THE MAMMALIAN FAUNA OF THE LYSITE MEMBER, WIND RIVER FORMATION, (EARLY EOCENE) OF WYOMING

DANIEL A. GUTHRIE

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VOLUME 5

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Printed by Anderson, Ritchie & Simon, Los Angeles, California

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THE MAMMALIAN FAUNA OF THE LYSITE MEMBER, WIND RIVER FORMATION, (EARLY EOCENE) OF WYOMING

DANIEL A. GUTHRIE[1]

ABSTRACT: The difficulty in recognizing faunas of Lysitean age has led to a review of the major collections of vertebrate remains from the Lysite Member of the Wind River Formation (early Eocene) and to a renewal of collecting in the type area of these deposits near Lysite, Wyoming. These deposits are considered to represent only the upper fourth of Lysitean time. About seventy species of vertebrates have been recovered from these deposits, sixty-one of which are mammals. Four new species are described. These are *Palaeanodon woodi*, an edentate; *Franimys lysitensis*, a rodent; *Prolimnocyon iudei*, a creodont; and *Miacis jepseni*, a carnivore. Twenty-three species are recorded in the Lysite for the first time and taxonomic changes are made in several early Eocene mammalian lineages.

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INTRODUCTION

"Current information discloses that the Lysite assemblage is the least distinctive Wasatchian fauna; its presence is determined in large part by negative evidence, the absence of *Homogalax* and *Lambdotherium*. Correlation of any strata with the Lysite beds must be made cautiously for certain presence of a Lysite equivalent is very difficult to establish" (Van Houten, 1945: 428).

The Lysite fauna, like so many other fossil assemblages, has never been thoroughly studied and, as the opening quotation indicates, is in need of definition and revision. Since one of the three standard chronologic divisions of the early Eocene continental deposits in North America is based on the Lysite deposits and since the Lysite fauna is one of the standard vertebrate faunas used in correlation, its accurate definition is of importance to both paleontology and stratigraphy. It was for these reasons that the current study was undertaken. Although several of the species that occur in the Lysite fauna have been treated in the last decade in generic and familial revisions, problems often arose in these studies with Lysite species because of the scarcity of Lysite material. It was thought that further collecting might produce the specimens necessary to solve these problems as well as provide samples large enough so that studies of the intraspecific variation, ecological relationships, and evolutionary rates of members of the fauna might be undertaken. Also, publication of accurate measurements of members of the Lysite fauna should facilitate future comparison of this fauna with other early Eocene faunas. Finally, it was hoped that the application of the biological concept of species to the Lysite fauna might clear up many of the taxonomic problems met with in the study and correlation of early Eocene faunas.

HISTORY OF INVESTIGATION

The Lysite deposits in the Wind River Basin were first discovered by Dr. Frederick B. Loomis of Amherst College in 1904, and subsequent expeditions from the American Museum of Natural History visited these deposits in the summers of 1905 and 1909. The next major collecting effort in the Lysite took place during the summers of 1928 and 1931 under the auspices of Princeton University. Several parties from Amherst College have visited the Lysite deposits in recent years. Groups under the direction of Dr. Albert E. Wood made collections in the Lysite during the summers of 1948, 1957, and 1960, and a collection was made by Dr. Dana R. Kelley for Amherst in 1951. The author has made collections for Amherst College during the summers of 1961, 1962, and 1963. The expeditions listed here have resulted in the collection of about 4000 fragments of mammalian dentitions representing at least 1300 individuals.

Loomis published only on the hyopsodonts (1905), primates (1906), rodents (1907) and a lizard (1919) in his collections. The American Museum material was included in Matthew and Granger's revisions of the Wasatch and Wind River faunas (Matthew, 1915a,b,c, 1918; Granger, 1915) and in several taxonomic studies that appeared at this time, notably Sinclair's review (1914) of the early Eocene artiodactyls, Matthew's review (1910) of the Ischyromyidae, and Granger's review (1908) of the early Eocene horses. The Amherst College material collected prior to 1954 has been reviewed by Kelley and Wood (1954). The present paper reviews all the Lysite material in the collections of Amherst College, Princeton University and the American Museum of Natural History and is the first study of the Princeton material and of the material collected for Amherst since 1954.

ACKNOWLEDGMENTS

I wish to thank Dr. Glenn L. Jepsen of Princeton University, Dr. Malcolm McKenna of the American Museum of Natural History, and Dr. Elwyn L. Simons of Yale University for making the collections at these institutions available to me for study. Dr. Leonard Radinsky and Dr. Giles MacIntyre have also given me much valuable advice and information, and Dr. Malcolm McKenna and Dr. Leigh Van Valen of the American Museum have read the manuscript of this paper critically and have offered many helpful suggestions for its improvement. Dr. Harry F. Tourtelot of the U.S. Geological Survey has provided me with geological information on the Wind River Basin, Dr. Richard Estes and Dr. Donald Baird have kindly aided me in the identification of reptilian and amphibian remains, and Dr. Pierce Brodkorb has identified the Lysite avian material. Finally, I wish to thank Dr. Albert E. Wood of Amherst College under whose direction this project was undertaken. He has provided invaluable advice and direction to this undertaking and has read the manuscript and offered many valuable suggestions as to its improvement. His unlimited assistance to me in my work has made its completion possible. The field work done by the author during the summers of 1961, 1962, and 1963 was financed, in part, by funds from a National Science Foundation grant (G-15918) to Dr. Wood.

METHODOLOGY

All measurements were made with Helios dial calipers, the dial scaled to 0.1 mm. Each measurement was made three times and the average value of the three used. Most of the specimens were measured under magnification. Drawings were made with the aid of a gridded eyepiece fitted to a binocular dissecting microscope and all are illuminated from the upper left corner. In illustrations where only the teeth are shown, lower teeth are always positioned with the external side at the top of the page. In drawings of upper teeth, the anterior end of the teeth is in the same direction as the side of the maxilla illustrated (an illustration of a right upper molar would have its anterior side to the right).

ABBREVIATIONS

AC	Amherst College, Amherst, Massachusetts
AMNH	American Museum of Natural History, New York, New York
FMNH	Field Museum of Natural History (formerly Chicago Natural History Museum), Chicago, Illinois
MCZ	Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts
PU	Princeton University Geological Museum, Princeton, New Jersey
ROM	Royal Ontario Museum, Toronto, Ontario, Canada
USNM	United States National Museum, Washington, D.C.
U W	University of Wyoming, Laramie, Wyoming
YPM	Yale Peabody Museum, New Haven, Connecticut
a	approximate measurement
L	length: maximum anteroposterior diameter on major axis of tooth
M	mean measurement
mm	millimeters (All measurements are given in millimeters.)
N	number of specimens included in sample
OR	observed range
s	standard deviation
Tal	width of talonid (maximum)
Tri	width of trigonid (maximum)
V	coefficient of variation
W	width: maximum diameter at right angle to major axis of tooth

GEOLOGY

The type area of the Lysite and Lost Cabin deposits is just north of the towns of Lysite and Lost Cabin in Fremont County, Wyoming. These deposits have been thoroughly mapped by Tourtelot (1946, 1953), and the geology of this area has recently been reviewed by Keefer (1965). Granger (1910) divided the Wind River Formation into two faunal zones which he described and which were subsequently named the Lysite and Lost Cabin faunal zones by Sinclair and Granger (1911). The Lost Cabin zone was characterized primarily by the presence of abundant remains of *Lambdotherium.* The Lysite zone was characterized by the absence of *Lambdotherium,* a species characteristic of the younger Lost Cabin beds, and by the absence of *Systemnodon (=Homogalax),* a species characteristic of the older Gray Bull beds.

Granger (1910) published a stratigraphic column for the Lysite deposits and a photograph of the deposits, presumably showing the area on which the stratigraphic column is based. The photograph was taken from the top of the escarpment along the eastern side of Cottonwood Creek (Fig. 1) and shows part of the face of the escarpment. It is believed that this photograph was taken at Lysite locality 5 as the strata at this location match both those in the photograph and those in Granger's stratigraphic column. This escarpment and the area surrounding it is the type locality for the Lysite fauna.

The type locality for the Lysite fauna differs from the type locality of the Lost Cabin in lithology, as well as faunally. Tourtelot (1946) designated these differing lithologies as the Lysite and Lost Cabin Members of the Wind River Formation and distinguished them as follows:

Lysite Member

1) Conglomerates consist chiefly of debris from post-Cambrian Paleozoic rocks.
2) Shales are brick red and orange red.
3) Variegated beds grade laterally into fine-grained gray beds.
4) Sandstones contain only a little white mica and are white.

Lost Cabin Member

1) Conglomerates consist chiefly of debris from Precambrian and Cambrian rocks.
2) Shales are violet and purple in color.

3) Variegated beds grade laterally into green beds.
4) Sandstones contain abundant black mica and are dark in color.

The Lysite lithology can be readily distinguished in the field from that of the Lost Cabin by color, the Lysite appearing brick red and white, the Lost Cabin purple and gray. These lithologic zones have been accurately mapped by Tourtelot (1953). The area in which sediments of Lysite lithology outcrop in the type area is very limited. They occur in an area about five miles long and one mile wide, bordered on the north by the Cedar Ridge Fault which separates the Lysite deposits from deposits that are late Eocene in age. On the other three sides the Lysite deposits are bordered by beds of Lost Cabin lithology. Faulting within the Lysite outcrop is confined to the margin of the Cedar Ridge Fault and is parallel to that fault. The effect of this faulting has not been accurately determined as the Lysite sediments near the fault are not very fossiliferous and as the relief is low. Quaternary gravels cover most of the Lysite deposits but good exposures occur in several spots which are indicated by dashed lines in figure one. The base of the Lysite lithology is not seen in this area. The oldest deposits are found along the base of the escarpment along the east side of Cottonwood Creek.

The Lysite deposits grade without noticeable hiatus into overlying beds of Lost Cabin lithology. A zone of nearly 100 feet thick that is transitional in color between the Lysite and Lost Cabin exists between the two lithologies and a section of strata nearly 250 feet thick exists between the highest Lysite beds and the lowest Lost Cabin beds from which sizeable mammalian faunas have been obtained. The faunal and lithologic boundaries between the Lysite and the Lost Cabin do not coincide. A fragment of a tooth of *Lambdotherium,* a genus whose presence is usually considered as indicative of Lost Cabin age, has been recovered from the upper part of the beds of Lysite lithology (Fig. 1).

Sediments similar in lithology to those of the Lysite Member occur at other localities in the Wind River Basin. The deposits of this type in the area of Boysen Reservoir are of middle and late Eocene age according to Tourtelot and Thompson (1948) and the deposits of this type in the vicinity

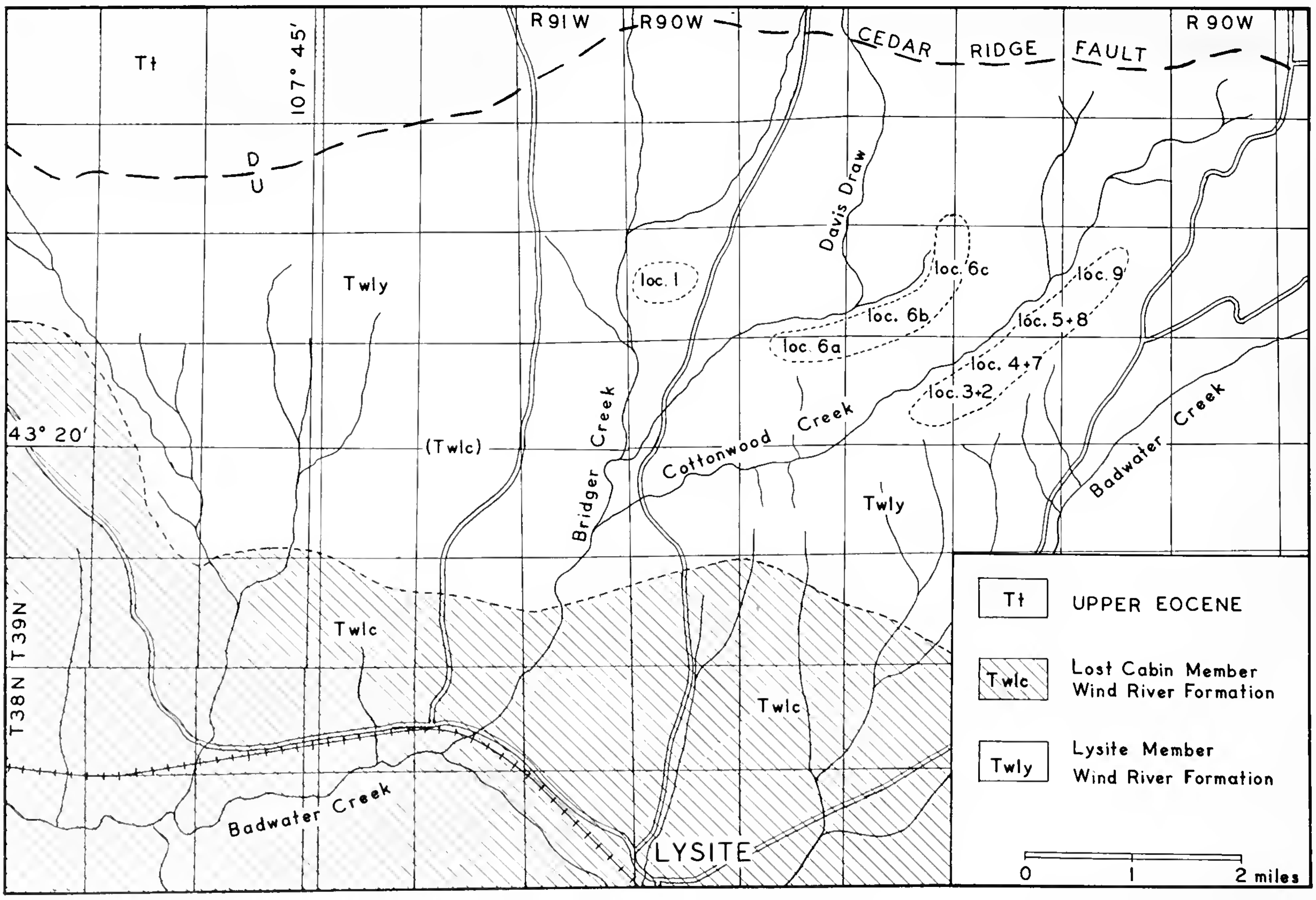

Figure 1. Geologic map of the Lysite area, Fremont County, Wyoming. Base from Tourtelot (1953).

of Dubois, Wyoming contain faunas similar to those found in the type Gray Bull, Lysite, and Lost Cabin deposits according to Love (1939). The small outcrops that occur to the west of the type area and that were mapped as Lysite in lithology by Tourtelot (1953) are on top of deposits of Lost Cabin lithology and are not Lysite in age. The Lysite plant locality, reported by Berry (1932) is in one of these small outcrops and is equivalent to the Lost Cabin or Bridger deposits in age, not to the Lysite as originally reported.

The Lysite shales, although brick red on the surface, are often green to purple below the surface. Several of the explanations of the origin of the color of these deposits involve the development of the color at the time of deposition but the color may be due instead to the rather recent oxidation of iron compounds in these deposits by surface weathering. A complete discussion of the theories concerning the red coloration in early Eocene sediments was presented by Van Houten (1948).

Although the Lysite deposits are conspicuously banded, none of these bands has great lateral extent. Plant material is entirely lacking in the deposit; no fragments of wood have been found and the shales are not of the sort in which leaf impressions could be preserved. Invertebrates are also exceedingly rare and only a few terrestrial snails have been recovered.

Occurrence of Material

Vertebrate remains are present throughout the type Lysite deposits, the remains of mammals occurring more commonly in red shale layers and the remains of crocodiles and aquatic turtles more commonly in gray layers. Mammals are usually absent in the white sandstone lenses but aquatic turtles and crocodilian remains in these lenses are common, supporting the identification of these sediments as channel sandstones. The bone in the Lysite deposits is fragmented and the discovery of articulated material is exceedingly rare. Some of the bone fragments have been gnawed by rodents and others show evidence of weathering. Much of the breakage of the material occurred prior to deposition. The bone is generally well mineralized and of a yellowish color. Ironstone concretions such as are found on bone from Gray Bull deposits in the Big Horn Basin are rarely found on Lysite bone. The bone is, however, often covered with nodules of cemented sand and clay. Much of this cementation as well as the mineralization of the bone is probably a recent occurrence, not beginning until the bone is near the surface. The entrance of surface moisture into the porous bone and the subsequent evaporation of this moisture under the arid conditions of the area probably accounts for much of the mineralization of Lysite fossils and explains the observation that bone picked up from the surface of the Lysite deposits is usually harder than bone that is recovered by quarrying.

Almost all of the fossils from the Lysite deposits have been obtained by surface prospecting. Although washing of the red shales would be difficult, some rich pockets have been found where quarrying might be profitable. Further examination of these areas is planned.

Principal Localities

There are three areas near the town of Lysite where good outcrops of Lysite sediments occur. The localities in these areas that were found to be especially rich in material are indicated in Figure 1. The locality data associated with the specimens in the American Museum collections is poor, but Granger indicates in the Annual Report of the American Museum for 1905 that most of the American Museum collection was obtained from locality 6. Loomis's collection for Amherst College and the Princeton University collections were also obtained from locality 6.

Localities 3 and 5 are at the same stratigraphic level and are about 60 feet above the level of localities 2 and 4. These latter localities, in turn, are about 60 feet above the level of localities 7 and 8. Samples of *Hyracotherium* and *Hyopsodus* from these three levels have been large enough that they could be compared. In these studies (Tables 19, 25) localities 3 and 5 and their horizontal equivalents along the escarpment on the south-east side of Cottonwood Creek have been referred to as "Upper Cliff," localities 2 and 4 and their horizontal equivalents as "Middle Cliff," and localities 7 and 8 and their horizontal equivalents as "Basal Cliff." The relationship of localities one, 6, and 9 to the above localities could not be determined exactly by geologic methods due to the lack of intervening outcrops between these localities and the cliff localities. Faunal comparison and approximate geologic correlation indicates that localities 6 and 9 are at about the same level as the Middle Cliff localities and that locality 1 is somewhat higher than the Upper Cliff localities and just below the level from which the earliest *Lambdotherium* remains have been recovered.

Correlation

Dr. Simons of Yale University has directed several expeditions into the Buffalo Basin area of the Big Horn Basin in recent years and has obtained numerous mammal remains from deposits of Lysite age. Through the kindness of Dr. Simons I have been able to examine these collections and make use of the stratigraphic section of the area compiled by Dr. Radinsky of Brooklyn College and Grant Meyer of Yale while they were associated with the Yale expedition.

If the base of the Lysite is placed at the last appearance of *Homogalax* and the first appearance of *Heptodon* and the top of the Lysite is placed at the first appearance of *Lambdotherium,* as is usually done, then there are about 350 feet of deposits of Lysite age in Buffalo Basin where this section is completely exposed. This compares with approximately 200 feet of exposed deposits in the type area of the Lysite in the Wind River Basin. *Hyopsodus powellianus* is present in great abundance throughout the Wind River Lysite deposits but is not positively known to occur below the upper fourth of the Lysite deposits in Buffalo Basin (but see Fig. 27). Furthermore, a species by species comparison of the Lysite fauna from the Wind River Basin with the fauna from the upper fourth of the Lysite deposits in Buffalo Basin revealed no significant differences in size or morphology between the species in the two faunas. The only differences between the samples are in relative abundance of some of the less common species and in the absence of a few of the rarer species from one or the other of the two deposits. These differences can be explained by inadequate sampling of these deposits. It seems likely, therefore, that the two basins were not separated by any barriers to faunal dispersal and that if a species as common as *H. powellianus* was present in one basin it should have been present in the other. The Lysite deposits in the Wind River Basin are, therefore, considered to correspond to only the upper fourth of the Lysite deposits in Buffalo Basin and to represent only the upper fourth of Lysite time.

