PALEOFAUNAL & ENVIRONMENTAL RESEARCH ON MIOCENE FOSSIL SITES TVOR SE AND TVOR S ON FORT POLK, LOUISIANA, WITH CONTINUED SURVEY, COLLECTION, PROCESSING, AND DOCUMENTATION OF OTHER MIOCENE LOCALITIES

by

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ABSTRACT *(Maximum 200 words)*

Focus of paleontological research on the Miocene of Fort Polk is currently the marine locality TVOR SE, which also has yielded large and small terrestrial Miocene vertebrates, and a single Cretaceous dinosaur tooth, reworked from older beds outside the local area. Other sites have continued to be productive. The two beautifully preserved tortoises from DISC have been identified as *Hesperotudo*.The first venomous snake from the Fort Polk Miocene is from TVOR. Sample sizes from screening have risen to levels which permit examination of variation. *Copemys* from Stonehenge form a single size cluster and the TVOR SE *Copemys* fall well within the range, so only one species can be recognized. New emphases of this phase of research has included more work on lower vertebrates, reevaluation of paleomagnetic dating with study of additional samples, production of short videos on the ancient animals, and a revision of the educational booklet for youngsters.

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ABSTRACT

Focus of paleontological research on the Miocene of Fort Polk is currently emphasizing the marine locality TVOR SE, which contains both marine and large and small terrestrial Miocene vertebrates, reworked Cretaceous foraminifera, and a single reworked dinosaur tooth from a small dromeosaur. It remains the only site which has yielded a varied fauna to quarrying. The lithified sandy marine shell bank which has yielded terrestrial vertebrates has been completely quarried and dissolved, but mudstone at the site continues to yield fossils to quarrying. Since Schiebout *et al.* (2002), a vertebral fragment, possibly from a large crocodile and a fragmentary gomphothere tooth recovered through surface search. A peccary tooth has also been recovered from TVOR SE. Small vertebrates were recovered from the mudstone by wet screening, without acid treatment.

Catastrophes have generally not been involved in the Fort Polk Miocene record, but at TVOR SE site, a storm seems to have played a major role. Large camelid bones, rodent and insectivore teeth, cetacean bones, and oysters are physically mixed in less than a meter vertically, suggesting that materials from land and sea, both shallow and open ocean, were dumped together with little sorting. The site contains fossils from a greater range of ages than the other sites. A hurricane could have brought waves to rework the nearshore, both marine and terrestrial, and heavy rain to erode soils in both river terrace dryer highlands and wet coastal lowlands. Cretaceous foraminifera and the dinosaur tooth, found for the first time in the Fort Polk sites, could have been added by a through going river in flood, reworked from older beds outside the local area.

Other Fort Polk Miocene sites have continued to be productive. The two beautifully preserved tortoises from DISC, found by James Grafton and Robert Hays, remain the most complete specimens recovered from the Fort Polk Miocene. They have been identified as *Hesperotestudo.* The first venomous snake specimen from the Fort Polk Miocene is now recognized from TVOR Site.

Sample sizes from screening have risen to levels which permit examination of variation within animals from a site and between sites and to begin examination of questions of speciation. *Copemys* from Stonehenge has been studied, and the small sample from TVOR SE compared to the results. The *Copemys* first upper molar appeared to offer distinctive features for differentiation of subgroups within the specimens, but these teeth still form a single size cluster from Stonehenge, a consistent relationship of size and morphology cannot be determined, and the TVOR SE *Copemys* fall well within the Stonehenge range.

New emphases of this phase of Fort Polk Miocene research have included more work on lower vertebrates, reevaluation of paleomagnetic dating with study of additional samples, production of short videos on the fossils and ancient animals, and a revision of the booklet on the Fort Polk Miocene for youngsters.

ACKNOWLEDGMENTS

We wish to thank individuals at Fort Polk, especially Director of Public Works Roy A. Bethel and his environmental staff, including Dr. Charles Stagg, James Grafton, Robert Hays, and Ellen Ibert for their help and cooperation which made this research possible. We greatly appreciate being allowed to study specimens in or on loan from other institutions. Mary Lee Eggart of the LSU Department of Geography & Anthropology drafted figures and Kerry Lyle of the LSU Coastal Studies Institute took photographs. Zhong Geng Ling and Kun Lian provided microphotography expertise and took scanning electron micrographs. Discussions with many colleagues were very helpful. The U. S. Geological Survey, Ruston, Louisiana, office, drilled and cored three fifty-foot holes for sedimentological, stratigraphic, paleopedologic and other study. James Rogers, a consultant retired from the U. S. Geological Survey, logged the well coring on these three cores. The U. S. Geological Survey shared core material on the 100-foot well (Well 3) at Discovery (DISC) Site. Many LSU students have assisted with field work on the Fort Polk Miocene. Michael Williams, Paul White and Ray Wilhite helped in field work in 2002 and 2003. John Grubb assisted with report formatting.

Work has been and is currently supported by the U. S. Army FORSCOM, on contracts administered and managed by U. S. Army Corps of Engineers, Fort Worth District, issued under contracts to Prewitt and Associates, Inc. Support has also been provided by the LSU Museum of Natural Science and Judith A. Schiebout.

I. INTRODUCTION

Background

This is the fourth report for the Corps of Engineers since 1994 to be prepared on a portion of the work supported by the U. S. Army FORSCOM on contracts with the Corps of Engineers via Prewitt and Associates. Publications in the scientific literature and presentations at scientific meetings are given in Appendix E. The fauna has grown appreciably, both in numbers and in taxa recovered. The Fort Polk Miocene fauna occupied 577 numbers in the Vertebrate Paleontology collections of the LSU Museum of Natural Science at the completion of the first report (Schiebout, 1997b), 3,991 numbers for the second report (Schiebout and Ting, 2001), 4,389 numbers for the third report (Schiebout *et al.*, 2003). As of 7/31/03, 540 additional specimens have been catalogued.

Before the discovery of the Fort Polk Miocene sites, there was only a single report of Miocene land animal remains from Louisiana (Arata, 1966), the tips of the lower tusks of a gomphothere (Mammalia: Proboscidea). Arata (1966) estimated that the specimen was from Miocene beds of Fort Polk, and it could have come from the vicinity of one of the sites currently under study in this project, but precise locality information on it was not available. The previous lack of Louisiana Miocene fossil mammals results in most genera recovered in the research on the Fort Polk Miocene fauna being new to the state.

In the following report, emphasis is on the TVOR SE site and its fauna. Abbreviations are given in Appendix A.

General Geologic History, Regional Correlation, and Depositional Environments

The upper half of the Castor Creek Member of the Fleming Formation (Figure 1) has yielded the mammals discussed in this report. The Castor Creek Member underlies the Blounts Creek Member, uppermost of the six members in the Fleming Formation, which outcrop in a broad band crossing Fort Polk. Further information on the extent, composition, and depositional environments of the Member is found in Rogers and Callandro (1965), Jones *et al.* (1995), Hinds (1998, 1999), and McCulloh and Heinrich (2000). The Castor Creek mam-

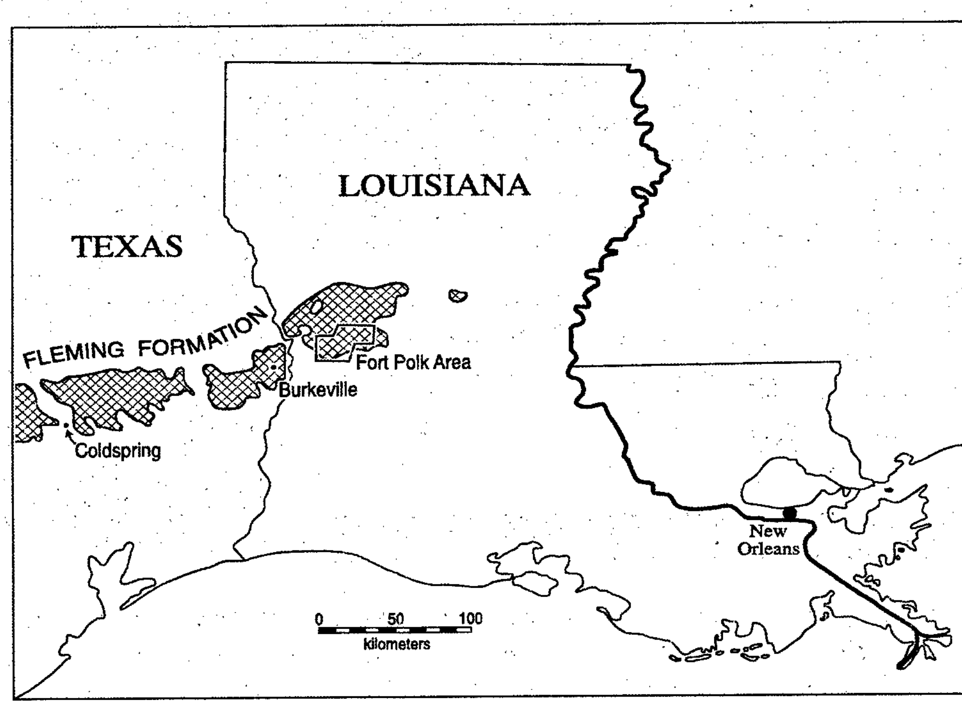


Figure 1. East Texas and Louisiana Fleming Formation outcrops, after Schiebout and Ting (2001).

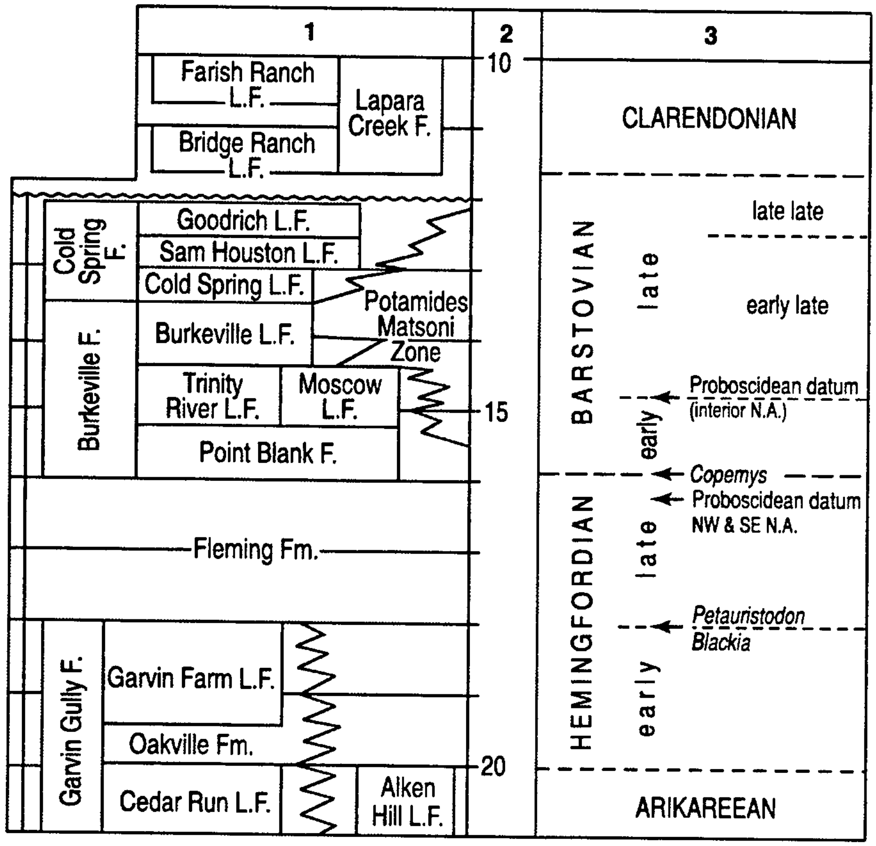


Figure 2. Fleming Formation vertebrate faunas in East Texas (1), age in millions of years (2), and North American Land Mammal Ages with selected defining taxa relevant to the Fort Polk Miocene Sites (3), after Schiebout and Ting (2001). Illustration after Schiebout and Ting (2001). Shaded area indicates intertonguing marine deposit. 1 and 2 modified from Schiebout (1994), which was modified from Tedford *et al.*, (1987, Fig. 6.2), 3 modified from Woodburne and Swisher (1995). After Schiebout and Ting (2001).

mal faunas of the DISC site have been correlated with the Cold Spring Local Fauna of east Texas (Figure 2), younger than the stratigraphically lower Burkeville Local Fauna of Wilson (1956) in Schiebout *et al.* (1996), Schiebout (1997a, 1997b); Schiebout *et al.* (1998; Schiebout and Ting (1998); Schiebout and Ting (2001); and Schiebout *et al.*, (2002). The upper Castor Creek Member was deposited during a period of falling sea levels. TVOR SE (Figure 3, 4, 5) is one of the stratigraphically lowest sites, and remains the only site with an appreciable marine component and an appreciable pre-Miocene reworked component. It contains a mixture of terrestrial and marine forms and was probably deposited in a shallow marine environment.

II. METHODS

Field and laboratory methods of fossil recovery are given in detail in Schiebout (1997b), Schiebout *et al.* (1998), Schiebout and Ting (2001), and Schiebout *et al.* (2002). Most of the screening for fossils from TVOR SE has been of mudstone. Mudstone is soaked in water in plastic boxes and screened without chemical treatment. Sandstone from TVOR SE that is strongly cemented with calcite is treated as the nodule-rich Fort Polk fossiliferous conglomerates from younger sites are. Treatment of the conglomerates involves soaking chunks in approximately 10% acetic acid to partially dissolve and break up the rock, which releases the fossils and nodules as a residue, which is then sorted under the microscope to pick out small fossils, mainly

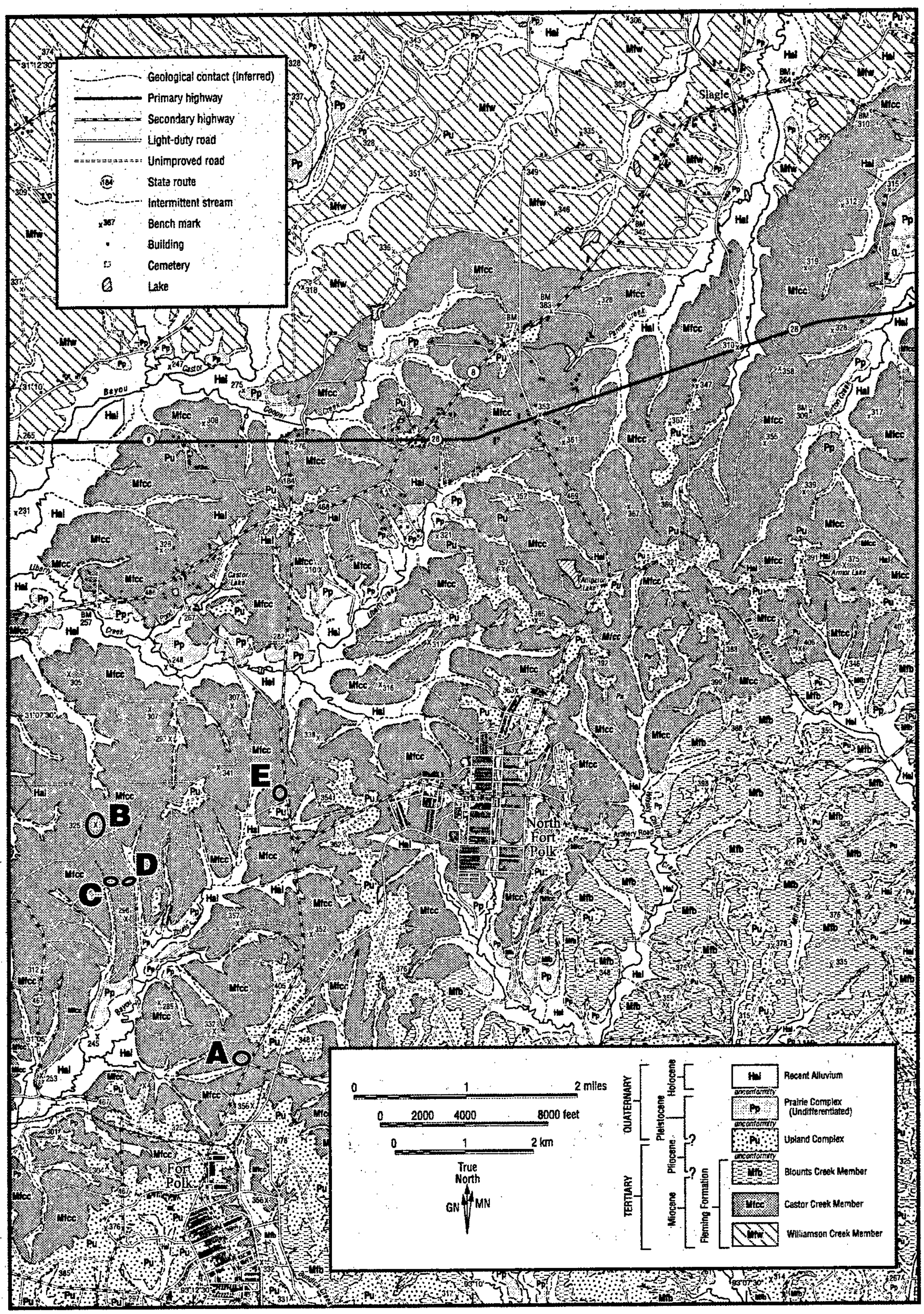


Figure 3. Main Miocene vertebrate sites within Fort Polk superimposed on a geologic map, after Schiebout and Ting (2001). Modified from Hinds (1999). A. DISC Site cluster; B. TVOR Site and sites N of it; C. TVOR S; D. TVOR SE; E. Shamrock.

bone scrap and teeth. Material washed from TVOR SE in the period of this report currently totals 1532 pounds and is expected to reach 2000 pounds by the end of August.

