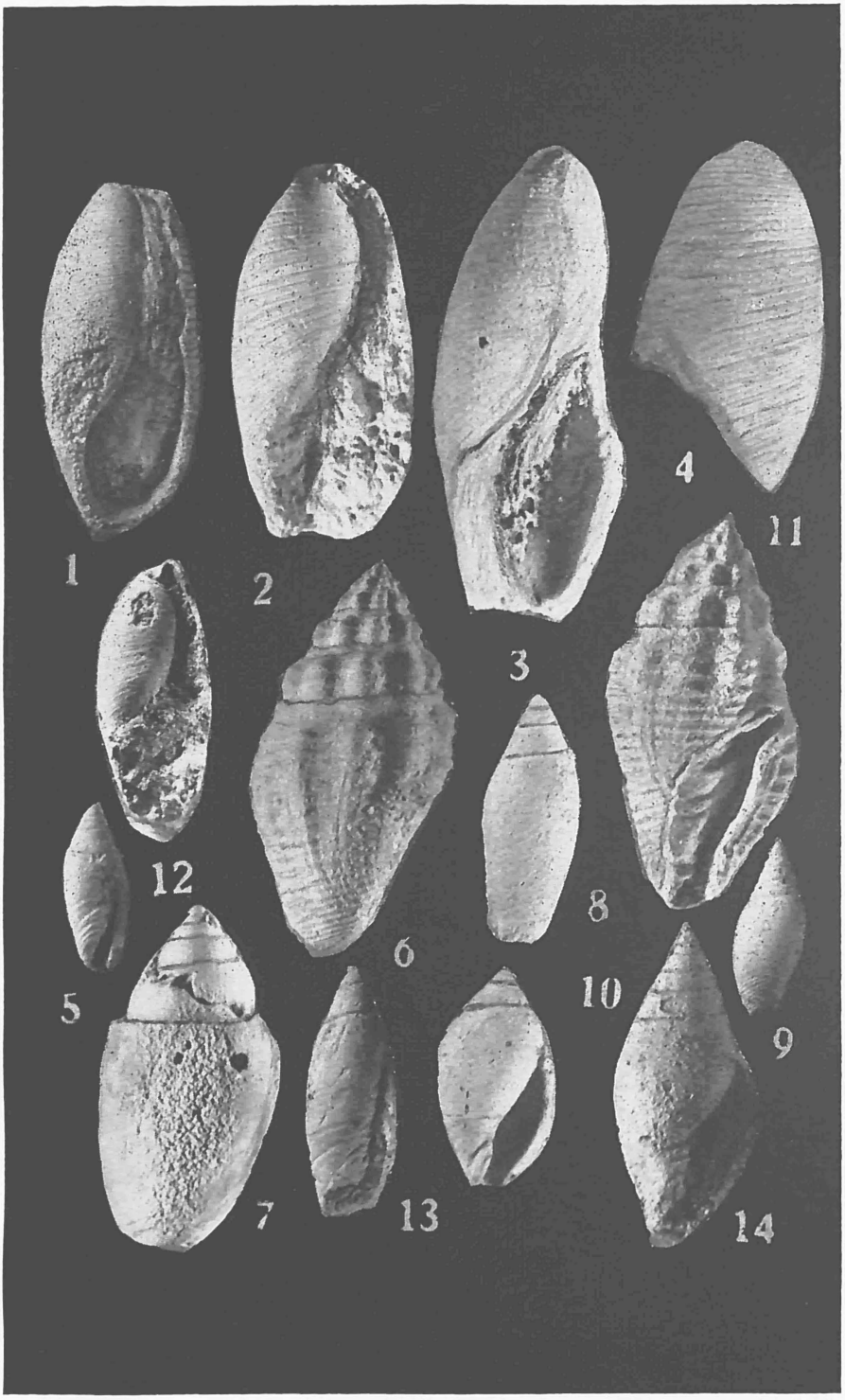
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PLATE 7

Figures

1-3, 9. *Sycospira eocenica* Palmer, n. sp. 1, 2, holotype, No. I-7620, 115 mm., height, 67 mm., greatest diameter. 3, 9, paratype, No. I-7621, 27 mm., height, 17 mm., greatest diameter. Loc. L-93.

4-7. *Eovasum vernoni* Palmer, n. sp. 4, paratype, No. I-7615, 52 mm., height, 30 mm., greatest diameter. 5, 6, paratype, No. I-7616, 50 mm., height, 35 mm., greatest diameter. 7, holotype, No. I-7614, 70 mm., height, 40+ mm., greatest diameter. Loc. L-93.

8. *Diastoma* sp. No. I-7404, 25 mm., height, 6 mm., greatest diameter. Loc. L-139.

10, 11. *Distorsio* (*Personella*) *jacksonensis* (Meyer). No. I-7644, 13 mm., height, 8 mm., greatest diameter. Loc. L-93.