The southern Wyoming faunas of Knight Station and Fossil Buttes, reported by Gazin (1952, 1962), differ from the Wind River Lysite only in the presence of *Hexacodus* rather than *Diacodexis,* although the absence of this latter genus in southern Wyoming may be due to insufficient collecting. All other differences between these faunas and the Lysite can be attributed to differences in taxonomic viewpoint, to changes in taxonomy since the studies of the southern Wyoming faunas appeared in print, and to insufficient collecting. These faunas are definitely Lysitean in age but even though they contain *Hyopsodus powellianus* (*H. browni* of Gazin), they may be slightly older in age than the Wind River Lysite. The interpretation of the larger Four Mile species of *Hyopsodus* as a member of the lineage that includes *H. powellianus* (Fig. 27), if correct, means that this species existed in southern Wyoming long before it appeared in the Wind River Basin. That a barrier to the northward dispersion of *H. powellianus* may have existed is further evidenced by the failure of *Hexacodus* to enter the Wind River Basin. Correlation between these basins should not, however, be based solely on the presence or absence of a single species whose movements between them may have been affected by a physical or ecological barrier, but instead on a careful evaluation of the whole faunas involved. Unfortunately, such an accurate comparison of the Lysite fauna with the southern Wyoming faunas cannot be done at this time owing to the small size of the latter faunas and to the absence of published measurements on the specimens that have been recovered. Similarly, a more exact correlation of the New Mexican San José Formation with the Lysite will not be possible until these deposits are studied in greater detail.

The La Barge fauna, also reported on by Gazin (1952, 1962) is definitely Lostcabinian in age yet seems in many respects to be more like the Lysite fauna than is the fauna from the Lost Cabin deposits in the Wind River Basin. Several La Barge species, including *Cynodontomys knightensis, Prolimnocyon elisabethae,* and *Viverravus lutosus,* seem intermediate in size and morphology between samples from the Lysite and Lost Cabin deposits. A gap of nearly 250 feet exists between the horizons from which the Lysite and Lost Cabin faunas in the Wind River Basin were recovered, and most of this 250 feet is Lostcabinian in age as *Lambdotherium* has been found near the base of this interval. It may be that the La Barge fauna is from strata equivalent to this sparcely fossiliferous section of the Wind River sediments.

THE FAUNA

Faunal Lists

The remains of 61 species of mammals have been recognized in the material from the Lysite deposits of the Wind River Basin, and are listed below. The numbers for each species are based on American Museum, Princeton University and Amherst College collections and represent the minimum number of individuals necessary to account for the specimens recovered. These minimal numbers are based on teeth only and were calculated separately for each locality, and then these locality figures were combined. This measure of faunal composition is crude, based as it is on samples obtained by surface collection and on teeth alone. It is hoped that future work in the Lysite deposits will include quarrying operations from which a more accurate measure of faunal composition will be obtained.

Several lower vertebrates are also known from the Lysite deposits. A preliminary list of these, prepared with the kind assistance of Dr. Brodkorb of the University of Florida, Dr. Baird of Princeton University, and Dr. Estes of Boston University appears below.

Lower Vertebrates

Class Osteichthyes

Order Lepidosteiformes
Family Lepidosteidae
Lepisoseus sp.

Class Amphibia

Order Salientia
Family Pelobatidae
new genus and species

Class Reptilia

Order Chelonia
Family Trionychidae
Trionyx sp.
Family Emydidae
Echmatemys sp.
Order Crocodilia
Family Crocodylidae
Crocodylus sp.
Order Squamata
Family Varanidae
Saniwa sp.
Family Anguidae
Glyptosaurus obtusidens
Family Iguanidae
Parasauromalus olseni
Family Amphisbaenidae
Lestophis anceps

Class Aves

Order Gruiformes
Family Gruinae
Paragrus prentici

Class Mammalia

	Minimum number of individuals	Percent of total fauna
Order Insectivora	19	1.43
Palaeictops cf. *pineyensis*	9	.68
Apatemys whitakeri	4	.30
Entomolestes nitens	5	.38
Tulpavus sp.	1	.07
Order Creodonta	30	2.26
Didelphodus sp.	2	.15
Prolimnocyon elisabethae	4	.30
Prolimnocyon iudei, new species	1	.08
Tritemnodon strenua	5	.37
Prototomus vulpecula	8	.60
Oxyaena forcipata	10	.76
Order Primates	173	13.06
Omomys minutus	1	.08
Anemorhysis musculus	1	.08
Absarokius abbotti	40	3.02
Phenacolemur citatus	8	.60
Pelycodus frugivorus	18	1.36
Pelycodus jarrovii	24	1.81
Cynodontomys latidens	81	6.12
Order Taeniodonta		
Ectoganus cf. *simplex*	4	.30
Order Edentata		
Palaeanodon woodi, new species	1	.08
Order Rodentia	164	12.39
Paramys copei	72	5.44
Paramys excavatus	18	1.36
Reithroparamys atwateri	2	.15
Franimys lysitensis, new species	2	.15
Pseudotomus coloradensis	5	.38
Leptotomus loomisi	2	.15
Microparamys lysitensis	14	1.08
Lophiparamys debequensis	20	1.51
Knightomys depressus	24	1.81
Dawsonomys minor	5	.38
Order Carnivora	56	4.24
Didymictis protenus	22	1.66
Viverravus gracilis	1	.08
Viverravus lutosus	12	.91
Miacis latidens	3	.23
Miacis exiguus	9	.68
Miacis jepseni, new species	1	.07
Uintacyon massetericus	3	.23
Uintacyon sp.	1	.08
Vulpavus cf. *canavus*	3	.23
Vulpavus sp.	1	.07
Order Condylarthra	457	34.52
Esthonyx bisulcatus	19	1.44
Thryptacodon loisi	2	.15
Anacodon ursidens	1	.08
Hapalodectes leptognathus	6	.44
Apheliscus insidiosus	1	.08
Hyopsodus powellianus	200	15.11
Hyopsodus miticulus	180	13.60
Hyopsodus wortmani	6	.45
Phenacodus primaevus	1	.07

Class Mammalia (cont.)

	MINIMUM NUMBER OF INDIVIDUALS	PERCENT OF TOTAL FAUNA
Phenacodus brachypternus	1	.08
Phenacodus vortmani	40	3.02
Order Pantodonta		
Coryphodon molestus	36	2.72
Order Dinocerata		
Probathyopsis lysitensis	2	.15
Order Perissodactyla	322	24.32
Hyracotherium vasacciense	275	20.77
Hyracotherium index	5	.37
Hyracotherium craspedotum	10	.76
Heptodon calciculus	32	2.42
Order Artiodactyla	60	4.52
Bunophorus macropternus	9	.68
Bunophorus etsagicus	2	.15
Bunophorus sinclairi	1	.07
Wasatchia lysitensis	1	.08
Diacodexis metsiacus	47	3.55
Total	1324	100.00

Faunal Composition

Several of the species included in the Lysite faunal list are new (see Table 1). The discovery of the species *Miacis exiguus, Miacis latidens* and *Bunophorus etsagicus* and the genera *Didelphodus* and *Apatemys* was to be expected as these taxa had been found previously in deposits both younger and older than the Lysite in age. Six of the species listed, *Palaeanodon woodi, Prolimnocyon iudei, Miacis jepseni, Uintacyon sp, Bunophorus sinclairi* and *Franimys lysitensis,* are new species and the first five of these six represent lineages previously unrecorded in the early Eocene. The discovery of the other species and genera listed in Table 1 extends the ranges of these taxa from either older or younger deposits into Lysite time. In addition to the species listed in Table 1, *Ectoganus simplex, Pseudotomus coloradensis, Prototomus vulpecula,* and *Uintacyon massetericus* have not been previously found in the Wind River Lysite deposits. These species have been found, however, in Lysite equivalents elsewhere and their recovery in the Lysite extends only their geographic range and not their temporal range.

Most of these species that have not been previously reported from Lysite deposits belong to lineages whose members are rare in early Eocene deposits. Their addition to the fauna is a result of the intensive collecting of recent years. A few of the new records such as those of *Hyracotherium index* and *Phenacolemur citatus* are based on taxonomic changes or on specimens that have long gone unrecognized in collections.

Although nearly all the mammal species that one would expect to find in the Lysite are present in the faunal list, the fauna is by no means well known. Fifteen species are known by only a single specimen and seven more by only two specimens. Fewer than ten specimens have been recovered of no less than 41 of the 61 species in the fauna. Adequate samples of teeth from the Lysite are available for only ten species and adequate skeletal material has been recovered for only one species. Further collecting will, hopefully, unearth better and more complete material of the known species as well as recover the few taxa that are known from either deposits equivalent to the Lysite in age or from both younger and older deposits but that have not as yet been recovered from the Lysite. Among these forms are the marsupials, *Pachyaena,* and several of the smaller primates and insectivores. The absence of *Meniscotherium* and *Hexacodus* from the Lysite fauna is probably due to differences in ecology rather than to their rarity. *Homogalax* and *Ectocion* have been reported from deposits both younger and older than the Lysite but the occurrence of these genera above the Gray Bull is rare and they may not have been a part of the Lysite fauna.

One of the most striking things about the composition of the Lysite fauna is the numbers of *Hyopsodus* and *Hyracotherium* that are encountered (Fig. 2). Nearly half the specimens obtained from Lysite deposits belong to three species in these genera. The abundance of these species and of other large members of the fauna, especially *Coryphodon,* is probably exaggerated somewhat by the method of collecting. McKenna's (1960) Four Mile Faunas, recovered by washing rather than surface collecting, contain a much larger percentage of small forms, particularly primates and insectivores, than the Lysite fauna does and this indicates that many small specimens and species may have been overlooked in the Lysite. This collecting bias, however, cannot account for the great preponderance of *Hyopsodus* and *Hyracotherium* and these genera must have been a very significant part of the fauna in Lysite time.

Hoofed forms, the perissodactyls, artiodactyls and phenacodonts, account for about a third of the specimens recovered from the Lysite (Fig. 2). Nearly half the specimens recovered are of species that are clawed and probably could climb. This is not to say that these forms were arboreal. *Paramys,* as Wood (1962) has recently shown is no more squirrel like in limb ratios than it is rat like, but the Lysite rodents, as well as the primates and hyopsodonts, while not definitely arboreal in hab-

TABLE 1. Range Extensions

	GRAYBULLIAN	LYSITEAN	LOSTCABINIAN
Didelphodus	————————	. . . .	————————†
Apheliscus	————————	. . . .	
Palaeictops pineyensis		. . . .	————————
Tulpavus sp.	?	. . . .	?
Apatemys	————————	. . . .	————————
Phenacolemur citatus	————————	. . . .	
Palaeanodon woodi		. . . .	
Franimys	————————	. . . .	
Hapalodectes leptognathus	————————	. . . .	
Prolimnocyon iudei		. . . .	
Viverravus lutosus		. . . .	————————
Miacis latidens	————————	. . . .	————————
Miacis exiguus	————————	. . . .	————————
Miacis jepseni		. . . .	
Uintacyon sp.		. . . .	
Vulpavus sp.	————————	. . . .	
Hyracotherium index		. . . .	————————
Bunophorus etsagicus	————————	. . . .	————————
Bunophorus sinclairi		. . . .	. . . .

†Solid lines indicate that the species were known by previous records while dotted lines indicate new records from sediments of the ages indicated; ?, indicates unsatisfactory data.

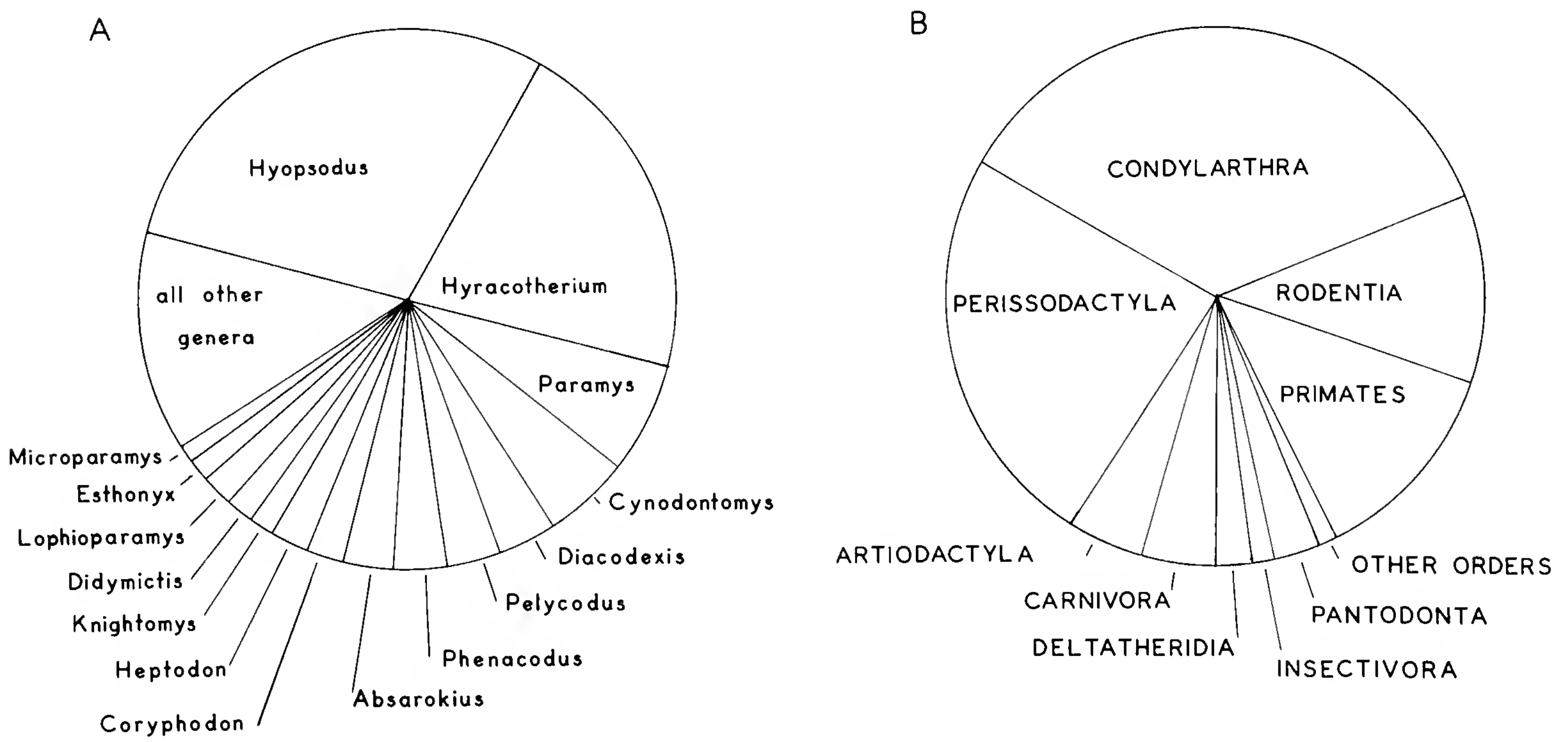

Figure 2. A. Relative abundance of identifiable Lysite mammalian remains arranged by genus. All genera that contain more than one percent of the identified mammalian remains are listed. B. Relative abundance of identifiable mammalian remains arranged by order.

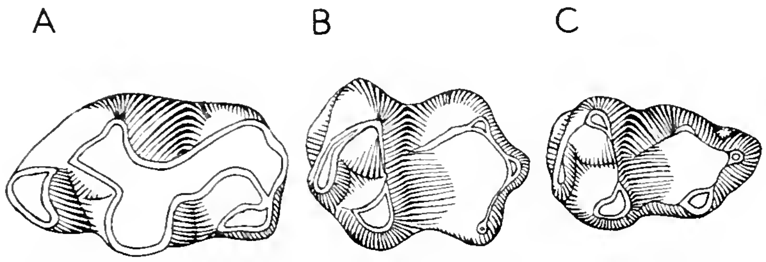

Figure 3. Palaeictops cf. *pineyensis.* A. AC 2918, right P_4. Crown view X 7.3. B. AC 11075, right M_2. Crown view. X 7.3. C. AC 4376, right M_3. Crown view. X 7.3.

its, were clawed and probably were capable of climbing. Several of the smaller carnivores were probably also semi-arboreal in habitus.

Although plant remains are not found in the Lysite deposits, several localities in the Wind River Formation have yielded floras. These have been reported by Berry (1932) and by Tourtelot (1946, 1953). These floras consist of several ferns, a number of fruit-bearing shrubs and trees and a few larger trees as well as one or two tall grasses that probably grew in marshes. The flora suggests that the climate was humid and semi-tropical in Lysite time and that a good plant cover existed in the area of the Lysite deposits, but the complete lack of plant remains from the beds themselves makes environment reconstruction difficult. The lack of plant remains and mollusc layers indicates that ponds were absent and the presence of numerous arboreal forms in the fauna suggests that forests occurred nearby. There is no evidence that open plains areas were present. Plains grasses were not developed in the lower Eocene and the ungulates in the Lysite fauna were probably forest browsers. The picture of the environment of the Lysite fauna, then, is one of a semi-tropical forest in an area where the stream gradient was steep enough to prevent pond formation yet not too steep to prevent periodic flooding and the deposition of the Lysite deposits. The bones that are found show evidence of breakage prior to deposition and many show evidence of surface weathering prior to deposition. Slow burial such as this indicates would allow time for any plants to be decomposed by bacteria and thus removed from the deposits.

SYSTEMATICS

Order Insectivora
Family Leptictidae
Palaeictops cf. *pineyensis* (Gazin, 1952)
Table 2, Figures 3 and 4

Only nine specimens of leptictid insectivores, five of them isolated teeth, have been recovered from the Wind River Lysite deposits. Three of these specimens have P_4 preserved and are identifiable as *Palaeictops* rather than *Diacodon* by the shape of this tooth (see discussion in Gazin, 1962). The remaining specimens are also referred here as they seem to agree better with this genus, especially in the configuration of the talonid basin on the lower molars, than they do with *Diacodon.* The Lysite specimens are most similar in both size and molar pattern to *P. pineyensis* from the La Barge and are referred tentatively to this species.

The most complete Lysite specimen of *Palaeictops,* PU 13419, has both upper and lower dentitions and associated skeletal remains preserved. The bones of this specimen are completely disarticulated yet closely associated in a matrix different from and harder than the usual Lysite sediments. This mode of preservation is quite similar to that found in the case of *Palaeanodon* (see below) and suggests that the animal may have died in a burrow. A distal end of a left humerus associated with PU 13419 (Fig. 4) agrees in size and configuration with skeletal remains referred to *Diacodon puercensis* by Matthew (1918), and is believed to belong to *Palaeictops.* The fragment exhibits no clear adaptations to a burrowing habitus.

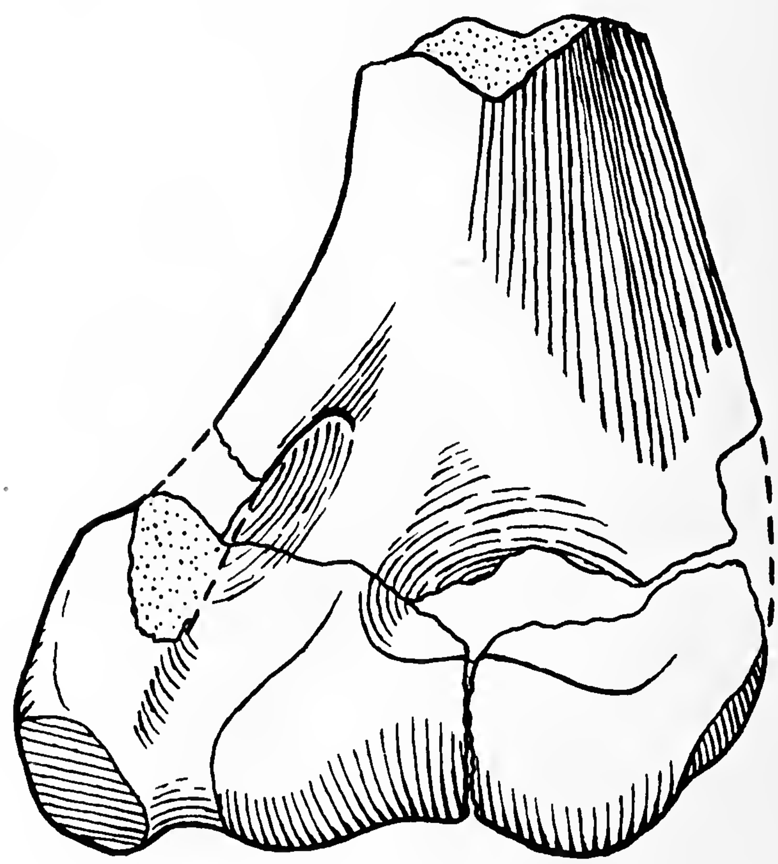

Figure 4. Palaeictops cf. *pineyensis.* PU 13419, distal end of left humerus. X 9.