TVOR SE and Shamrock are the only sites where quarrying was a major collecting method and TVOR SE is the only current active quarrying site, although surface finds continue at DISC Site. The other quarry site, Shamrock Site, has yielded parts of an individual rhinoceros.

Removal of calcium carbonate nodular material, other mineral coatings, and clay from large vertebrate specimens is accomplished mechanically, either with an engraving tool or with mounted needles and dental tools.

III. SITE DESCRIPTIONS

More detailed descriptions of sites worked prior to 2002 are given in the three previous reports on Fort Polk research. Locations are given in Figure 3. Relative heights and stratigraphic relationships are given in Figure 19.

TVOR sites are named after the terminal very-high frequency omni range radar tower, off of Exchange Road. TVOR SE is an erosional gully striking E-W. Natural exposure is mainly yellow and gray clay. The patchy, complex masses of hard sandstone which contain both oysters and bones of large marine fish and terrestrial and marine mammals have been quarried and dissolved for screening to recover fossils.

IV. SYSTEMATIC PALEONTOLOGY

Descriptions of taxa which have already been described in Schiebout (1997B), Schiebout and Ting (2001), and Schiebout *et al.* (2002) are abbreviated.

PALEOBOTANY

Clays at TVOR SE are rich in pieces of charcoal. Wood is not identifiable. No additional palynological work has been done in the period of this report.

INVERTEBRATE ANIMALS

Foraminifera

No foraminifera other than the specimens of *Globorotalia menardii* and ? *Wheelerella* reported in Schiebout *et al.* (2002) have been recovered.

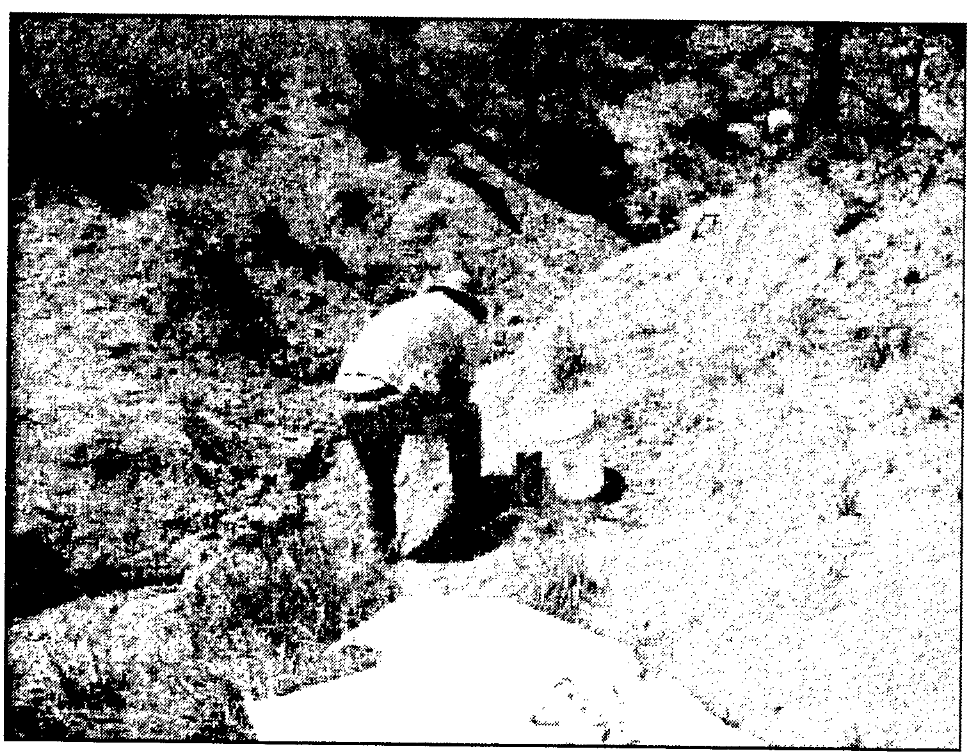


Figure 4. James Grafton examines surface at north wall of TVOR SE Site, April 18, 2003. View to the west.

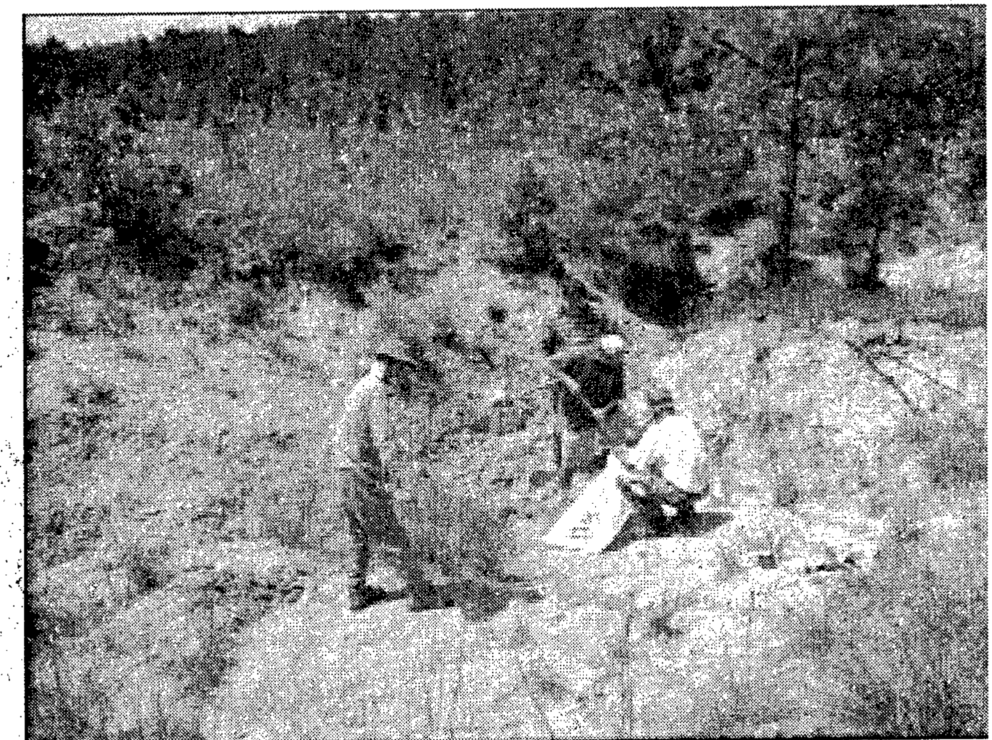


Figure 5. Robert Hays holds bag while Michael Williams (in cap) and James Grafton shovel in clay for screening. Dr. Ting to left. Bagging is at TVOR SE north side of gully, with the south side of the TVOR SE gully in background, July 29, 2003.

Mollusca

The original patch of sandstone rich in oysters and snail steinkerns at TVOR SE has been collected and processed and most material currently being processed from TVOR SE is mudstone. It is locally rich in remains of partly dissolved bivalves which weather to a friable white powder.

No additional identifiable mollusk taxa have been recovered. Slabbing of hard sandstone from TVOR S, which at least superficially resembles the oyster-rich, mammal–bearing rock from TVOR SE, did not reveal oysters, but they may have been dissolved more thoroughly than the molluscan remains at TVOR SE. The well-lithified rock at TVOR S may still be the source of some of the fossils recovered loose in the TVOR S ravine, and some of that rock is undergoing acid treatment now. It may represent an ancient environment similar to the productive layers at TVOR SE.

VERTEBRATES

Systematic paleontology below lists those taxa for which there are new materials in the period of this report or new results of study and does not cover every taxon recognized from the Fort Polk Miocene. Where new material has been found, but it does not change previous taxonomic descriptions, numbers of additional specimens are listed by site.

Class CHONDRICHTHYES

Order BATOIDEA

MYLIOBATIS sp.

Two pavement teeth have been recovered from TVOR SE.

Class OSTEICHTHYES

Order LEPISOSTEIFORMES

LEPISOSTEUS sp.

Gar scales continue to be found at every site.

Order AMIIFORMES

?AMIA sp.

One additional vertebra, LSUMG 12775, has been recovered from TVOR SE.

Order SILURIFORMES

cf. *ICTALURUS PUNCTATUS*

Catfish spines continue to be common finds in screening.

Order PERCIFORMES

LARGE PERCIFORM FISH

Referred specimens LSUMG 10895, 36 large fish spines from TVOR SE. Three new spines have been found, but no other material which can be assigned to the big fish.

Locality TVOR SE

Discussion All of the large fish spines from TVOR SE are being catalogued with a single number. The number of spines has passed the number that a single individual would be expected to yield, but which spines belong together and the total number of individuals cannot be determined. These spines appear to be from a fish as large or larger than modern giant sea bass which are over 100 years old and 500 pounds in weight. Such a fish would have heavily ossified elements other than the dorsal spines, but nothing else referable has been recovered so far.

Family SCIAENIDEA

APLODINOTUS sp.

Over 350 drum teeth, described in Schiebout and Ting (2001), have been recovered from TVOR SE.

Class REPTILIA

Order CROCODYLIA

Genus ALLIGATOR

ALLIGATOR sp.

Figure 6 A, B

Alligator teeth continue to be found both in screening and surface search. They remain among the more common teeth found in the Fort Polk Miocene and are recovered from TVOR SE.

A partial vertebral centrum (LSUMG 12342) from TVOR SE, 50-60 feet SE of the main locality, was initially reported as possible whale material (Schiebout *et al.* (2002) before cleaning revealed that it is probably a large crocodilian.

Order CHELONIA

Suborder CRYPTODIRA

Superfamily TESTUDINOIDEA

Family TESTUDINIDAE

HESPEROTESTUDO sp.

Figure 7 A, B

Referred specimens LSUMG 12224, male tortoise carapace and plastron;
LSUMG 12223, female tortoise carapace and plastron.

Locality Discovery

Description Two remarkably preserved tortoise shells both with an almost complete carapace and plastron. The 2nd and 4th neural bones of the carapace are octagonal-shaped.

Discussion According to Hay (1908), *Geochelone* is distinguished from other tortoise species, such as *Stylemys* and *Hadrianus,* by having octagonal shaped 2nd and 4th neural bones of the carapace. *Geochelone* in North America is called *Hesperotestudo* (Robert McCord, *pers comm.*, 2003).

Even though X-ray study has not revealed any additional bones inside the shells, these specimens remain the most complete individual animals from the Fort Polk Miocene. It is hoped that comparison of these animals with specimens from the Miocene of Florida and/or the High Plains will allow for identification down to species level.

ORDER SQUAMATA

Suborder SERPENTES

Family NATRICIDAE

Figure 8

Referred specimens LSUMG 12740

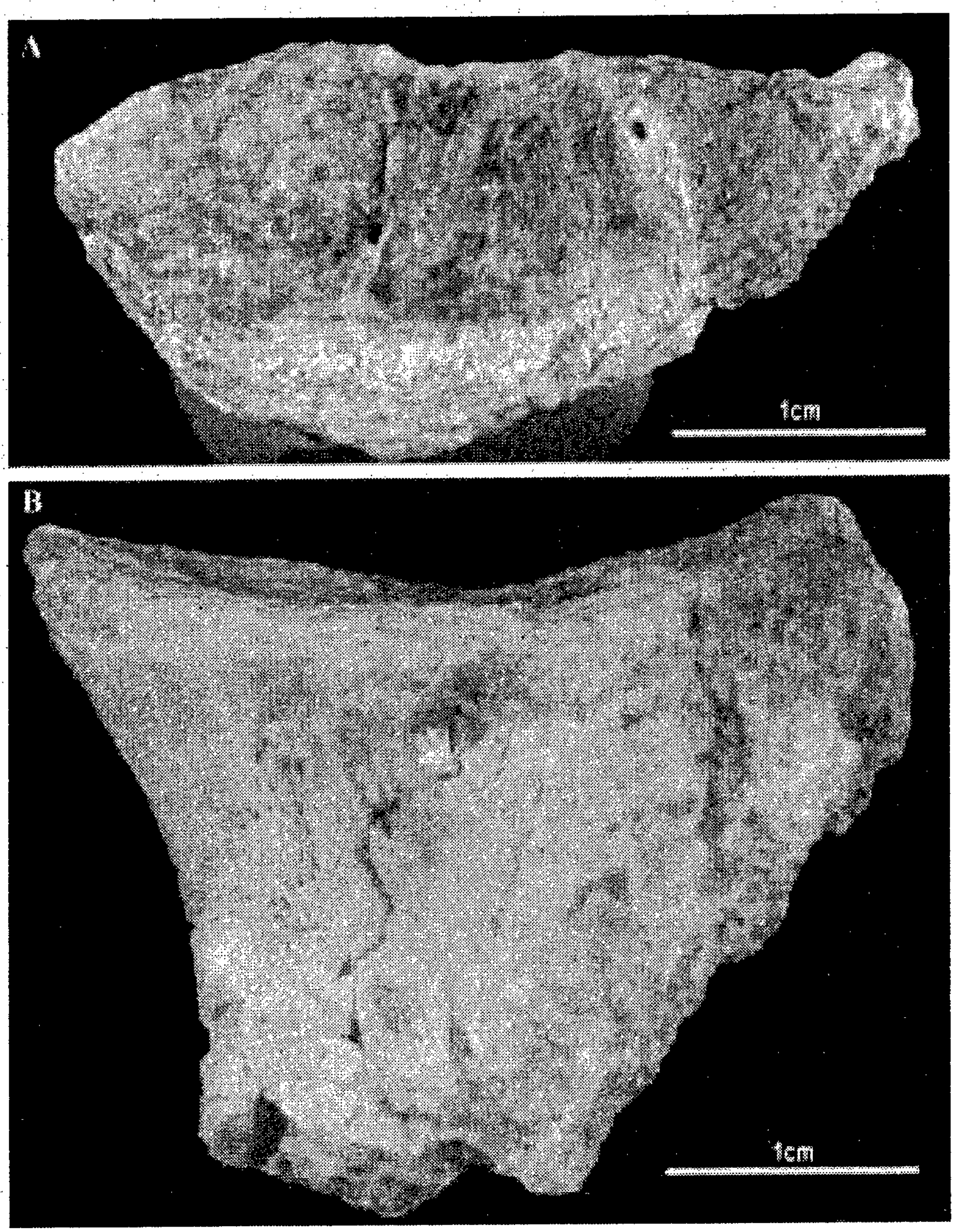


Figure 6. Vertebral centrum fragment (LSUMG 12342), possibly from a large alligator. A. Anterior; B. Lateral.

