THE DEPARTMENT OF NATURAL RESOURCES

mississippi geology

Bureau of Geology
2525 North West Street
Jackson, Mississippi 39216

Volume 6, Number 2
December 1985

PRELIMINARY REPORT OF A *METAMYNODON* SKULL FROM THE BYRAM FORMATION (LOWER OLIGOCENE) IN MISSISSIPPI

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ABSTRACT

A well preserved skull of the large, semiaquatic amynodont *Metamynodon planifrons* is reported here from the lower Oligocene Byram Formation of west-central Mississippi. It is the first report of any amynodont from the eastern United States and one of very few occurrences of an Oligocene terrestrial animal found in coastal plain sediments. Attached corals and oysters suggest that, after the animal had been washed into the nearshore marine environment, the skull lay on the sea floor for some time prior to burial.

The Byram skull helps provide a link between the lower Oligocene Chadronian Land Mammal Age and the Rupelian marine stage. It also provides useful information on sexual dimorphism in *Metamynodon planifrons* as well as new data on its ear region.

INTRODUCTION

The skull of a large land mammal was discovered by the field party of David and Mary Dockery, Luc and Therese Dolin, and Edward Lollar on August 5, 1985, while collecting invertebrate marine fossils from the lower Oligocene Byram Formation at MGS locality 106 on the Big Black River in west-central Mississippi. Only the anterior end of the skull was exposed at the time (Figure 1). These bones were encrusted with the coral

Archohelia vicksburgensis (Conrad, 1848), a hermatypic coral common in the Vicksburg Group. The skull lay flat on a shell bed, with the dorsal side up and the anterior pointing out of the bank (westward). After preliminary preparation, the skull was identified by the senior author as a *Metamynodon,* an animal related to the living rhinoceros but with a semiaquatic habitat. It is one of only a few Oligocene land mammal finds reported from the marine sediments of the northern Gulf Coastal Plain.

EXCAVATION

A preliminary excavation was undertaken by David Dockery and Michael Bograd on August 23rd to determine the completeness and extent of the skull. The skull was found to be largely complete. With the consent of the property owner, a full-scale excavation was undertaken by staff members of the Bureau of Geology on the 29th of August. This excavation was not completed due to incoming thunderstorms preceding Hurricane Elena, and the skull was reburied for protection. A second attempt on the following day was successful as the hurricane had moved eastward away from the region.

The remote location of the *Metamynodon* find made its recovery difficult. On August 30th the excavation was completed. Two members of the excavation team, Bob Merrill and Mike Meadows, approached the excavation site by johnboat from a landing on the Big Black River six miles downstream from the site. This stretch of river has many shallows and boulders where it crosses the outcrop belt of the Glendon Limestone. The other team members, including David Dockery, Peter Clark, and Phillip Higdon, began the final excavation of the skull. A trench (about one foot wide) was dug around the skull so that it stood on a pedestal of matrix (Figure 2). About a foot of matrix below the skull was included in this pedestal in hope that an articulated mandible (or jaw parts) might also be present. No additional bones were found in the course of excavation. The skull and accompanying matrix were covered in wet paper and wrapped in wetted plaster-impregnated gauze until they were enclosed in a strong protective cast (Figure 3). This cast was then undercut, and the bottom side was wrapped in plaster (Figure 4).

The final cast weighed about three hundred pounds. It was strapped to a dolly (Figures 5 and 6), taken to the Bureau's johnboat, successfully transported to the landing (though a near capsize was avoided when the boat pivoted about a boulder in swift currents), and was taken to the Bureau of Geology.

PREPARATION

Preliminary preparations of the skull were made at the Mississippi Bureau of Geology. The plaster jacket was cut through at the girdle, and the top half removed in its entirety, a procedure which proved to be a mistake. As the upper cast was removed, anterdorsal portions of the skull separated into several fragments due to the softness of the bone while wet. Several days were required to repair the damaged anterior. Once repaired, matrix was slowly removed from the dorsal portions of the skull (Figure 8C), and the bone was hardened with an alcohol-soluble resin. Resting adjacent to the posterior extremities of the skull on the dorsal side were the inner ear bones (periotics) and the fourth left premolar. No other isolated bones were found.

Due to the size and fragility of the *Metamynodon* skull, the Mississippi Bureau of Geology requested the assistance of the Louisiana State University Museum of Geoscience in Baton Rouge, Louisiana, where the final preparation of the specimen was done.

STRATIGRAPHIC HORIZON AND CORRELATION

Figure 7 gives a measured section of the sediments exposed along the Big Black River at MGS locality 106. Beds in this section are labeled A through Q for reference purposes. The *Metamynodon* skull was found near the base of bed F, a fossiliferous, silty clay unit located approximately in the middle of the Byram Formation. Fossil mollusks in this bed are not as abundant as in other units, but those present are often well preserved.

The diverse molluscan fauna of the Byram Formation is given in Dockery (1982) and MacNeil and Dockery (1984). This fauna contains several species that are closely related to taxa from the Stampian (Rupelian) of the Aquitaine Basin in southwestern France. Siesser (1983) studied the calcareous nannoplankton of the Byram Formation in Alabama and placed it in zone NP 22. Hazel et al. (1980) stated that the Byram was younger in western Mississippi than in Alabama and placed the formation as NP 22-23 undifferentiated. Both zones NP 22 and NP 23 are of early Oligocene age and correlate with the Rupelian Stage of Europe.

PALEOECOLOGY

Sedimentary beds of the Byram Formation can be traced continuously for about one fourth mile along the east bank of the Big Black River (Figure 5). These

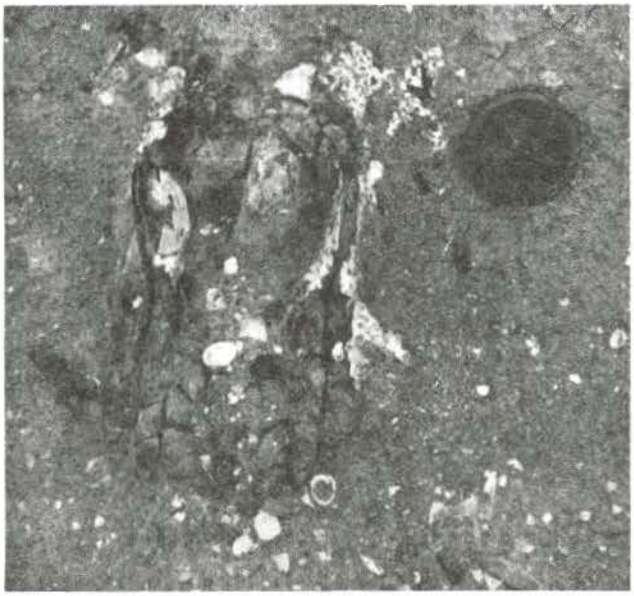


Figure 1. Anterior of *Metamynodon* skull as first seen protruding from marine sediments of the Byram Formation. Encrusting the bones are the coral *Archohelia vicksburgensis* and oyster *Pycnodonta paroxis*. Camera lens cap for scale.