TABLE 2. Measurements of Teeth of Lysite Lepticids Referred to *Palaeictops pineyensis*

	N	OR	M
M^2			
L	1	——	2.80
W	1	——	4.55
P_4			
L	3	3.10-3.90	3.43
W	2	1.55-2.20	1.87
M_1			
L	3	2.40-2.58	2.49
W	2	1.95-2.30	2.13
M_2			
L	6	2.60-2.96	2.79
W	6	2.00-2.45	2.16
M_3			
L	2	2.90-3.10	3.00
W	2	1.80-2.00	1.90

Family Apatemyidae

McKenna (1960) provisionally divided the early Eocene apatemyids into two groups, distinguished as follows:

GROUP I	GROUP II
1) reduced, single-rooted P_4	1) unreduced, two-rooted P_4
2) strong buccal fossa below P_4	2) fossa below P_4 weak or absent
3) two major mental foramina	3) a single large mental foramen

The type species of both *Apatemys* (*A. bellus*) and *Teilhardella* (*T. chardini*) were placed in group II by McKenna, although in *A. bellus* P_4 is reduced somewhat in size. Jepsen (1930), in erecting *Teilhardella,* considered the unreduced condition of P_4 as a feature distinguishing this genus from *Apatemys*. However, in the type of *T. chardini* M_{1-2} are missing and whether or not P_4 is reduced in size is, therefore, difficult to determine. In a specimen at the Royal Ontario Museum, (ROM 4249) referred to *T. chardini* and from the Gray Bull as is the type of this species, P_4-M_3 are present and, although P_4 is two-rooted, it is clearly smaller than M_1 and its tip does not reach as high as the crowns of the three molars. P_4 in both this specimen and in the type of *T. chardini* is about the same size as this tooth is in *A. bellus* (see Matthew, 1909, pl. 52, figs. 1,2). For this reason, *Teilhardella* is here considered to be a synonym for *Apatemys*.

Whether or not McKenna is correct in thinking that his two groups represent two distinct lineages of apatemyids that should be separated generically cannot be determined with the material presently available. Although all Lysite specimens belong in Group I and, therefore, exhibit several differences in structure from the type of *Apatemys,* it seems best at present to leave all the species referred to *Apatemys* and *Teilhardella* in *Apatemys* until more material belonging to this group is recovered.

Apatemys whitakeri (Simpson, 1954)
Table 3, Figure 5

Four apatemyid jaws have been recovered from the Lysite of the Wind River Basin. One of these, AC 2956, is completely edentulous. A second, AC 2661, contains only the root of the incisor. In the other two specimens teeth are preserved, AC 4300 containing M_{2-3} and AC 2502 containing M_{1-3}. Measurements of three of these jaws are presented in table 3. A deep fossa beneath P_4 and a single alveolus for the root of P_4 is present in all specimens except AC 2661 where this portion of the jaw is missing. In other characteristics, however, the specimens are not uniform. In AC 2956 the root of the incisor extends posteriorly within the jaw only as far as M_1 and appears as if it were turning upward on leaving the jaw. In the other specimens the incisor root extends posteriorly under M_3 and it appears as if the incisor were procumbent. In AC 4300 there are two mental foramina under M_2 whereas in the other specimens this foramen is single. Despite these differences, all four jaws appear to belong to a single species.

The Lysite specimens differ significantly in size from the published measurements of the type and only known specimen of *Apatemys whitakeri* only in length of M_1 and in the depth of the jaw below M_2. However, in the type specimen M_1 is broken and the lower part of the jaw is missing.

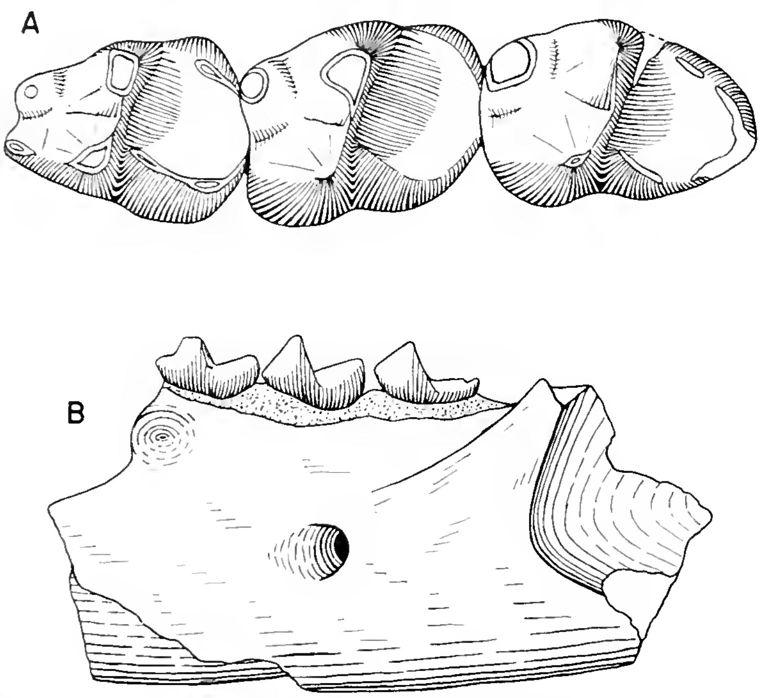

Figure 5. Apatemys whitakeri. AC 2502, left lower jaw with M_{1-3}. A. Crown view. X 13. B. External view. X 5.

Both these measurements, therefore, include approximations as to the size of missing parts and may well be in error. The Lysite material is so close to this New Mexican species in all other respects that specific separation of the Wyoming material from *A. whitakeri* seems unwarranted at this time.

Gazin (1962) separated *A. hurzeleri* of the La Barge from *A. whitakeri* because the jaw of his specimen was deeper and the teeth narrower than they were in the New Mexican species. The difference in jaw depth, however, does not seem real (see above) and the differences in molar proportions are not very great (see Table 3). The specimen from the Lost Cabin deposits near Boysen Reservoir in the Wind River Basin identified by White (1952) as *Teilhardella sp.,* although edentulous, is also similar to the Lysite, La Barge, and New Mexican specimens in size and in the possession of a single-rooted P_4 and a large fossa below P_4. The differences that occur between these specimens are too slight to warrant their inclusion in more than one species. *A. hurzeleri* is, therefore, considered a synonym of *A. whitakeri* and the Lysite and Lost Cabin specimens are also referred to this species.

A. whitakeri, as understood here, is smaller than *A. bellulus* of the Bridger Formation and has a less developed paraconid on the lower molars but was probably ancestral to this small middle Eocene apatemyid. One of McKenna's criteria for the separation of early Eocene apatemyids into two groups, that of the number of mental foramen in the lower jaw, seems to break down in the light of the variation observed in *A. whitakeri,* but this minor difference certainly does not invalidate his conclusions.

Family Amphilemuridae
Entomolestes nitens Matthew, 1918

Five specimens of this species have been recovered from the Wind River Lysite. One of these, AMNH 14674, was referred to this species by Matthew (1918); the other four specimens have not been recorded previously. These are PU 13232, a lower jaw containing M_{1-3}; AC 2658 and AC 2755, each an isolated P_4; and AC 4399 a jaw fragment with P_{2-4}. McKenna (1960) referred the Four Mile specimens of *Entomolestes* to this species but suggested that the Four Mile material probably represented a new and more primitive species. The new Lysite material supports this conclusion as it agrees in both size and in the development of P_4 with the upper Gray Bull type of this species and does not approach the more primitive premolar pattern and smaller size that is found in the Four Mile material.

Tulpavus sp.
Figure 6

A fragment of the left ramus of a small insectivore, AC 2666, is most closely referrable to this genus. Only the last two molars are preserved, M_2 measuring 1.92 mm in length and 1.30 mm in width, and M_3 measuring 1.88 mm by 1.10 mm respectively. This specimen is somewhat smaller than the specimen from the Lost Cabin equivalent of the Huerfano Formation referred to *Tulpavus* sp. cf. *T. nitidus* by Robinson (1966) yet is more similar to this specimen (AMNH 55226) than to the type of *Tulpavus nitidus,* which is of Bridgerian age. This Lysite specimen and possibly the Lost Cabin specimen from the Huerfano is specifically distinct from *T. nitidus*, but the material is insufficient to warrant description as a separate species at this time.

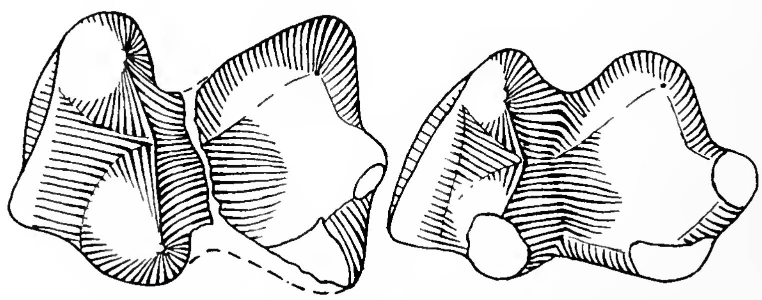

Figure 6. Tulpavus sp. AC 2666, right lower jaw with M_{2-3}. Crown view. X 18.5.

TABLE 3. Measurements of Lower Teeth of *Apatemys whitakeri*

	Almagre *AMNH* 48004† TYPE	*AC* 2502	*Lysite* *AC* 4300	*AC* 2956	*Lost Cabin* *USNM* 14838‡	*La Barge* *USNM* 22386¶ (TYPE OF *A. hurzeleri*)
I_1						
L	2.45	2.6	2.35	—	—	2.5
W	1.35	1.4	1.2	—	—	1.4
P_4						
L	0.7	—	—	—	—	—
W	0.4	—	—	—	—	—
M_1						
L	1.3	1.70	—	1.4_a	1.7_a	—
W	1.1	1.28	—	—	—	—
M_2						
L	1.7	1.85	1.72	1.6_a	1.7_a	2.0
W	1.2	1.45	1.40	—	—	1.3
M_3						
L	—	2.00	1.90	2.0_a	2.0_a	—
W	—	1.35	1.45	—	—	—
LM_{1-3}	—	5.55	—	5.3_a	5.7_a	—
Jaw depth at M_2	3.6	4.5	4.0	5.2	—	4.8

†Measurements of AMNH 48004 are from Simpson, 1954.
‡Measurements of USNM 14838 are from White, 1952.
¶Measurements of USNM 22386 are from Gazin, 1962.

Order Creodonta

Van Valen (1966) has elevated this group to ordinal rank under the name Deltatheridia. This ranking has been questioned by MacIntyre (1966: 198) who considers the term Creodonta as usable for this assemblage, and by McKenna (1962: 19) who treats this group as a super-family of the Insectivora. Although the rank of this group is still under debate, I am following Van Valen's ordinal ranking as I agree with his view that this group is distinct enough in habitus from most insectivores to justify their separation from that order. I am following MacIntyre, however, in using the term Creodonta for this group.

Family Palaeoryctidae
Didelphodus sp.
Figure 7

Two specimens from the Lysite, AC 2815, a left ramus with P_4-M_2 and an unnumbered jaw fragment in the Princeton University collection with only P_4, are referable to this genus. The mataconid on P_4 in both specimens is as well developed as it is in the Gray Bull specimen of *Didelphodus absarokae secundus* figured by Matthew (1918) and quite unlike other specimens of *Didelphodus* in this respect. Van Valen (1966) in his monograph on the Deltatheridia recognized two species of *Didelphodus*, *D. absarokae*, primarily found in Gray Bull deposits, but also represented by one specimen from the Lost Cabin of the Wind River Basin, and *D. altidens*, known from deposits of Lostcabinian and Bridgerian age. The lower molars of these two species are clearly separable on the basis of size alone; *D. altidens* is the smaller of the two. The Lysite specimens fall between *D. altidens* and *D. absarokae* in size, as they would in horizon if the one specimen of *D. absarokae* from the Lost Cabin were discounted. The presence of both species in Lostcabinian times and the possibility that both species were present in middle Gray Bull deposits as well (see discussion in Van Valen, 1966: 27) makes the reference of the Lysite specimens to species impossible until a more accurate picture of the size variation in the Lysite population is obtained.

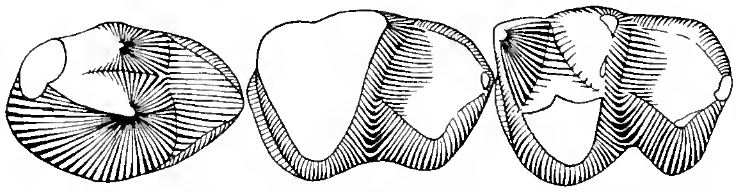

Figure 7. Didelphodus sp. AC 2815, left lower jaw with P_4-M_2. Crown view. X 7.

Family Limnocyonidae
Prolimnocyon iudei,[2] new species
Table 4, Figure 8

Type: AC 2767, a fragment of a left ramus containing M_{2-3}.

Hypodigm: Type only.

Horizon and Locality: The type specimen was collected by Judy Guthrie during the summer of 1962 from locality 6c in the Lysite Member of the Wind River Formation.

Diagnosis: M_3 reduced in size but two-rooted and not as reduced as in other Lysite and Lost Cabin members of this genus where this tooth has but a single root. Talonid basins narrow, more so than in other members of this genus, save for *P. robustus*. Size 30 percent smaller than the contemporary species *P. elizabethae* and about 20 percent smaller than *P. atavus* from the Gray Bull, the smallest previously known species of *Prolimnocyon*.

Discussion: Van Valen (1966) considers the type specimen of *Prototmus viverrinus* to have been a proviverrine *(=Sinopa)* whereas McKenna (1960: 94) considered it conspecific with *Prolimnocyon*, a name over which *Prototomus* has precedence. The question of which interpretation of Cope's illustration of the now lost type specimen of *P. viverrinus* is correct will, it is hoped, be settled in Van Valen's favor by ruling of the International Commission on Zoological Nomenclature requested by Van Valen (see 1966: 70). The reduction of M_3 sets this species apart from *Sinopa*, (*sensu* Matthew, 1915a), yet this tooth is not reduced in this species nor in *P. robustus* to the extent that it is in other species of *Prolimnocyon*. The constriction of the talonid basin, on the other hand, is similar to the condition found in *Sinopa* and unlike the usual condition found in *Prolimnocyon*. In this characteristic also, this species agrees with *P. robustus*, and I feel that a new genus could be erected to set these two species apart from both *Sinopa* and *Prolimnocyon*. At present, however, the material referred to these two species is much too fragmentary to warrant such a separation.

Prolimnocyon elisabethae Gazin, 1952
Table 4

In addition to the maxilla referred to this species by Kelley and Wood (1954), jaws of three individuals have been recovered from the Lysite deposits of the Wind River Basin. There is but a single alveolus for M_3 in these jaws and in AC 4328, where M_3 is preserved, this tooth, although much reduced in size, retains a three cusped trigonid with the paraconid and metaconid reduced in size. The three Lysite specimens vary both in robustness and in the development of the parastylid on the premolars but none are quite as small as the Gray Bull species, *P. atavus*, or as large as the New Fork specimen referred to *P. antiquus* by Gazin (1962). The Lysite specimens certainly belong to the same species as the La Barge sample with which they agree in size and shape and which Gazin has named *P. elisabethae*. The type of *P. antiquus* is still the only known specimen belonging to this genus that has been recovered from the Lost Cabin horizon in the Wind River Basin, and although edentulous, seems larger than either the Lysite or La Barge specimens, especially in the length of the premolar series. If it should prove, as I suspect it will, that there is more variation in isochronous populations of *Prolimnocyon* than previously realized and that the Lost Cabin sample of *Prolimnocyon* overlaps

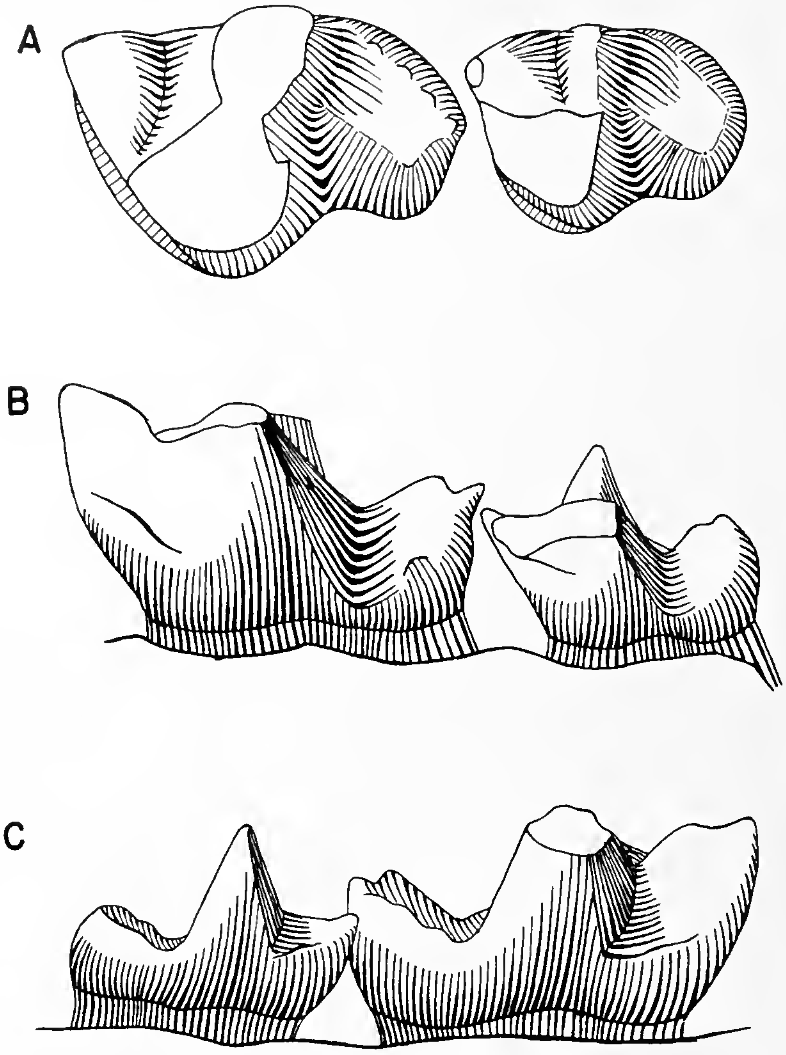

Figure 8. Prolimnocyon iudei new species. Type, AC 2767, fragment of left lower jaw with M_{2-3}. A. Crown view. X 8.5. B. External view. X 8.5. C. Internal view. X 8.5.

[2]Named for Mrs. Daniel A. Guthrie.

the Lysite and La Barge samples in size, then these three samples should perhaps be referred to *P. antiquus*. Until more specimens from the Lost Cabin are recovered, however, it seems best to retain the referral of the Lysite and La Barge specimens to *P. elisabethae*.

Family Hyaenodontidae

The species referred to as *Sinopa* by Matthew (1915a) and most of the other authors cited in this paper have recently been reviewed by Van Valen (1965). His changes in terminology are followed here.

Tritemnodon strenua (Cope, 1875)

At least two species of *Sinopa* (*sensu* Matthew, 1915a) are present in the Lysite of the Wind River Basin and can be distinguished from each other on the basis of size. The larger species is represented by two jaws, AC 2586 and PU 12776, and a number of isolated teeth. On all the lower molars in these specimens the talonids are narrow-basined and narrower than the trigonid. They agree with both *T. strenua* and *T. hians*, the types of which are from the San José Formation of New Mexico, in this respect as well as in size (see also Matthew, 1915a) but are closer to the former species in that there is no diastema behind P_2 in either of the jaws. Such a diastema is present in *T. hians*. Although some of the isolated teeth are nearer to the type of *T. hians* in shape than they are to the type of *T. strenua*, a preliminary survey of the specimens in the American Museum that are referred to these two species has indicated to me that *T. hians* may be synonymous with *T. strenua*. Certainly the amount of variation found among specimens referred to these two species is no greater than that found in many lower Eocene populations. All specimens of *Tritemnodon* from the Lysite are therefore referred to *T. strenua*, pending a revision of this genus.