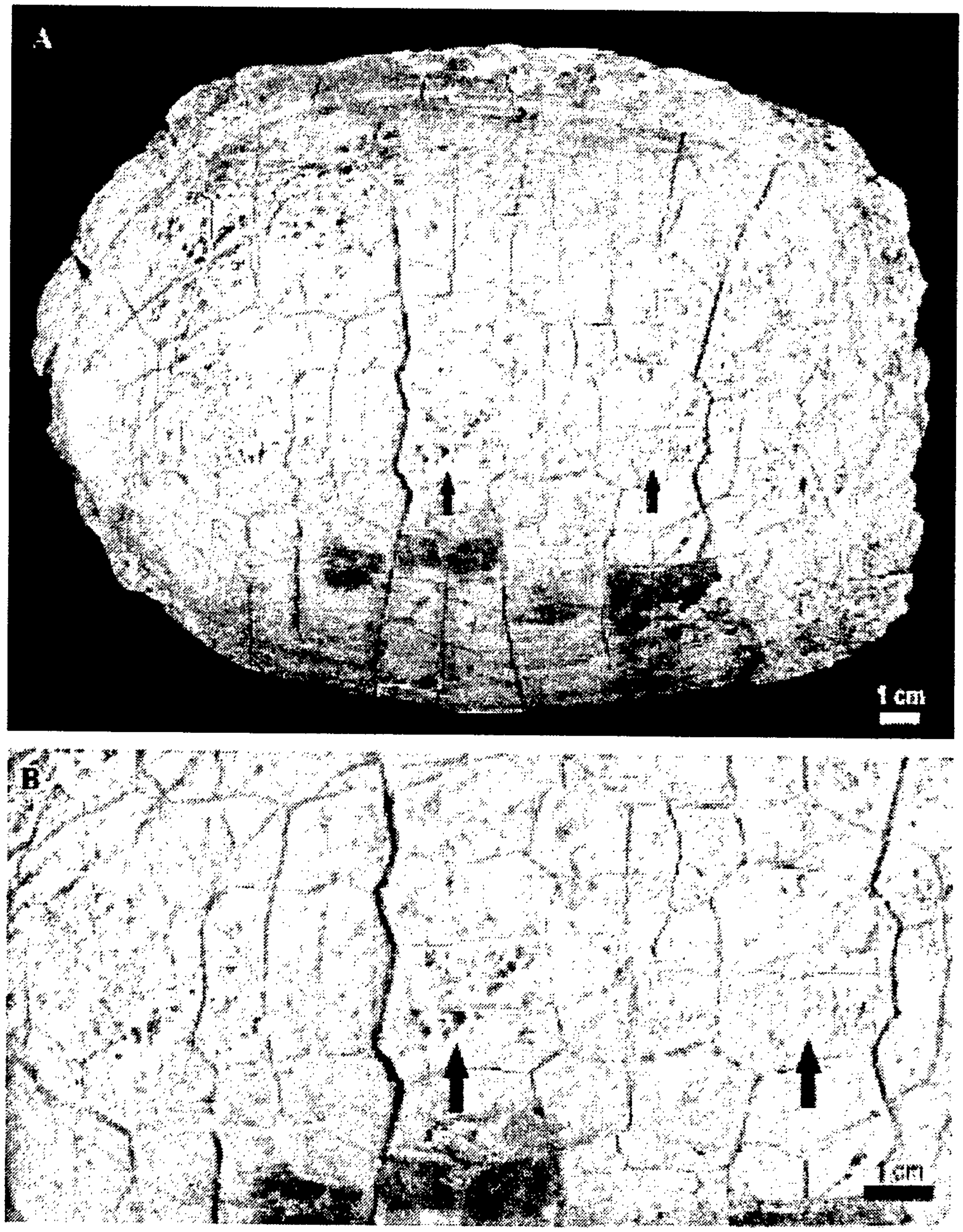


Figure 7. A. Dorsal view of entire carapace of female tortoise from Discovery Site (LSUMG 12223). Arrows point to octagonal-shaped neurals; B. Close up of neural numbers 2 and 4.

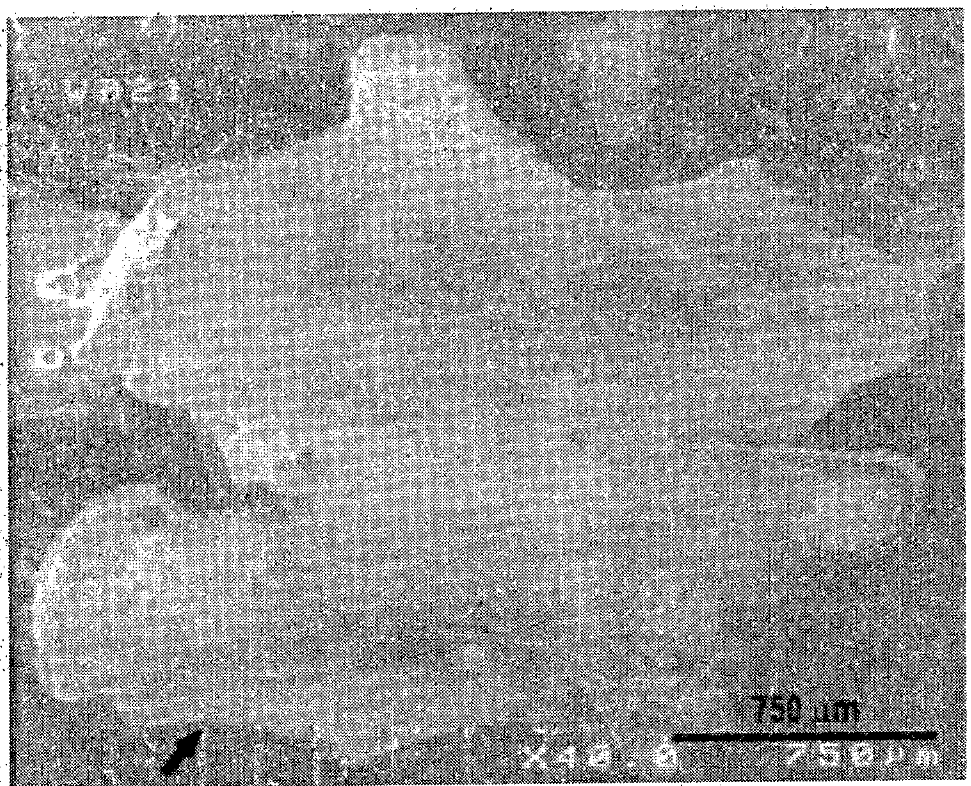


Figure 8. Scanning electron micrograph of natricine snake vertebra (LSUMG 12740) in lateral view. The arrow points to the broken hypapophysis.

Locality Stonehenge
Description LSUMG 12740 is a small vertebra with a fractured hypapophysis that is short, thin, and less than 1/3 as wide as the condyle (Figure 8). The neural spine is present, but broken. The length of the centrum is 2.0 mm, and the width is 1.4 mm.
Discussion Although this vertebra is probably assignable to the genus *Nerodia* because the centrum length is only slightly longer than the width (Holman, 1979), comparison of this vertebra to the vertebrae of several species of modern *Nerodia* needs to be conducted before it can confidently be identified to the generic level. Modern natricine snakes include water and garter snakes, both of which require nearby permanent water sources to seek out aquatic prey.

Family COLUBRIDAE

Figure 9

Referred specimen LSUMG 4478
Locality Stonehenge
Description LSUMG 4478 is a small snake vertebra with no hypapophysis present, but the hemal keel is thin and distinct and is more than 1/2 as wide as the cotyle. The broken neural spine is thin and long (Figure 9). The centrum length is 2.7mm and the width is 2.0mm.
Discussion The vertebral characters of LSUMG 4478 are the same as those found on the Miocene genus *Texasophis* (Holman, 1979), but future comparison with *Texasophis* vertebrae will determine the genus with more confidence.

Family VIPERIDAE

Figure 10

Referred specimens LSUMG 9643
Locality TVOR
Description LSUMG 9643 is a robust verte-

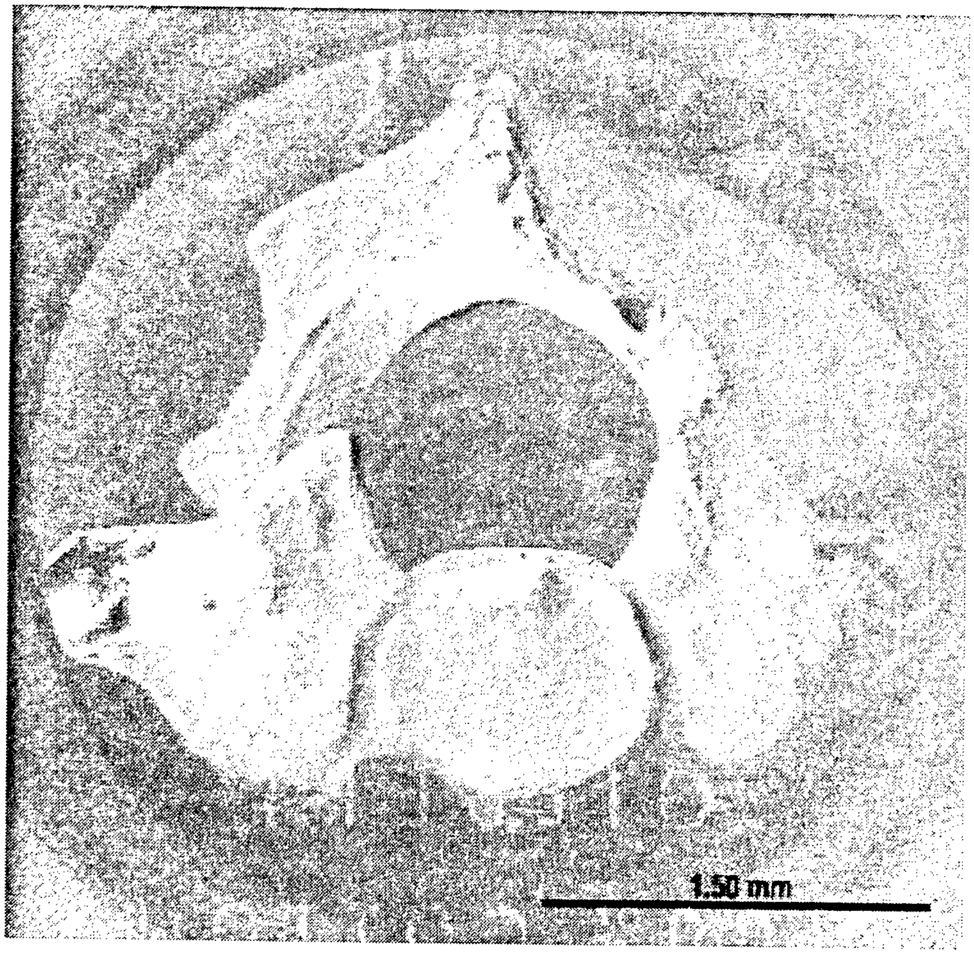


Figure 9. Scanning electron micrograph of a colubrid snake vertebra (LSUMG 4478) in anterior view.

bra with a broken hypapophysis. The width of the hypapophysis is over 1/3 the width of the condyle (Figure 10). The length of the centrum is 6.7 mm and the width is 5.8 mm.

Discussion This vertebra compares favorably with the vertebrae of modern *Agkistrodon*, which includes both cottonmouths and copperheads. Both species of *Agkistrodon* are common throughout Louisiana today. Cottonmouths favor aquatic habitats like streams, bayous, and lakes; whereas, copperheads are more common in drier, upland forest habitats. LSUMG 9643 is the first venomous snake recovered from the Fort Polk Miocene.

Indeterminant squamate

Figure 11 A, B

Referred specimen LSUMG 12774

Locality Stonehenge

Description LSUMG 12774 is a small, toothy fragment of a right dentary, with teeth that are peg-like, terminating with a small bulbous crown (Figure 11 B). The labial surface contains many small foramina.

Discussion LSUMG 12774 is currently under study and must be compared with several species of frog, salamander, and lizard before its taxonomic status can be determined.

Class MAMMALIA

Order INSECTIVORA

LIMNOECUS NIOBRARENSIS

Eight teeth have been recovered from Stonehenge.

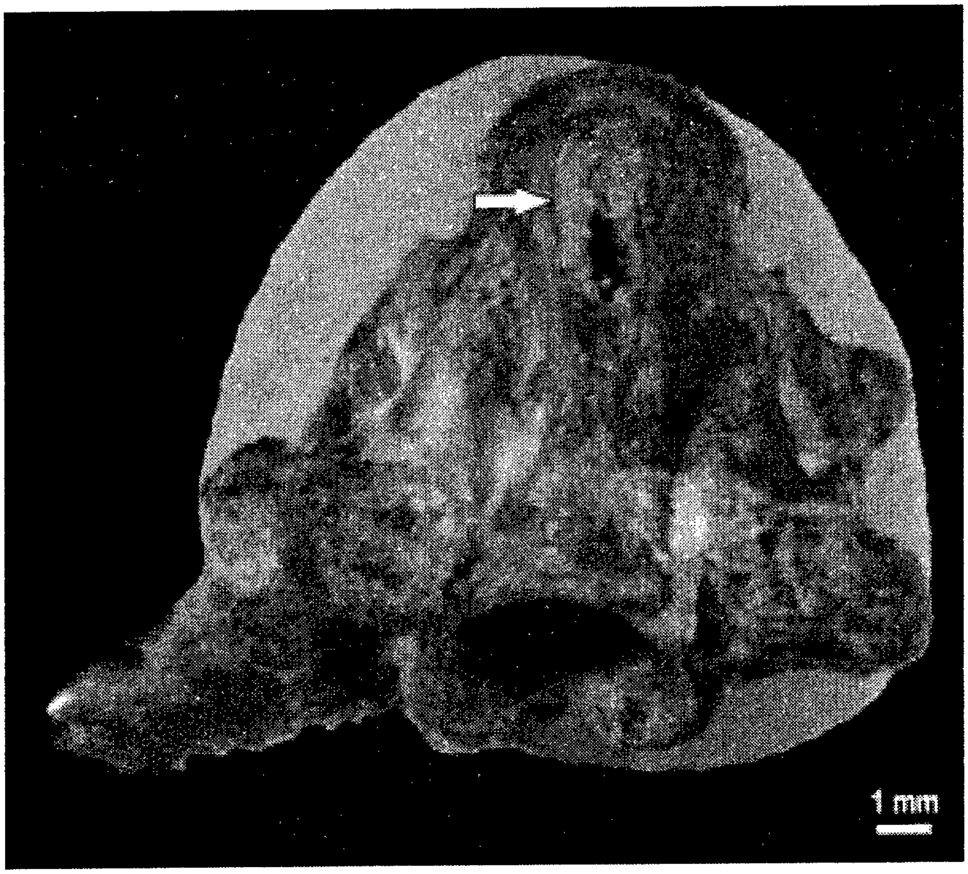


Figure 10 Viper vertebra (LSUMG 9643), showing the condyle (rounded portion) and the broken hypapophysis, indicated with an arrow.

Order CETE

Parvorder MYSTICETI

Figure 12

LSUMG 11876, a petrosal from a small baleen whale from TVOR SE (Schiebout *et al.,* 2002), was compared to the petrosal of the Eocene whale *Basilosaurus* from central Louisiana for a rough estimate of how "small" a small baleen whale this was. Figure 12 is the result of this estimate, which is definitely a rough estimate given the taxonomic and time difference between the two whales.

Order ARTIODACTYLA

Family *TAYASSUIDAE*

CYNORCA* or *DYSEOHYUS

Figure 13 A, B, C

Referred specimen LSUMG 12741

Locality TVOR SE

Description m2 crown enamel cap, probably from a deciduous tooth.

Discussion Abundant, rounded, closely packed cusps are consistent with referral to a peccary, and the size is reasonable for a very small form such as *Cynorca* or *Dyseohyus,* both of which have been reported from the Barstovian of east Texas. (Woodburne, 1969). The specimen has only the enamel cap indicating that it was a shed tooth or was partly dissolved in the gut of an alligator.

Order PERISSODACTYLA

Family RHINOCEROTIDAE

***?APHELOPS* sp.**

Figure 14 A, B; 15 A, B

Referred specimen LSUMG 12681, fragment of a rhino tooth crown; LSUMG 12681, scaphoid of a large rhino.