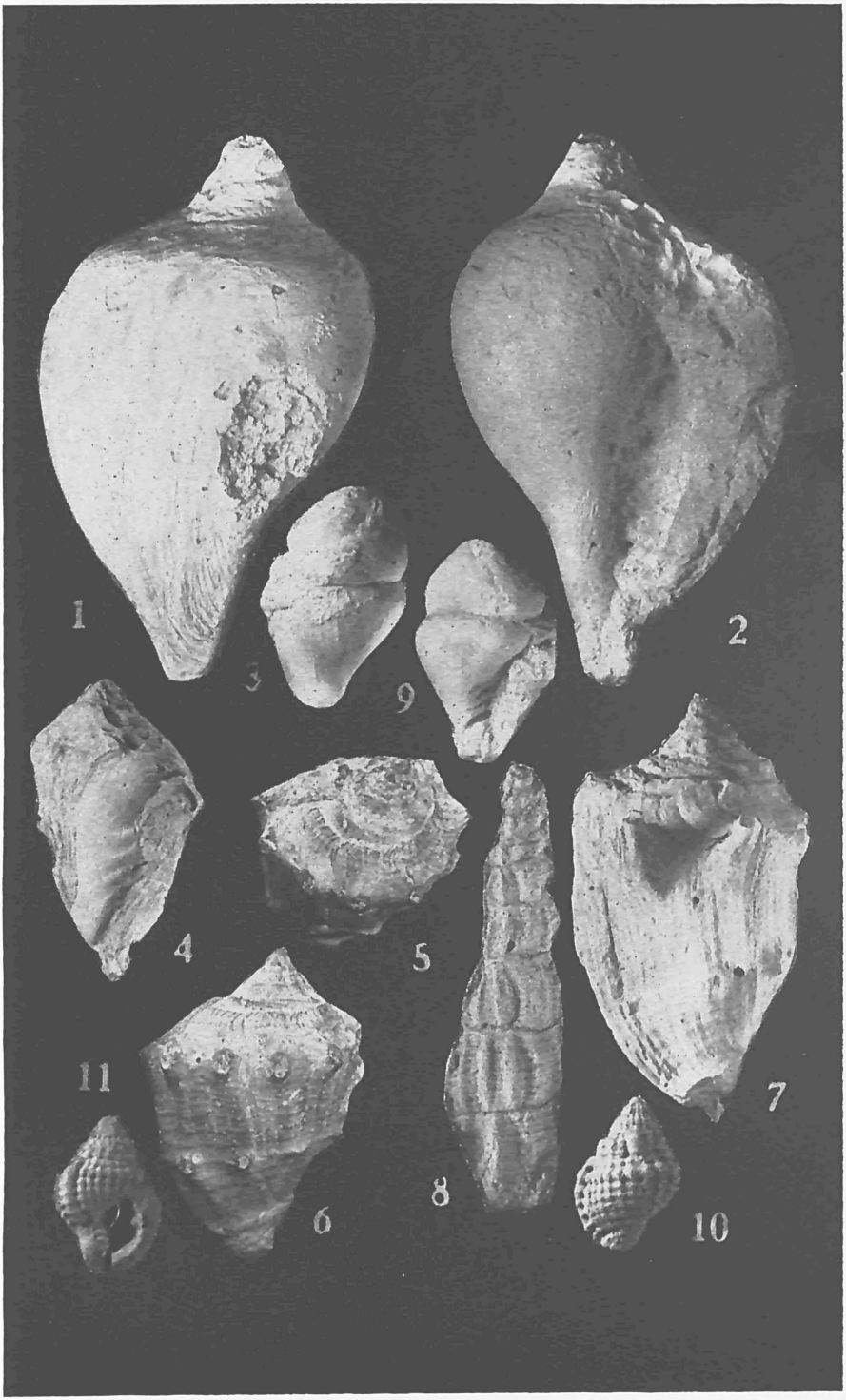
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PLATE 8

Figures

1-4. *Papillina gunteri* Palmer, n. sp. 1, holotype, No. I-7645, 180± mm., height, 75 mm., greatest diameter. 2, paratype (plastotype), No. I-7646, 33 mm., height, 35 mm., greatest diameter. 3, paratype (immature), No. I-7647, 27 mm., height (fragment), 16 mm., greatest diameter. 4, paratype (young), No. I-7648, 7 mm., height, 8 mm., greatest diameter. Loc. L-93.

5, 12. *Pseudoaluca clarki* Palmer, n. sp. Holotype, No. I-7641, 33 mm., height, 12 mm., greatest diameter. Loc. L-93.

6, 8. *Athleta arangia* Palmer, n. sp. 6, paratype (plastotype), No. I-7618, 36 mm., height, 15 mm., greatest diameter. Loc. C-11. 8, holotype, No. I-7617, 29 mm., height, 13 mm., greatest diameter. Loc. L-93.

7. *Lyria citrusensis* Palmer, n. sp. Holotype (plastotype), No. I-7629, 22 mm., height, 13+ mm., greatest diameter. Loc. C-11.