Prototomus vulpecula (Matthew, 1915a)

The small species of *Sinopa* (*sensu* Matthew, 1915a) in the Lysite is represented by eight badly broken jaws and one partial maxilla. The jaw fragments are referrable, on the basis of size, to either *P. vulpecula* or *P. multicuspis*. The upper molars in the maxilla, PU 17695, are more similar to those of *P. vulpecula* in that they do not have

TABLE 4. Measurements of Teeth of some Early Eocene Species of *Prolimnocyon*

	P. atavus GRAY BULL†		*P. elisabethae* LYSITE			*P. antiquus* LA BARGE†	*P. antiquus* LOST CABIN	*P. antiquus* NEW FORK†	*P. iudei* LYSITE
	AMNH 16816 TYPE	AC 3026	AC 2576 LEFT	AC 2576 RIGHT	AC 4328	USNM 19350 TYPE	AMNH 14768 TYPE	USNM 22452	AC 2767 TYPE
P_1-M_3	—	—	—	34.9	—	35.0	41.0	40.0	—
P_1-P_4	—	—	—	19.9	20.0	20.6	25.3	25.0	—
M_1-M_3	14.0	—	—	15.1	—	14.0	15.5	15.0	—
P_2									
L	—	—	—	4.6	4.7	5.0	—	4.9	—
W	—	—	—	2.5	2.4	2.1	—	2.1	—
P_3									
L	—	—	—	—	5.0	5.4	—	—	—
W	—	—	—	—	2.0	2.0	—	—	—
P_4									
L	—	5.7	6.1	6.2	5.5	5.8	—	6.3	—
W	—	2.9	3.0	2.9	2.9	2.6	—	2.9	—
M_1									
L	6.2	—	6.3	6.5	5.7	5.9_a	—	6.4	—
W	3.4	—	3.3	3.4	3.5	3.0_a	—	3.5	—
M_2									
L	6.4	—	6.6	—	—	6.8	—	7.0	4.40
W	4.2	—	4.0	—	—	3.5	—	4.0	2.85
M_3									
L	2.6	—	—	—	3.3	—	—	—	3.10
W	1.7	—	—	—	1.8	—	—	—	2.15
Jaw depth below M_2	—	—	—	—	—	—	—	—	6.80

†Measurements of Gray Bull, La Barge and New Fork specimens are from Gazin (1962).

TABLE 5. Measurements of Teeth of *Oxyaena forcipata* from the Wind River Basin

	Lysite Sample			Lost Cabin Specimen MCZ 3423 Type of *O. ultima*
	N	OR	M	
M_{1-3}	1	—	33.3	33.4
LM_1/LM_2	1	—	0.84	0.79
P_3				
L	1	—	13.7	—
W	1	—	7.5	—
P_4				
L	5	14.3-15.7	15.3	16.6
W	7	8.0- 9.3	8.7	8.2
W/L	5	0.52-0.59	0.56	0.49
M_1				
L	3	15.0-15.7	15.3	14.7_a
W	3	8.1- 8.4	8.3	8.7
M_2				
L	3	18.0-19.0	18.4	18.7
W	3	8.2-10.5	9.4	10.6

the protocone lingually elongated as it is in *P. multicuspis.* As the type of *P. vulpecula* is from the Lost Cabin horizon in the Big Horn Basin and the type of *P. multicuspis* is from the San José Formation in New Mexico, it may be that the differences between these two species are due to geographical separation rather than to their belonging to separate lineages. If this is the case, then *P. vulpecula* should probably be considered a synonym of the earlier described species *P. multicuspis.* Still, until more is known of these species, it seems best to refer the Lysite sample to *P. vulpecula,* the species to which it is morphologically and geographically most closely related.

Family Oxyaenidae
Oxyaena forcipata Cope, 1874
Table 5

Ten fragmentary specimens of *Oxyaena* have been recovered from the Wind River Lysite deposits. Kelly and Wood (1954), after examining four of these specimens, concluded that they all belonged to a single species and decided that this species was *O. ultima,* although they noted that the Lysite specimens were intermediate between *O. lupina, O. forcipata,* and *O. ultima* in a number of respects. Their conclusions as to the intermediate position of the Lysite material and as to the presence of only one species of *Oxyaena* in the Lysite are strengthened by my study of the larger amount of material from the Lysite currently available. Moreover, Denison's (1938) separation of *O. ultima* from *O. forcipata* seems open to question. Denison considered *O. forcipata* to be larger and to have more robust premolars than *O. lupina* and separated these species on this basis. He separated *O. ultima* from the similar sized *O. forcipata* by the narrowness of the lower premolars in the former species.

O. ultima, O. forcipata, and *O. lupina* are rather similar in size and contain among them just enough variation to make their inclusion in one species questionable. Moreover, in the Wasatch of New Mexico, where the types of *O. forcipata* and *O. lupina* were recovered, there exists a distinct difference in size and in the narrowness of the lower premolars between the specimens referred to these two species. In Wyoming, no such distinction exists and all the oxyaenids referred to these three species from deposits of Lysite and Lost Cabin age seem to belong to a single species, intermediate in the shape of the premolars between the two New Mexican samples but similar to *O. forcipata* in size. Denison (1938) described a specimen from the Lost Cabin of the Wind River Basin that had these characteristics as a new species, *O. ultima,* but the existence of a species of *Oxyaena* in Wyoming genetically isolated from the two species in New Mexico seems unlikely as *Oxyaena* was a large carnivore and probably ranged widely over the western United States. That the Wyoming sample of *Oxyaena* was a geographical variant of the New Mexican species *O. forcipata* seems much more likely, especially in the light of current knowledge of the variation within this Wyoming sample of *Oxyaena* (Table 5).

Order Primates
Family Anaptomorphidae
Omomys minutus (Loomis, 1906)

The type of this species, AC 3365, is still the only known specimen and was probably recovered from locality 6c. McKenna (1960) included this species in *Anemorhysis* and referred several Four Mile specimens to it. The trigonids on the molars of the type of *O. minutus* are, however, much higher above the talonids than they are in the referred Four Mile material and M_3 is more reduced in the referred material than it is in the type specimen. Gazin (1962) has recently restudied the type of this species and reaffirms his position (1958) that it is distinct from *Anemorhysis* and belongs in *Omomys,* a view with which I agree. I am not following Gazin's familial ranking of the Omomyidae, however, as the distinction between this family and the Anaptomorphidae does not seem clear from the material presently available.

Anemorhysis musculus (Matthew, 1915c)

No specimens other than the type of this species, AMNH 12830, have been recovered from the Lysite. Although McKenna (1960) questioned the separation of this species from *Omomys minutus,* Gazin (1962) has restudied both specimens and affirms their distinctness, as indicated in the preceding section.

Absarokius abbotti (Loomis, 1906)
Tables 6 and 7, Figure 9

About forty specimens referrable to this species have been recovered from Lysite deposits in the Wind River Basin. While only five of these specimens have enough of the symphysial region of the mandible preserved to allow determination as to the size of the lower canine, none of the specimens have M^3_3 as well developed as they are in *Tetonius* or seem referrable to this genus. Although the Lysite sample shows little size variation, some interesting variants in molar pattern occur. In AC 2499, a maxilla with right P^4-M^3 the molars possess cingula completely around their lingual sides, a feature not observed in other specimens of *Absarokius.* Several lower molars have crenulations in the talonid basin similar to those found in the Cathedral Bluffs species *A. witteri* (Morris, 1954). Despite these variations, all the Lysite specimens seem to belong to a single species. Kelley and Wood (1954) have recently discussed the variation in dentition that is found in the Lysite sample of *Absarokius.* Their description is accurate except for the statement that P_4 is larger than M_1. P_4 varies considerably in size (Table 7) and may be larger or smaller than M_1. *Absarokius noctivagus* from the Lost Cabin differs from *A. abbotti* only slightly; the principal difference is the larger P_4 in the former species. Gazin's referral of a specimen UW 1644, from the Gray Bull equivalent in the red desert region of Wyoming to *A. abbotti* may not be correct for, as Gazin notes, P_4 in this specimen is larger than what is normal for *A. abbotti* while the molars in this specimen are small when compared to *A. abbotti.*

Family Paromomyidae
Phenacolemur citatus Matthew, 1915c
Table 8, Figure 10

Eight specimens of *Phenacolemur* have been recovered from Lysite deposits in the Wind River Basin. Only two of these, AC 3463 and PU 13841, jaws containing the right M_2 and left M_3 respectively, were known to Simpson (1955), who referred them tentatively to the San José species of *Phenacolemur, P. jepseni,* primarily because of the small size of these teeth. Two of the more recently collected specimens from the Lysite, AC 2874 and AC 4301, contain P_4 and in both cases this tooth agrees much more closely with the corresponding tooth in *P. citatus* from the upper Gray Bull than with *P. jepseni.* The Lysite sample also agrees closely with *P. citatus* in size and is therefore referred to this species. Simpson (1955) treated *P. citatus* as a subspecies of the lower Gray Bull species, *P. praecox,* but this is not followed here. Simpson pointed out (p. 424 to 425) that the upper Gray Bull sample is distinctly smaller in size than the older species (Table 8). Also, the talonid seems more constricted in *P. citatus* and is distinctly wider than the trigonid. For these reasons Matthew's original separation of *P. citatus* from *P. praecox* is followed here, although McKenna's (1960) inability to identify the Four Mile species of *Phenacolemur* due to the great amount of variation found in the sample indicates that the taxonomy of this genus is not yet settled.

The mean sizes of the teeth of *P. praecox,* as it is understood here, are larger than these for *P. citatus,* from the upper Gray Bull, but these latter specimens show no real difference in size from the Lysite sample of *P. citatus.* If these three samples are successionally related to one another as appears to be the case, then the decrease in size with

TABLE 6. Measurements of Teeth of Early Eocene Species of *Absarokius*

	UW† 1644	*A. abbotti* AC 3479 TYPE	*A. noctivagus* AMNH 15601 TYPE
P_3			
L	1.5	1.90	—
W	1.8	1.80	—
P_4			
L	2.4	2.26	3.00
W	2.5	2.36	2.60
M_1			
L	2.3	2.30	2.40
W	1.8	2.08	2.40
M_2			
L	2.0	2.25	2.20
W	1.7	2.13	2.20
M_3			
L	2.1	2.36	2.40
W	1.4	1.70	1.70

†Measurements are from Gazin (1962).

TABLE 7. Measurements of the Lysite Sample of *Absarokius abbotti*

	N	OR	M	s	V
P^3					
L	4	2.13-2.40	2.27	—	—
W	4	2.42-2.60	2.49	—	—
P^4					
L	4	2.30-2.63	2.48	—	—
W	4	3.20-3.40	3.30	—	—
M^1					
L	4	2.15-2.20	2.18	—	—
W	4	3.22-3.45	3.34	—	—
M^2					
L	6	2.00-2.20	2.08±.03	0.07±.03	3.37± .97
W	6	3.12-3.78	3.50±.09	0.23±.09	6.57±1.90
M^3					
L	4	1.20-1.40	1.30	—	—
W	4	2.38-2.72	2.56	—	—
P_3					
L	3	1.80-1.90	1.87	—	—
W	3	1.72-1.85	1.79	—	—
P_4					
L	12	2.10-2.70	2.34±.05	0.16±.03	6.71±1.37
W	11	2.00-2.45	2.30±.04	0.14±.03	6.09±1.30
M_1					
L	20	2.22-2.55	2.39±.02	0.09±.01	3.77± .60
W	21	1.93-2.37	2.19±.02	0.11±.02	3.02± .77
M_2					
L	33	2.09-2.42	2.26±.01	0.08±.01	3.54± .44
W	33	1.80-2.30	2.10±.02	0.11±.01	5.21± .64
M_3					
L	19	2.17-2.48	2.31±.02	0.09±.01	3.90± .63
W	19	1.48-1.80	1.68±.02	0.09±.01	5.39± .87

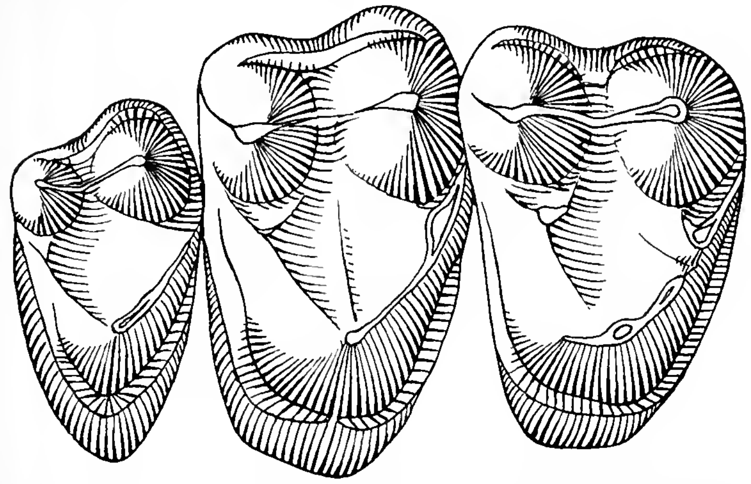

Figure 9. Absarokius abbotti. AC 2499, right maxilla with M^{1-3}. Crown view. X 10.

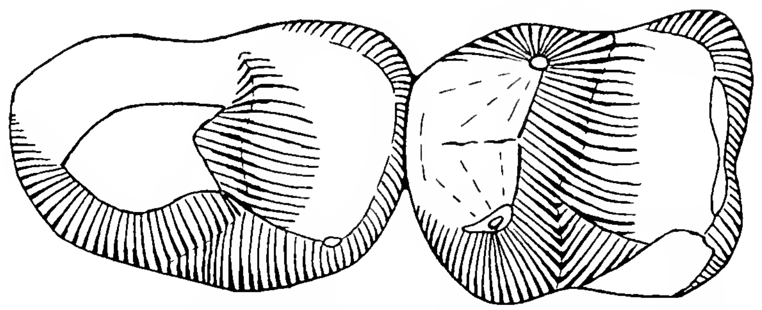

Figure 10. Phenacolemur citatus. AC 4301, left lower jaw with P_4-M_1. Crown view. X 13.

TABLE 8. Measurements of Lower Teeth of *Phenacolemur*

Measurements of *P. citatus* from the Lysite of the Wind River Basin

	N	OR	M
P_4			
L	2	2.6-3.1	2.85
W	2	1.9-2.1	2.0
M_1			
L	2	2.5	2.5
W	2	1.9-2.0	1.95
M_2			
L	4	2.2-2.9	2.5
W	4	1.7-2.1	1.95
M_3			
L	4	3.1-3.9	3.4
W	4	1.8-2.0	1.9
Measurements of *P. citatus* from the upper Gray Bull of the Big Horn Basin†			
	N	OR	M
P_4			
L	1	—	2.8
W	1	—	1.8
M_1			
L	4	2.3-2.6	2.4
W	4	2.0-2.1	2.0
M_2			
L	3	2.3-2.6	2.5
W	3	2.0-2.2	2.1
M_3			
L	2	3.5-3.8	3.6
W	2	1.9-2.0	2.0
Measurements of *P. praecox* from the lower Gray Bull of the Big Horn Basin†			
	N	OR	M
P_4			
L	9	2.7-4.0	3.4
W	9	1.9-2.7	2.3
M_1			
L	10	2.4-3.2	2.9
W	10	1.9-2.6	2.3
M_2			
L	7	2.3-3.1	2.8
W	7	2.1-2.6	2.3
M_3			
L	1	—	3.5
W	2	—	3.1

†Measurements of Gray Bull specimens are from Simpson (1955, table 4).

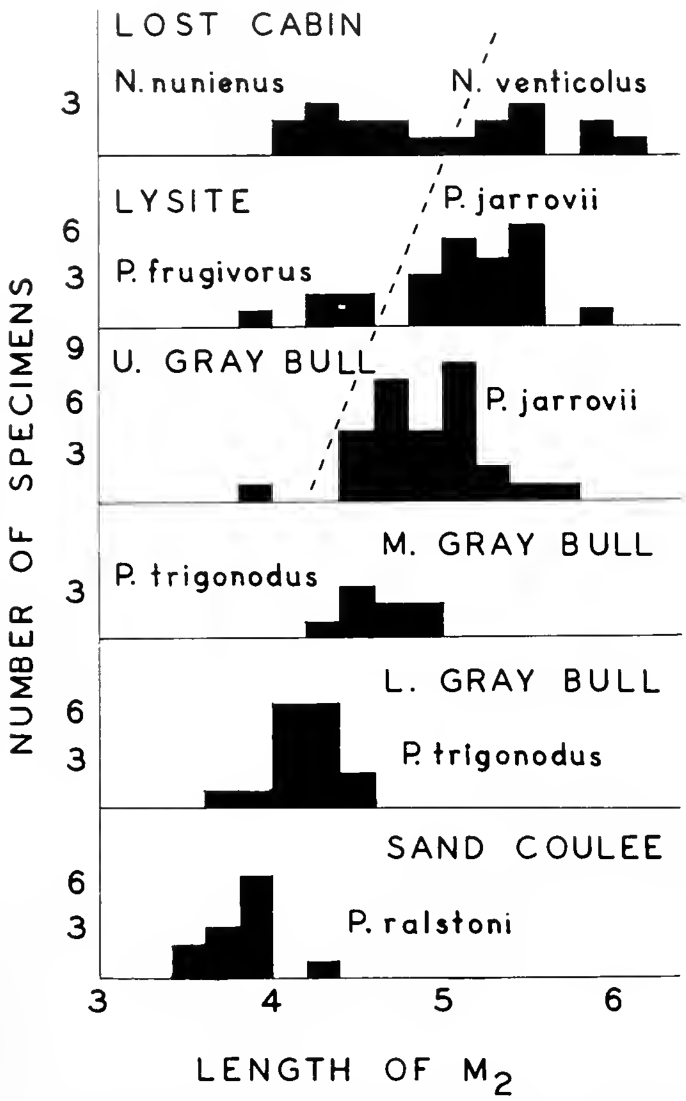

Figure 11. Variation in the length of M_2 in some early Eocene samples of *Pelycodus* and *Notharctus*. The dashed line indicates the separation in size between two of the early Eocene lineages of notharctids.

time in this genus in the Gray Bull, noted by Simpson (1955), does not appear to have continued into Lysite time.

Family Notharctidae

Pelycodus is distinguished from *Notharctus* by the rudimentary condition of the hypocone and mesostyle on the upper molars of the former genus and the development of these cusps in the latter genus. Two lineages belonging to this family occur in both the Lysite and Lost Cabin deposits (Fig. 11) and in these lineages the development of the hypocone and mesostyle on the upper molars is correlated with larger tooth size in all three of the possible ways; within populations, between contemporary populations, and between successive populations (see Simpson, 1953: 11).

The specimens of *Notharctus* and *Pelycodus* from the Wind River Basin in the collections of the American Museum of Natural History were apparently labelled soon after their collection, and were labelled according to a typological concept of taxonomy. Large variants of both the Lysite species of *Pelycodus* are labelled as belonging to the genus *Notharctus* as they possess the characteristic cusp development of this genus. Small variants of the two Lost Cabin species of *Notharctus,* especially the smaller one, are labelled as belonging to the genus *Pelycodus* as they have poorly developed cusps on the molars. Furthermore, the border between the two Lost Cabin species of *Notharctus* is not clear (Fig. 11) and several specimens near this border in size are labelled as belonging to the wrong species.

These taxonomic errors were not followed by Matthew (1915c) nor by subsequent authors, who recognize the boundary between these genera as a horizontal one corresponding with the time line between the Lysite and Lost Cabin. However, the original labelling has never been corrected and apparently misled Gazin (1952) into considering his La Barge sample of a small *Notharctus* as belonging to a new species.

Gazin states in his description of *N. limosus* that "the lower molars average noticeably smaller in size than those in the American Museum specimens of *Notharctus nunienus* from the Lost Cabin beds . . . The length of M_2 for example, has a range of from 4.9 to 5.3 mm in *N. nunienus,* and in *N. limosus* the range would be 4.3 to 4.7 mm except that one specimen measures 5.0 mm. The average in the two species is 5.2 and 4.6 mm respectively (*op. cit.,* p. 23)." However, the sample of *N. nunienus* in the American Museum collections that Gazin is referring to consists of only the large members of *N. nunienus* and several mislabelled small specimens of *N. venticolus.* The smaller specimens of *N. nunienus,* as understood here, are labelled as belonging to *Pelycodus frugivorus.* The length of M_2 in the Lost Cabin sample of *N. nunienus,* as understood here, ranges in size from 4.0 mm to 4.8 mm and averages 4.4 mm. This is very similar to the measurements of *N. limosus* and as the other differences that Gazin used to separate *N. limosus* from *N. nunienus* do not occur between the samples of these two species as they are understood here, *N. limosus* is considered to be a synonym of *N. nunienus.* The record of *Pelycodus* in the Lost Cabin recorded by Simpson (1929) may also have resulted from the mislabelled Lost Cabin specimens in the American Museum.