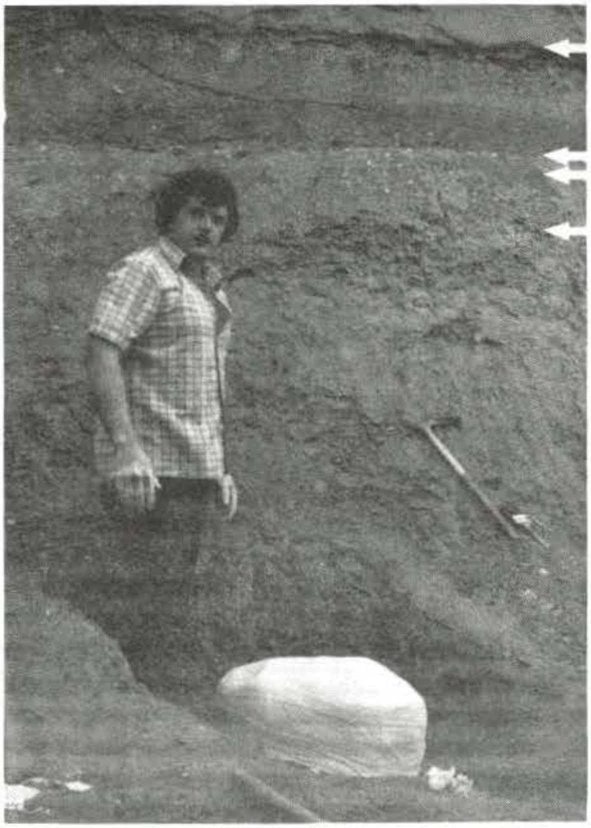


Figure 3. Skull and upper half of plaster jacket in situ before removal. Standing by the skull is Bureau geologist Mike Meadows, who helped in wrapping the specimen in plaster-impregnated gauze. Arrows in the upper right mark in ascending order the contacts between beds F and G, G and H, H and I, and I and J (see Figure 7). Fossil molluscan shells can be seen weathering from bed H.

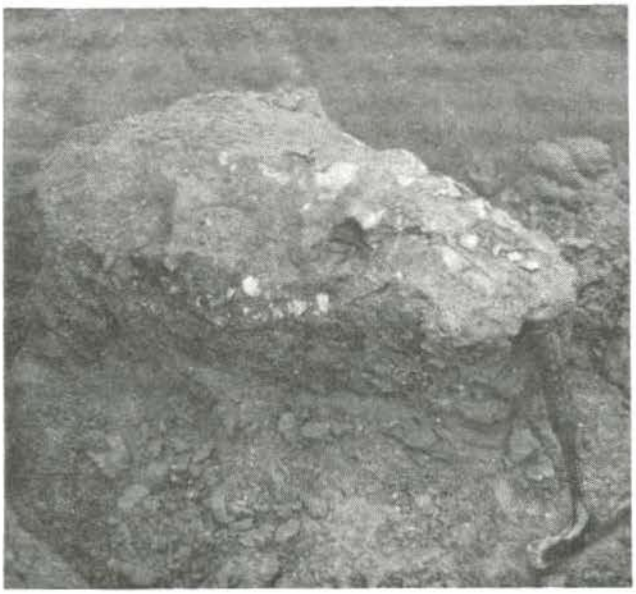


Figure 2. Excavated skull supported by a pedestal of sediments before addition of plaster jacket.

Figure 4. Completion of plaster jacket after removal of skull. Working on the plaster jacket from left to right are Phillip Higdon, Peter Clark, and Mike Meadows.

Figure 5. Bureau johnboat and dolly are brought in to transport the *Metamynodon* specimen. The extent of the Byram Formation outcrop as well as log jams and shallows of the Big Black can be seen in the distance.

Figure 6. Bureau geologist Bob Merrill straps the approximately three hundred pound, plaster-jacketed *Metamynodon* skull to dolly for transportation to boat.

beds indicate variable rates of deposition in a nearshore marine shelf environment. Though the invertebrate fauna is similar throughout the Byram section, some beds contain a biocoenosis (life assemblage) of infaunal bivalves buried in life position (e.g. beds G and K of Figure 7), while others, such as the shell layer underlying the *Metamynodon* skull (and beds E, H, and L of Figure 7), contain a thanatocoenosis (death assemblage) of current-deposited shells. The Byram Formation is part of a regressive sequence intermediate between the shelf carbonates of the Glendon Limestone below and the lagoonal clays of the Bucatunna Formation above. Fisher and Ward (1984) studied foraminiferal communities in the Byram Formation at Vicksburg, Mississippi, and suggested that the formation was deposited in shallow offshore bars seaward of a bay environment. The *Metamynodon* may have been transported from a river to the shallow sea as a floating carcass.

The *Metamynodon* skull provided an "island" of hard substrate on the muddy Byram sea floor, and was an ideal site for encrusting organisms. Only two species

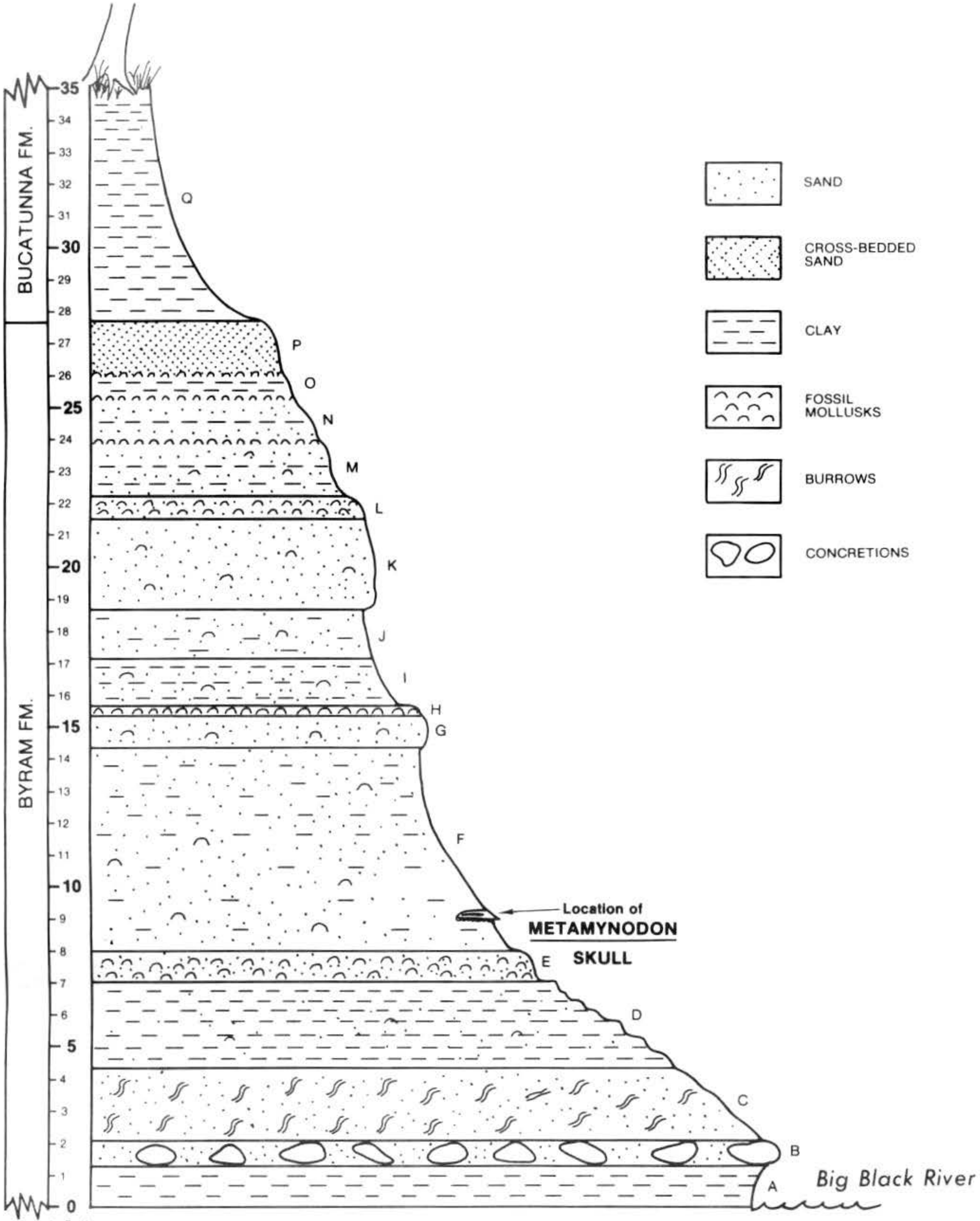


Figure 7. Measured section of the Byram-Bucatunna sedimentary sequence along the bluffs of the Big Black River at MGS locality 106. Position of the *Metamynodon* skull is indicated in bed F. Bed H of this sequence is figured in Dockery, 1982, Figure 23, as being particularly fossiliferous.

