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RHYTHM OF THE PALEOCENE-EOCENE SEAS OF THE CENTRAL GULF COAST, AS DEFINED BY FOSSILS AND SEDIMENTS

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The Paleocene-Eocene strata of the Gulf Coastal Plain occupy the general area from southwestern Texas eastward through Alabama and north as an arc in Arkansas, Kentucky, and Tennessee. The greater mass of the formations of this region are shallow water, marine clastics—arenaceargillaceous, calcareous, and glauconitic. Alternating stages of marine and nonmarine deposits (with fossils of land plants) characterize the sediments in the area.

The marine formations abound with well-preserved fossil invertebrates. At certain localities immense collections may be obtained, attesting to past prolific marine life. In both surface and subsurface formations the members of the Foraminiferida, large and small, are excellent zonal markers. Although representatives of sponges, corals, brachiopods, bryozoans, ostracodes, and crustaceans are present, mollusk shells exceed all other invertebrate megafossils in abundance. They are useful as surface guides to formations and to the discrimination of the stratigraphic stages. Outstanding in the fossil population of the southern coastal area are the mollusks made famous by those from Claiborne Bluff, Alabama River, in Alabama.

Because of their prominence at many distinct localities in the regional unit, their splendid preservation, and their coherent biologic and geologic history, the mollusks are a profound factor in the interpretation of the history of the Paleocene-Eocene embayments of the Gulf Coast. For over 150 years, by more than a score of authors, the fossils have been collected, studied, described, and illustrated. The formations have been equally investigated, correlated, and the stratigraphic column standardized with general agreement. Published studies on the mollusks include everything from brief papers to monographs of over 500 pages, with illustrations up through 90 plates. A wealth of data on the molluscan species has been accumulated as to origin, correlation, variation, similarities, biologic relationships, geographic extent, stratigraphic range, environmental aspects, and other pertinent factors. Palmer and Brann (1965) have listed some 2400 species and recent investigations continue to increase the number.

From this wealth of detailed studies of the fossils and sediments substantial deductions can be made as to the sequence of events through the Paleocene-Eocene time of the southern coastal embayments. Because of the many natural exposures with their well-preserved stratigraphic sections extending laterally and vertically, the area is renowned as a standard of Paleocene-Eocene Paleontology and Stratigraphy, a so-called "classic of lower Cenozoic history."

Though equivalency of separate sections may not be totally agreed upon, the correlation of the major units is of general approval. The sediments and fossils have been grouped into time-rock units (Stages) of a four-part general designation:

1. Paleocene *Midway Stage* — type area, Alabama. MARINE PHASE.
2. Eocene (lower) *Sabine Stage* — type area, Sabine River, Texas and Louisiana. MARINE AND NON-MARINE PHASES.
3. Eocene (lower middle) *Claiborne Stage* — type area, Alabama. MARINE PHASE. Eocene (upper middle) *Claiborne Stage* — type area, Alabama. MARINE AND NON-MARINE PHASES.
4. Eocene (upper) *Jackson Stage* — type area, Mississippi. MARINE PHASE.

The period of time of these Stages represents a sequence of transgression, regression; transgression, recession; transgression and final regression — presenting three periods of flood in the Paleocene-Eocene and two times of general retreat of the mother Gulf waters in the southern Coastal Plain (see figure 1).

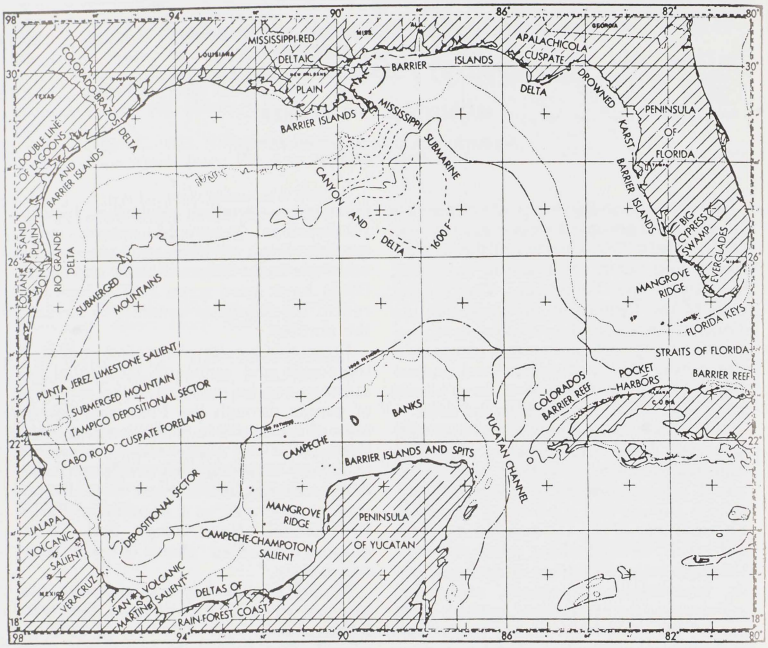
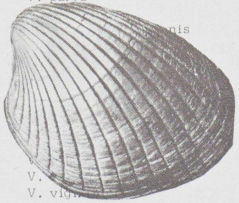


Figure 1. Shorelines and major geographic features of the Gulf of Mexico. (After Price, 1954). Courtesy L.D. Toulmin.