Pelycodus jarrovii (Cope, 1874)
Table 9, Figure 11

Kelley and Wood (1954) thought that possibly only one species of *Pelycodus* was present in the Lysite but study of the larger number of speci-

TABLE 9. Measurements of Teeth of *Pelycodus jarrovii* from the Lysite of the Wind River Basin

	N	OR	M	s	V
M^1					
L	1	—	4.65	—	—
W	1	—	6.10	—	—
M^2					
L	2	4.40-4.68	4.54	—	—
W	2	7.15	7.15	—	—
P_4					
L	2	4.32-4.40	4.36	—	—
W	2	2.90-3.02	2.96	—	—
M_1					
L	11	4.70-5.20	4.93±.05	0.16±.03	3.25± .69
W	16	3.85-4.43	4.07±.05	0.18±.03	4.42± .78
M_2					
L	20	4.84-5.80	5.24±.06	0.27±.04	5.15± .81
W	20	4.15-4.98	4.60±.04	0.20±.03	4.35± .69
M_3					
L	9	6.28-6.90	6.49±.07	0.20±.05	3.08± .73
W	8	3.78-4.51	4.19±.09	0.25±.06	5.97±1.49

TABLE 10. Measurements of Teeth of *Pelycodus frugivorus* from the Lysite of the Wind River Basin

M^1			
L	2	3.90-4.30	4.10
W	2	5.20-5.50	5.35
M^2			
L	4	3.70-4.20	3.99
W	4	6.00-6.25	6.16
M^3			
L	2	3.30-3.48	3.39
W	2	5.00-5.10	5.05
M_1			
L	1	—	4.30
W	1	—	3.58
M_2			
L	5	3.90-4.45	4.28±.13
W	5	3.70-4.15	4.02±.09
M_3			
L	5	5.25-5.90	5.58±.10
W	5	3.30-3.77	3.50±.08

mens currently available indicates the presence of two species, separable from each other only on the basis of size. Gazin (1962) expressed doubts as to whether *P. jarrovii,* the type of which is from an unknown horizon in the New Mexican San José formation, should be recognized in Wyoming. As noted by Matthew (1915c), however, the Wyoming material is so similar to the New Mexican type that specific separation of the two samples seems uncalled for. Differences between the New Mexican and Wyoming samples of *P. jarrovii* do occur but are of such small magnitude that they seem best explained in terms of geographic and temporal differences within a species rather than as differences between species. The larger Lysite species is, therefore, referred to *P. jarrovii.*

Pelycodus frugivorus Cope, 1875
Table 10, Figure 11

Gazin's (1962) arguments against recognizing *P. jarrovii* in Wyoming could also be applied to *P. frugivorus,* the type of which is also from an unknown horizon of the San José Formation. The differences between the type of *P. frugivorus* and the smaller Lysite species of *Pelycodus* are so minor that specific separation of these samples seems uncalled for.

The mean tooth size in the two lineages that contain *P. frugivorus* and *P. jarrovii* increases during the early Eocene (Fig. 11) and many of the specimens identified as *P. frugivorus* in the upper Gray Bull collections of the American Museum actually belong to *P. jarrovii,* which is near the size of the Lysite sample of *P. frugivorus* in Gray Bull time. The species from lower Gray Bull deposits, *P. trigonodus* and *P. ralstoni* differ in both size and molar pattern from *P. frugivorus,* as noted by Matthew (1915c), and also seem distinct from each other, although this latter difference was doubted by McKenna (1960).

Family Microsyopidae
Cynodontomys latidens Cope, 1882
Table 11

Cynodontomys is the commonest Lysite primate genus, represented by nearly 90 individuals from the Wind River Basin. All these specimens appear to belong to a single species as no gaps in variation in either molar pattern or in size occur in this sample and as the coefficients of variation for this sample are of a magnitude normal for a mammalian deme. Matthew (1915c) recognized three species of *Cynodontomys* in Wyoming, *C. angustidens* from the Gray Bull, *C. latidens* from the Lysite, and *C. scottianus* from the Lost Cabin, and felt that these species were successionally related to one another in a single lineage. To the base of this sequence might be added *C. alfi,* described by McKenna (1960) from the Four Mile deposits of Colorado. The presence of this last species in Wyoming is established by AMNH 15083, a lower jaw with M_{2-3} from the lower Gray Bull of the Big Horn Basin. It is interesting to note that this specimen is labelled "*C. mus,* type." Apparently Matthew realized that this specimen represented a new species but did not describe it, presumably because of the poorness of the then available material.

Gazin (1952) attributed the difference between *C. knightensis* from the La Barge of southern Wyoming and *C. scottianus* from the Lost Cabin of northern Wyoming to ecological causes. I would be more inclined to attribute the observed differences to chronological rather than to ecological differences between the two deposits as I consider the La Barge as intermediate between the Lysite and Lost Cabin in time. According to this interpretation, *C. knightensis* would fall between *C. latidens* and *C. scottianus* in the lineage under discussion.

TABLE 11. Measurements of Teeth of *Cynodontomys latidens* from the Lysite of the Wind River Basin

	N	OR	M	s	V
P^4					
L	3	3.03-3.55	3.14	—	—
W	3	3.47-3.78	3.62	—	—
M^1					
L	7	3.15-3.58	3.39±.06	0.17±.05	5.01±1.34
W	7	3.80-4.38	4.11±.08	0.22±.06	5.35±1.43
M^2					
L	6	3.35-3.90	3.60±.09	0.22±.06	6.11±1.77
W	6	4.11-4.80	4.53±.10	0.24±.07	5.30±1.53
M^3					
L	6	3.30-3.75	3.44±.07	0.16±.05	4.65±1.34
W	6	3.60-4.25	3.91±.09	0.23±.07	5.88±1.70
P_3					
L	1	—	2.55	—	—
W	1	—	1.50	—	—
P_4					
L	21	3.00-3.65	3.34±.04	0.19±.03	5.69± .88
W	22	2.00-2.71	2.30±.04	0.17±.03	7.39±1.11
M_1					
L	38	3.20-3.92	3.49±.03	0.16±.02	4.58± .53
W	44	2.35-3.20	2.73±.03	0.18±.02	6.59± .70
M_2					
L	44	3.30-4.21	3.66±.03	0.17±.02	4.64± .49
W	49	2.65-3.30	2.88±.02	0.15±.01	5.21± .53
M_3					
L	32	3.70-4.80	4.22±.04	0.20±.03	4.74± .59
W	31	2.30-2.85	2.54±.02	0.11±.01	4.33± .55

Van Houten (1945) records the presence of Lost Cabin specimens in the Princeton collection labelled *C. angustidens* and *C. latidens*. This mislabelling is, as was the case in *Pelycodus* (see above), the result of applying a typological species concept to a lineage where species have been separated horizontally. These specimens, while nearer in size and morphology to the type of *C. latidens* than to *C. scottianus,* are clearly small variants of the Lost Cabin population of *C. scottianus* and do not indicate the presence of a small species of *Cynodontomys* in the Lost Cabin. The question can be raised, however, whether this lineage of *Cynodontomys* is too finely split. Kelley and Wood (1954) found considerable overlap in both size and dental pattern between the Lysite population of *C. latidens* and the Gray Bull population of *C. angustidens* and, therefore, considered the latter species as a synonym of the former. While it is true that considerable overlap in size does occur between the samples in this lineage and that some specimens cannot be assigned to species unless the exact horizon from which they were obtained is known, most specimens of *Cynodontomys* are accurately assignable to species on morphological grounds. For this reason I agree with McKenna (1960) in not following Kelley and Wood's (1954) treatment of *C. angustidens* as a synonym of *C. latidens*.

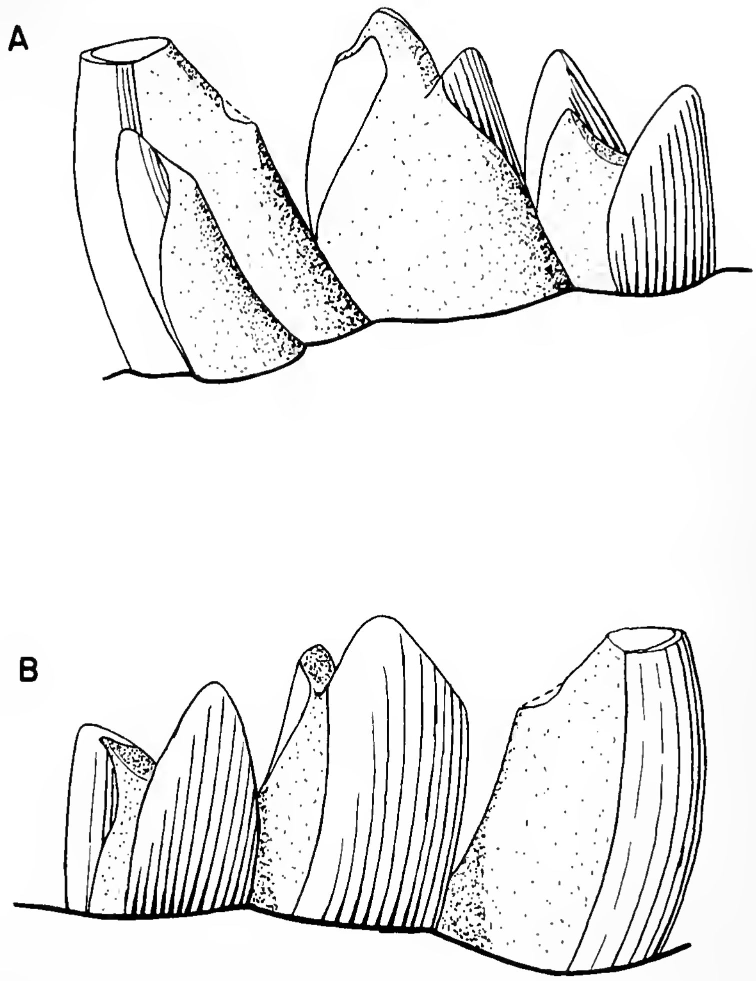

Figure 12. Ectoganus cf. *simplex*. AC 2879, fragment of right jaw with I, C, P_{1-2}. A. Internal view, X. 1.5. B. External view. X. 1.5. Areas where only dentine is present are stippled.

Order Taeniodonta
Family Stylinodontidae
Ectoganus cf. *simplex* (Cope, 1884)
Figure 12

Three specimens from the Wind River Lysite have been referred to this genus. Two of these, although recognizable as stylinodont remains, are mere fragments of enamel. The third specimen, AC 2879, consists of the front half of a right ramus containing the incisor, canine, P_{1-2}, and M_1. This specimen is figured here as unworn anterior teeth of *Ectoganus* have not been described previously. The incisor is enameled in a manner similar to that found in the related genus *Psittacotherium,* the enamel limited to the anterior and lateral surfaces of the tooth. The canine is also enameled only on the anterior and lateral surfaces. P_1 is roughly triangular in shape and consists of two cusps, a large, flattened, buccal cusp extending the entire length of the tooth and a smaller, more posterior, lingual cusp. Enamel is limited mostly to the tip and buccal side of the larger cusp and to the tip and posterior side of the smaller lingual cusp. There is no enamel in the valley between these cusps and only a little enamel on the anterior and lingual faces of the tooth. P_2 also consists of two cusps, a larger, anteriorly directed buccal cusp and a smaller, posteriorly directed lingual one. The two cusps are separated by a rather wide valley and, as in P_1, enamel is mostly limited to the crowns and lateral sides of these cusps; the area between them is almost devoid of enamel.

The taxonomy of this group will not be clear until more and better stylinodont material is recovered. The Lysite specimens are tentatively referred to *E. simplex* as their size and shape agree better with this species than with *E. gliriformis,* which is somewhat smaller. A full discussion of the relationship of these two species appears in Gazin (1936).

Order Edentata
Family Metacheiromyidae
Palaeanodon woodi,[3] new species
Figure 13

Type: AC 2766, a partial skeleton consisting of the rami of both jaws, the front half of the skull,

[3]Named for Dr. Albert E. Wood of Amherst College.

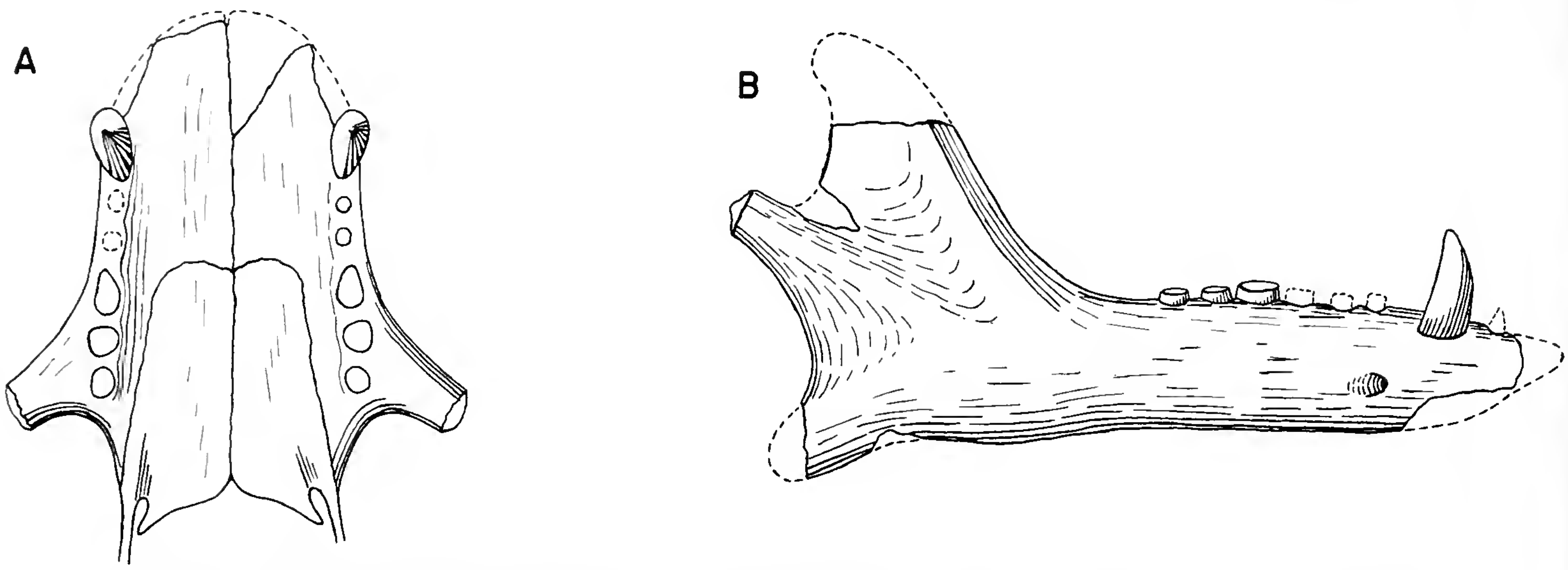

Figure 13. Palaeanodon woodi, new species. Type, AC 2766. A. Palatal view of maxilla. X. 1.5. B. External view of right lower jaw. X. 1.5.

all the thoracic and lumbar vertebrae and ribs, the right humerus, radius and ulna and the distal half of the left humerus, the distal half of the right femur, both tibiae, a fragmented pelvis, a fragment of the left scapula, and assorted foot bones, including both astragali and the right calcaneum.

Hypodigm: Type only.

Horizon and Locality: The type specimen was recovered near locality 8 in the Lysite Member of the Wind River Formation by Dr. A. E. Wood during the summer of 1960.

Diagnosis: Dental formula I ?/1, C 1/1, P-M 5/6. All cheek teeth lack enamel and are single rooted except for the central upper cheek tooth, which has two roots. Size similar to *P. parvulus* of the Clark Fork, 20 percent to 30 percent smaller than *P. ignavus* from the Gray Bull. Skeleton similar in morphology to that of *P. ignavus* in all respects except that the distal ends of the tibia and fibula are not fused.

Discussion: The primitiveness of the dentition and the separation of the fibula and tibia, a feature found in *Metacheiromys* but not in *P. ignavus,* sets this species apart from previously described members of this genus and makes it a better ancestral form for *Metacheiromys* than *P. ignavus.* The cheek teeth that are preserved lack enamel and their crowns are worn flat. The shapes of the cheek teeth differ slightly from each other (see Fig. 13).

The fossorial adaptations in the skeleton of this group are already known (Simpson, 1931) and the use of these adaptations in burrowing is evident from the preservation of this skeleton and of other specimens referred to this family.

The type specimen, although completely disarticulated except for a section of the thoracic and lumbar vertebrae, was intimately associated in a ball of matrix that was harder than the surrounding sediments and colored differently from them. This sort of preservation seems rather common in this family and indicates that these animals may have died in burrows. On decomposition and dismemberment the bones would be held in close association in the confines of the burrow. The burrow then would fill slowly with wind blown material of a finer texture than the surrounding stream deposits and this would account for the hardness of the matrix surrounding the specimen.

Order Rodentia

Wood has recently studied the smaller rodents from the Lysite Member of the Wind River Formation. The following four species are discussed thoroughly by him (Wood, 1965) and will only be listed here.

Family Sciuravidae

Knightomys depressus (Loomis, 1907)
Dawsonomys minor Wood, 1965

Family Paramyidae

Microparamys lysitensis Wood, 1962
Lophiparamys debequensis Wood, 1962

The remaining rodents from the Lysite all belong to the family Paramyidae and were recently studied by Wood (1962). However, as new material from the Lysite has been recovered since Wood's treatment of this group a few comments on each of the remaining Lysite species of rodents seems in order.

Paramys copei Loomis, 1907
Table 12, Figure 14

About 70 specimens of this species have been recovered from the Wind River Lysite. As many of these specimens were not known to Wood (1962) and as he did not separate the Lysite material from Gray Bull and Lost Cabin specimens in his statistical treatment of this species, I have presented measurements based only on the Lysite specimens (Table 12). Two of the isolated upper incisors (AC 11090 and 11279) referred to the subspecies *P. c. bicuspis* by Wood seem too small to belong to this species and are here considered as belonging to *P. excavatus*.

Wood (1962) considered two of the species Loomis (1907) found in the Lysite, *P. bicuspis* and *P. major*, as synonyms of *P. copei*, the type of which is from the Lost Cabin. He retained Loomis' separation of these species, however, by giving *P. major* and *P. bicuspis* subspecific rank under *P. copei*. Wood made the division between these subspecies arbitrarily on the basis of size but, because these two subspecies seemed to be ancestral to two subspecies of *P. copei* in the Lost Cabin that were more divergent in size, he felt that this subdivision might have some basis, perhaps indicating a difference in ecology between the two Lysite subspecies. While it is true that the Lost Cabin sample of *P. copei*, when taken as a whole, contains more variation than is normally found within a single deme, the Lysite sample does not contain as much variation, the amount observed here being more in line with that usually found within a single deme. It may be that the Lysite sample contains two sibling species as the Lost Cabin sample, with its greater variation, appears to. Until further collecting in intervening sediments is done, however, it is impossible to determine whether this is the case or whether a second species similar to *P. copei* migrated into the Wind River Basin between the time of deposition of the Lysite and Lost Cabin deposits.