9-11. *Lapparia conradi* Palmer, n. sp. 9, paratype (young), No. I-7612, 15 mm., height, 7 mm., greatest diameter. 10, 11, holotype, No. I-7611, 35 mm., height, 14 mm., greatest diameter. Loc. L-93.

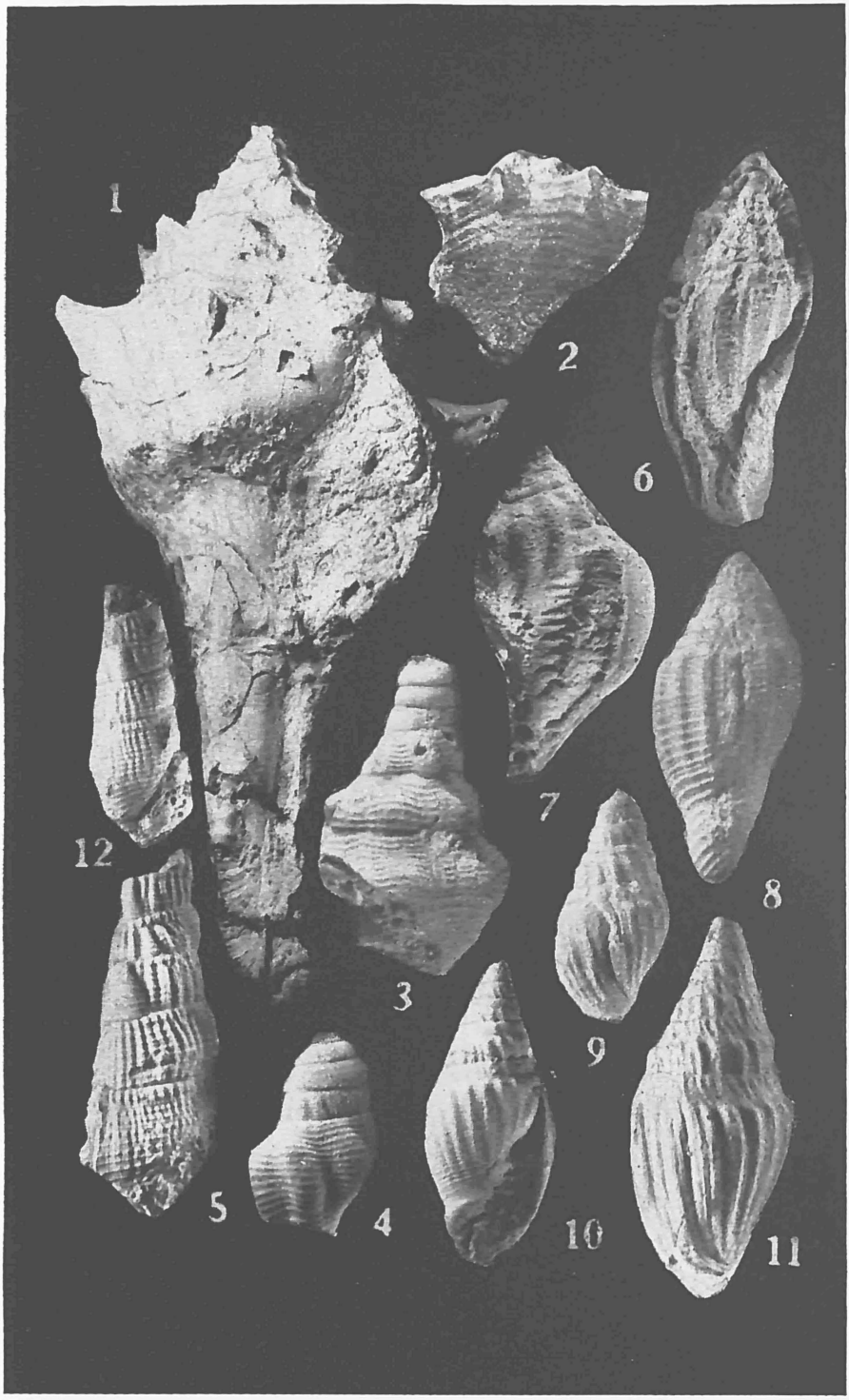
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PLATE 9

Figures

1. *Barbatia palmerae* Richards, n. sp. Holotype, No. I-7551, 14.0 mm., height, 21.2 mm., length. Loc. L-93.

2. *Barbatia? inglisia* Richards, n. sp. Holotype, No. I-7550, 16.9 mm., height, 29.0 mm., length. Loc. L-93.

3, 4. *Glycymeris lisbonensis* Harris. 3, No. I-7553, 19.2 mm., height, 20.5 mm., length. 4, No. I-7552, 19.2 mm., height, 20.2 mm., length. Loc. L-93.

5. *Anomia* cf. *A lisbonensis* Aldrich. No. I-7531, 26.5 mm., length. Loc. L-76.

6. *Ostrea* sp. No. I-5338, 26.4 mm., length. Loc. L-93.