Such an analysis of the movements of rhythm of the lower Cenozoic Gulf waters would suggest five Stage (time-rock) units instead of four as presently generally outlined. Five stages were stipulated by the late G.D. Harris in 1918, 1919 as: *Midway,* marine; *Sabine,* lignitic (non-marine); "*St. Maurice,*" marine; *Claiborne,* lignitic (non-marine); and *Jackson,* marine. I subscribe to the Harris division of stages, with the exception of using the name "St. Maurice" for the third stage; however, we should limit "Claiborne" to the upper-middle Eocene as a stage. This would include the marine Gosport Sand and the non-marine sediments elsewhere. I would hope that a separate name for the marine lower-middle "Claiborne" can be provided in place of "St. Maurice" or "lower Claiborne." If the 4-part table of stages is used, an adequate image of the upper middle Eocene interval is not truly presented. To use the term "Gosport Sand" as representing the recession in the so-called "Claiborne" Stage is misleading as to the nature of the strand line. The fossils of the Gosport Sand are famous and their reputation dominates the general image of the southern American Eocene. The fauna of the Gosport Sand represents a concentration of marine invertebrate remains, particularly mollusks, piled in a small area of the total region involved in the stage. Other than the marine phase of the Gosport Sand, the sediments of the stage are generally nonmarine and represent the recessional

Paleocene	Lower Eocene	Middle Eocene		Upper Eocene
		L.M.U. Claiborne gr.	Gosport sd.	
	Venericardia alticostata "var."	Venericardia angustoscrobis	Venericardia aldrichi V. alticostata	
Venericardia bulla	> V. aposmithii	V. bilineata		
V. crenaea	V. ascia	V. blandingi		
V. eoa	V. bashiplata	V. brittoni		
V. francescae		V. carolinensis		
V. gardnerae		V. claiboplata	> V. claiboplata	
V. hesperia				
V. hijuana		V. claviger		
V. jewelli		V. complexicosta		> Venericardia apodensata
V. mediaplata		V. cookei		V. cookei
V. mingoensis				V. diversidentata
V. moa	V. densata pendletonensis	> V. densata		
V. m. "n. subsp."		V. eutawcolens	V. diversidentata sym-metrica	V. d. symmetrica
V. regia	V. greggiana			V. d. "var."
> V. smithii	V. gulielmi		V. inflatior	V. inflatior jacksonensis
V. whitei	V. hatcheplata	V. klimacodes		V. klimacodes
V. wilcoxensis	V. horatiana	V. leonensis		V. ocalaedes
V. spp.	V. intermedia	V. mooreana		
	V. nanaplata	V. natchitoches		
	V. n. nanna	V. parva	V. parva	V. parva "var."
	V. pilsbryi			V. praecisa
	V. potapacoensis	V. [illegible]nis	V. [illegible]	V. vicksburgiana
	V. sabinensis		V. [illegible]	V. withlacoochensis
	V. turneri			V. spp.
		V. [illegible]	V. [illegible]	
		V. vi[illegible]		



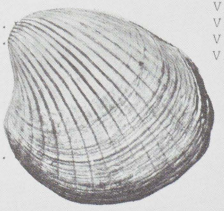


Fig. 2 Representative species of Venericardia planicosta stock, Gulf Coastal Area, Paleocene-Eocene (after Palmer and Brann, 1965, pp. 60-61)