In either case, the fact remains that the Lysite sample cannot be separated on any nonarbitrary basis into two groups. Furthermore, the amount

TABLE 12. Measurements of Teeth of *Paramys copei* from the Lysite of the Wind River Basin

	N	OR	M	s	V
I^1					
L	28	4.20-5.08	4.70±.04	0.20±.03	4.30± .57
W	28	2.23-3.00	2.53±.03	0.17±.02	6.80± .91
P^4					
L	6	2.82-3.10	2.97±.04	0.11±.03	3.60±1.04
W	3	3.70-3.95	3.79±.07	0.14±.05	3.59±1.44
M^1					
L	9	2.10-3.49	3.21±.08	0.23±.05	7.10±1.67
W	5	3.65-4.05	3.87±.07	0.17±.05	4.32±1.37
M^2					
L	10	3.10-3.60	3.30±.06	0.20±.04	6.06±1.36
W	7	3.42-3.95	3.79±.06	0.17±.05	4.45±1.21
M^3					
L	8	3.48-3.75	3.64±.04	0.10±.03	2.77± .69
W	7	3.30-3.47	3.38±.06	0.16±.04	4.73±1.26
I_1					
L	62	3.30-4.44	3.76±.03	0.27±.02	7.16± .64
W	63	1.90-2.60	2.21±.02	0.16±.01	7.05± .63
P_4					
L	15	2.70-3.55	3.31±.06	0.25±.05	7.54±1.37
Tal	16	2.55-3.37	2.99±.06	0.23±.04	7.53±1.33
Tri	7	2.18-2.84	2.52±.11	0.29±.08	11.31±3.02
M_1					
L	22	3.10-3.60	3.27±.03	0.13±.02	3.83± .58
Tal	21	2.80-3.38	3.12±.03	0.16±.02	4.97± .77
Tri	20	2.45-3.11	2.83±.04	0.16±.03	5.74± .91
M_2					
L	32	3.23-3.60	3.43±.02	0.10±.01	2.89± .36
Tal	27	3.15-3.93	3.45±.03	0.18±.02	5.07± .69
Tri	27	2.98-3.78	3.36±.04	0.20±.03	5.92± .81
M_3					
L	21	3.60-4.53	4.04±.04	0.22±.03	5.34± .82
Tal	18	2.90-3.61	3.15±.04	0.19±.03	5.98±1.00
Tri	19	3.00-3.88	3.32±.05	0.23±.04	6.86±1.11

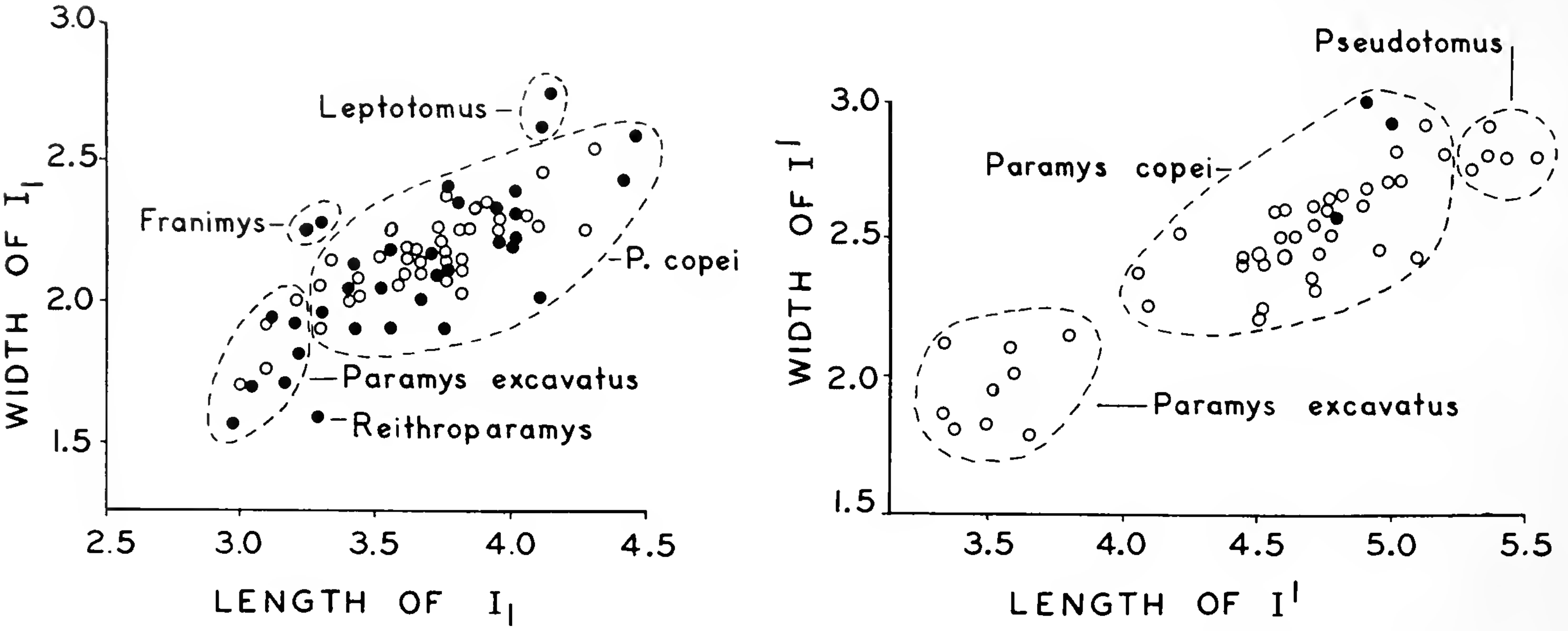

Figure 14. Scatter diagram of length-width measurements of the incisors of the larger Lysite rodents. Solid circles represent incisors associated with molar teeth. Open circles represent isolated incisors.

of variation within the Lysite sample is not so great as to suggest that more than one interbreeding population was present. The splitting of the Lysite sample of *P. copei* into two subspecies, therefore, seems uncalled for and is not followed here. It may well be that the Lysite sample actually does contain two sibling subspecies but as long as they cannot be separated morphologically from one another, the sample should be treated as a single population.

Paramys excavatus Loomis, 1907
Table 13, Figure 14

About 30 specimens, including the type of this species, have been recovered from the Lysite of the Wind River Basin. The measurements for these specimens are somewhat smaller than those given by Wood (1962) for *P. e. excavatus,* a subspecies found in both Lysite and Lost Cabin horizons but this is to be expected as *P. excavatus* appears to have been increasing in size with time. *P. excavatus* is most similar in size and molar pattern to *Reithroparamys atwateri* and to *Franimys lysitensis,* both of which occur in the Lysite and, as noted by Wood, the Lysite and Gray Bull members of these three genera would be considered congeneric if they had not given rise to the more divergent middle Eocene forms with which they are generally grouped. The separation of these three genera becomes increasingly difficult in older deposits and, as Wood points out, *Paramys excavatus obliquidens* of the Gray Bull could be assigned to either *Reithroparamys* or *Franimys.* By Lysite time, however, these genera had diverged in morphology to the extent that their lower teeth can be separated from each other without too much difficulty. Since the upper dentition of *Reithroparamys atwateri* is unknown and too few upper teeth of *P. excavatus* and *Franimys lysitensis* are known to give a true picture of the variation possible within these species, the accurate identification of isolated upper molars from the Lysite will not be possible until more material is recovered.

Reithroparamys atwateri (Loomis, 1907)
Table 13, Figure 14

Only two specimens from the Lysite of the Wind River Basin are referrable to this species. One, AMNH 15610, consists of a right ramus with M_{2-3} and has been discussed by Wood (1962). The other specimen, AC 4395, is an isolated right M_1. The molars of both specimens agree with the Gray Bull type of this species in possessing a well developed ridge between the mesolophid and entoconid, a feature that is not found in the Lysite members of *Paramys excavatus* with which this species might be confused. The Lysite specimens also agree with the type in lacking features common to the middle Eocene members of this genus, notably a separation of the entoconid from the hypoconulid and the presence of a ridge extending from the entoconid towards the hypoconid.

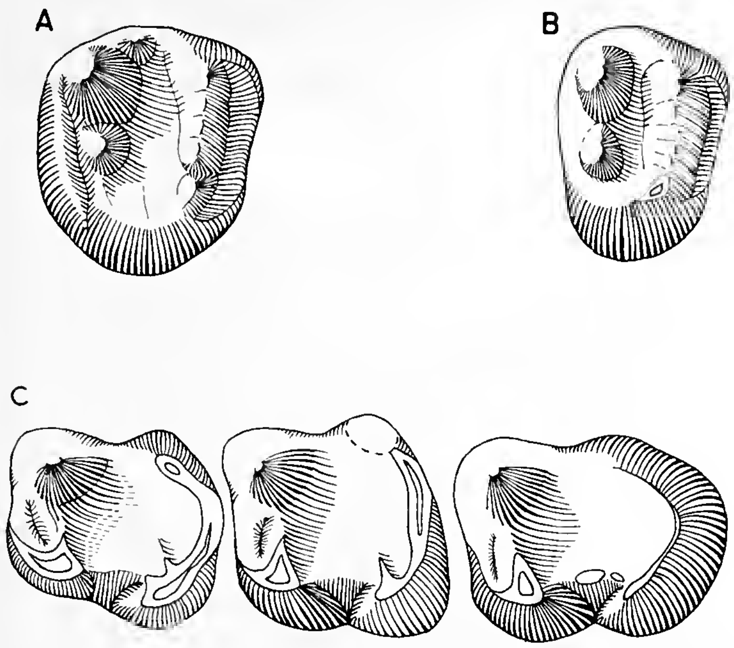

Figure 15. Franimys lysitensis, new species. A. AC 4394, right M^1. Crown view. X 7. B. AC 4394, right P^4. Crown view. X 7. Type, AC 2536, left M_{1-3}. Crown view. X 7.

Franimys lysitensis,[4] new species
Table 13, Figures 14 and 15

Type: AC 2536, a pair of lower jaws, the right with M_{2-3}, the left with M_{1-3}.

Hypodigm: Type and AC 4394, an isolated right P^4 and an isolated right M^1.

Horizon and Locality: The type was collected by the author from locality 6 during the summer of 1962. The referred specimen was recovered during the summer of 1963 from an ant hill at locality 2. Both are from the Lysite Member of the Wind River Formation.

Diagnosis: The lower molars of *F. lysitensis* can be distinguished from those of *Reithroparamys atwateri* by their lack of a ridge connecting the mesostylid with the entoconid. They differ from the Lysite specimens of *Paramys excavatus* in the weakness of the mesostylid and the anterior cingulum, and in the indistinctness of the trigonid basin. The lower jaw is about 20 percent larger than the type of *F. amherstensis* from the Gray Bull and the upper teeth are about 20 percent larger than the type of *F. buccatus* from the San José Formation of New Mexico. The paracone of P^4 in the referred specimen is larger than in other species of *Franimys* but the generic position of this tooth and of M^1 is clearly indicated by the poor development of lophs, and the width of the mesostyle on M^1. The upper teeth are of the proper size to be associated with the lower jaws.

[4]Named for the Lysite Member of the Wind River Formation.

Discussion: The discovery of *F. lysitensis* extends the range of this genus, known previously from only the Gray Bull, into Lysite time.

Pseudotomus coloradensis Wood, 1962
Figures 14 and 16

AC 2569, an isolated right M^2 from locality 6, agrees in size and pattern with the type of *P. coloradensis.* Although this species has not previously been found in the Lysite of Wyoming, it has been recorded in the Lost Cabin deposits in the Wind River Basin and in the Lysite equivalent in the Debeque Formation of Colorado. Several isolated upper incisors from the Lysite may also belong to this species. Some of these, catalogued as PU 16566, were, in fact, identified as *P. coloradensis* by Wood but were not mentioned in his paramyid monograph. Measurements of these incisors and of others of similar size are represented in Figure 15. AMNH 14712 and CNHM 16142, isolated upper incisors referred by Wood (1962) to *P. coloradensis,* seem too small to belong to this species, measuring 4.62 mm by 3.03 mm and 4.58 mm by 3.42 mm respectively.

Leptotomus loomisi Wood, 1962
Figure 14

AC 2568, a right ramus, edentulous except for the root of the incisor, is referred here as the

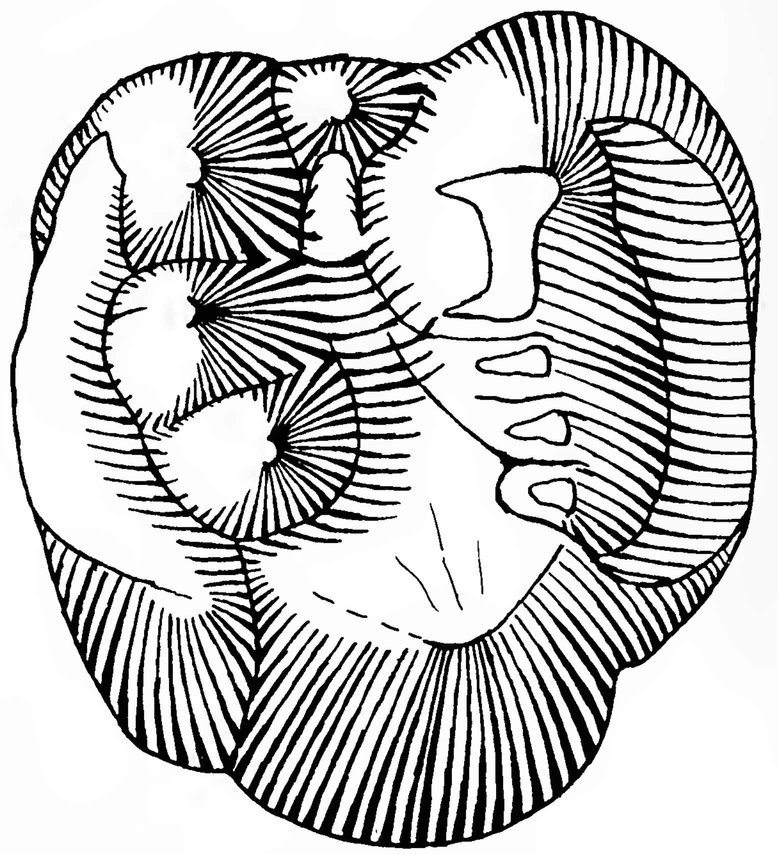

Figure 16. Pseudotomus coloradensis. AC 2569, right M^2. Crown view. X 15.5.

TABLE 13. Measurements of Rodent Teeth from the Lysite of the Wind River Basin

	Franimys lysitensis			*Paramys excavatus*			*Reithroparamys atwateri*	
	AC 4394	AC 2536 Type right	left	N	OR	M	AMNH 15610	AC 4395
P^4								
L	2.40	—	—	—	—	—	—	—
W	3.30	—	—	—	—	—	—	—
M^1								
L	3.10	—	—	—	—	—	—	—
W	3.50	—	—	—	—	—	—	—
I_1								
L	—	3.25	3.35	10	2.97-3.20	3.10	3.28	—
W	—	2.25	2.08	10	1.57-2.00	1.80	1.59	—
P_4								
L	—	—	—	1	—	3.10	—	—
Tal	—	—	—	1	—	2.40	—	—
Tri	—	—	—	1	—	1.90	—	—
M_1								
L	—	—	2.90	4	2.50-2.80	2.65	—	2.52
Tal	—	—	2.81	4	2.37-2.68	2.49	—	2.39
Tri	—	—	2.38	4	2.15-2.34	2.25	—	2.18
M_2								
L	—	3.00	2.97	6	2.50-2.80	2.63	2.80	—
Tal	—	3.17	3.19	6	2.65-2.88	2.74	2.78	—
Tri	—	2.90	2.90	6	2.50-2.83	2.64	2.45	—
M_3								
L	—	3.60	3.63	6	2.91-3.43	3.17	3.60	—
Tal	—	2.83	2.87	6	2.40-2.83	2.51	2.62	—
Tri	—	2.85	2.88	6	2.40-2.93	2.58	—	—

incisor root agrees well with the type specimen in shape and size, measuring 4.14 mm by 2.75 mm in cross section. Both this specimen and the type are from locality 6c. Upper incisors of this species are unknown and although the upper incisors listed under *Pseudotomus coloradensis* agree with *L. loomisi* in size, it seems doubtful that they belong here as the upper incisors in other species of *Leptotomus* are, as shown in the illustrations in Wood (1962), markedly different in cross section from those of either *Pseudotomus* or *Paramys.* An exception to this statement is found in the type of *L. costilloi,* a species from the Lost Cabin equivalent of Huerfano Formation of Colorado, where the upper incisor is more like that of *Pseudotomus* than that of any other member of the genus *Leptotomus.* The upper molars of *L. costilloi* are also more like *Pseudotomus* in having two cusps in the metaloph rather than only one as do other species of *Leptotomus.* Although the shape of the lower incisor of *L. costilloi* does agree well with *Leptotomus* rather than *Pseudotomus,* these other differences suggest that *L. costilloi* may be incorrectly assigned as to genus.

Order Carnivora

Family Miacidae

Didymictis protenus (Cope, 1874)

There are nearly two dozen specimens of this genus in the Amherst, American Museum, and Princeton collections from the Wind River Lysite. All appear to belong to one species, here recognized as *D. protenus* on the authority of Dr. Giles MacIntyre who is currently engaged in a revision of this group. The specimens are generally fragmentary and add nothing to our current knowledge of this genus.

Viverravus lutosus Gazin, 1952

Table 14, Figure 17

Nearly a dozen fragmentary jaws, all representing a small species of *Viverravus,* have been recovered from the Lysite of the Wind River Basin. These are AC 2577, 2591, 2748, 2825, 2828, PU 13248, and three unnumbered specimens in the Princeton Collection. These specimens are all intermediate between *V. lutosus* from the La Barge and *V. acutus* from the Sand Coulee in size as well as in age but, as the Lysite sample

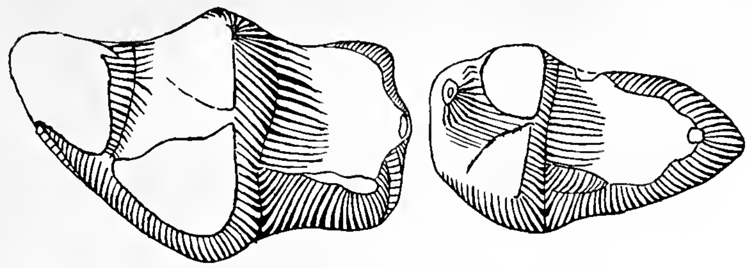

Figure 17. Viverravus lutosus. AC 2577, left lower jaw with M_{1-2}. Crown view. X 7.8.

is closest to *V. lutosus* in both size and molar pattern, it is referred to this species. Van Houten (1945) records specimens from the Lysite labelled as *V. dawkinsianus* and *V. acutus* as present in the Princeton collection. The specimens that these records are based on are nearer to the type of *V. lutosus* in size and pattern than they are to either of the former species. Isolated upper molars from the Lysite referred to *V. lutosus* resemble those figured by Matthew (1915a) for *V. acutus* but are slightly larger. The intermediate position of the Lysite sample between the types of *V. acutus* and *V. lutosus* suggests an ancestor-descendent relationship between these two species.

Viverravus gracilis (Marsh, 1872)
Table 14, Figure 18

AC 4391, an isolated left M_1 from locality 4, is most nearly assignable to *V. gracilis.* The talonid of this tooth has a marked cingulum behind the hypoconid such as is found only in the miacid genera *Didymictis* and *Viverravus* and the wide separation of the paraconid from the metaconid rules out the inclusion of this specimen in the former genus. The specimen is clearly larger than contemporary specimens of *V. lutosus* (see Table 14) and much smaller than the large Gray Bull species, *V. politus.* It comes closest to the Lost Cabin species, *V. dawkinsianus,* in size. The Lysite specimen differs from the type of *V. dawkinsianus,* however, in the height of the trigonid, the protoconid rising 5.9 mm from the base of the enamel in the type of *V. dawkinsianus* but only 5.3 mm in this specimen. Of what significance this difference may be cannot be determined from the number of specimens currently available for study. Robinson (1966) considers *Viverravus dawkinsianus,* the type of which is from the Lost Cabin of the Wind River Basin, a probable synonym of the Bridgerian species *V. gracilis,* a position with which I agree. On the basis of size alone, it would seem that at least three lineages of *Viverravus* were present in the lower Eocene, one containing *V. acutus* and *V. lutosus,* a second one containing *V. gracilis,* and a third one containing *V. politus.* The Four Mile sample of *Viverravus,* which, according to McKenna (1960) is more progressive in molar pattern towards *V. gracilis* than is the Gray Bull sample of *V. acutus,* may not belong to *V. acutus* where McKenna has placed it but rather to the *V. gracilis* lineage. This cannot be determined positively until more specimens of this genus are recovered from deposits of Gray Bull age.

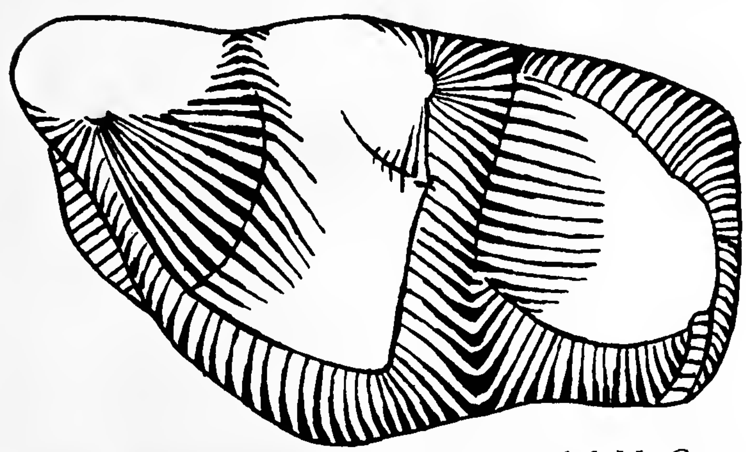

Figure 18. Viverravus gracilis. AC 4391, left M_1. Crown view. X 13.