7. *Divaricella robertsi* Richards, n. sp. Holotype, No. I-7567, 14.4 mm., length, 16.0 mm., height. Loc. L-93.

8. *Volsella* sp. No. I-7560, 50.7 mm., height, 35.8 mm., length (incomplete). Loc. L-93.

9, 10. *Crassatella inglisia* Richards, n. sp. 9, holotype, No. I-7541, 21.4 mm., height, 26.9 mm., length. 10, paratype, No. I-7542, 20.3 mm., height, 24.1 mm., height. Loc. L-92.

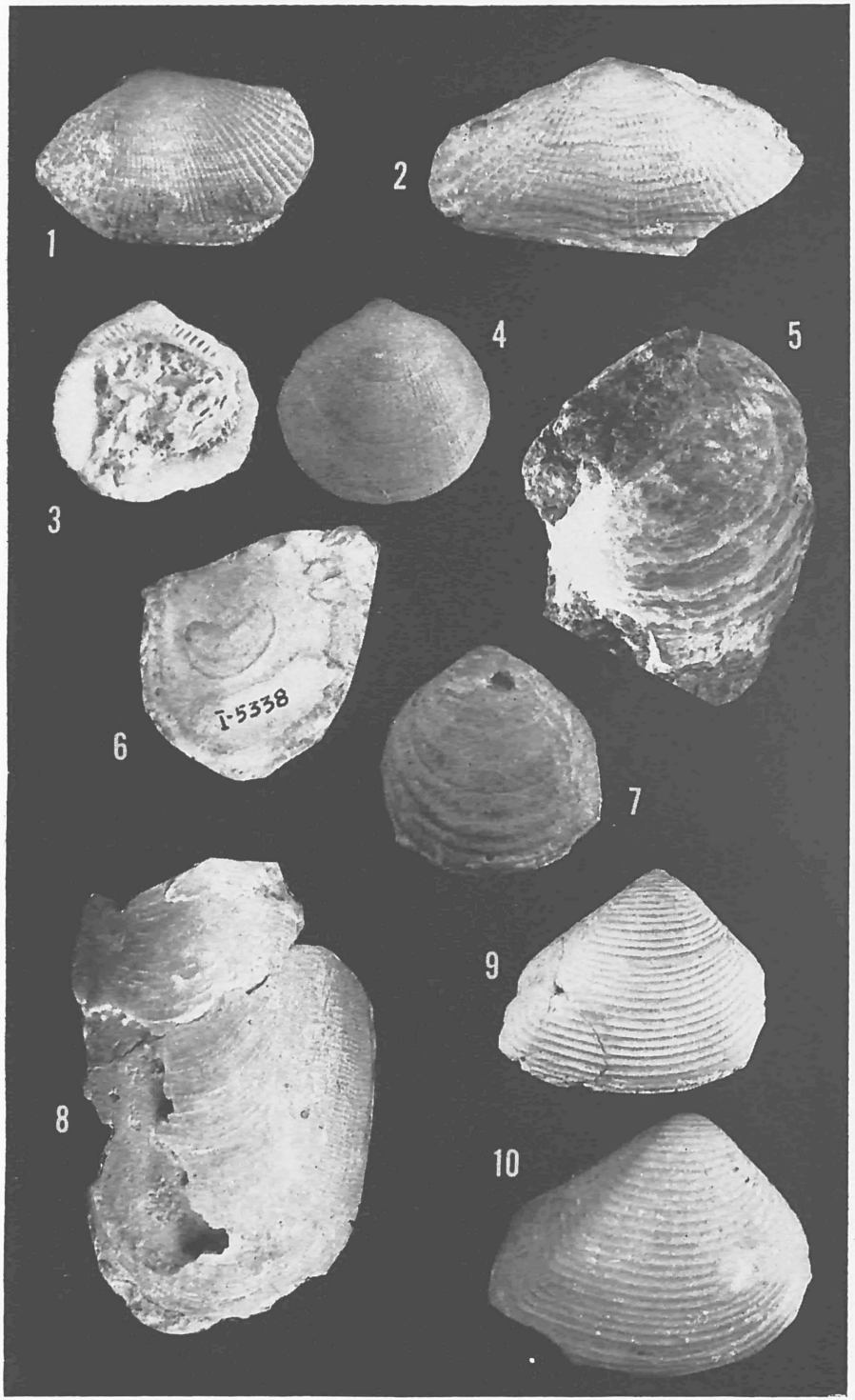
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PLATE 10

Figures

1, 2. *Venericardia scabricostata* Guppy. 1, No. I-7533, 12.5 mm., height, 12.5 mm., length. 2. No. I-7534, 9.4 mm., height, 9.3 mm., length. Loc. L-93.

3. *Crassatella* sp. No. I-7549, 45.9 mm., height, 59.3 mm., length. Loc. C-11.

4. *Crassatella entawacolens* Harris. No. I-7548, 35.3 mm., height, 45.5 mm., length. Loc. L-93.