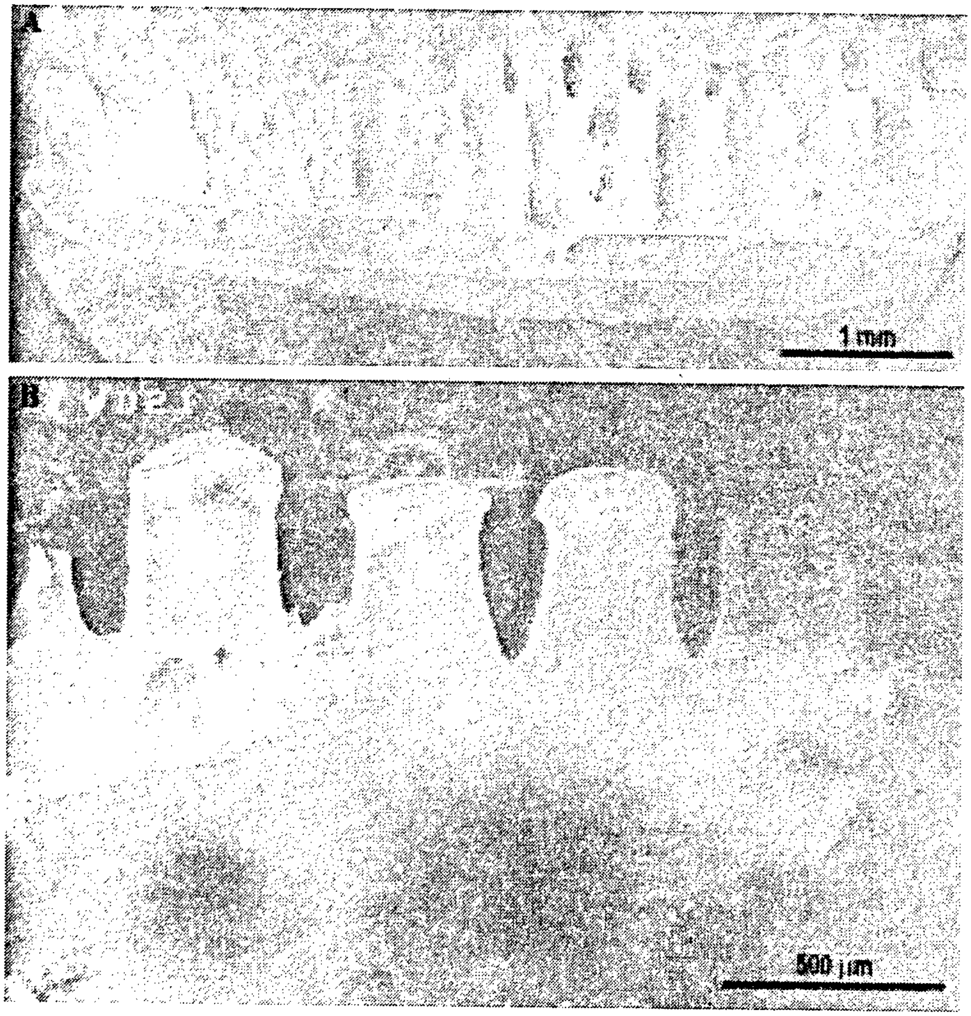


Figure 11. Scanning electron micrographs of a small, possibly lizard, right dentary fragment (LSUMG 12774). A. Lingual view of entire fragment. B. Close-up of the labial view, showing dentition and foramina.

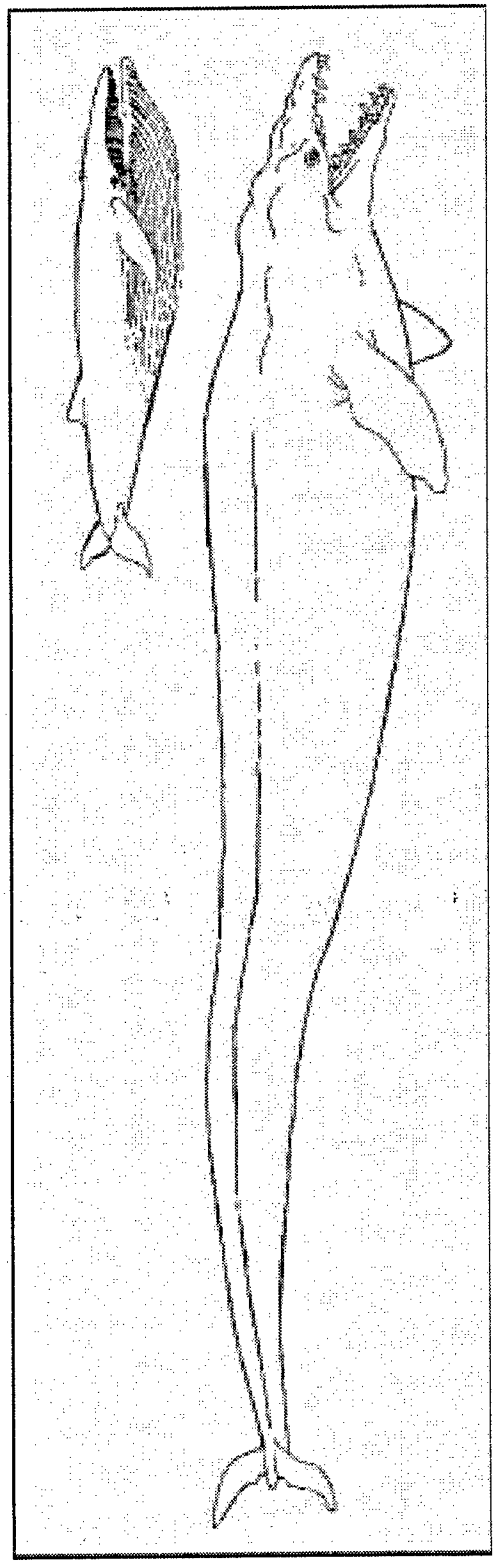


Figure 12. Sketch of a small baleen whale approximately the size of the one represented from Fort Polk by petrosals, compared to the larger Eocene *Basilosaurus* from Montgomery Landing, Louisiana.

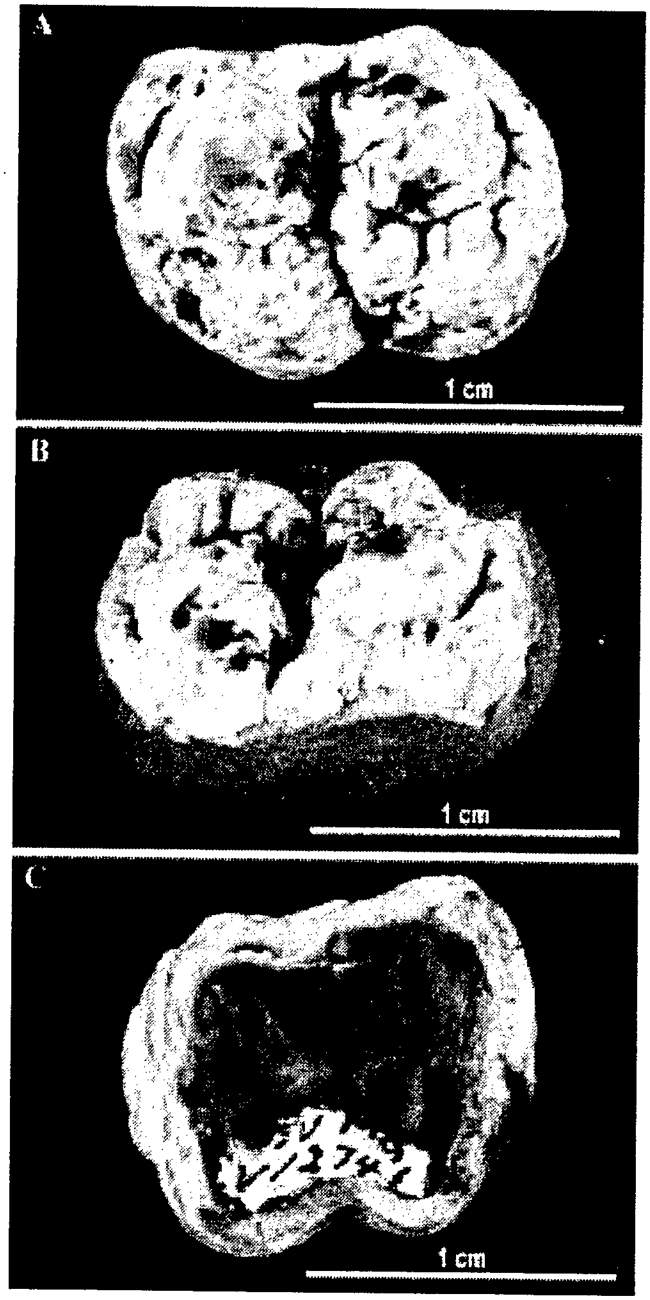


Figure 13. Peccary m2 (LSUMG 12741) from TVOR SE, A. Crown; B. Lateral oblique; C. Basal view.

Locality TVOR SE

Description The bone is from a large perissodactyl and the only reasonable Fort Polk Miocene candidate so far is a large rhino. Horses are too small and we do not have unequivocal chalicothere material. The enamel chewing surface on LSUMG 12681 shows banding characteristic of rhinoceros teeth and has to have come from a big tooth.

Discussion *Aphelops sp.* has been recognized from DISC and TVOR SE, but Prothero and Serreno (1980) have described four rhinos for the Miocene Gulf Coast, two dwarf and two large forms. There have been no Fort Polk Miocene specimens clearly referable to *Teleoceras*, the other big rhino, but it could well be present and could have yielded large undiagnostic rhino material. Until there is definitive evidence of its presence, large rhino material will be referred to *Aphelops*.

In Florida, the two big rhinos occur in the same deposits. MacFadden (1998) considers *Aphelops* to be similar in life style to the modern African black rhino, a browser, and *Teleoceras* to be similar to the African white rhino, a grazer. The white rhino is not white, but has a broader snout than the black one, and the Dutch/German word for "wide" sounds a little like "white". Both grazing and browsing animals are present among the Fort Polk Miocene herbivores, for example, our merychippine horses were grazers and *Prosynthetoceras* was probably a browser.

Order PROBOSCIDEA

Family *GOMPHOTHERIIDAE*

Figure 16 A, B, C

Referred specimens LSUMG 12343, a piece of large worn tooth.

Locality TVOR SE.

Description A well worn tooth fragment with root from the anterior of the tooth of a large gomphothere.

Discussion This specimen is the most complete gomphothere material from the current Fort

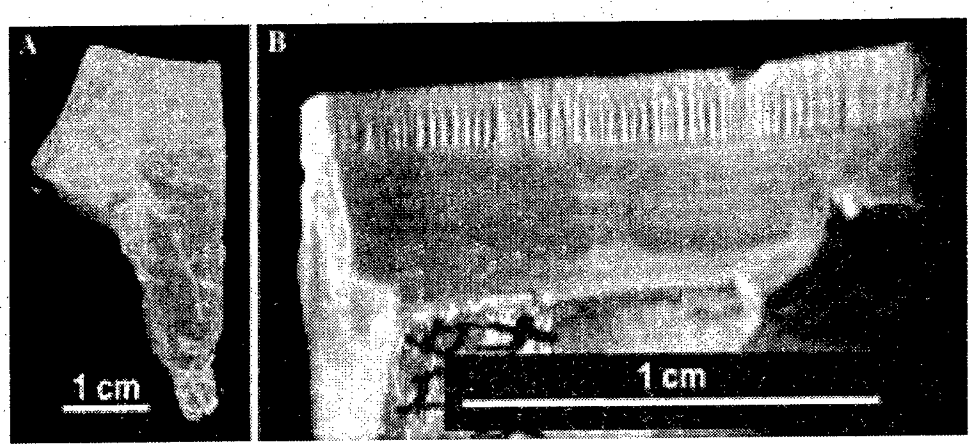


Figure 14. Fragment of a tooth of a large rhino (LSUMG 11775), possibly *Aphelops*, showing banding in enamel which is characteristic of rhinoceri.

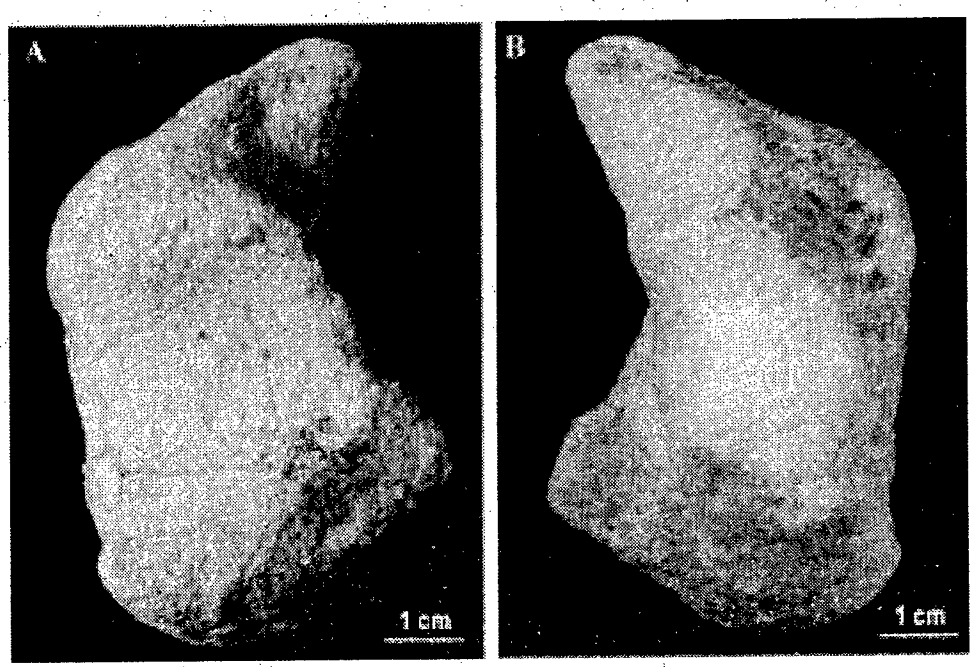


Figure 15. Scaphoid of a large rhinoceros, possibly *Aphelops*. A. Proximal view. B. Distal view.

Polk Miocene study. It appears to have been a larger animal than TMM 40775-1, *Gomphotherium cimmaronis* from Noble Farm site in Grimes County, east Texas.

Order RODENTIA

The most common rodents are geomyoids, heteromyids, and cricetids. New material has not affected their identification. All three have been recovered from TVOR SE. Figure 17 A shows the distribution of numbers of these three rodents from all sites from the start of the Fort Polk Miocene project through December 2001 and Figure 17 B during 2002 and 2003 up to July 31, 2003.

Family CASTORIDAE

Three taxa of castorids (beavers) are present in the Fort Polk Miocene (Schiebout and Ting, 2001). A relatively large form is represented, so far, only by a fragment of upper incisor enamel, probably from an animal more than twice as large as the other two taxa. Two new beaver teeth are from Stonehenge and do not add any characters to previous descriptions of beavers in Schiebout and Ting (2001). LSUMG 12345 is referred to *Eucastor cf. E. pansus*, which has been recovered from Stonehenge Site before. LSUMG 12389 is referred to *Eucastor n. sp.*, a species which was not previously known from Stonehenge.

Family GEOMYIDAE

TEXOMYS RICHEI

Figure 18

Characteristics of p4 are major determinants for recognizing the genus *Texomys* (Slaughter, 1981) As material from Fort Polk increases, more p4's, in differing wear stages, have become available. The range of variation in cusp arrangement in the trigonid of the teeth and the differences seen in different wear stages, are beginning to suggest synonymizing *Texomys* out of existence as a genus.

Family CRICETIDAE

COPEMYS

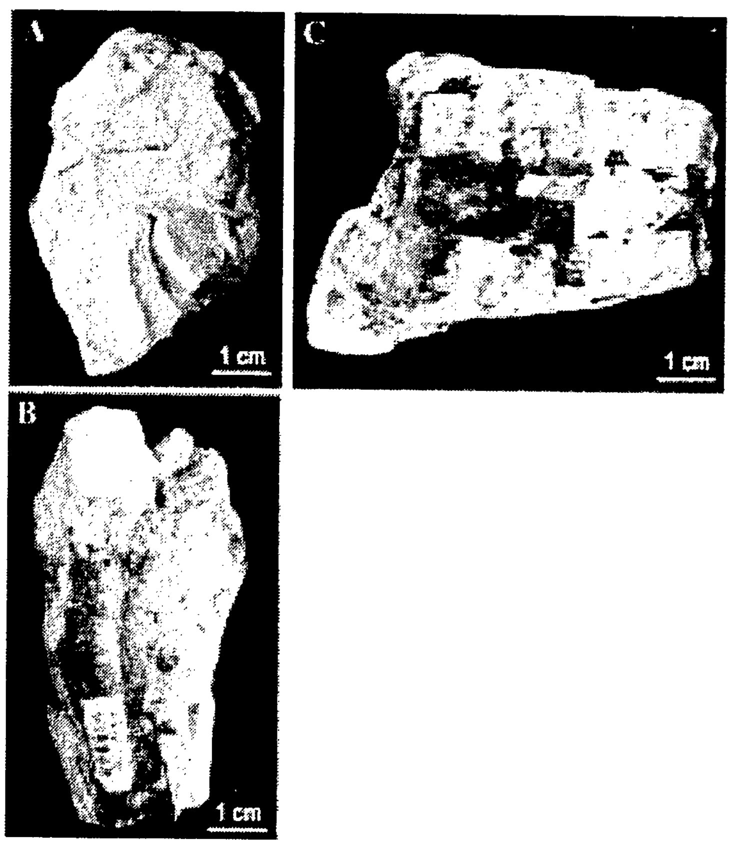


Figure 16. Fragment of a gomphothere tooth. A. Crown view, B. Lateral view, C. Posterior view.