Miacis latidens Matthew, 1915a
Table 15, Figure 19

Three specimens have been recovered from the Wind River Lysite deposits which differ only slightly in size from the type of *M. latidens.* The type of this species is from deposits of Lost Cabin age as are all but one of the other specimens previously referred to this species. The exception is AMNH 15177-8 from the Gray Bull of the Big Horn Basin which was figured by Matthew (1915a) and considered by him as possibly a primitive mutant of *M. latidens.* The Lysite specimens here referred to this species are generally more primitive than the Lost Cabin sample. They are slightly smaller in size, and in the one specimen where M_3 is preserved, this tooth is not as reduced as in the Lost Cabin specimens. Where the anterior portion of the jaw is preserved, the

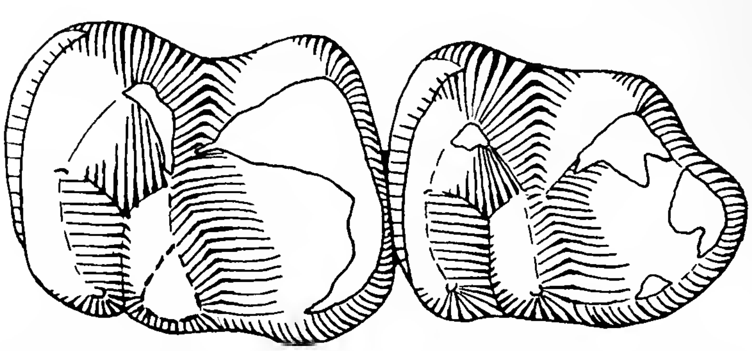

Figure 19. Miacis latidens. AC 4327, fragment of right lower jaw with M_{2-3}. Crown view. X 7.

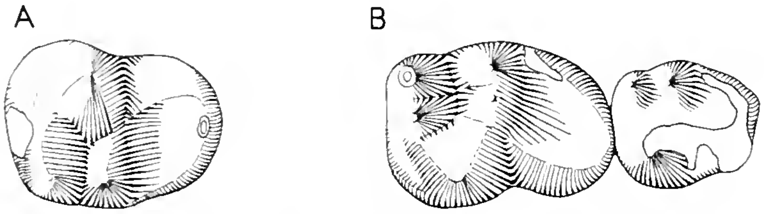

Figure 20. Miacis exiguus. A. AC 2592, right M_2. Crown view. X 6. B. PU 17696, left M_{2-3}. Crown view. X 6.

Lysite specimens lack the diastema between P_2 and P_3 that is found in the Lost Cabin members of this species. Although, at present, specimens can be assigned to either Lost Cabin or Lysite age on the basis of these differences between the two samples, separation of these samples taxonomically does not seem advisable. The Gray Bull specimen referred to this species is more like the type specimen in the reduction of the third molar than is the Lysite specimen in Figure 19, an indication that the differences observed between the Lysite and Lost Cabin samples may be due to individual variation and not be of phyletic significance.

Miacis exiguus Matthew, 1915a
Table 15, Figure 20

This species, represented by eight fragmentary specimens, is the commonest member of this genus in the Lysite. The best of these specimens is PU 17696. This specimen and AC 2592, are illustrated (Fig. 20) to give an indication of the variation that can occur in a single deme of this species. The Lysite specimens, although of the same size as the type of this species, which is from the Gray Bull, show advances towards the Bridgerian members of this genus. This is particularly evident in the further reduction in the size of M_3 and in the more complete development of a lingual shelf around the bases of the upper molars. It may be that the Lysite and Lost Cabin specimens

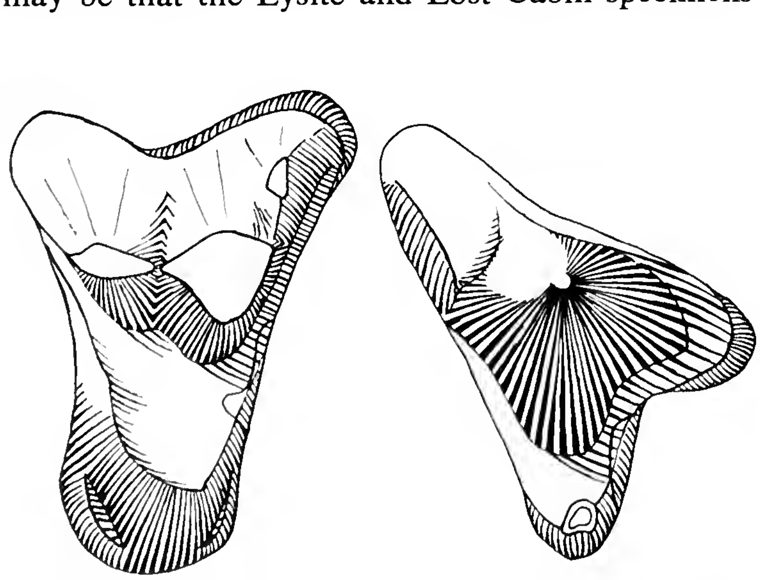

Figure 21. Miacis jepseni, new species. Type, PU 16440, right maxilla with P^4-M^1. Crown view. X 9.

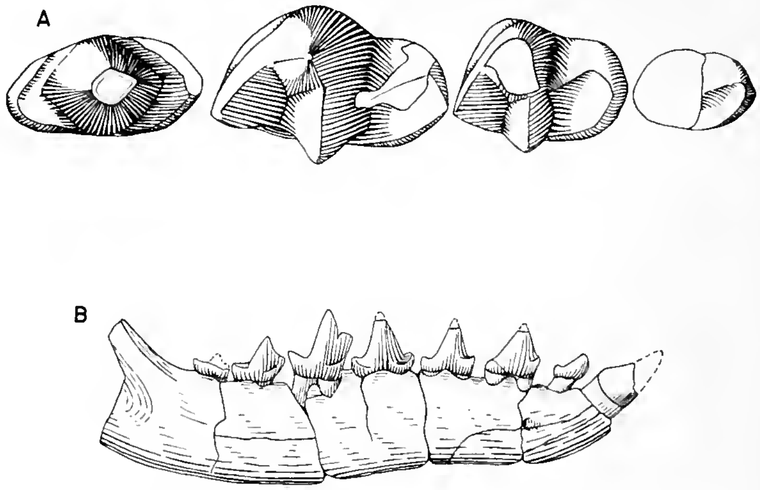

Figure 22. Miacis jepseni, new species. Type PU 16440, right lower jaw with C-M_3. A. Crown view of P_4-M_3. X 5. B. External view X 1.7.

referred to this species could be separated taxonomically from the Four Mile and Gray Bull specimens of *M. exiguus* on the basis of this difference in molar pattern but, as in the case of *M. latidens,* not enough specimens referrable to this species have been recovered to indicate whether the differences observed between samples are due to phyletic changes within the species or to individual variation.

Miacis jepseni,[5] new species
Table 15, Figures 21 and 22

Type: PU 16440, consisting of a right ramus with the canine and P_1-M_3, a left ramus with the canine and P_{1-3}, a right maxilla with P^4-M^1, and a left maxilla with P^3-M^1 and parts of the last two molars. The crowns of left P_4-M_3 are present but are imbedded in matrix in semiocclusion with the left maxilla.

Hypodigm: Type only.

Horizon and Locality: The type specimen was collected by the Princeton University expedition of 1931 from the Lysite Member of the Wind River Formation. The label with the specimen gives the locality as "Red badlands west of Cottonwood Cr., N. of Lost Cabin, Wyo." This is locality 6.

Diagnosis: M. jepseni differs from previously described species of *Miacis* in its smaller size, narrower talonids on the lower molars, absence of a hypoconid on P_4, less inflated M_2, less developed posterior lingual cingulum on M^1 and more lingual position of the protocone on M^1.

[5]Named for Dr. Glenn L. Jepsen of Princeton University.

TABLE 14. Measurements of Teeth of some Early Eocene Species of *Viverravus*

	V. acutus GRAY BULL AMNH 16112 TYPE	*V. lutosus* LYSITE N	OR	M	*V. lutosus* LA BARGE† USNM 19339 TYPE	*V. dawkinsianus* LYSITE AC 4391	*V. dawkinsianus* LOST CABIN AMNH 4788 TYPE
M_{1-2}	7.80_{a}	3	8.67-8.87	8.75	8.7	—	9.85
P_4							
L	4.30	4	4.40-4.80	4.53	4.9	—	5.30
W	1.65	5	1.86-1.95	1.92	1.8	—	1.88
M_1							
L	4.55_{a}	5	4.84-5.05	4.93	5.1	5.65	5.60
W	2.70	5	2.85-3.05	2.94	2.9	3.20	3.35
M_2							
L	3.25	3	3.82-3.97	3.88	—	—	4.25
W	1.70	3	2.20-2.49	2.30	—	—	2.50

†Measurements of the type of *V. lutosus* are from Gazin (1952).

TABLE 15. Measurements of Teeth of *Miacis* from the Lysite

	M. jepseni PU 16440 TYPE right	left	*M. exiguus* N	OR	M	*M. latidens* N	OR	M
P^3								
L	—	3.2	—	—	—	—	—	—
W	—	—	—	—	—	—	—	—
P^4								
L	4.4	4.5	—	—	—	—	—	—
W	5.2	—	—	—	—	—	—	—
M^1								
L	3.7	3.8	2	4.75-5.10	4.92	—	—	—
W	3.2	—	2	6.60	6.60	—	—	—
M^2								
L	—	2.1	—	—	—	—	—	—
W	—	—	—	—	—	—	—	—
M^3								
L	—	1.5_{a}	—	—	—	—	—	—
W	—	2.9_{a}	—	—	—	—	—	—
P_1-M_3	23.9	—	—	—	—	—	—	—
P_{1-4}	14.0	—	—	—	—	—	—	—
M_{1-3}	9.7	—	—	—	—	—	—	—
P_1								
L	1.8	1.8	—	—	—	—	—	—
W	0.95	0.95	—	—	—	—	—	—
P_2								
L	3.0	2.85	—	—	—	—	—	—
W	1.35	1.3	—	—	—	—	—	—
P_3								
L	3.35	3.2	—	—	—	—	—	—
W	1.6	1.6	—	—	—	—	—	—
P_4								
L	3.6	—	—	—	—	—	—	—
W	1.8	—	—	—	—	—	—	—
M_1								
L	4.4	—	2	5.00	5.00	1	—	5.85
W	2.4	—	2	3.20-3.35	3.27	1	—	3.85
M_2								
L	3.2	—	3	3.42-3.60	3.51	2	4.5-4.7	4.6
W	2.1	—	3	2.50-2.70	2.63	2	3.7-3.9	3.8
M_3								
L	2.1	—	1	—	2.35	1	—	4.3
W	1.55	—	1	—	2.00	1	—	3.2

TABLE 16. Measurements of Teeth of Early Eocene Species of *Uintacyon*

	Uintacyon masseretericus					*Uintacyon asodes*	
	GRAY BULL		LYSITE			LA BARGE	NEW FORK
	AMNH† 4250 TYPE	AMNH† 16750	AMNH† 15647	AC 2953 RIGHT	AC 2953 LEFT	USNM‡ 19351 TYPE	USNM‡ 22468
P_1-M_3	—	—	—	32.6	32.1	35.0	—
P_1-P_4	—	—	—	17.3	17.3	18.1	—
M_1-M_3	—	—	—	15.3	14.8	17.0	—
P_4							
L	6.0	—	5.3	5.5	5.7	6.1	5.8
W	2.9	—	—	3.1	3.4	3.3	3.5
M_1							
L	6.9	7.0	7.3	7.1	7.1	7.5	7.9
W	4.8	4.1	—	5.0	4.9	5.5	5.9
M_2							
L	4.2	4.5	4.6	5.0	4.8	5.9	6.0
W	3.6	3.2	3.8	4.3	4.4	—	5.1

†Measurements of American Museum specimens are from Matthew (1915a).
‡Measurements of U.S. National Museum specimens are from Gazin (1952, 1962).

Discussion: M. jepseni is the smallest and most primitive species of *Miacis* known; the primitiveness of the dentition is shown by the relatively uniform size of the lower teeth, as contrasted to other species of *Miacis* where M_1 and P_4 are greatly increased in size, whereas $M_{2\text{-}3}$, especially the trigonids, are reduced. There seem to have been three lineages of *Miacis* present in Wyoming during the early Eocene. The two larger lineages, containing *M. latidens* and *M. exiguus,* were increasing in tooth size during the early Eocene and therefore, do not seem ancestral to the smaller Bridgerian members of this genus. *M. jepseni* could very well have been ancestral to the small Bridgerian species *M. parvivorus,* which it approaches in size as well as in the poor development of an accessory cusp on P_4.

Uintacyon masseretericus (Cope, 1882)
Table 16, Figure 23

Two nearly complete lower jaws of this species probably belonging to the same individual have been recovered from locality one. P_1 is two rooted and M_3 appears to have had but a single root in both jaws. Only two other specimens of *U. masseretericus* of Lysite age are known. These are AMNH 15647 from the Big Horn Basin which was previously referred to *U. masseretericus* by Matthew (1915a), and AMNH 20464, from the Wind River Lysite but not mentioned by Matthew (1915a). The Lysite specimens fall between the type of *U. masseretericus* from the Gray Bull and the type of *U. asodes* from the La Barge in size (see Table 16) but are nearer to the former species in size of M_2 and in the single rooted condition of P_1. This intermediacy of the Lysite specimens in size and pattern between *U. masseretericus* and *U. asodes* indicates that *U. asodes* is descended from *U. masseretericus.*

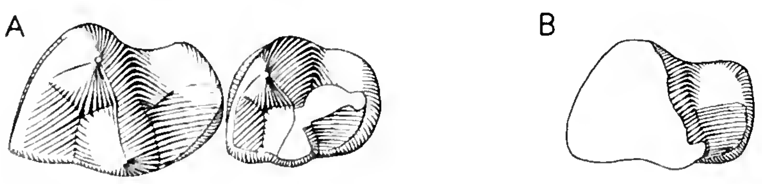

Figure 23. Uintacyon from the Lysite. A. *Unitacyon masseretericus.* AC 2953, right $M_{1\text{-}2}$. Crown view. X 3. B. *Uintacyon* sp. AC 4398, right M_1. Crown view. X 3.

Uintacyon sp.
Table 16, Figure 23

AC 4398, a fragment of right ramus with only the talonid of M_1 preserved is believed to represent a new species of *Uintacyon.* The specimen, although extremely fragmentary, shows the median ridge on the talonid that is characteristic for this genus. This tooth which measures 6.38 mm by 4.40 mm at its base is much smaller than those of other early Eocene species of *Uintacyon* (Table 16). The occurrence of a small species of *Uintacyon* in early Eocene deposits is not surprising as some middle Eocene species in this genus, notably *U. jugulans* and *U. edax,* are smaller in size than the only known Lost Cabin species of *Uintacyon,* *U. asodes,* a species that seems to have been increasing in size with time. Although this specimen represents a previously undescribed species, it is not described here because the known material is fragmentary, and is not morphologically separable from the smaller Bridgerian members of this genus.

Vulpavus cf. *canavus,* Matthew, 1915a

Matthew (1915a) records specimens of both *V. canavus* and *V. australis* from the Lysite but only two specimens of the latter, AMNH 12772 and 12773, are from the Wind River Basin. Three other specimens are known from the Lysite of the Wind River Basin, AC 3422, a jaw fragment with M_3, and AC 4397 and PU 18164, isolated M_1's. Whether the Lost Cabin species, *V. canavus,* the San José species, *V. australis,* or the La Barge species *V. asius,* is represented by these specimens cannot be determined due to their fragmentary nature. Indeed, the specimens referred to these three species are so similar in size and molar pattern that the validity of two of these species is questionable. I am for the present referring the Lysite material to *V. canavus* as this species has priority over the other two species of *Vulpavus* mentioned here and as the type of this species is from the neighboring Lost Cabin deposits of the Wind River Basin.

Vulpavus sp.
Figure 24

An isolated M^2, catalogued as AC 2454, closely resembles USNM 22473, a specimen from the Bitter Creek equivalent of the Gray Bull figured by Gazin (1962) and referred to by him as cf. *Vulpavus sp.* I agree with Gazin that these upper teeth represent *Vulpavus,* noting especially the completeness of the basal cingulum around the lingual side of the upper molars, a feature not found in other miacid genera. These specimens undoubtedly represent a new species and lineage of *Vulpavus* for, as Gazin points out, they are distinctly smaller than the other early Eocene members of this genus. The Amherst specimen is from locality 2 and is the first specimen of this species from deposits of Lysitean age. The specimen has an anteroposterior diameter of 4.2 mm and a transverse diameter of 5.8 mm.

Order Condylarthra

Van Valen (1963) is followed here in the consideration of the Tillodontia as a suborder of Condylarthra, and the families Arctocyonidae and Mesonychidae are also referred here on his authority (1966:102). Gazin (1959) included *Apheliscus* in the Pantolestidae, but McKenna (1960) referred this genera to the Hyopsodontidae, a position with which I agree for the reasons presented by McKenna (1960: 110 to 114), and after a comparison of the lower dentition of *Apheliscus* with *Phenacodaptes* and *Helaletes.*

Family Esthonychidae
Esthonyx bisulcatus Cope, 1874
Table 17

Since Kelley and Wood (1954) reviewed the Lysite material of *Esthonyx,* 12 more fragmentary specimens have been recovered. All fall within the size range given by Gazin (1953) for the Gray Bull sample of *E. bisulcatus.* No specimens referrable to *E. acutidens* have been found, although Gazin felt that this species might also be present in the Lysite and listed it as such in his 1953 paper.

The mean size of the few teeth known from the

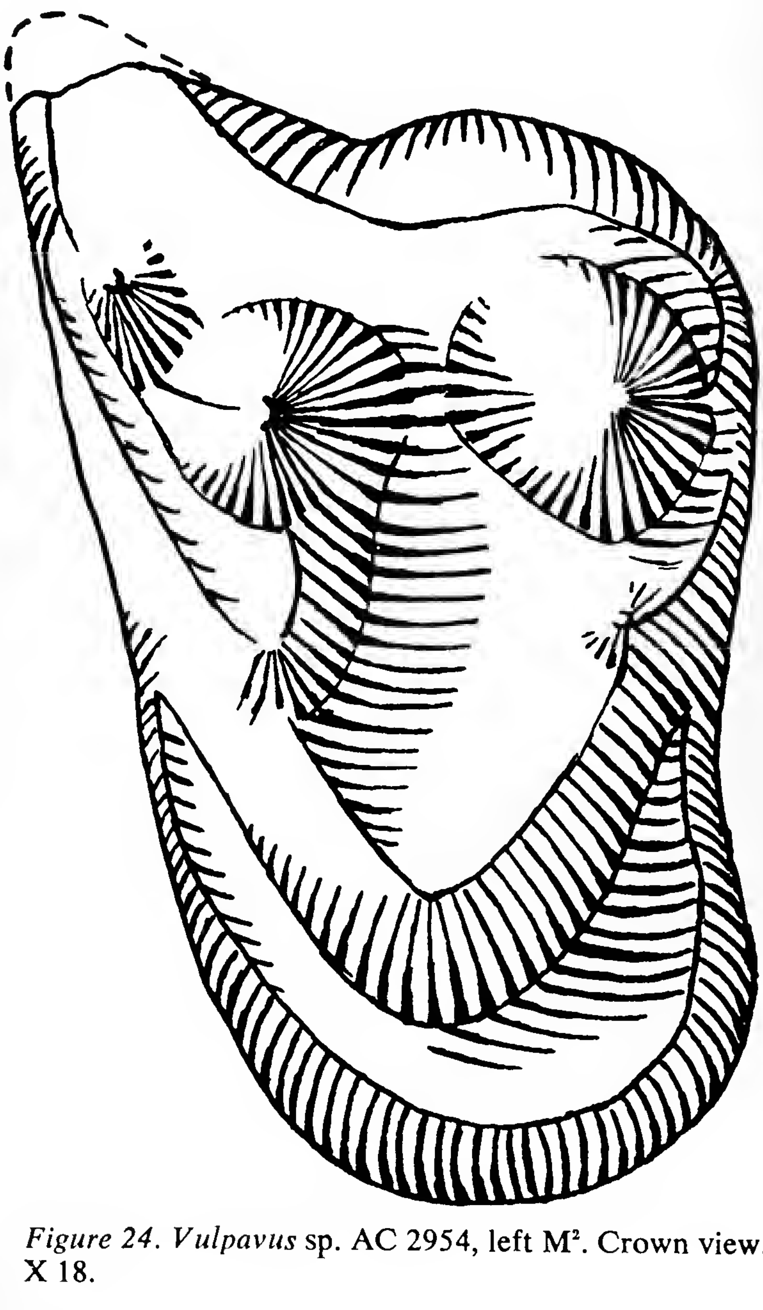

Figure 24. Vulpavus sp. AC 2954, left M^2. Crown view. X 18.