utilized this substrate: the coral *Archohelia vicksburgensis* (Conrad, 1848) and the oyster *Pycnodonta paroxis* (Dockery, 1982). The presence of the hermatypic coral *Archohelia* provides the following environmental data: (1) warm subtropical or tropical climate, (2) shallow water depth within the zone of light penetration (photic zone), and (3) normal marine salinity. The growth rate and developmental stage of both the corals and oysters provide information on the length of time the skull was exposed on the sea floor before burial. *Archohelia* covered much of the anterodorsal portion of the skull including anterior cavities. However, this coral had not yet developed its characteristic branching form and was probably at an early stage in its development. The largest oyster was located in a prominent position on the dorsal midline in the center of the anterior half of the skull and had a diameter of 58 mm. Large adult oysters of this species reach a size of 87 mm (see Dockery, 1982, pl. 17, fig. 13), a size comparable to that of the common Gulf and Atlantic commercial oyster *Crassostrea virginica* (Gmelin). According to a study by Ingle and Dawson (1952), *Crassostrea virginica* juveniles (spat) in Florida waters can grow to an average of 60 mm in fifteen weeks. It is probable that the *Metamynodon* skull was exposed on the sea floor for a period of one year or less before burial. This burial was caused most likely by settling of the skull into the soft substrate (probably aided by the burrowing activities of crabs) rather than the accumulation of additional sea-floor sediments at an unusually high rate. Settling of the skull also provides an explanation for the dorsal position of the dislocated periotics and premolar.

SYSTEMATICS

Class Mammalia Linne, 1758
Order Perissodactyla Owen, 1848
Suborder Ceratomorpha Wood, 1937
Superfamily Rhinocerotoidea Gill, 1872
Family Amynodontidae Scott and Osborn, 1883
Subfamily Cadurcotheriinae Kretzoi, 1942
Genus *Metamynodon* Scott and Osborn, 1887
Metamynodon planifrons Scott and Osborn, 1887

The characters which link the Byram skull to the various taxa of the amynodont hierarchy (at the level the character first becomes derived) are as follows:

Amynodontidae - molars with enlarged, labially deflected metastyles; facial fossa present; premolars reduced in size; the first upper premolar (dP1/) lost.

Cadurcotheriinae (essentially, the advanced amynodonts) - molars elongate with very long ectolophs, post-canine diastema reduced, molar crown height mesodont.

Metamynodon group (includes *Paramynodon* and *Zaisanamynodon* as well as *Metamynodon)* - zygomatic arch broad, face shortened, facial fossa deep and well defined, overall size increased, the second upper premolar (P2/) very reduced.

Metamynodon - orbit placed high on skull, nasal incision retracted and premaxillae broadly fused (a thickened upper lip was probably present - Wall, 1980).

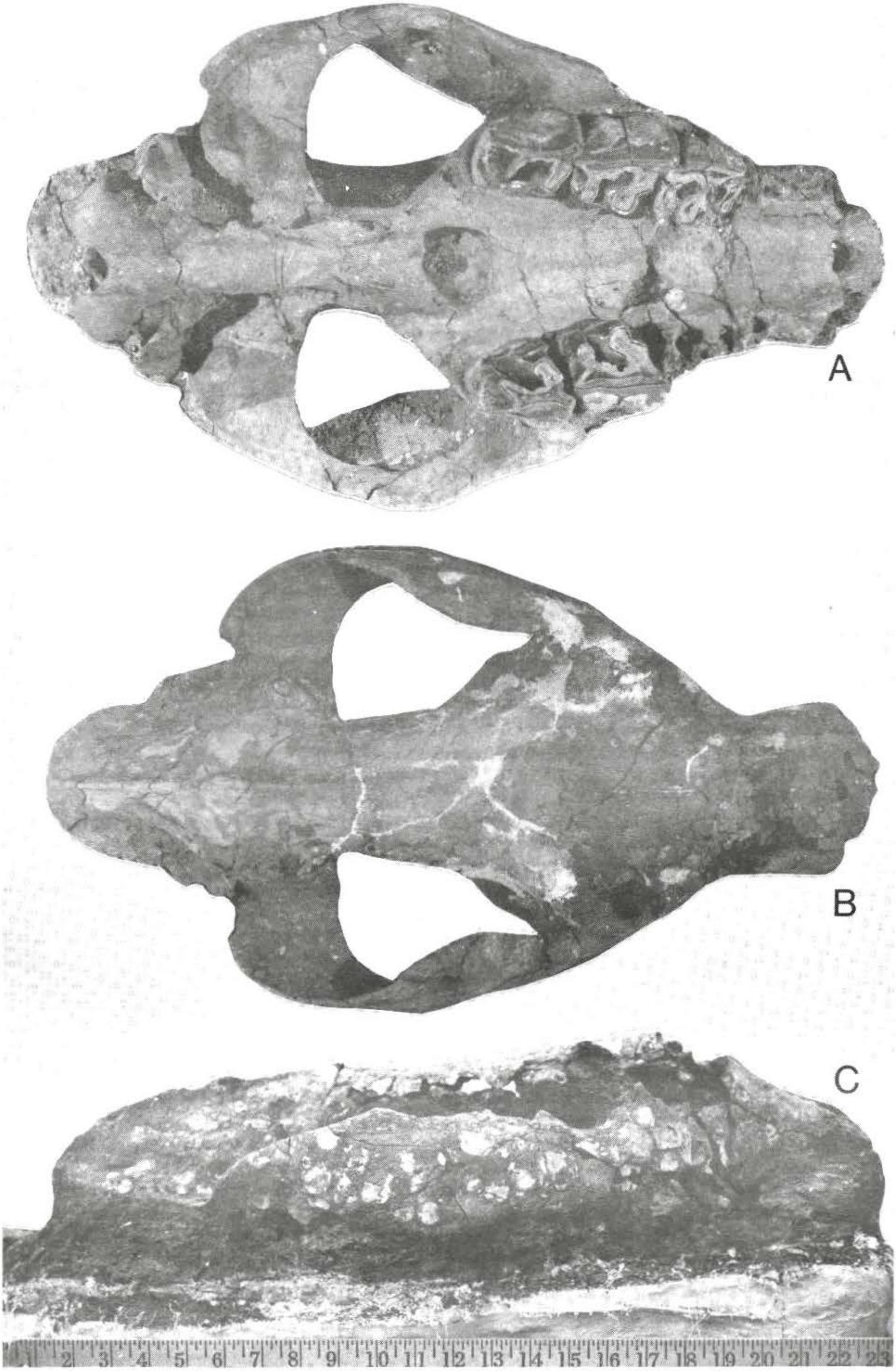
The skull is assigned here to *Metamynodon planifrons* based on comparable measurements of the type specimen (Scott and Osborn, 1887). A more detailed comparison with the abundant High Plains material should be made at some point.

Comparison to the latest Eocene *Megalamynodon regalis* Wood, 1945, shows the Byram skull to be more derived in several respects: (1) it is larger, (2) the premolars are more reduced, (3) the molars are larger and more elongate anteroposteriorly, (4) the internal nares are retracted farther (from the anterior of the third upper molar in *M. regalis* to the mid third upper molar in the Byram skull), and most interestingly (5) the posttympanic process is not free (as in *M. regalis*) but is fully fused to the paroccipital process.

Metamynodon mckinneyi, a large late Uintan amynodont from west Texas, is presently known only from lower jaws and two questionably assigned second upper molars (Wilson and Schiebout, 1981). The second molars are somewhat smaller than those of the Byram skull (Table 1). Without a skull, the assignment of *M. mckinneyi* to *Metamynodon* is, at best, doubtful.