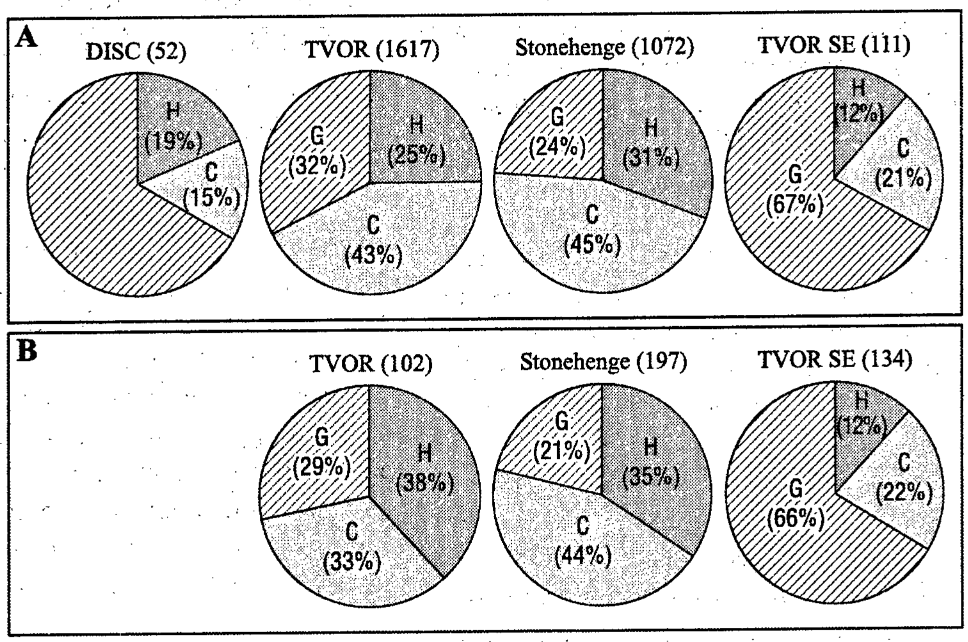


Figure 17. A. Distribution of cricetid (C), heteromyid (H) and geomyoid (G) rodents at four Fort Polk sites as of December 2001. B. Distribution of cricetid (C), heteromyid (H) and geomyoid (G) rodents at three Fort Polk sites added as of July 31, 2003. Number after site name is total specimens.

Copemys is an example of a taxon in which a relatively large number of specimens are now available, making possible a study of variability in size and morphology at a single site (p. 20).

Family SCIURIDA

Squirrel specimens are all from Stonehenge and do not add any characters to previous descriptions of squirrels in Schiebout and Ting (2001).

Subfamily SCIURINAE

Genus NOTOTAMIAS

NOTOTAMIAS sp.

Referred specimens LSUMG 12604, Right upper M1 or 2

Genus ?*AMMOSPERMOPHILUS*

Referred specimens LSUMG12570, Right upper M1 or 2, LSUMG 12646, Left lower m1 or 2.

V. REVISED PALEOMAGNETIC CORRELATION AND DISCUSSION OF SITE AGES

Additional samples have been processed at the laboratory of Dr. Wulf Gose at the University of Texas at Austin (Figure 19; Appendix C). The main difference from previously presented versions is that the TVOR core correlation shows TVOR conglomerate (X) as in 5ABn instead of 5AAn. The paleomagnetic data would also fit if TVOR core was raised by one normal zone, so the decision has been made on the basis of vertebrate paleontology to place the DISC main conglomerate and TVOR conglomerate in the same zone and TVOR S and TVOR SE in the same zone as Stonehenge, the most marine-influenced of the DISC sites. TVOR sites lie updip from the DISC cluster, which also makes the higher correlation for TVOR core less appropriate.

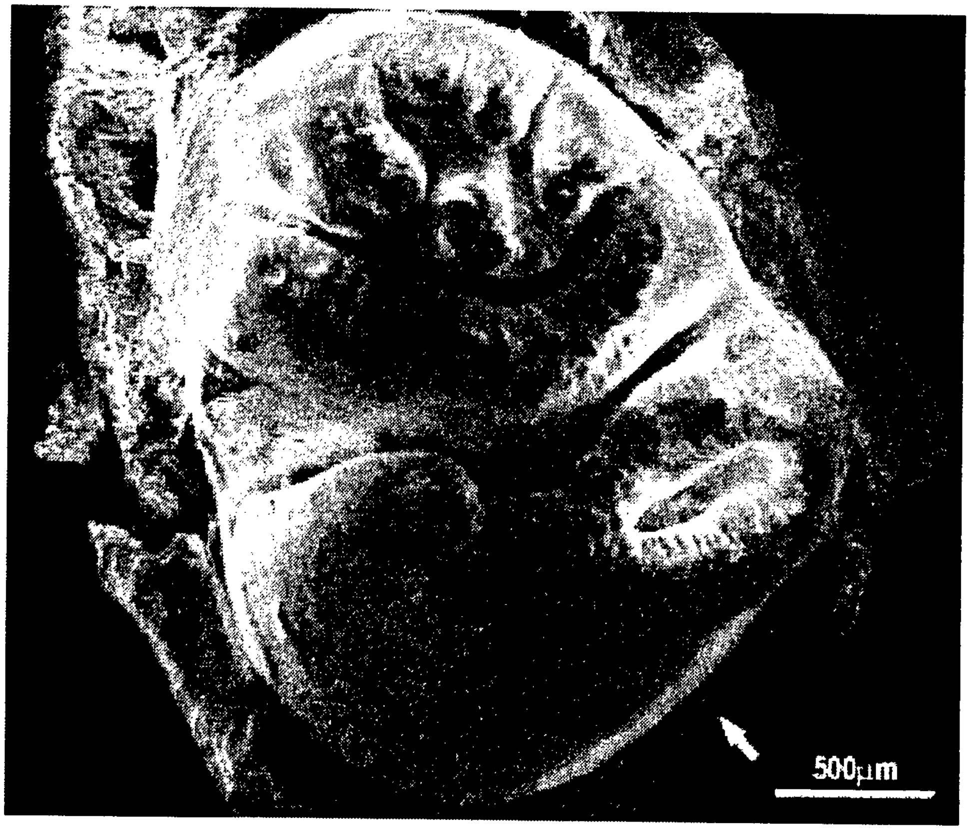


Figure 18. Scanning electron micrograph of crown of *Texomys* p 4. Arrow indicates posterior of tooth.

TVOR SE is older than 13.6 Ma if the correlation above is correct, and older than 13.2 if TVOR core is to be moved up a zone. Palynological research (John Wrenn, pers. comm.) suggests an age for TVOR SE no older than 11 and the foraminifera-based estimate is no older than 12 Ma (Peter McLaughlin, pers. comm.). At present, placing the Fort Polk Miocene sites in the late Late Barstovian or Clarendonian, when no vertebrates characteristic of these levels in east Texas have been recovered, seems contraindicated, leaving a contradiction which may be resolved with further work.

A half century ago, Dr. John A. Wilson and others from the University of Texas at Austin investigated east Texas Miocene terrestrial fossil sites and stratigraphy, and developed a system of successive vertebrate local faunas (Wilson, 1956). Newly recovered mammals from TVOR SE do not contradict its association with the Cold Spring Local Fauna of east Texas as discussed in Schiebout and Ting (2001) and Schiebout *et al.* (2002)(Figure 2). Tvor SE is a marine site, and the older and stratigraphically lower Burkeville Local Fauna is from marine sites and has been collected nearby in east Texas, so efforts are underway to relocate these sites. Small vertebrates are not available in the Texas Memorial Museum collections from the Burkeville vicinity, so relocation and screening would make comparison of the Fort Polk sites and the older east Texas ones much more precise. During the winter of 2002-2003, an attempt was made by Michael Williams to relocate classic Burkeville sites in east Texas, but unfortunately to no avail. In the almost 50 years since the area was last examined, large trees and extensive undergrowth could have grown in the previously open location of the site and the water level of the creek in mid winter could have been over the site. The space shuttle debris recovery efforts prevented spring 2003 field work in the east Texas Burkeville area, but this effort is planned to resume in December 2003.

VI. PALEOBIOLOGY AND PALEOECOLOGY

Screening has produced numbers of specimens of small rodents high in comparison to those from many Miocene vertebrate sites. These samples offer an opportunity for study of morphological and size variation. The rodent *Copemys*, a relative of the cotton mouse, is an important animal in dating Miocene sites. Lindsay (1972) defines the Hemingfordian/Barstovian boundary as solely determined by the first appearance of *Copemys* (approximately 16 Ma). Age of the Fort Polk sites is limited to after the immigration of these creatures from Eurasia. The following discussion of *Copemys* is drawn from a study by Grant Boardman.

How many species of the small rodent *Copemys* occur at a single prolific screening site, Stonehenge?

The Stonehenge Site rodent sample is comprised solely of isolated teeth so that data on relative proportions and variation in size are essential for identification of species. No associated dentitions of *Copemys* are known from the Fort Polk area. The size of teeth (the upper first molar, M^1) is relatively stable and suitable for evaluation, but this alone will not separate species. When considered along with other morphologic characters for M^1s, insight into whether there is more than one species present in the bulk sample should be possible.

Lindsay's (1972, p. 75) cusp terminology for *Copemys* M^1s is used (Figure 20) in the following discussion. After evaluation of molar variation, M^1s were chosen for additional study. Data were collected from 103 *Copemys* M^1s from the Stonehenge Site. Broken, excessively worn, or any specimens on which identification to *Copemys* was equivocal, were excluded.

Length to width ratios of M^1s appear to hold promise for identification of *Copemys* species. Clear ratio ranges in Stonehenge specimens

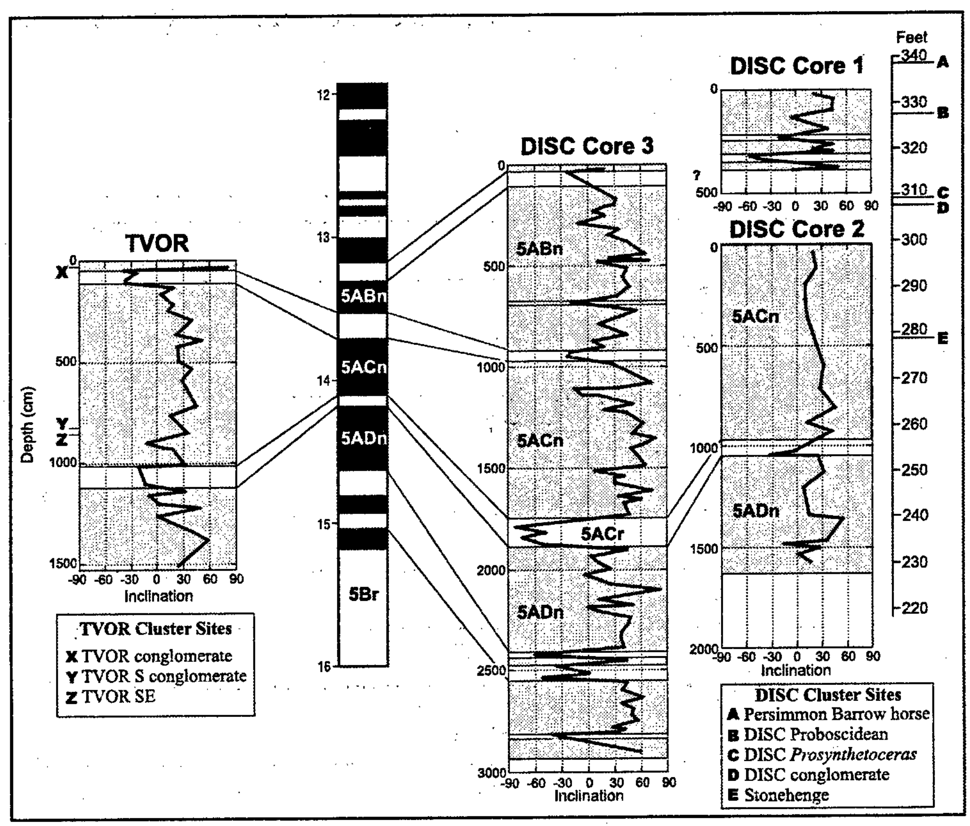


Figure 19. Correlation of polarity intervals between four cores at Fort Polk, Louisiana. Modified from Figure 33 of Schiebout et al. (2002) by the addition of new samples processed by Dr. Wulf Gose.

include 2:1, 3:2, and 4:3. The outline of the tooth is perhaps most affected by this ratio. Buccal and lingual cusps remain relatively the same in morphology throughout the span of ratios; it is, in fact, the area of the anterocone of the M^1, whose shape is almost defined by these ratios (Figure 21). For teeth that are 2:1, the area of the anterocone is more narrow and pointed. For the other ratios, the anterocone shape is blunted, with width being very often equal to or greater than length (Figure 24). Among teeth of ratios 3:2 and 4:3 the area of the metacone of the M^1 is often pronounced, though it does not appear diagnostic for *Copemys* and may simply suggest its early development in relation to the other cones. The connection between general area of the anterocone shape and other morphological characters is not yet clear.

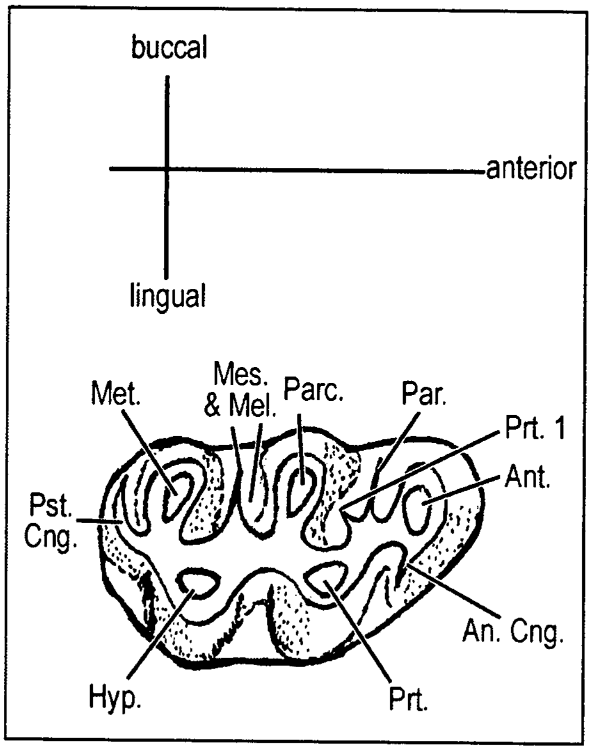


Figure 20A. *Copemys* M1 dental terminology: An.Cng. = Anterior Cingulum, Prt. = Protocone, Hyp. = Hypocone, Pst.Cng. = Posterior Cingulum, Met. = Metacone, Mes. = Mesostyle, Mel. = Mesoloph, Parc. = Paracone, Prt.1. = Protolophule I, Par. = Paralophule, Ant. = Anterocone. Sketch is of M1 of LSUMG 9207.

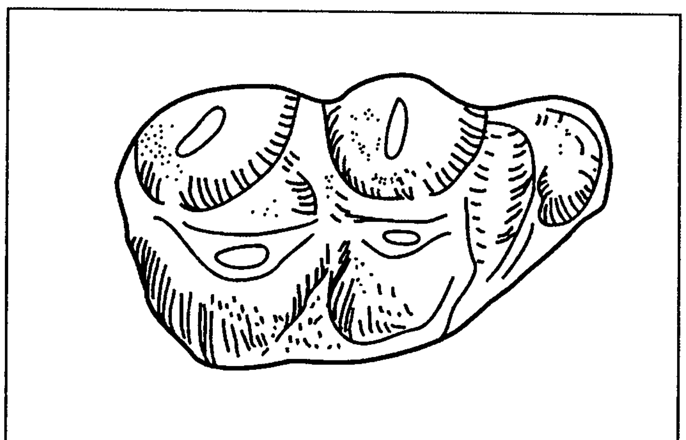


Figure 20B. Sketch of M1 LSUMG 9207.