5. *Venericardia withlacoochensis* Richards, n. sp. Holotype, No. I-7539, 19.5 mm., height, 17.5 mm., length. Loc. L-93.

6. *Pseudomiltha megameris* Dall. No. I-7562, 175.0 mm., height, 100.0 mm., length. Loc. C-11.

7. "Lucinoid." No. I-7587, 38.0 mm., height, 37.5 mm., length. Loc. L-139.

8. *Here* sp. No. I-7564, 14.4 mm., height, 11.3 mm., length. Loc. L-118.

9. *Here* cf. *H. wacissana* Dall. No. I-7563, 22.9 mm., height, 22.9 mm., length. Loc. C-11.

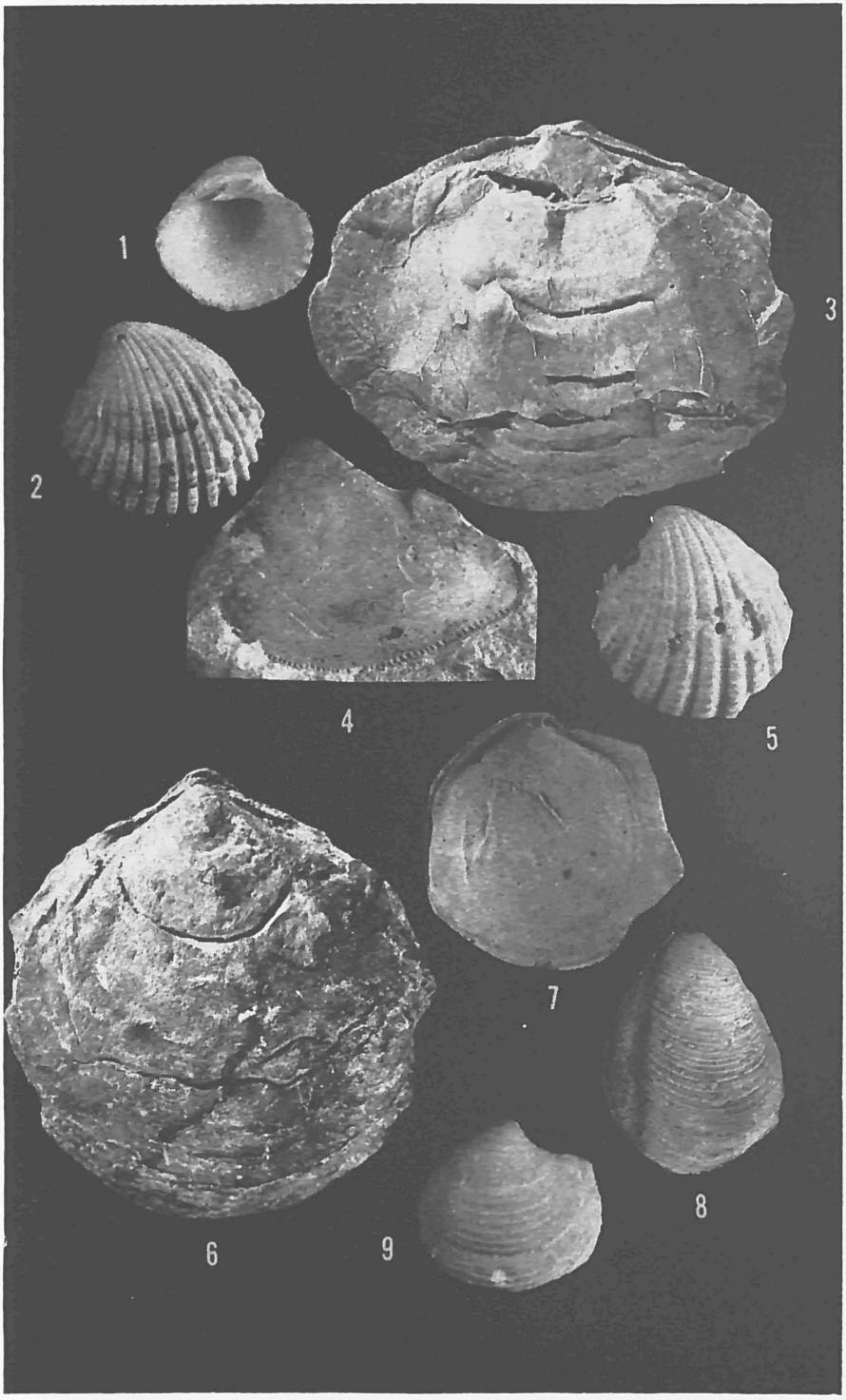
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PLATE 11

Figures

1. *Fimbria olssoni* Richards, n. sp. Holotype, No. I-7558, 30.5 mm., height, 43.9 mm., length. Loc. L-118.

2-4. *Fimbria vernoni* Richards, n. sp. 2, No. I-7557, 24.0 mm., height. Loc. L-139. 3, 4, holotype, No. I-7556, 30.5 mm., height, 29.5 mm., length. Loc. L-93.