Metamynodon chadronensis was originally based solely on a lower jaw (Wood, 1937). Wood noted that *M. chadronensis* is considerably smaller than *M. planifrons.* Wilson and Schiebout (1981) have recently assigned skull material to *M. chadronensis* from the

Figure 8. (A) Ventral, (B) dorsal, and (C) lateral views of *Metamynodon planifrons* skull. MGS specimen 1493. White areas in lateral view are encrusting oysters and corals, most of which were removed in the final preparation. Scale in inches. Dorsal and ventral views were photographed after final preparation.


A
B
C
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23

	Metamynodon mckinneyi Candelaria local fauna, west Texas		Metamynodon chadronensis Porvenir local fauna, west Texas		Metamynodon planifrons Brule Fm. High Plains		Metamynodon planifrons Byram Fm. Mississippi	
Tooth Dimensions	Range	Number of Specimens	Range	Number of Specimens	Range	Number of Specimens	Range	Number of Specimens
Length from front of M1/ to rear of M3/					140-172	4	150	1
P4/ Length			39.4	1	23-30	4	30	1
Width			-	-	43.7-47	4	46	1
M1/ Length			43.7-50.2	2	36-51	4	49	1
Width			52.5	1	56-58	3	60	1
M2/ Length	54.9	1	54.0-65.4	2	59-68	2	66	1
Width	50.9	1	50.2-60.9	2	72	1	64	1
M3/ Length			50.0-67.4	2	58-70	4	65	1
Width			48.5-58.0	2	60-64	3	60	1

Table 1. Measurements (in millimeters) of upper teeth of Metamynodon. Measurements of M. mckinneyi and M. chadronensis, from Wilson and Schiebout (1981, Table 12, 14) and M. planifrons from Scott and Jepsen (1941) and Troxell (1921).

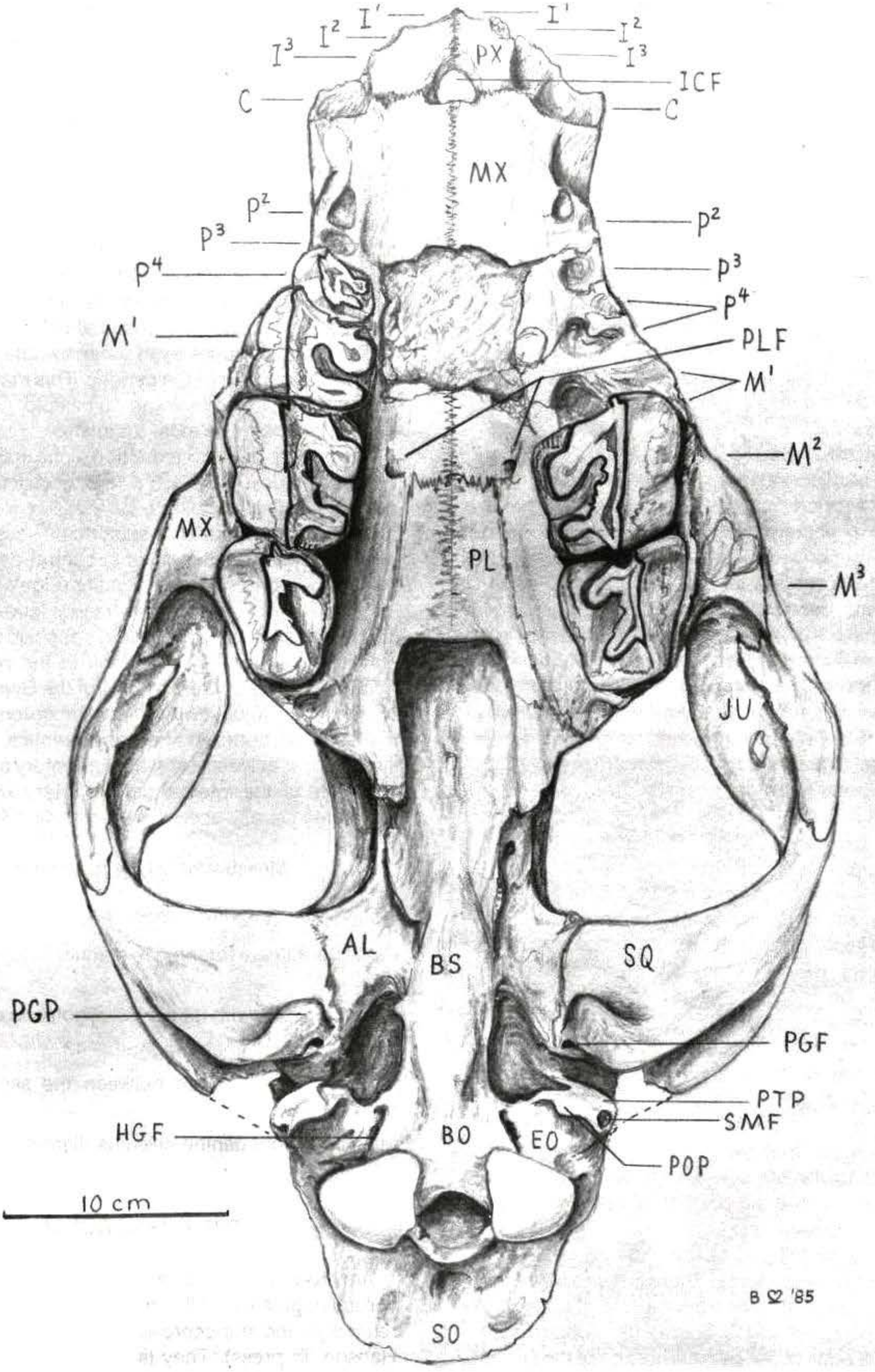
early Chadronian (Duchesnian) Porvenir Local Fauna of west Texas. The Byram skull differs from the Texas material in having a shorter snout with a broader, flatter anterior. Because of the shorter snout, the maxilla of the Byram skull has a narrower lateral exposure. In addition, the Byram skull is slightly larger in overall size and has a better developed preorbital fossa. The Byram skull is probably about three million years younger than the Porvenir material.

The primary differences distinguishing the Byram skull from most figured *Metamynodon planifrons* skulls (e.g. Osborn and Wortman, 1895) are probably related to the female sex of the Byram skull. This is suggested by the small canine alveolus. The raised sagittal crest seen in the mounted American Museum *M. planifrons* skeleton (Osborn and Wortman, 1895) may be a male feature, related to the function of the enlarged canines. Male hippos, for example, hold their huge heads up to expose their tusks in threat displays. This activity in male metamynodons probably required massive dorsal neck musculature. The nearly flat dorsal skull profile (Figure 10B) of the Byram skull, with its low sagittal crest, may be the result of having smaller neck and jaw musculature because the canines were used differently. It should be noted that the skull of the type specimen also has small canine alveoli (Scott and Osborn, 1887), and may also represent a female. The Byram skull is probably somewhat older than most known High Plains specimens of *M. planifrons*.

DESCRIPTION

The Byram *Metamynodon* skull (Figures 8-11) is excellently preserved, with only slight dorsoventral compression of the central part of the zygomatic arches and some compression of the rostrum in the area of the posterior premolars. Dentition present includes an isolated upper left fourth premolar (P4/), and in place on the skull: left second and third molars (M2/-3/) and right fourth premolar to the third molar (P4/-M3/). Moderate wear on all molars and the fourth

Figure 9. Ventral view of *Metamynodon planifrons* skull. The left upper fourth premolar and the periotics were not found in place on the skull and have not been included here. Abbreviations: AL - alisphenoid, BO - basioccipital portion of the occipital, BS - basisphenoid, C - canine alveoli, EO - exoccipital portion of the occipital, HGF - hypoglossal (anterior condyloid) foramen, I - incisor alveoli, JU - jugal, M - molars and molar alveoli, MX - maxilla, P - premolar and premolar alveoli, PGF - postglenoid foramen, PGP - postglenoid process of the squamosal, PL - palatine, PLF - palatine foramina, POP - paroccipital process of the exoccipital, PX - premaxilla, SMF - stylomastoid foramen, SO - supraoccipital portion of the occipital, SQ - squamosal.