As is noted from the plot of length to width in millimeters, there is only one cluster of points (Figure 22). This suggests that ratio of length to width of M^1s cannot be used to distinguish species in this case. Had the measurements plotted up showing more than one distinguishable cluster, perhaps size could be used to separate and identify more than a single species at the site. The plot is similar to those observed by Mein (1971) for similar Eurasian cricetids of Hemingfordian age. Other morphological characters would have to be used to help determine if there is more than one species of *Copemys* at Stonehenge.

The M^1s from Stonehenge seemed upon first observation to share a number of diagnostic features (Figure 23), the presence of all five cones described by Lindsay (1972), a characteristically large anterocone, a furrow between the anterocone and the protocone, and between the anterocone and the paracone, a medially narrowing posterior cingulum, and the seemingly complete absence of the mesostyle and mesoloph. The shape of the anterocone and its orientation is highly variable, from medially symmetric to asymmetrical with buccal orientation (anterior to the paracone). The high rate of variability makes this feature of *Copemys* a bad choice for recognizing species. Instead there are two variable features that seemed a better

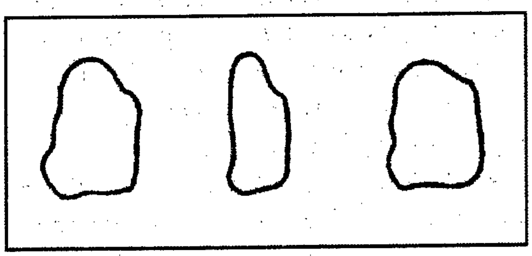


Figure 21. Comparison of the area of the anterocone shape among size ratios 3:2, 2:1, and 4:3 respectively.

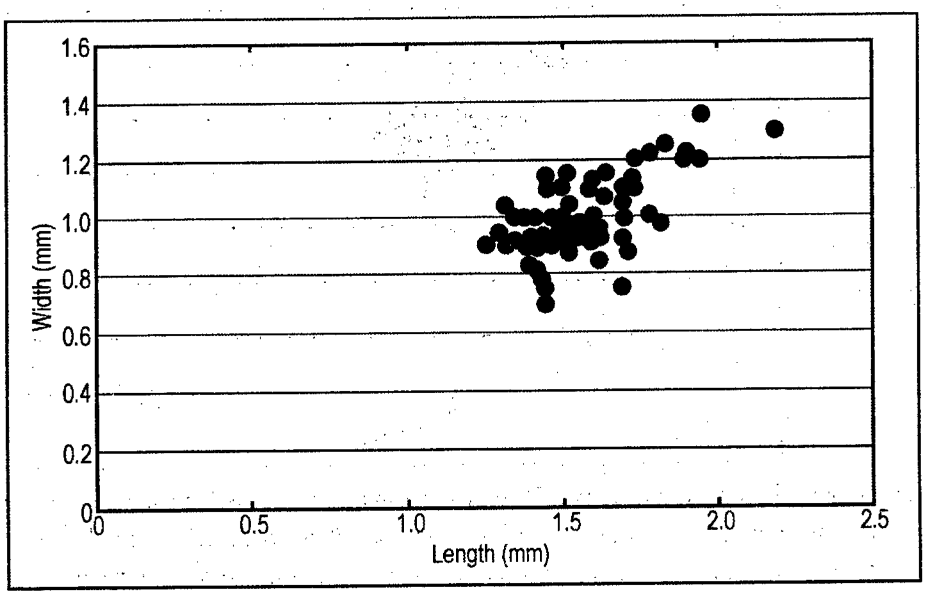


Figure 22. Distribution of Upper M1 samples for the Stonehenge site using width versus length.

choice. 1) In unworn specimens, the connection between the hypocone and paracone was discernable at least weakly in all specimens, 2) The presence or absence of a fused protolophule I/ paralophule (connule). The presence and absence of aforementioned features were noted for all measured specimens. When these features are taken into consideration with length and width data, no size correlation to the features was noted (Figure 24).

The likelihood of a feature being absent seems equally as likely to be caused by wear as it to be caused by genetics. For example, sample LSUMG 11361, is well worn and smoothly weathered. Upon further examination, the determination of the absence of the notable features is problematical at best, as the connule could have been worn down and weathered or simply not present at all. It should be noted, however, that M^1s with a deep continuous furrow (from the anterior cingulum) between the anterocone and the other anterior cones, always lack the fused connule. This being so, the determination of the presence or absence of the fused connule is made clearer when looking at worn teeth, being that all that must be taken into account is whether or not the furrow is continuous and relatively deep. A small amount of wear is all that is needed to wear away the connection between the hypocone and the paracone. When cones are worn down evenly to the baseline of the tooth, features, such as cones, connules, and the connections between them are destroyed. Particular wear patterns have been made by this process but have yet to be well documented.

Deciduous teeth appear to not be recognizable by any particular morphology, size ratio, or amount and style of preservation. Splayed roots and or the absence thereof alert us to the deciduous nature of these teeth. In the measured sample, a sizeable number of teeth (approximately 20) exhibit fused roots, generally the two buccal or the two lingual roots appear as one large root, or as two separate roots connected strongly (Figure 25). The cause of this feature is unknown, though similar fusing is exhibited in other mammalian teeth when material from an unformed tooth is incorporated into the roots of neighboring teeth, which more often than not causes fusing (Butler, 1978).

The average length and width of Stonehenge *Copemys* M^1s are 1.55 and 0.99 millimeters respectively. These numbers are comparatively smaller than those for *C. pagei* and *C. tenuis*, the two smallest *Copemys* species measured and reported by Lindsay (1972) being 1.55 and 1.05 and 1.90 and 1.30 respectively.

Figure 23. Stonehenge site. *Copemys* M1 Morphologic variation

Character combinations	Number of specimens with character combinations.
1,3	4
1,4	5
2,3	26
2,4	41
5	27

Characters:
1 fused protolophule I/paralophule (connule)
2 connule absent
3 strong connection between paracone and hypocone
4 weak or no connection between paracone and hypocone
5 neither feature present or hard to distinguish (due to wear and or preservation)

The relatively small size of Stonehenge's *Copemys* may be accounted for by the difference of the environment in which this population lived. According to Lindsay (1972) the Barstow *Copemys* lived in arid localities, much as this region of California is today, with little to no permanent bodies of water and sparse vegetation. The Stonehenge site was wet and forested. This difference in environment is perhaps not in and of itself enough to account for the small size of Stonehenge's *Copemys*, but it does begin to point towards an environmental causation. The possibility of *Copemys* living in a microenvironment at Stonehenge could lead to their diminutive size, as there would likely be a denser population competing for less living space. This reduction in size when living in a microenvironment is well documented in other mammals and should be a rational line of thought for *Copemys* as well.

There is a general trend of reduction in size of cricetid rodents from the Barstovian to the Hemphillian Age: from the relatively large *Copemys* to its smaller descendant *Peromyscus* (Lindsay, 1972). Neither trend has been observed for the Fort Polk *Copemys*. (Schiebout *at al.*, 2002).

Based on size alone there is no way to distinguish more than one species of *Copemys* from M[1]s at Stonehenge. The small sample from TVOR SE falls within the range of the Stonehenge population and does not show any morphology distinctive from it (Figure 26).

Rodent distributions.

In Schiebout (1997a, b), Schiebout and Ting (2001), and Schiebout *et al.* (2002), percentages of the three most abundant rodent types were used for estimation of relative amounts of forest and open areas at Fort Polk sites. Modern heteromyid rodents prefer open areas, and cricetid rodents prefer wooded areas (Dorsey, 1977). Palynological work by John Wrenn, reported in Schiebout and Ting (2001), indicated that the TVOR SE region included a mixed hardwood forest with pines. Phytoliths indicate a grassy savanna habitat associated with all sites (Schiebout and Ting, 2001, p. 28), but it must be kept in mind that 40% of them were unidentifiable and that the phytoliths were affected by

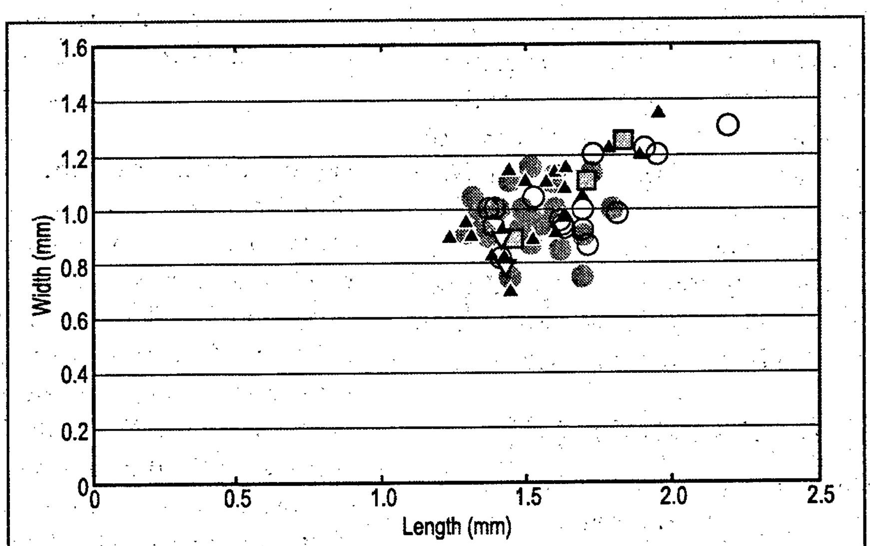


Figure 24. Distribution of morphological features of Upper M1 samples for the Stonehenge site using width versus length. Squares = fused protolophule I/paralophule (connule) and weak or no connection between paracone and hypocone, Open circles = connule absent and strong connection between paracone and hypocone, Triangles = connule absent and weak or no connection between paracone and hypocone, Inverted triangles = connule present and strong connection between paracone and hypocone, Solid circles = neither feature present or hard to distinguish (due to wear and or preservation).

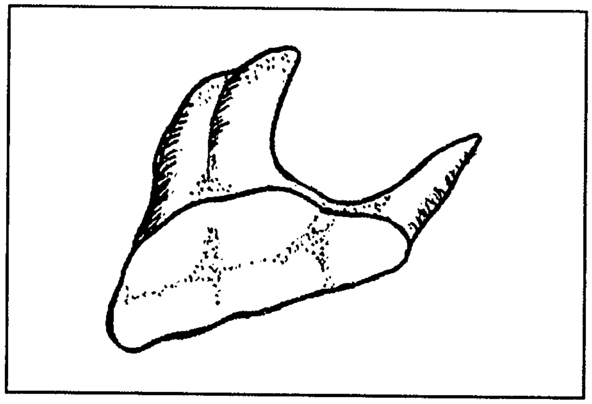


Figure 25. Example of fused/connected roots; in this case the lingual roots are strongly connected in sample number 10639.

diagenesis. Figure 17 contrasts the 2002 results with the distributions of specimens collected within the span of this report. TVOR SE rodents have doubled in number, but the pattern of geomyoids being strongly most common with heteromyids least, remains.

DISC and TVOR SE have similar percentages of geomyoids and remain the sites with the highest percentage of geomyoids. TVOR SE has approximately twice as many cricetids as heteromyids. Results prior to work at TVOR SE had the site with the highest percentage of geomyoids also the lowest in cricetids. High percentages of geomyoids and low percentages of cricetids had been interpreted to indicate a relatively more open and possibly drier situation at DISC (Schiebout and Ting, 2001) The TVOR SE pattern does not seem to be an artifact of low screening results for TVOR SE, as it is remaining steady with increased work (Figure 17).

VII. TAPHONOMY OF TVOR SE

In Schiebout *et al.* (2002), it was postulated that the shallow marine TVOR SE Site incorporated mammals from a mix of terrestrial environments, perhaps with a river in flood adding material eroded from both recent soils and older terraces. A mix of deep water and shallow water marine dwellers also occurred, perhaps as a storm brought deep water marine animals

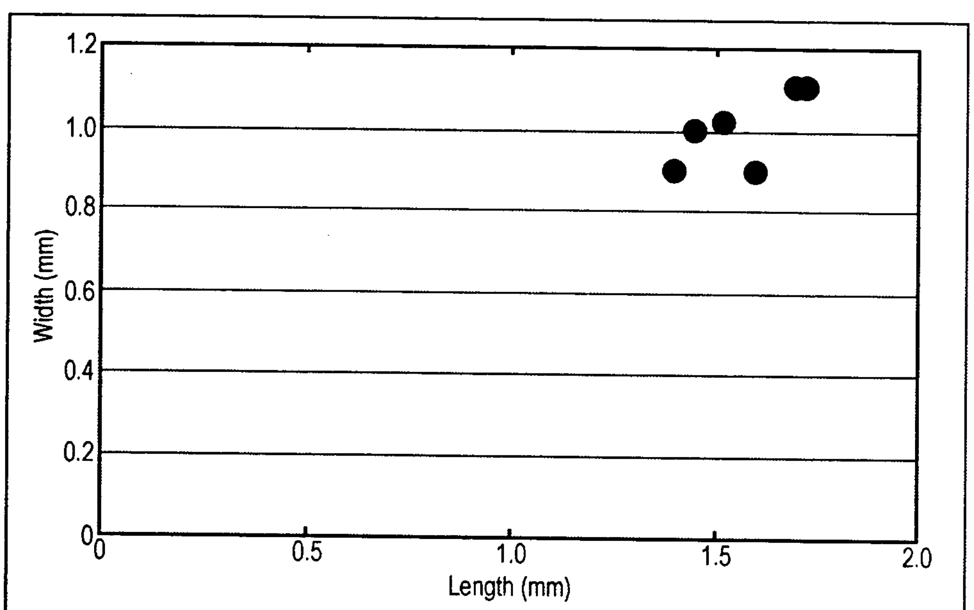


Figure 26. COPEMYS Upper M1 Length versus Width for TVOR SE.

into the nearshore. The continuing finds at TVOR SE of large mammal bones and fragments such as the rhino scaphoid (Figure 15), and gomphothere molar piece (Figure 16), suggest components from the bedload of a through going river.

The presence of Cretaceous fossils at TVOR SE and their absence so far from other heavily screened Fort Polk Miocene sites, may be evidence that a river with a relatively large watershed contributed material to TVOR SE. Reworking of soils to concentrate nodules and animal remains at sites such as DISC involved streams with more local drainage. Specimens from large mammals such as rhino and gomphothere at TVOR SE may have undergone considerable transport.

Sites like DISC yield small vertebrate remains to screening of soil nodule concentrates and some bones which have not been transported far, if at all, from the site of the animal's death, such as the *Prosynthetoceras francisi* mandible from DISC, which is one of the fossils key to assigning it to the Cold Spring Local Fauna, and the tibia, astragalus, and calcaneum collected on 7/29/03 at DISC. These bones are from a medium to large artiodactyl, and may be from the same individual. They were not articulated, but were associated.

Reworked Fossils

The presence of reworked Cretaceous fossils is also indicative of the contribution to TVOR SE of a through going river. A formaniferan, ?*Wheelerella* was reported from TVOR SE in Schiebout *et al.* (2002). Barun Sen Gupta (pers. comm.) considered it to be probably from the Cretaceous, and perhaps originally from as far away as the Appalachians. The only shark reported from Fort Polk is LSUMG 11841 a single tooth lacking its base from Stonehenge (Schiebout and Ting, 2001). According to Robert Purdy (USNM, pers. com.), it could have come from an animal similar to the sand tiger shark and could be Miocene. Schiebout and Ting (2001) considered the possibility that it is reworked, possibly from Eocene rocks exposed further north. Eocene marine specimens are mixed with the older (Miocene, Arikarean) Toledo Bend mammalian fauna of east Texas (Albright, 1992; Manning 1990). When originally considered, it was the only possibly reworked fossil in the Fort Polk Miocene. Stonehenge is considered roughly stratigraphically similar to TVOR SE (Figure 19), so the presence of reworked material at TVOR SE strengthens the possibility that the shark is reworked.