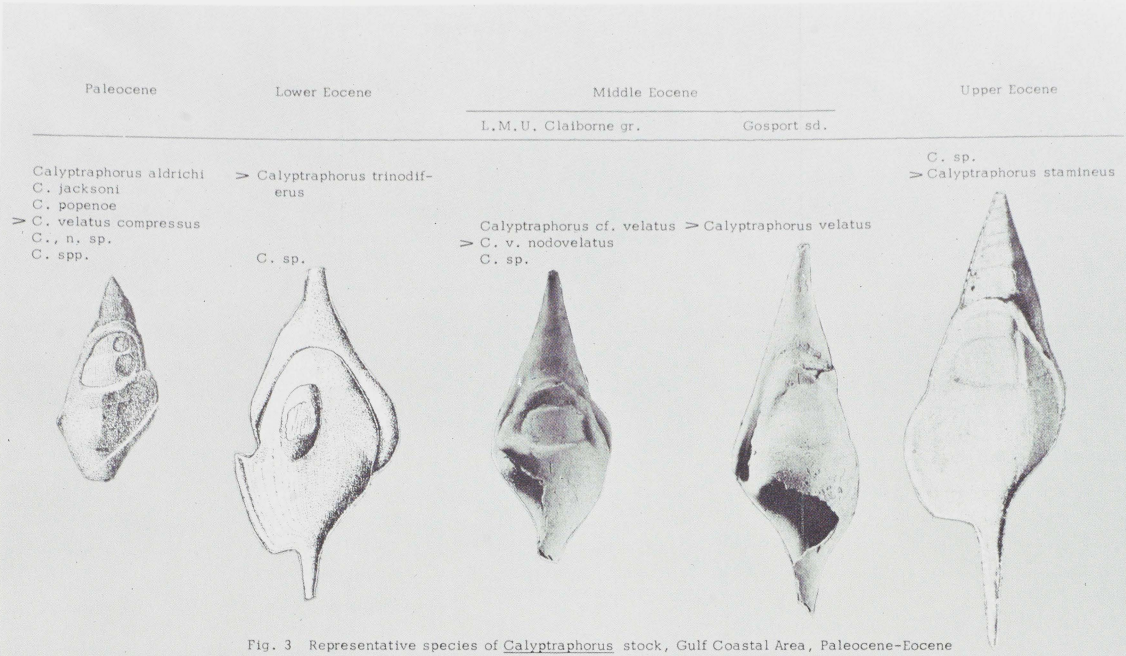


Fig. 3 Representative species of Calyptraphorus stock, Gulf Coastal Area, Paleocene-Eocene (after Palmer and Brann, 1966, p. 1032)

Paleocene	Lower Eocene	Middle Eocene L.M.U. Claiborne gr.	Middle Eocene Gosport sd.	Upper Eocene
	Athleta clarae	Athleta clayi A. dalli A. d. forma smithvillensis >A. haleanus A. lisbonensis A. l. forma crockettensis A. l. forma wechesensis A. petrosus A. p. smithi	> A. petrosus A. sayanus	Athleta arangius Athleta haleanus jacksonius > A. symmetricus Cf. A. triplicatus A. spp.
Athleta cf. tuomeyi A. sp.	> A. tuomeyi Cf. A. tuomeyi	A. wheelockensis A. w. forma bastropensis A. w. forma sabinensis		

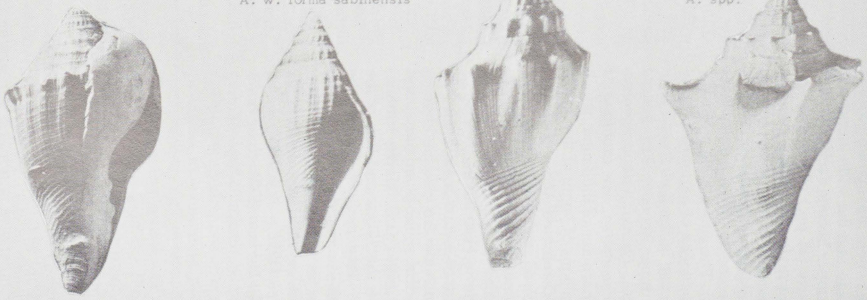


Fig. 4 Representative species of Athleta stock, Gulf Coastal Area, Paleocene-Eocene (after Palmer and Brann, 1966, p. 1030)

movements between the marine "Lower Claiborne" Stage and the wide inundation of the marine upper Eocene Jackson Stage.

General charts (46 pp.) of the distribution of the approximate number of 2400 molluscan species by stages have been outlined by Palmer and Brann (1965, 1966). Three of those charts are presented here (figures 2, 3, 4). The charts shown also depict the development of certain stocks of lineages occurring in the time from Paleocene through upper Eocene. Such genera as *Venericardia, Ostrea, Calyptraphorus, Athleta,* and *Pseudoliva,* are examples of the inherent character of the fauna, which through the millions of years of the Paleocene-Eocene dominated the region but evolved specifically with change of time and environment in the stages. The figures depict the species of each stock that is the particular guide to each stage.

The sequence of certain lineages also exploits and illustrates the biologic changes influenced by the shiftings in the strand line. Those changes G.D. Harris summarized in 1918 as the "Flow and Ebb of the Eocene Seas." That cyclic routine is the "Rhythm" of the time and seas. The term "cyclic," or the term "rhythm," is not new but has been utilized by many researchers such as Barrel (1917 - "cyclic"), Weller (1930 - "cyclic"), Hudson (1924 - "rhythm"), Plummer (1933 - "cyclic"), and Murray (1961). In addition, Ellisor (1929), Fisk (1938), Hunter (1939), Stenzel (1938, 1952), and many others (for references see Murray, 1961) have expounded on the phenomenon of sediments in strand line changes, particularly with the units in the "Claiborne" Stage. The Paleocene-Eocene of the Gulf Coastal area is a prime example of the alternating facies that have occurred within the boundaries of the embayment and the accompanying evolution in the fauna. This phenomenon may be depicted as a rhythm of the lower Cenozoic.

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