I^1
I^2
I^3
PX
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P^2
P^3
P^4
M^1
PLF
M^2
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JU
AL
BS
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PGP
PGF
PTP
SMF
HGF
BO
EO
POP
10 cm
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premolars show that the skull represents a mature adult. The cheek teeth present are like those of *M. planifrons*. Most anterior teeth are missing, but alveoli are present for left and right first, second, and third incisors, canines, and second and third premolars (as well as the left first molar). Based on the alveolus, the second upper premolar (P2/) was a very reduced, peg-like tooth.

The nasal area is slightly damaged, but it can be seen that the premaxillae were broadly fused and the nasal incision somewhat retracted. The face is short. The preorbital fossae are deep and well defined. The orbits are placed high on the skull. There is no post-orbital bar. The supraoccipital is peaked and extends posteriorly over the occipital condyles. Both jugal and squamosal parts of the zygomatic arch are dorsoventrally quite broad.

The basicranial area (Figure 9) is beautifully preserved and undistorted in any way. The posteroventral squamosal supports a broad glenoid surface and a strong, blunt, postglenoid process. The postglenoid process is slightly flattened anteroposteriorly. The large, pointed paroccipital process is separated by a minimum one centimeter gap from the postglenoid process. Unlike the more derived *M. planifrons* skulls, the Byram skull shows no ventral closure of the external auditory meatus. The paroccipital process is thickest in its central part, where the post-tympanic process is fused to it. A 9x7 mm stylomastoid foramen is present on the lateral side of the paroccipital process. An 11x7 mm hypoglossal foramen is present just medial to the paroccipital process. The heavy basioccipital is 4.0 cm across its narrowest place. The basioccipital/basisphenoid suture appears to be fully fused.

One of the most remarkable things about this skull is the excellent preservation of the periotics (Figure 12) and the basicranial area housing the periotics. The periotics were isolated from the skull, both found, surprisingly, on the dorsal side of the skull. Isolated periotics have not previously been described in amynodonts. In the Byram skull, they were clearly only loosely attached to the skull—an unusual condition in a terrestrial ungulate. The botryoidal masses of bone seen on the sutural surfaces of the mastoid portion of the periotics suggest that there were only cartilaginous attachments to the alisphenoid (posteromedial to the glenoid process) and exoccipital (anteromedial to the paroccipital process). It is easy to see how these inner ear bones could fall out of the skull as soon as the cartilage had decayed away. There is also a slight bony growth extending laterally from the lateral edge of the upper basioccipital which apparently supported the anterodorsal edge of the petrous portion of the periotic. Curiously, this process is considerably larger on the right side than on the left. How the loose connection of the periotics to the skull affected the hearing of the animal is a subject of interest. The decoupling of the periotics from the skull in this way may have been an adaptation to the detection of underwater vibrations (as it is in whales), rather than air-borne sound detection. There is no evidence of an ossified bulla. There was apparently no mastoid process on the mastoid portion of the periotic. The post-tympanic process of the squamosal abuts directly on the paroccipital process of the occipital (forming a single, fully fused process with a stylomastoid foramen in the center). This squamosal/occipital contact on the side of the skull precludes even a narrow lateral exposure of the mastoid part of the periotic. This makes the skull (in artiodactyl terminology) "amastoid", an unusual, derived condition in most ungulates.

Besides the peculiar reduction of the mastoid portion of the periotics, there are a few other features of the periotics which appear to be derived for ungulates. These include a shallow subarcuate fossa, a greatly reduced ventral hiatus fallopii, central depression on the promontorium, and a peculiar ridge on the medial edge of the promontorium (see Figure 12A). The anterior tip of the petrous portion appears to have been cartilaginous, leaving only a pit in the bone. A very unusual feature of the periotics of the Byram *Metamynodon* is the retention of faint promontory and stapedial sulci on both left and right periotics. These sulci suggest that at least vestigial promontory and stapedial branches of the internal carotid artery were present, structures usually absent in perissodactyls.

Measurements (in millimeters)

Greatest skull length - 600

Posterior incisive foramen to anterior foramen magnum - 490

Greatest skull width (at central zygomatic arches) - 342

Diameter of foramen magnum - 43

Minimum palate width between the second molars (M2/'s) - 79

Maximum right canine alveolus diameter - 34

THE AMYNODONTS

Amynodonts are an extinct group of large herbivorous ungulates. Of living forms, they are most closely related to the rhinoceroses (Prothero, Manning, and Hanson, in press). They lived in North America from the middle Eocene (early Uintan Land Mammal Age) till