Louisiana's first dinosaur fossil

Class REPTILIA

Order Saurischia

dromaeosaur (a small theropod)

Figure 27, 28

Referred specimen LSUMG 12229
Locality TVOR SE
Description A small, sharp theropod tooth
Discussion The oval cross section and chisel-shaped denticles on the posterior carina are consistent with its having come from a small dromaeosaur (Currie *et al.*, 1990; Baszio, 1997; Brinkman, 2002). Figure 29 shows a Late Cretaceous shoreline for North America, and Figure 30 shows three versions of Late Cretaceous coastlines derived from the same data, indicating considerable variation in interpretations, but all showing land masses north of the area which was to become Louisiana. The small dinosaur was not a marine animal, so it lived and died on a Cretaceous land mass, most likely to the north. The animal or the tooth alone could have been carried by a river and initially deposited, to be later reworked, perhaps more than once, before becoming bed load in a Miocene river in what was to become Louisiana.

VIII. CONCLUSIONS

Animals numbers in some groups from the Fort Polk Miocene are now large enough to allow detailed size and morphology studies such as one on *Copemys*, which indicates that the *Copemys* from Stonehenge are best considered to be one species, possibly one new to science, and that the small sample of *Copemys* from TVOR SE falls within its ranges. Work to follow can include a look at how such animals are changing though time in response to environmental differences.

Questions remain that have not been clarified by continuing work, most notably the disparity of ages produced by vertebrate paleontology and magnetostratigraphy on one hand (older) and paleopalynology and study of foraminifera (younger) on the other. Processing of additional paleomagnetic samples has not resolved the difference.

TVOR SE, the first Fort Polk Miocene site to yield an in-place marine fauna, continues to yield surprises. The reworked Cretaceous foraminiferan has been joined by Louisiana's first dinosaur fossil, a reworked small theropod tooth, probably also Cretaceous. The site has continued to yield Miocene mammals. Older sites also remain productive. DISC has yielded remains such as those of rhinoceri. New fossils from TVOR SE do not give evidence of an age earlier than the Cold Spring Local Fauna of Texas.

Recovery of gomphothere and large rhino fragmentary fossils from TVOR SE strengthens the idea that a large river capable of moving large mammal bones and fragments as bed load was nearby. TVOR SE yields a fauna less localized in age and environment than other Fort Polk Miocene sites because of reworking both in the local Miocene deposits and from a range of rocks contributing to the river's bedload, including Cretaceous rocks to the north.

IX. RECOMMENDATIONS

Sites

Work at all currently known productive sites should continue. This report represents an intermediate stage in ongoing work which is continuing to yield results for publication in the scientific literature.

As noted in Schiebout and Ting (2001) and Schiebout *et al.* 2002 , the possibility of new sites

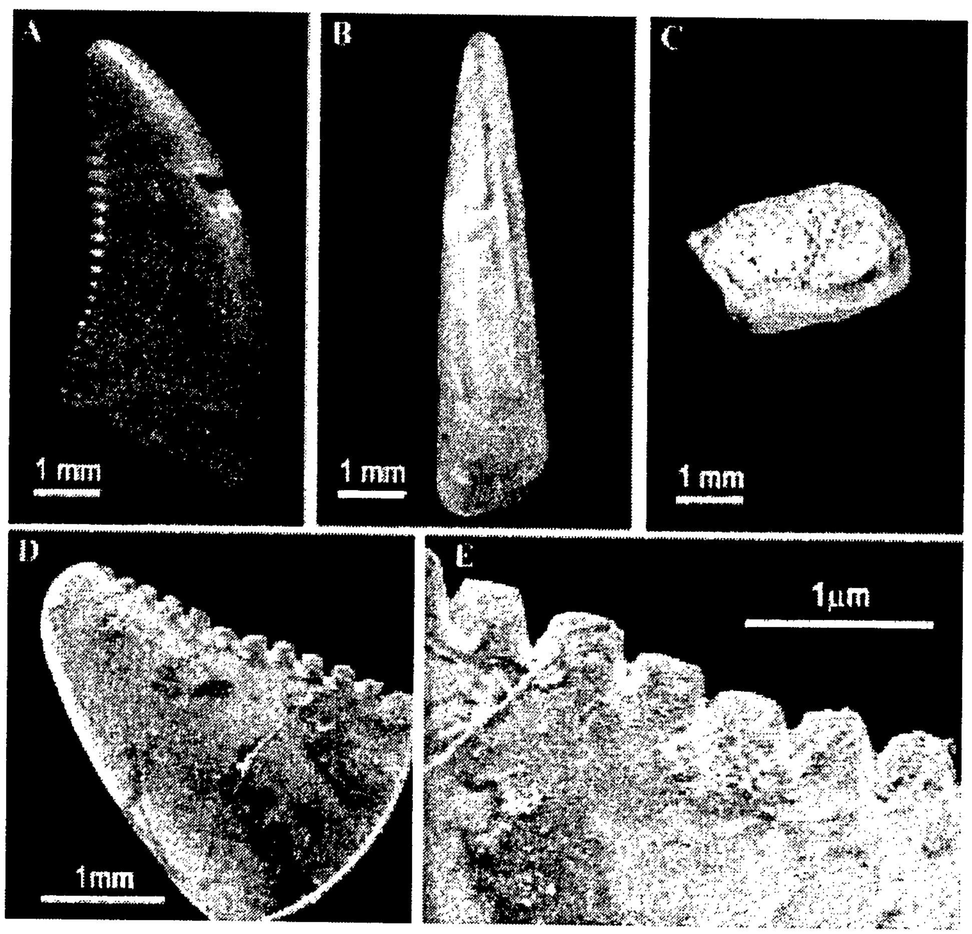


Figure 27. Photomicrographs of LSUMG 12229, small dromaeosaurid dinosaur tooth, A. Lateral, B. Anterior, C. Basal. Scanning electron micrographs, D. Lateral, E. Lateral close-up.

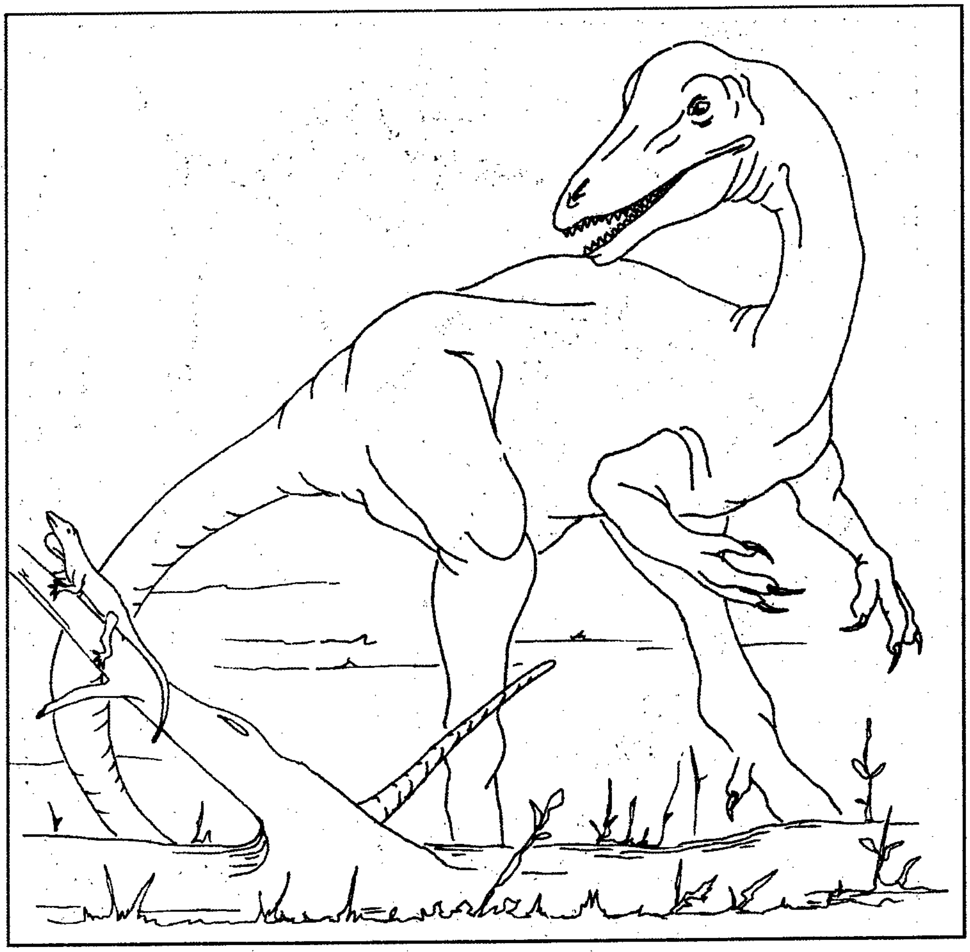


Figure 28. Drawing of a small Late Cretaceous dromaeosaurid dinosaur probably similar to the animal that yielded LSUMG 12229. Modified by Mary Lee Eggart from a sketch by Brandon Kilbourne.

is good wherever the top 20 m of the Castor Creek Member is exposed, either by erosion or human activities. The nodule-bearing layers that have been productive at sites such as DISC, Stonehenge, and TVOR should be investigated wherever found, but the amount and taxonomic range of specimens from TVOR SE from mudstone, indicates that locally productive spots can be found where no soil nodule concentrates are present.

Additional comparison of Fort Polk Miocene fossils with specimens at other museums such as the Florida State Museum in Gainesville and the Nebraska State Museum in Lincoln should take place. Research on vertebrates which are less thoroughly reported in the Miocene literature, like the lower vertebrates such as frogs and lizards, is now becoming a focus of effort. We want to keep increasing animals available for study, both in numbers per taxa and taxa, but focus has shifted to some of the difficult to identify, like the lower vertebrates and to analyzing populations rather than simply recording occurrence of a taxon.

TVOR SE

Both surface search, quarrying, and screening should continue. The clay which overlies and smothered the original oyster bed, offers an enviroment of much less sporadic depositon than the younger sites where most specimens are recovered by screening of concentrates produced from erosion of soils. More complete bones and more complete animals are a possibility. As TVOR SE information develops, it can be contrasted with the very different suite

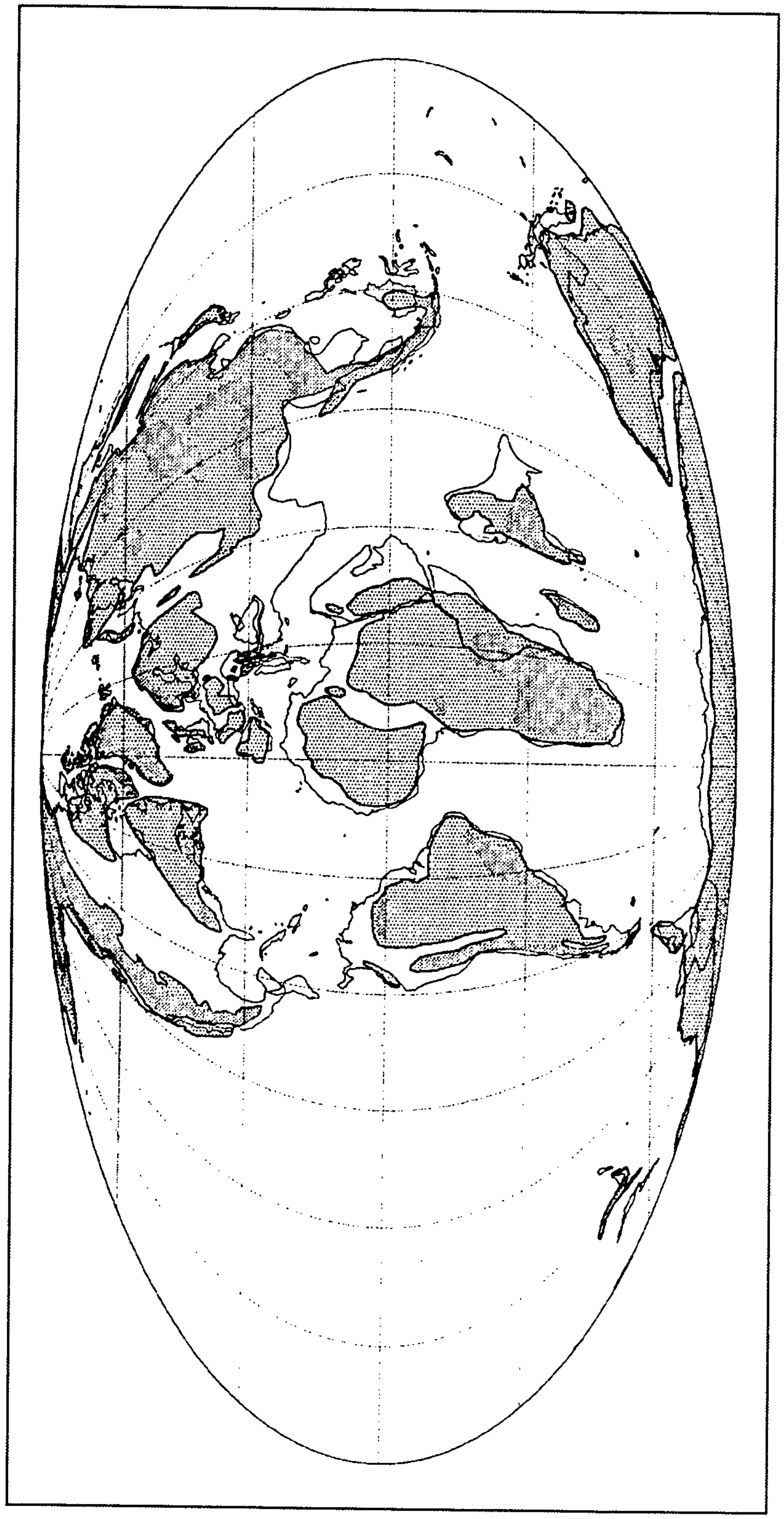


Figure 29. Late Cretaceous (Maastrichtian, 70 million years ago) paleocoastline modified from (Smith et al., 1994).

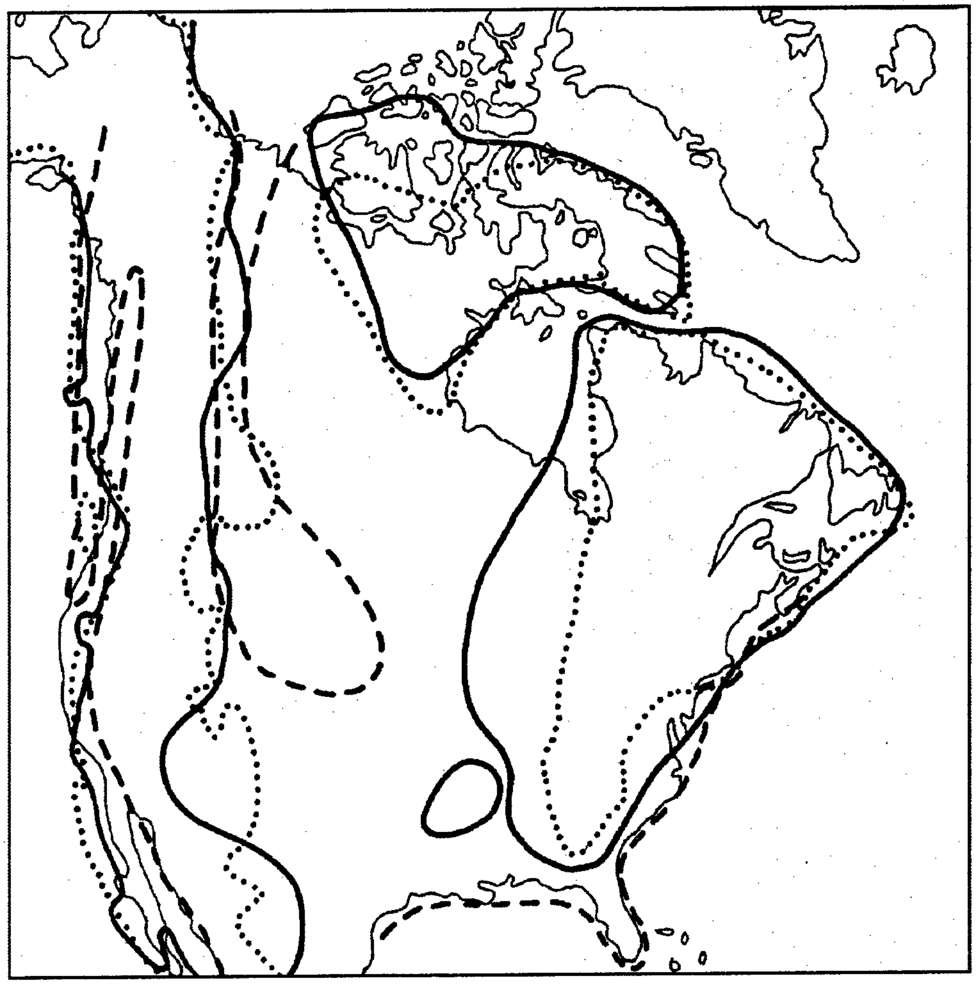


Figure 30. Three late Cretaceous coastlines, produced from similar data, modified from (Smith et al., 1994). The solid line is the one in Figure 21, the dotted line is from E. C. Kauffman and D.A. Beeson (unpublished) and the dashed line is from Funnell (1990).

of sites like TVOR and DISC. Continued screening of mudstone from the north wall of the TVOR SE site where the dinosaur was recovered might yield more Cretaceous material which might make it possible to pinpoint the region of outcrops from which it was eroded, a more exact age, and perhaps a closer identification.