5, 6. *Cardium (Trachycardium)* cf. *C. claibornense* Aldrich. 5, No. I-7570, 30.0 mm., height, 33.0 mm., length. 6, No. I-7569 (plastocast), 29.0 mm., height, 30.0 mm., length. Loc. L-93.

7. *Cardium (Dinocardium) levyi* Richards, n. sp. Holotype, No. I-7568, 39.0 mm., height, 35.7 mm., length. Loc. L-76 .

8. *Dentalium* sp. No. I-7588, 28.5 mm., length. Loc. L-93.

9. *Cardium (Anthocardia?) avonum* Richards, n. sp. Holotype, No. I-7575 (plastocast), 29.0 mm., height, 27.0 mm., length. Loc. L-76.

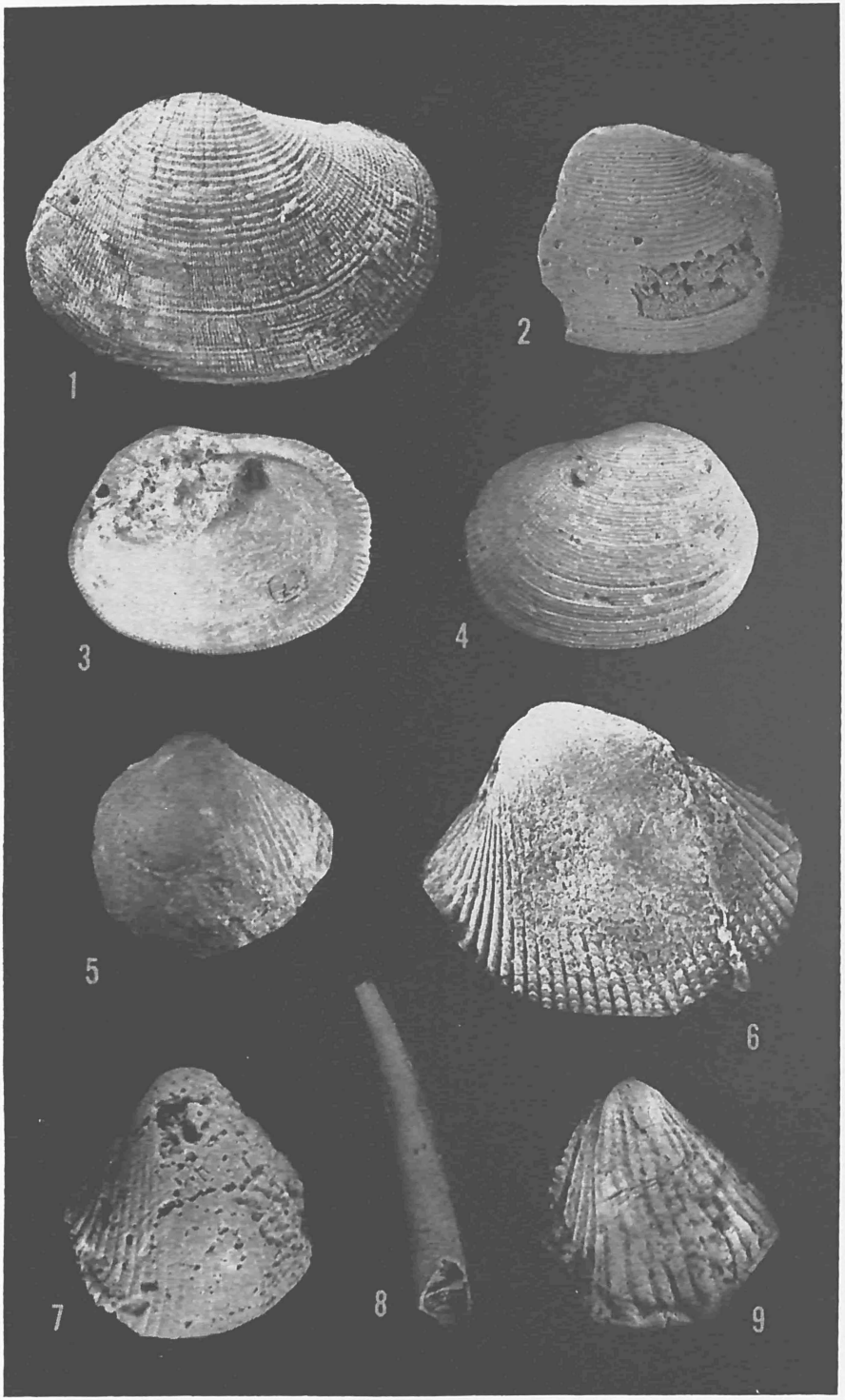
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PLATE 12

Figures

1-3. *Cardium (Trigoniocardium) protoaliculum* Richards, n. sp. 1, holotype, No. I-7572, 26.0 mm., height, 18.0 mm., length. 2, paratype, No. I-7573, 17.5 mm., height, 15.0 mm., length. 3, paratype, No. I-7571, 41.5 mm., height, 30.0 mm., length. Loc. L-93.