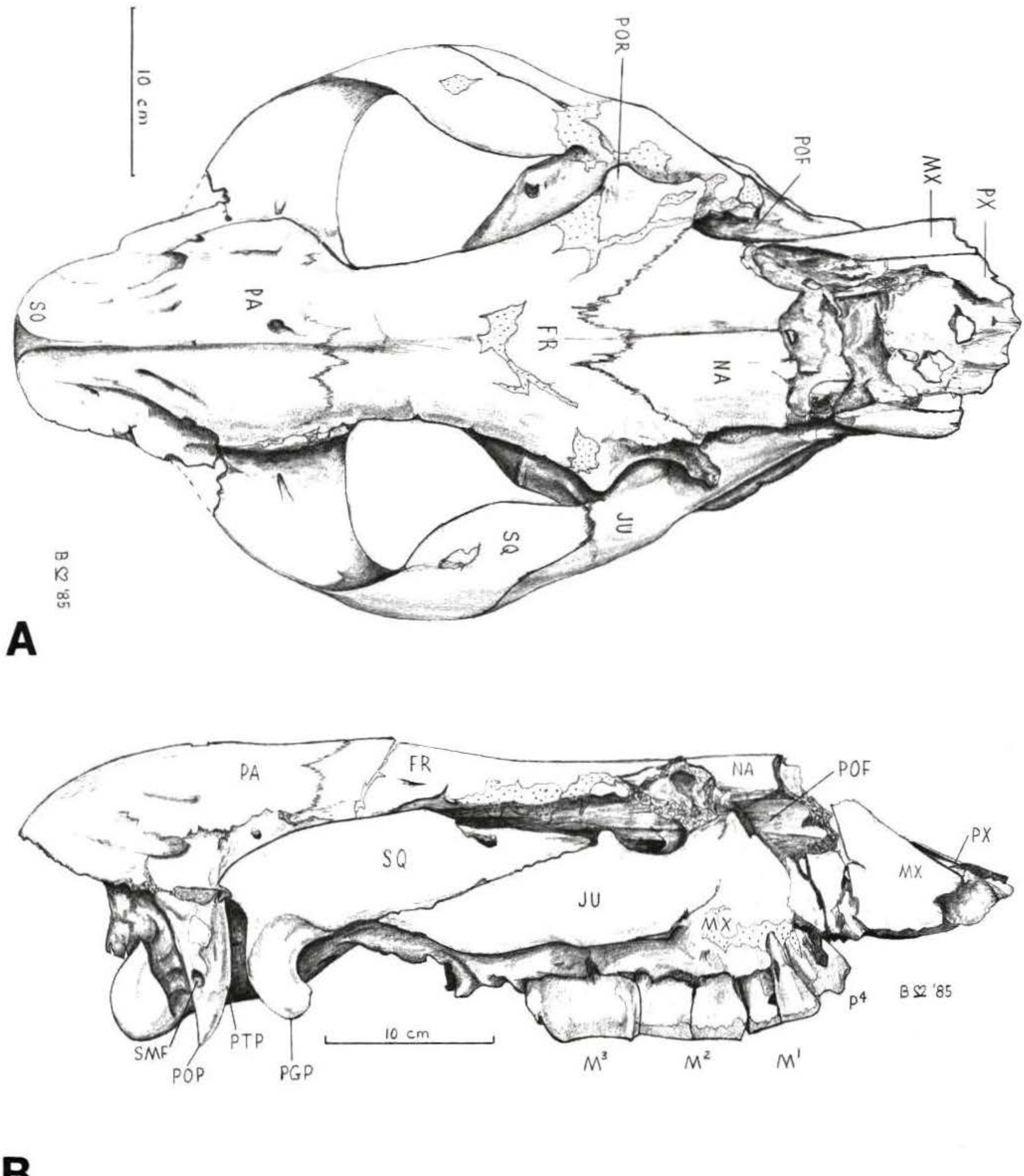

Figure 10. (A) Dorsal and (B) right lateral views of *Metamynodon planifrons* skull. Stippled areas have been restored in plaster. The anterior nasal area is incomplete. Abbreviations: FR - frontal, JU - jugal, M - molars, MX - maxilla, NA - nasal, P - premolar, PA - parietal, PGP - postglenoid process of the squamosal, POF - preorbital fossa, POP - paroccipital process of the exoccipital, POR - postorbital process of the frontal, PTP - post-tympanic process of the squamosal, PX - premaxilla, SMF - stylomastoid foramen, SO - supraoccipital portion of the occipital, SQ - squamosal.

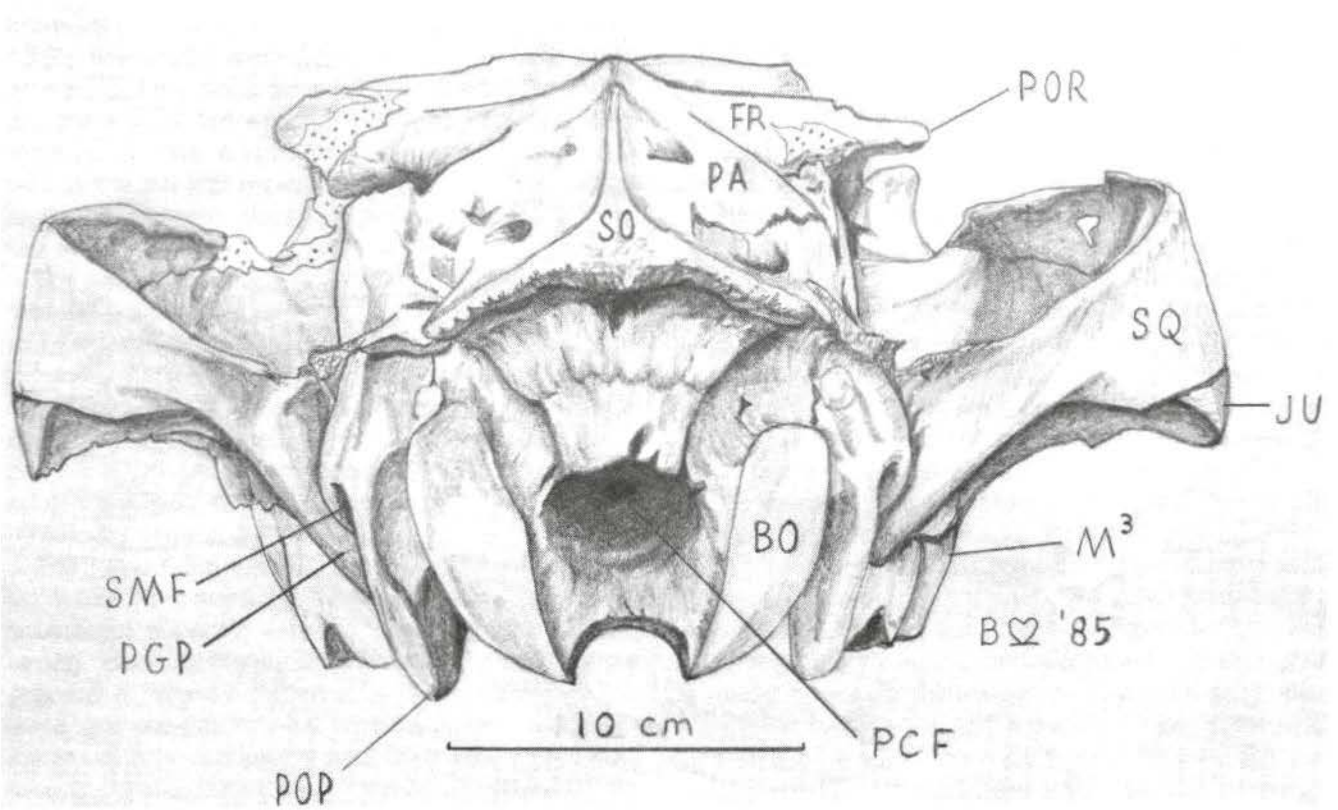

Figure 11. Posterior view of *Metamynodon planifrons* skull. Stippled areas have been restored in plaster. Abbreviations: BO - basioccipital portion of the occipital, FR - frontal, JU - jugal, M - molar, PA - parietal, PCF - posterior condyloid foramen, PGP - postglenoid process of the squamosal, POP - paroccipital process of the exoccipital, POR - postorbital process of the frontal, SO - supraoccipital portion of the occipital, SQ - squamosal.

the middle Oligocene (late Orellan Land Mammal Age), a period of only about 16 million years. They were predominantly an Asian group which appears to have crossed the Bering land bridge into North America several times in the late Eocene and early Oligocene. Their failure to catch on in the New World was probably due to competition with rhinos, which were also getting started in North America at about the same time.

Metamynodon was the most successful American amynodont. Its line appears in the latest Eocene (about 38 million years ago) and survived in North America till the middle Oligocene (about 31 million years ago). They were the last of the American amynodont lineages to become extinct.

Unlike most amynodonts (which were horse-sized), metamynodonts were large—built rather like the living hippopotamus. Like hippos, they had short legs; a huge, barrel-like chest; and eyes placed high on their head. These features have long ago suggested that *Metamynodon* was semiaquatic like hippos (Matthew, 1899). The high-placed eyes would allow it to stand in shallow water with only its eyes above the surface. In High Plains Oligocene deposits, *Metamynodon* is usually found in river channel sandstone deposits. This also suggests it spent a lot of time in river water.

One important difference between hippos and metamynodonts is in the tooth construction. The complex, high-crowned molars of hippos allow them to feed primarily on grass. While they stay in rivers during the heat of the day, they graze in nearby grasslands at night. The molars of *Metamynodon* are simpler and lower crowned, suggesting that their diet was based more on leaves and twigs than on grass. It was primarily a browsing animal, not a grazer. For this reason, it was probably an ideal herbivore for the well-forested Oligocene Gulf coast.

TERRESTRIAL VERTEBRATES IN OLIGOCENE COASTAL PLAIN DEPOSITS

Terrestrial vertebrates are always rare, isolated finds in coastal plain beds. Since these deposits are usually formed under shallow marine conditions, it is only