TVOR S

It should be examined by surface prospecting and the strongly cemented rock which appears similar to the oyster sandstone at TVOR SE should undergo more quarrying, dissolution, and screening.

TVOR Site Cluster

As noted in Schiebout and Ting (2001), original TVOR and exposures north and northwest of the well site should be periodically examined for additional conglomerate. Extensive bulldozing and churning of the surface has taken place, and future rains may clean off conglomerate now concealed by mud.

DISC Site Cluster

Stonehenge Rock, previously excavated and stored on Post, has been moved to our lab and is undergoing dissolution, with only one truckload remaining at DISC landfarm. Stonehenge remains one of our most productive sites. It is the site processed by screening from which the most complete specimens of tiny animals are recovered. Continued processing of the Stonehenge rock and study of resulting fossils is recommended.

Gully Periodic examination for exposure of new promising conglomerate should be done.

DISC Surface search of any areas still open should continue. The associated artiodactyl bones recently recovered from DISC indicates that there is even a possibility of additional associated remains from a single animal.

OUTREACH

A main focus of outreach efforts should remain the Fort Polk Environmental Learning Center. The recently revised nontechnical booklet for youngsters (Schiebout *et al.* 2003), the posters prepared for professional meetings which are then brought to the center, and the hands-on fossil dig, which uses casts and picked screening residue from the project to simulate fossil hunting, are available there. Videoclips have been prepared for use at the Center. LSU undergraduate and graduate classes have been brought on field trips to the Fort Polk Miocene, and portions of the research have been carried

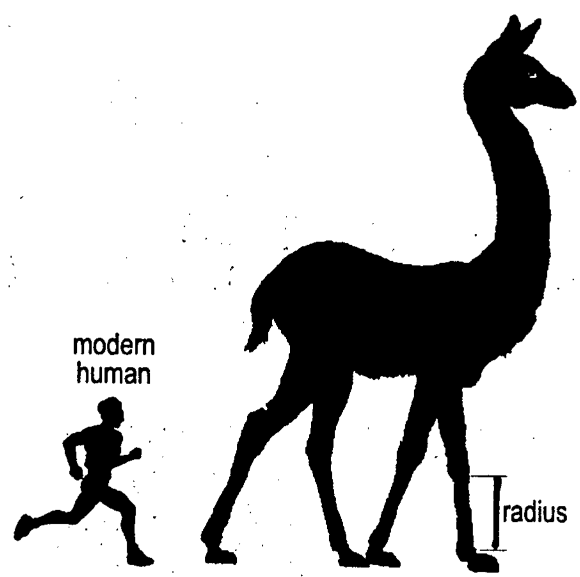
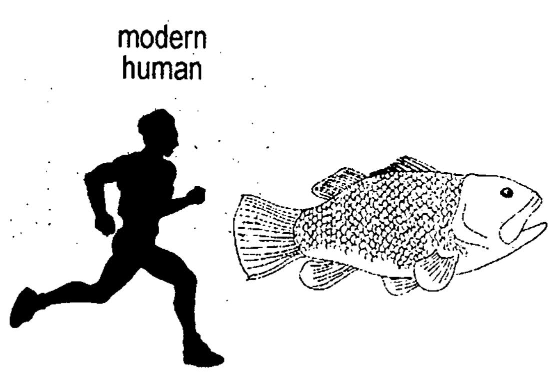


Figure 31. Sketch of a giant camel (?*Aepycamelus*) with the location of specimen LSUMG 12235 (radius) from TVOR SE shown.

Figure 32. Sketch of giant sea bass in relation to a modern human.



out by graduate and undergraduate students as part of their training, and this should continue.

Other outreach approaches could include:

Cast replicas of a variety of fossils

These could be used in presentations for visitors and could be handled and passed around without danger to originals. Some fossils could be replicated at original size, the male and female tortoises, the *Prosynthetoceras* mandible, jaws of an equine and hipparionine horse, and a modern and ancient giant sea bass dorsal spine. In many of the fossils, the originals are too small to be handled and examined by visitors, but Dr. Timothy Rowe of the University of Texas at Austin has the capacity to scan and make accurate enlarged replicas of tiny fossils (Digital Morphology program http://www.digimorph.org/index.phtml). Possible candidates for this procedure could be: the dinosaur, a *Copemys* molar, the tiny new species of beaver, a hedgehog tooth, and a shrew jaw.

Illustrations for display

Murals and sketches are a possibility, both for use at the center and for posters and coloring pages. Sketches such as that of the giant camel from the nontechnical booklet (Figure 31) that show the size and location of fossil remains recovered from the Fort Polk Miocene, in this case the animal's radius, can be made. Another example is the sketch of a giant sea bass that shows size in relation to that of a modern human (Figure 32). It is also from the non technical booklet.

Videos and CD's

Videos on the fossils and the animals they represent have been prepared, but videotaping of work in the field has not been done. The vodeos made so far are strings of videoclips, not a stand-alone video production.

A Miocene gomphothere

This elephant relative is one of the most spectacular animals from the Fort Polk Miocene. This animal now occurs at lower as well as stratigraphically higher sites. The Sam Noble Oklahoma Museum of Natural History displays a California Miocene gomphothere cast replica, and has some duplicate material, and Berkeley staff are investigating if the mold from which it was made may still be useable, allowing reproduction of selected parts. A replica tusk would make a good touchable display.

The LSU Museum of Natural Science is now the main component of the Louisiana State Museum of Natural History, and it is hoped that increased outreach on museum research will become possible in the future. Information on the Fort Polk Miocene research is already on the Museum webpage. As the Fort Polk Miocene fauna grows, spectacular animals like the giant camel and rhino are added, and the ecological picture comes into sharper focus, to be fit into earth history on the global scale. The opportunities to interest and educate the public can be expected to expand in the future.

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APPENDICES

APPENDIX A

Abbreviations

AP—Anteroposterior

AMNH—American Museum of Natural History

D-V—dorso-ventrally

DISC—Discovery, as in DISC Site or cluster of sites.

FP—Fort Polk

FPM—Fort Polk Miocene

L—Length

LSUMG—Louisiana State University Museum of Natural Science, Division of Geoscience. Fort Polk Miocene fossils are mainly in the vertebrate paleontology collections, with a small number with invertebrate paleontology.

LSUMZ—Louisiana State University Museum of Natural Science, Division of Zoology

TMM—Texas Memorial Museum, University of Texas at Austin

TRANS or T—Transverse

TVOR—TVOR site, near the terminal very-high frequency omni range radar tower, and other sites occurring in its cluster

USNM—US National Museum

UT—University of Texas at Austin

W—Wide

APPENDIX B

CURATION LIST

Through 07/31/2003

Vertebrate Fossils (4, 628)

540 added in period of this report

Fish	
Chondrichthyes	9
Osteichthyes	80
Reptiles	131
Amphibians	4
Mammals	528
Lagomorphs	7
Carnivorans	75
Insectivores	241
Cetaceans	5
Artiodactyls	27
Perissodactyls	35
Proboscidea	2
Rodents	3,986

Invertebrate fossils (4)

Records

- Field notebook
- Topographic maps
- Laboratory notes
- Acid lab notes
- Computer curation files
- Computer files of all SEM pictures

Specimens are curated to the LSU Museum of Natural Science and records are kept at the Museum, with the exception of palynological slides which are kept in collections of the LSU Department of Geology and Geophysics' Center for Excellence in Palynology. Vertebrate fossils are curated to the MNS Vertebrate Paleontological Collections and invertebrate animal fossils are curated to the Collection of Fossil Protists and Invertebrates. Copies of all published papers are on file at the LSU Museum of Natural Science. Computer data, including curational information, reports, SEM photographs and black and white photographs, is on the computer and backed up on Syquest cartridges or CD's at the Museum.

This research is part of an ongoing project, and some materials from screening and surface search are not identified or curated. If further research and more recent finds allow their identification, they will be numbered and curated to the Museum of Natural Science, and if not, they will be preserved in curated lots in the Museum for further research.

APPENDIX C

New Paleomagnetic Samples,

Core 1

Depth	Inclination
190	39
230	-20
260	44.5
278	-1
296	44.5
318	-55
329	-46.6
372	49.7
384	-3.8
568	53.1
749	46.6
753	49.3
920	44.4
925	52.3
1065	-38.9
1070	-49.4
1141	-0.6
1145	6.2
1148	4.4
1306	76.1
1442	69
1446	11.7
1510	-48.6
1514	-51.2

APPENDIX D

Stonehenge Site *Copemys*

Measurement Data (mm)

LSUMG	Length (AP)	Width (LL)	Features
3870	1.56	0.98	1,4
3563	1.5	0.98	2,3
4910	1.3	0.91	5
11360	1.6	0.95	2,4
4129	1.59	0.99	2,4
10347	1.7	1	2,3
9209	1.6	1	2,4
3819	1.5	1	5
3912	1.32	1.04	5
9206	1.54	0.95	2,3
V12358	1.64	1.07	2,4
9719	1.4	1	2,3
V12359	1.38	0.9	5
9939	1.91	1.22	2,3
11238	1.49	0.92	2,4
11359	1.48	0.94	2,4
11606	1.43	0.92	2,3
9199	1.63	0.93	2,3
4886	1.4	0.9	1,4
11605	1.5	0.95	2,3
9718	1.44	0.94	2,4
V12410	1.5	0.95	5
4895	1.74	1.2	2,3
10348	1.44	0.78	1,3
10166	1.61	1	2,4
4420	1.4	1	2,4
3783	1.3	0.95	2,4
11713	1.73	1.13	5
4073	1.7	0.92	2,3
11751	1.6	1.13	5
11140	1.9	1.2	2,4
11603	1.7	0.9	2,3
10639	1.52	0.87	5
11609	1.6	1.12	5
4889	1.7	1.1	2,3
11141	1.46	0.9	1,4
10169	1.5	1	5
11361	1.8	1	5

10168	1.7	1.05	4
11142	1.5	1.1	4
9721	1.5	1.1	4
3125	1.72	1.1	4
3862	1.48	1.12	4
11604	1.95	1.2	3
10170	1.6	1	5
11006	1.45	0.75	5
3782	1.45	1.14	4
11738	1.42	1	5
10632	1.42	1	3
10938	1.6	1	4
9204	1.5	1	4
11254	2.2	1.3	3
11358	1.55	0.95	4
4890	1.42	0.82	4
10346	1.6	1	3
9993	1.5	1	3
3791	1.6	0.92	4
4896	1.74	1.1	3
10631	1.96	1.35	4
9208	1.52	1.15	5
11608	1.59	1.1	4
V12412	1.79	1.22	4
9201	1.62	0.94	4
10167	1.84	1.25	4
4125	1.25	0.9	4
11610	1.48	1.12	3
11139	1.32	0.9	4
9942	1.42	0.89	3
11850	1.5	1.1	5
9200	1.58	0.93	4
10421	1.56	0.94	4
3330	1.5	0.92	3
4892	1.38	1	3
3367	1.82	0.98	3
11607	1.62	0.96	4
4412	1.52	0.9	3
4885	1.49	1	3
4419	1.32	0.9	3
V12411	1.35	0.92	5
9207	1.53	0.95	4
10165	1.52	0.9	4
9202	1.48	0.92	4

11849	1.45	1.1	5
9205	1.5	1	4
11096	1.35	1	5
4887	1.62	0.85	5
4110	1.55	0.94	4
4893	1.4	0.93	3
4888	1.4	0.83	4
11714	1.6	1.1	5
4894	1.6	1	4
10887	1.72	0.87	3
3795	1.53	1.04	3
9720	1.7	0.75	5
V12356	1.4	0.9	5
V12357	1.48	1	5
11752	1.64	1.15	4
9203	1.6	1	5
11716	1.45	0.7	5
3793	1.45	0.7	4
9717	1.5	1.1	4
11524	1.5	0.92	4
11715	1.56	0.98	5

APPENDIX E

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Submitted

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APPENDIX F

Sample Videotape Shooting Script-"Louisiana's First Dinosaur". Script is presented in original spacing to maintain relationships of segments.

AUDIO	VIDEO
Videoclip- Louisiana's First Fossil Dinosaur	
People who want to hunt for fossils in Louisiana can find fossils older than the dinosaurs in river gravels	Presenter holding rocks
These rocks were eroded from older rocks further north and carried to Louisiana by rivers.	Presenter puts rock under the Elmo
These fossils are remains of ancient sea life, a trilobite and a clam. The fossil shows a trilobite's tail. This replica of a trilobite shows a similar tail.	Cut to Elmo
The animals are from the middle of the Paleozoic, as shown in this chart from Norman (1991). They did not live or die where they were found today.	Powerpoint 1-chart
People often ask me about Louisiana dinosaur fossils, and I have told them for over twenty five years, that finding any dinosaur fossils in Louisiana is unlikely—we just don't have rocks of the correct age. Louisiana is built out into the Gulf by river and coastal deposits, so rock from the time of the dinosaurs is deeply buried under our state. Dinosaur-bearing rocks are exposed in areas where erosion is taking place further north so there always has been a tiny chance of some material being carried along with the sand and gravel in river bottoms, and deposited in younger rocks.	Presenter Powerpoint of screening Powerpoint of tooth
Screening for tiny fossils from the middle of the Age of Mammals	Presenter
Work onn Fort Polk has yielded over four thousand tiny fossils, including one from the Age of Dinosaurs, this tiny tooth.	Elmo—see dino tooth actual size
Although this dinosaur was found in western LA, the animal did not live or die here. It did not hunt the animals from the Age of Mammals whose bones are recovered from Fort Polk, any more than the trilobites in river gravels live in modern waters. The dinosaur tooth is "reworked", eroded from older rocks.	Powerpoint of scanning electron micrograph
The tooth is very small, Teeth are the toughest, most resis-	Powerpoint –3 dino teeth

AUDIO	VIDEO
tant part of a vertebrate's skeleton. This tiny tooth may have traveled with sands carried by rivers for hundreds of miles from the location of the rock deposited in the Age of the Dinosaurs, in which it was originally buried.	
We can tell from what kind of dinosaur the tooth came. It is the tooth of a small meat-eater. It is sharply pointed and has serrations like a steak knife.	Powerpoint *Dilophodon* fight over lizard
A closer look with a scanning electron microscope reveals chisel-shaped serrations. This serration shape and some other features indicate this is a tooth from a dromaeosaurid, a type of theropod. Theropods include *Tyrannosaurus rex* and many smaller meat eaters.	Powerpoint of time scale Presenter
We can not tell exactly what type of small dromaeosaur used this tooth. Here are three dromeosaurs from Dixon *et al.*, 1988.	Powerpoint Schiebout and Ting hunt in field.
Another example of a small dromaeosaur is the animal *Dilophodon,* which was featured in the first Jurassic Park movie. It was represented as having a neck frill and being able to spit poison. We don't really know that it had a frill or was poisonous. This reconstruction shows two dilophodon fighting over a small lizard they have caught.	
Our dinosaur probably hunted small prey in the Cretaceous, the last of the periods of the Age of Dinosaurs. It may have lived at the same time as *T. rex,* or may have lived earlier. There is a very small chance of finding more tiny dinosaur fossils in the study of Fort Polk fossils, but such fossils represent a very rare set of circumstances, and the chance of finding a skull or skeleton is effectively zero.	