4. *Gari jacksonense* Harris. No. I-7661, 13.2 mm., height, 13.2 mm., length. Loc. L-179.

5. *Callista annexa* Conrad. No. I-7578, 21.1 mm., height, 28.0 mm., length. Loc. L-118.

6. *Blagraveia? gunteri* Richards, n. sp. No. I-7579, 16.5 mm., height, 19.0 mm., length. Loc. L-93.

7. *Blagraveia? gunteri* Richards, n. sp. (?). No. I-7580, 21.2 mm., height, 18.7 mm., length. Loc. L-93.

8, 9. *Corbula densata* Conrad. 8, No. I-7582, 11.6 mm., height, 16.2 mm., length. 9, No. I-7583, 11.8 mm., height, 17.5 mm., length. Loc. L-93.

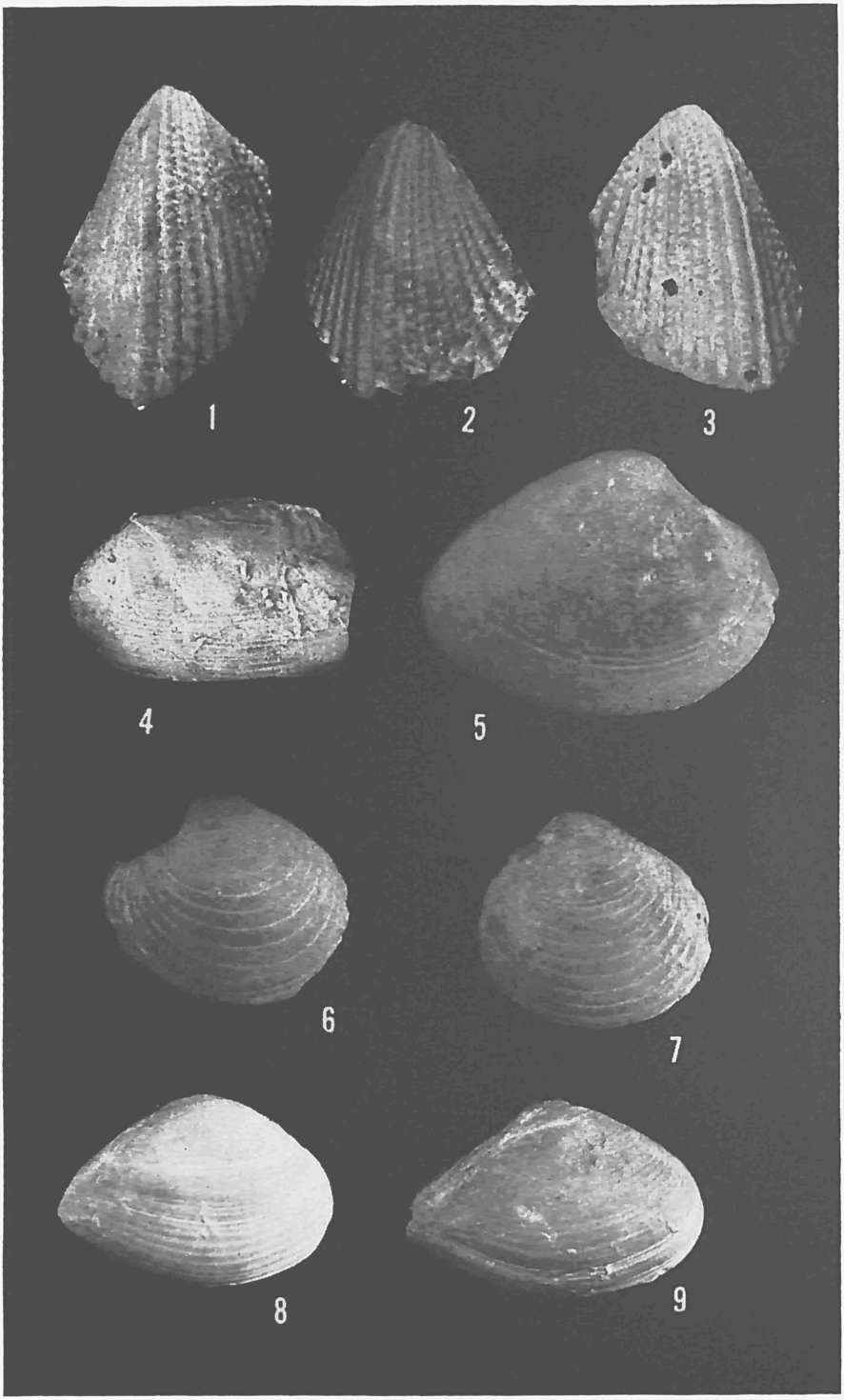
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PLATE 13

Callianassa inglisestris Roberts, n. sp.

Figures

1-4. Holotype. Fla. Geol. Surv. No. I-7590. Left hand of female; outer, inner, lower, and front views. Specimens 8.5 x 6.5 x 2.7 mm.