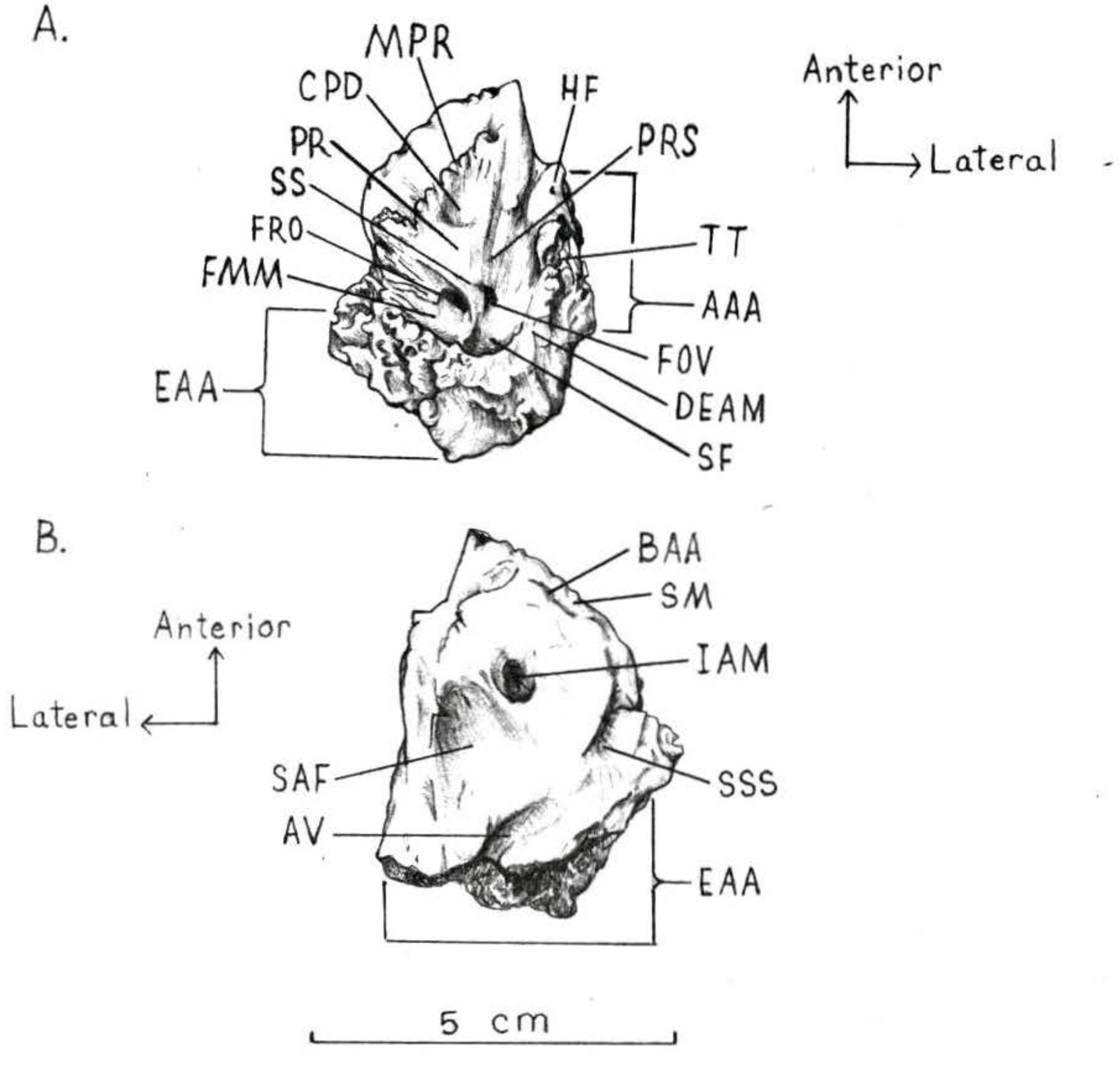

Figure 12. (A) Ventral (tympanic) and (B) dorsal (cerebellar) views of the left periotic of *Metamynodon planifrons*. The specimen is complete with very little breakage. Illustration at natural size. Abbreviations: AAA - alisphenoid attachment area, AV - aqueductus vestibuli, BAA - possible basisphenoid attachment area, CPD - central promontorium depression, DEAM - depression for the external auditory meatus, EAA - exoccipital attachment area, FMM - fossa musculus minor, FOV - fenestra ovalis, FRO - fenestra rotundum, HF - hiatus fallopii, IAM - internal auditory meatus, MPR - medial promontorium ridge, PR - promontorium, PRS - promontory sulcus, SAF - subarcuate fossa, SF - sulcus facialis, SM - sulcus medialis, SS - stapedial sulcus, SSS - sulcus for sigmoid sinus, TT - tegmen tympani.

when land animals are washed out into the sea that they become preserved. These beds are better known for fossil marine vertebrates - sharks, rays, fish, sea turtles, sea snakes, whales, and sea cows.

Despite the unlikelihood, land animals have been buried at sea throughout the history of the Gulf Coastal Plain. Fragmentary bones and teeth of dinosaurs and one early mammal have been found in several places in northeastern Mississippi (Dunn, 1948; Lull and Wright, 1942; Kaye and Russell, 1973; Horner, 1979; Emry, Archibald and Smith, 1981; Carpenter, 1982). Eocene vertebrates have been found in both the Gulf and Atlantic coastal plains, including an excellent titanothere skull from near Quitman in central eastern Mississippi (Gazin and Sullivan, 1942). Miocene land animals have been found in all parts of the coastal plain, but are best known from faunas of the Fleming Formation in southeastern Texas and the Calvert Formation along Chesapeake Bay in Maryland.

Unlike the earlier Eocene Epoch and the later Miocene Epoch the Oligocene has produced few finds of land animals in the Gulf or Atlantic coastal plains. Oligocene beds form a narrow band through the middle of the coastal plain from Texas to South Carolina (they do not extend into the Mississippi Embayment as the Eocene beds do), but they have produced few land animal remains. Marine vertebrates are not uncommon, however. Excellent fossil whales have been recovered from the late Oligocene Cooper Formation of southern South Carolina. The middle Oligocene Mint Spring Formation of Mississippi has revealed a large vertebrate fauna of sharks, rays and fish. The Chickasawhay and Red Bluff formations of central eastern Mississippi have produced several aquatic vertebrates - including sharks, rays, fish, turtle and sea cow (Arata and Jackson, 1965).

Oligocene land animal finds are limited to perhaps only three sites in the coastal plain. A possible condor footprint from the Catahoula Formation of central Louisiana was originally (Wetmore, 1956) thought to be early Miocene in age, but may be late Oligocene instead. The only extensive Oligocene coastal plain fauna is the I-75 fauna from near Gainesville, Florida (Patton, 1969). This site occurred in a sinkhole deposit, so it was not typical of coastal deposits. The Byram skull reported here is the first Oligocene land animal from Mississippi, and the first report of the amynodont family from anywhere on the coastal plain.

MARINE/TERRESTRIAL CORRELATION

According to Prothero et al., 1982, calcareous nannoplankton zone NP 22 is correlated to the late Chadronian Land Mammal Age. The occurrence of a Chadronian mammal in a marine bed is a rare chance to match Oligocene land faunas to marine ones. By the marine standard, NP 22 correlates to foram zone P 19 and the late Rupelian marine stage. All are late early Oligocene, about 35 million years old.

Metamynodon is known from High Plains Oligocene beds of both the Chadronian and Orellan land mammal ages. These beds (mostly of the White River Group) are found in outcrop in western North and South Dakota, western Nebraska, eastern Wyoming and northeastern Colorado. *Metamynodon* is rare in Chadronian beds of the West, making the Byram skull even more important—as it would be somewhat older than most known High Plains material. It is most often found in channel deposits of early Orellan age (late middle Oligocene) in the lower nodular level of the lower Oreodon beds of the Scenic Member in the Brule Formation of southern South Dakota. These sandstone beds have long been called the "Metamynodon Channels", and have long been identified as bearing a distinctive aquatic, forest-living fauna (Matthew, 1901; Sinclair, 1924). *Metamynodon* was originally described from High Plains material (Scott and Osborn, 1887), and has become well known from these beds. The skeleton of *Metamynodon* has been described (Osborn and Wortman, 1894), reconstructed (Osborn and Wortman, 1895), individual bones figured (Scott and Jepsen, 1941), and the entire animal restored (Augusta and Burian, 1966) mostly on the basis of material from the badlands of South Dakota. With the discovery of the Byram skull, the range of *Metamynodon* is extended from the High Plains to the Gulf Coastal Plain.

A prediction might be made here about future discoveries of Oligocene land animals in the coastal plain. Another extinct group of semiaquatic mammals is often found in the *Metamynodon* Channels of the High Plains—the long-snouted, pig-like anthracotheres. Such animals would also be at home on the coastal plain, and might well be the next range extension.

ACKNOWLEDGMENTS

The writers gratefully acknowledge the help of several people. The property owner and his wife, who wish to remain anonymous, graciously gave their permission to excavate the *Metamynodon* skull and provided their assistance in the process. Several staff members of the Mississippi Bureau of Geology (mentioned in the text) helped in the excavation. The Louisiana State University Museum of Geoscience provided financial support. Thomas LeFebvre assisted in the final preparation of the skull. Barbara Standhardt drew the illustrations in Figures 9-12, and Daniel Peace photographed the ventral and dorsal views of

the skull given in Figure 8. Marco Taviani provided useful comments on paleoecology, and Bill Demoran gave useful comments concerning Recent oysters.

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RECORD DECEMBER FLOW OF MISSISSIPPI RIVER

The U.S. Geological Survey, Reston, Virginia, reports that it was a wet December 1985 for most of the nation's streams, highlighted by a record-high flow of the Mississippi River. Flow of the Mississippi River at Vicksburg, Mississippi, averaged 765 billion gallons per day (bgd) during the month, the highest December flow in 58 years of record-keeping. This flow was 139 percent above the long-term average and 57 percent above the previous month's flow. The previous record-high for December was 741 bgd in 1982.

"In part, 'facts' are always sufficiently flexible to bend before the force of expectation."

Stephen Jay Gould
1981

I wouldn't have seen it if I hadn't believed it.

old geologist's saying

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The following open-file reports, for the year 1985, are presently available. To purchase these reports please send the publication number, publication title, and prepayment in the form of a check or money order made payable to the University of Mississippi. A list of older reports and publications is available upon request. All orders and/or correspondence should be addressed to The Mississippi Mineral Resources Institute, Old Chemistry Building, The University of Mississippi, University, Mississippi 38677.

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85-1Fa	Mississippi Lignite Utilization Studies - Task A.: Experimental and Modeling Studies of Sulfur Release and Retention By Ash During Devolatilization and Combustion of Mississippi Lignite; W.E. Genetti and Y.Y.Lee; July, 1985; 256 pgs., $10.00.
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85-8F	Zeolite Determination & Geothermometry Interpretations Associated with Volcanic Rocks in Oil Fields in Northwestern Mississippi; Dr. Daniel A. Sundeen; December, 1985; 24 pgs., $1.50.
85-9	The Economic Feasibility of Marketing Mississippi Gravel in Beaumont, Texas; S. Cabell Shull, Ph.D.; 1985; 12 pgs., $1.00.

PALSTRAT: A BIOSTRATIGRAPHIC COMPUTER PROGRAM FOR PALEOCENE AND EOCENE MOLLUSKS

David T. Dockery III
Mississippi Bureau of Geology

INTRODUCTION

The Mississippi Bureau of Geology has recorded occurrence data for 2816 Paleocene and Eocene mollusks (including species, subspecies, variations, and unnamed forms) in the Gulf and Atlantic coastal plains on a dBASE III database file named PALSTRAT. This data file has three fields: (1) TAXON, which contains the species' name complete with author(s) and date of publication, (2) REFSTRAT, which contains reference and occurrence data in abbreviated form, and (3) ACC, which contains the record's accession number. Only published data are included in the program, and the 2816 records require 964 Kbytes of storage.

REFSTRAT is the main work field of the data file and includes occurrence data preceded by the reference from which the data were taken. Reference abbreviations consist of two letters taken from the author or authors' initials followed by the last two numbers of the publication date. These abbreviations are enclosed in parenthesis if any change has been made in the species' name. Often in such a case, the source reference for the taxonomic revision follows the occurrence data and is preceded by a semicolon. Occurrence abbreviations consist of a two-letter abbreviation for the stratigraphic unit followed by a "/" and then the postal abbreviation for the state. If the stratigraphic citation given is of lesser rank than formation, a citation for the formation preceded by a semicolon is given as well. A sample record follows:

Record # TAXON
REFSTRAT
ACC

10 *Pycnodonta johnsoni* (Aldrich, 1886)
(PB65): CM/AL*, CM/MS; (TL77): TA/AL
10

The references used are Palmer and Brann, 1965 [(PB65)], and Toulmin, 1977 [(TL77)]. Both are in parenthesis as the compiler changed the generic placement from *Alectryonia* to *Pycnodonta*. Occurrences include the Cook Mountain Formation (= upper Lisbon Formation) in Alabama, the Cook Mountain Formation in Mississippi, and the Tallahatta Formation in Alabama. The type locality is indicated by an asterisk. The accession of species in the data file follows the sequence they appear in the references used.

PURPOSE

The PALSTRAT data file was compiled to provide an up-to-date source of both taxonomic and distribution information on Paleocene and Eocene mollusks and to evaluate extinction and speciation events in the Gulf and Atlantic coastal plains. A publication on Paleogene extinction events in the northern Gulf Coastal Plain is forthcoming. PALSTRAT also provides a means to study early Paleogene faunal provinces in the eastern United States. Table 1 is a correlation matrix showing the number of Paleocene and Eocene species in common between the Gulf and Atlantic states as given by their postal abbreviations. The diagonal of Table 1 gives the number of species occurring in each state. Four states in the northern Gulf, Texas, Louisiana, Mississippi, and Alabama, contain 2261 species or 80% of the species recorded. An analysis of Table 1, determining the percentage of the matrix number to the number of species in the state having the lesser, is given in Table 2. This table indicates the presence of three general faunal provinces: (1) a northern Gulf province extending from Texas to South Carolina, (2) a Florida province, and (3) a northwestern Atlantic province that, with the exception of Virginia and Maryland, contains dissimilar faunas from North Carolina to New Jersey.

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	TX	LA	AR	TN	MS	AL	GA	SC	FL	NC	VA	MD	NJ
TX	713												
LA	138	473											
AR	22	44	89										
TN	11	3	5	23									
MS	140	226	53	7	646								
AL	211	153	36	12	239	1247							
GA	12	8	7	9	14	46	95						
SC	49	36	2	0	52	84	5	182					
FL	2	9	3	0	10	14	11	1	104				
NC	3	3	0	0	2	4	1	6	1	64			
VA	3	3	1	0	5	13	3	1	0	0	120		
MD	2	1	0	0	2	9	3	1	0	0	70	118	
NJ	1	1	0	0	4	5	0	0	0	0	1	1	120

Table 1. Correlation matrix showing number of Paleocene and Eocene molluscan species in common between states. Number of species in each state appears along the diagonal.

	TX	LA	AR	TN	MS	AL	GA	SC	FL	NC	VA	MD	NJ
TX													
LA	29.2												
AR	24.7	49.4											
TN	47.8	13.0	21.7										
MS	21.7	47.8	59.6	30.4					Northern Gulf Province				
AL	29.6	32.3	40.4	52.2	37.0								
GA	12.6	8.4	7.9	39.1	14.7	48.4							
SC	26.9	19.8	2.2	0	28.6	46.2	5.3						
FL	1.9	8.6	3.4	0	9.6	13.5	11.6	1.0		Florida Province			
NC	4.7	4.7	0	0	3.1	6.2	1.6	9.4	1.6				
VA	2.5	2.5	1.1	0	4.2	10.8	3.2	0.8	0	0	Atlantic Province		
MD	1.7	0.8	0	0	1.7	7.6	3.2	0.8	0	0	59.3		
NJ	0.8	0.8	0	0	3.3	4.2	0	0	0	0	0.8	0.8	

Table 2. Percentage of fauna in common between states to the number of species occurring in the state having the lower number.

MISSISSIPPI GEOLOGY
Department of Natural Resources
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Mississippi Geology is published quarterly in March, June, September, and December by the Mississippi Department of Natural Resources, Bureau of Geology. Contents include research articles pertaining to Mississippi geology, news items, reviews, and listings of recent geologic literature. Readers are urged to submit letters to the editor and research articles to be considered for publication; format specifications will be forwarded on request. For a free subscription or to submit an article, write to:

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