5-6. Paratype 3. Fla. Geol. Surv. No. I-7592. Right hand of female; outer and inner views. Specimen 9.4 x 7.7 mm.

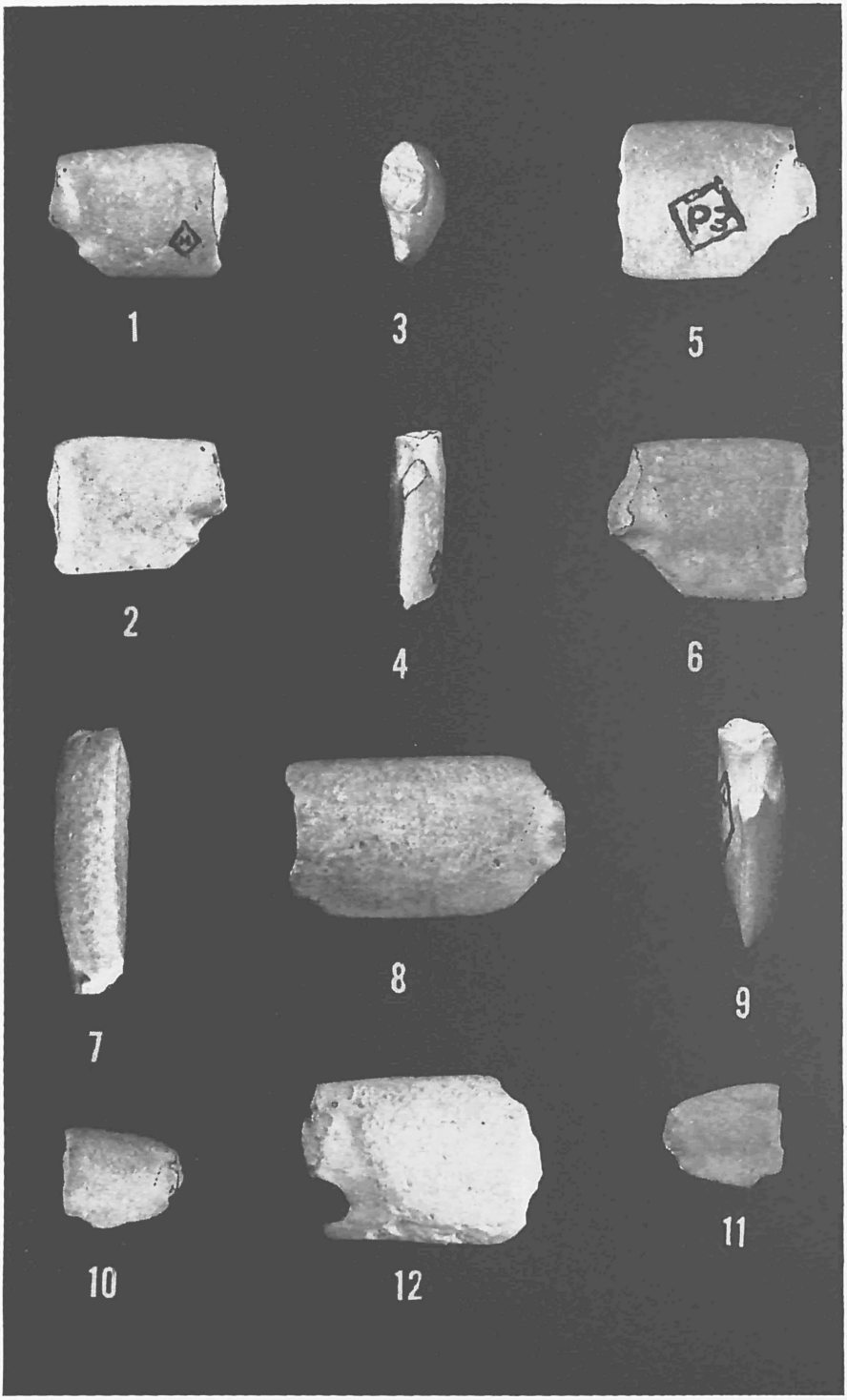
7-8. Paratype 2. Fla. Geol. Surv. No. I-7593. Right hand of male; outer and upper views; specimen 13.1 x 7.7 x 3.7 mm.

9. Paratype 4. W.F.I.S. No. 17231. Left hand of female; front view tilted upward to show prominence and tooth on interdigital sinus. Specimen 10.3 x 3.3 mm.

10, 11. Paratype 5. Fla. Geol. Surv. No. I-7594. Right minor hand of the first pair; outer and inner views; specimen 5.7 x 4.8 mm.

12. Paratype 1. Fla. Geol. Surv. No. I-7591. Left hand of female with stump for fixed finger; outer view; specimen 11.8 x 8.6. mm.

All specimens are from the Inglis member, Moodys Branch formation near Inglis, Levy County, Florida, Fla. Geol. Surv. Locality L-93.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