Lysite is smaller than that for the Gray Bull sample from the Big Horn Basin (Table 17). That the Lysite population of *Esthonyx* averaged smaller in size than the Gray Bull population as has been suggested by Kelley and Wood is, however, not supported by statistical comparison of these two samples (by student's test). The recovery of a small population of *Esthonyx bisulcatus* in the Lysite would be surprising as this genus increased in size during the early Eocene.

Family Arctocyonidae

Thryptacodon loisi Kelley and Wood, 1954

An isolated M_2 in the Amherst collection, AC 2822, is the second known specimen referrable to this species. It agrees with the type in shape as well as in size but came from locality 2, whereas the type probably came from locality 6. Kelley and Wood (1954: 346) described the type specimen as consisting of "three jaw fragments, each containing a tooth. The teeth represented are LP_4, LM_2, RM_3." The tooth described as the left P_4 was glued backwards on a fragment of the right ramus and resembles a left P_3 rather than a P_4. Whether this tooth belongs with the rest of the type specimen is open to question as the fragment of left ramus that is preserved does not contain the roots of any of the premolars and as P_3's in other genera, particulary *Pelycodus,* are very similar in size and shape to this tooth.

Anacodon ursidens Cope, 1882

AC 3382, collected by Loomis and mentioned by Kelley and Wood (1954), is still the only specimen belonging to this genus reported as recovered from the Wind River Lysite deposits. However, the matrix on this specimen resembles that on Gray Bull specimens from the Big Horn Basin and is unlike the usual matrix found on Lysite specimens. Although the specimen is associated with a Wind River label, no record of the existence of specimens of *Anacodon* from the Wind River Basin can be found in Loomis's card catalogue, whereas cards for *Anacodon* from the Big Horn Basin exist and the specimens that go with them are missing. Although the recent expeditions of Yale University have recovered specimens of this species in the Lysite deposits of the Big Horn Basin, its presence in the deposits of the Wind River Basin must remain in doubt.

Family Mesonychidae

Hapalodectes leptognathus (Osborn and Wortman, 1892)

Figure 25

Two species of *Hapalodectes* have been described from the Eocene of Wyoming, *H. compressus* from the Lysite of the Wind River Basin and *H. leptognathus* from the Gray Bull of the Big Horn Basin. These species differ primarily in the depth of the lower jaw, and Szalay and Gould (1966: 153) do not consider this variation sufficient to warrant recognition of more than one species. *H. compressus* is therefore considered to be a synonym for *H. leptognathus.*

Six specimens of *H. leptognathus* have been recovered from the Wind River Lysite deposits. These include the three fragmentary rami in the American Museum collections mentioned by Matthew (1915a) and three specimens in the col-

TABLE 17. Measurements of Teeth of *Esthonyx bisulcatus*

	LYSITE, WIND RIVER BASIN			GRAY BULL, BIG HORN BASIN†		
	N	OR	M	N	OR	M
M^2						
L	2	8.10- 8.20	8.15	—	—	—
W	2	10.40-12.70	11.55	—	—	—
P_4						
L	2	7.50- 7.90	7.70	—	—	—
W	2	4.90- 5.30	5.10	—	—	—
M_1						
L	2	7.35- 7.45	7.40	60	7.0-9.3	8.01
W	1	—	6.20	—	—	—
M_2						
L	4	8.00- 8.63	8.16	62	7.3-9.1	8.30
W	3	6.00- 6.95	6.62	—	—	—
M_3						
L	4	10.20-12.05	10.67	—	—	—
W	4	5.30- 6.40	5.74	—	—	—

†Statistics for the Gray Bull sample are from Gazin (1953).

lections of Princeton University, PU 18161, 16181, and 17698. The latter specimen consists of edentulous fragments of both rami, limb fragments including the distal end of the humerus, and a fragmentary left maxilla, containing M^{2-3}, the first known maxilla for this genus. M^3 has a maximum length along the buccal side of 4.8 mm and a width of 3.6 mm while M^2 measures 5.7 mm and 5.2 mm respectively. M^3 is reduced in size, but although the paracone is smaller than the metacone on M^3, it is not vestigial. The lingual portion of M^2 has a large protocone and appears to have a smaller, separate cusp that may be the hypocone. Between the protocones of the upper molars and premolars there are pits in the palate to accommodate the protoconids of the lower dentition, and a fragment of the protoconid of M_3 is imbedded in matrix in the pit between M^2 and M^3. There is a groove in the hypocone of M^2, presumably caused by wear from the paraconid of M_3. Matthew (1909) saw no evidence of wear in the lower molars of this genus and concluded that anteroposterior action between the upper and lower jaws did not occur. A deep groove cut into M^2 between the protocone and the paracone appears to have been caused by wear with M_3 and indicates that some anteroposterior movement of the jaws was possible.

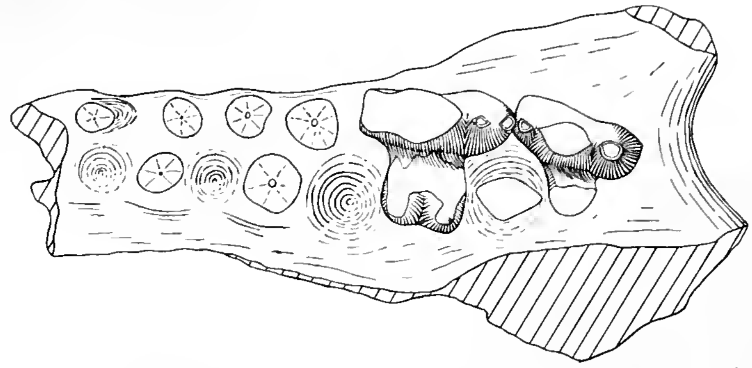

Figure 25. Hapalodectes leptognathus. PU 17698, left maxilla with M^{2-3}. Crown view. X 2.6.

Family Hyopsodontidae
Apheliscus insidiosus (Cope, 1874)
Figure 26

A fragment of a left ramus from locality 7, catalogued as AC 2505, is the only known specimen of this genus from the Lysite. This specimen, which contains only M_1 and the trigonid of M_2, is indistinguishable in both size and crown pattern from AMNH 15696, a Gray Bull specimen figured by Matthew (1918) as representative of *A. insidiosus.*

Hyopsodus powellianus Cope, 1882
Tables 18 and 19, Figures 27 and 28

A study of all available material from the Wind River Lysite belonging to this genus confirms the opinion of Kelley and Wood (1954) that three species of *Hyopsodus* are present in these deposits. The largest species, represented by the remains of about 200 individuals, was designated *H. powellianus* by Kelley and Wood as it had been earlier by Matthew (1915b). Gazin (1962: 64) noted that; "the type of *H. powellianus* is from an unknown horizon in the Big Horn Basin, and while it may well have come from the Lysite horizon, it could also be from the Lost Cabin level and represent a small individual of the form Matthew called *H. walcottianus.*" Gazin further noted that *H. lemoinianus,* while placed in synonymy with *H. mentalis* by Matthew (1915b), probably belonged to the larger Lysite species and has page priority over *H. powellianus.* He rejected this name, however, as the type of *H. lemoinianus* also came from an unknown horizon in the Big Horn Basin and instead used Loomis's (1905) name of *H. browni,* which is the earliest name applied to this large species of *Hyopsodus* where the exact horizon from which the type specimen was collected is known. The type of *H. lemoinianus* is indeterminate both to species and horizon (Fig. 27), but the type of *H. powellianus* could only have come from beds of Lysite age. Cope's expedition of 1881, which collected the type specimen of *H. powellianus,* never got into beds of Lost Cabin age in the Big Horn Basin, as evidenced by the absence of *Lambdotherium, Eotitanops* and *Hyrachyus* among the specimens they recovered (Cope, 1882: 190). As none of the specimens of *Hyopsodus* recovered from Gray Bull deposits are as large as the type of *H. powellianus* (Fig. 27), this specimen must be from deposits of Lysite age. This identification of the

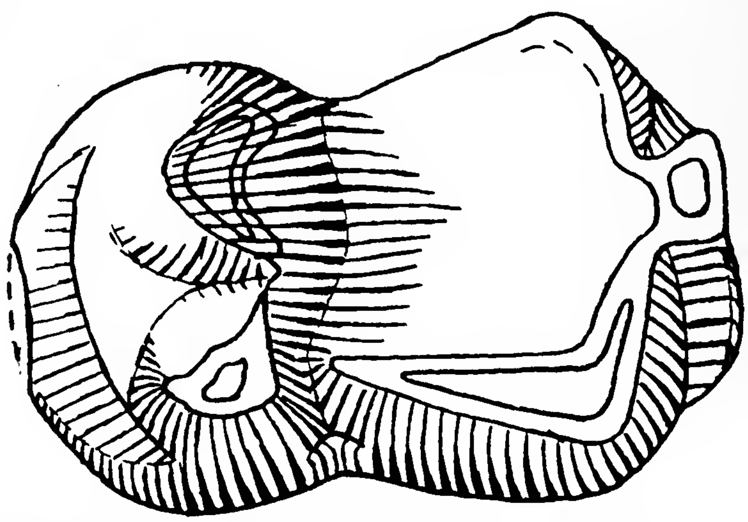

Figure 26. Apheliscus insidiosus. AC 2505, left M_1. Crown view. X 26.

TABLE 18. Measurements of Teeth of *Hyopsodus powellianus* from the Lysite of the Wind River Basin

	N	OR	M	s	V
P^3					
L	8	4.00-4.75	4.36±.08	0.24±.06	5.50±1.38
W	8	3.95-4.63	4.23±.10	0.27±.07	6.38±1.60
P^4					
L	16	3.67-4.50	4.03±.06	0.24±.04	5.96±1.05
W	16	4.70-5.80	5.26±.09	0.36±.06	6.84±1.21
M^1					
L	30	4.40-5.33	4.87±.04	0.24±.03	4.93± .64
W	30	5.60-7.00	6.23±.06	0.31±.04	4.98± .64
M^2					
L	34	4.80-5.78	5.21±.04	0.25±.03	4.80± .58
W	35	6.45-8.00	7.13±.07	0.41±.05	5.75± .69
M^3					
L	23	3.70-4.80	4.13±.07	0.32±.05	7.75±1.14
W	23	5.02-6.80	5.74±.10	0.48±.07	8.36±1.23
P_3					
L	17	3.69-4.64	4.16±.07	0.30±.05	7.21±1.24
W	17	2.36-2.90	2.60±.04	0.16±.03	6.15±1.05
P_4					
L	43	3.96-5.10	4.44±.04	0.27±.03	6.08± .66
W	44	2.69-3.44	3.06±.03	0.17±.02	5.56± .59
M_1					
L	83	4.41-5.60	4.94±.03	0.30±.02	6.07± .47
W	83	3.42-4.60	3.97±.03	0.27±.02	6.80± .53
M_2					
L	86	4.58-6.02	5.31±.04	0.34±.03	6.40± .49
W	86	3.84-5.06	4.45±.03	0.27±.02	6.07± .46
M_3					
L	67	5.20-6.58	5.82±.04	0.34±.03	5.84± .50
W	71	3.42-4.91	4.00±.03	0.27±.02	6.75± .80

type of *H. powellianus* as Lysite in age means that *H. powellianus* is the correct name for the larger Lysite species of *Hyopsodus.*

H. walcottianus, as noted by Matthew (1915b), is probably descended from *H. powellianus.* Although only the largest specimens of *Hyopsodus* from the Lost Cabin and its equivalents have been recognized as this species, smaller Lost Cabin specimens previously referred to *H. powellianus* by Matthew (1915b) and labelled as such in the American Museum collections undoubtedly belong to this same population. The Lysite and Lost Cabin samples of these two species from the Wind River Basin overlap in size (Fig. 28) and, at present, seem separable only on a stratigraphic basis. Until more specimens of *H. walcottianus* are recovered and the variation in this species can be accurately determined, however, it seems best to leave these samples separated with the understanding that the boundary between them is arbitrarily drawn in the Wind River Basin to coincide with the time boundary between the Lysite and Lost Cabin deposits.

H. powellianus increased in size during the Lysite, as indicated by a comparison of samples of this species from three levels in the Lysite deposits (Table 19). This rapid increase in size, especially of M_{2-3}, accounts for the large OR found for the Lysite sample of this species, when taken as a whole (Table 18). That this increase in size affected the more posterior molars and not the anterior teeth suggests that selection was favoring the development of more grinding surface on the teeth and perhaps a change from an omnivorous to a more herbivorus diet.

Hyopsodus miticulus (Cope, 1874)
Table 20, Figures 27 and 28

This medium sized species of *Hyopsodus* is represented in the Lysite by the remains of nearly 180 individuals. The lineage to which this sample belongs changes relatively little in tooth size through the early Eocene so that the Lysite sample is very similar in tooth size to samples from Lost Cabin and upper Gray Bull horizons. This overlap in size as well as in molar pattern was recognized by both Matthew (1915b) and Kelley and Wood (1954), who considered the Lysite sample as belonging to the Lost Cabin species, *H. mentalis,* and by Gazin (1962), who considered the Lysite sample as inseparable from *H. miticulus* of the Gray Bull. I agree with these authors that many of the specimens from the Lysite, Lost Cabin, and middle and upper Gray Bull are inseparable from one another.

Although there are differences between the mean measurements of samples from these three horizons as well as between the average conditions of development of molar pattern, so much overlap occurs between these three samples that it is impossible to assign isolated specimens accurately to horizon. Gazin (1962) noted that the New Mexican sample of *H. mentalis* was clearly distinct from the Lysite sample from Wyoming. I am, therefore, following Gazin's assignment of the Lysite sample to *H. miticulus* and am extending this assignment to include all specimens from the Wind River and Big Horn Basins of Wyoming previously referred to *H. mentalis.* Further work will be necessary to determine whether *H. mentalis* is distinct from *H. miticulus* in New Mexico and in Southern Wyoming (see Gazin, 1962). These species are not distinct in Northern Wyoming. Gazin (1962) noted in his referral of Wyoming specimens to *H. miticulus,* the type of which is from the San José Formation of New Mexico, that this may be perpetrating a taxonomic error. I am more inclined, however, to view the slight difference between the New Mexico and Wyoming sample of this species as due to geographic

TABLE 19. Measurements of Samples of Lower Teeth of *Hyopsodus powellianus* from Three Different Levels within the Lysite of the Wind River Basin

	N	OR	M	S	V
UPPER CLIFF					
P_4					
L	5	3.96-5.10	4.35±.21	0.46±.15	10.57±3.34
W	5	2.86-3.24	3.01±.07	0.16±.05	5.32±1.68
M_1					
L	18	4.74-5.60	5.17±.06	0.26±.04	5.03± .84
W	18	3.80-4.60	4.19±.06	0.24±.04	5.73± .96
M_2					
L	18	4.82-6.02	5.48±.09	0.37±.06	6.75±1.13
W	19	4.17-5.06	4.66±.07	0.30±.05	6.44±1.05
M_3					
L	10	5.20-6.58	6.09±.14	0.44±.10	7.22±1.62
W	13	3.73-4.55	4.11±.08	0.29±.06	7.06±1.38
MID CLIFF					
P_4					
L	8	4.13-4.80	4.43±.09	0.26±.07	5.87±1.47
W	8	2.69-3.22	2.94±.07	0.19±.05	6.46±1.62
M_1					
L	13	4.41-5.30	4.83±.09	0.31±.06	6.42±1.26
W	13	3.60-4.10	3.84±.05	0.17±.03	4.43± .87
M_2					
L	21	4.68-5.85	5.26±.07	0.32±.05	6.08± .94
W	21	3.90-4.63	4.32±.05	0.21±.03	4.86± .75
M_3					
L	14	5.27-6.52	5.73±.09	0.33±.06	5.76±1.09
W	14	3.70-4.91	3.98±.09	0.32±.06	8.04±1.52
BASAL CLIFF					
P_4					
L	5	4.29-4.44	4.36±.03	0.07±.02	1.61± .51
W	5	2.95-3.10	3.04±.03	0.07±.02	2.30± .73
M_1					
L	9	4.69-5.15	4.89±.04	0.12±.03	2.45± .58
W	9	3.67-4.00	3.89±.05	0.14±.03	3.60± .85
M_2					
L	8	4.90-5.35	5.15±.07	0.20±.05	3.88± .97
W	8	4.08-4.50	4.28±.05	0.14±.04	3.27± .82
M_3					
L	8	5.41-6.00	5.58±.10	0.28±.07	5.02±1.26
W	8	3.70-4.00	3.79±.06	0.16±.04	4.22±1.06

variation. The differences between the four samples of *H. miticulus,* from the upper Gray Bull, Lysite and Lost Cabin horizons in Wyoming and from the San José Formation of New Mexico, are so small that the use of subspecific terminology to separate these samples seems uncalled for.

The Four Mile sample of *Hyopsodus,* referred to *H. loomisi* by McKenna (1960) and the lower Gray Bull samples referred to this species by Gazin (1962) are clearly distinct from *H. miticulus* in cusp pattern on the lower molars but may have been ancestral to this species. The larger Four Mile species, which was referred to *H. miticulus* by McKenna, is the same size as the Lysite sample of *H. miticulus,* and seems too large to have given rise to the Gray Bull sample of *H. miticulus* (Fig. 27). It may, instead, be ancestral to *H. powellianus.* A few large specimens in the upper Gray Bull, previously referred to *H. miticulus,* may also belong to *H. powellianus.*

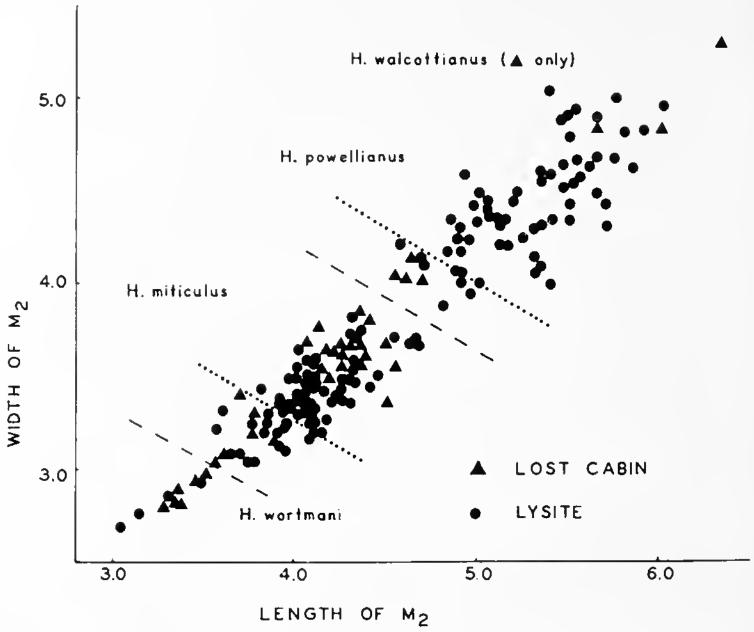

Figure 28. Scatter diagram of length-width measurements of M_2's of *Hyopsodus* from the Wind River Basin. Dashed lines indicate the separation between Lysite species while dotted lines indicate the separation between Lost Cabin species.

Hyopsodus wortmani Osborn, 1902
Table 21, Figures 27 and 28

The smallest species of *Hyopsodus* in the Lysite was described as *H. minor* by Loomis (1905), but Matthew (1915b) considered this species as a subspecies of the Lost Cabin species *H. wortmani.* A study of the six specimens from the Lysite that are the size of *H. minor* confirms Matthew's view that while the Lysite species is somewhat smaller in size than *H. wortmani* from the Lost Cabin, it is not specifically separable from it. This is indicated by the comparison of the Lost Cabin and Lysite samples of this species seen in Figure 28. Although Loomis (1905) noted the shortness of the teeth in the type of *H. minor* and Matthew (1915b) had reservations about placing *H. minor* in synonomy with *H. wortmani* because of this, remeasurement of the Lysite and Lost Cabin samples indicates that the teeth of the Lysite sample are not appreciably shorter than those of the Lost Cabin specimens. Several small specimens of *Hyopsodus* from the upper Gray Bull in the collections of Yale University and the American Museum may also belong to this species.

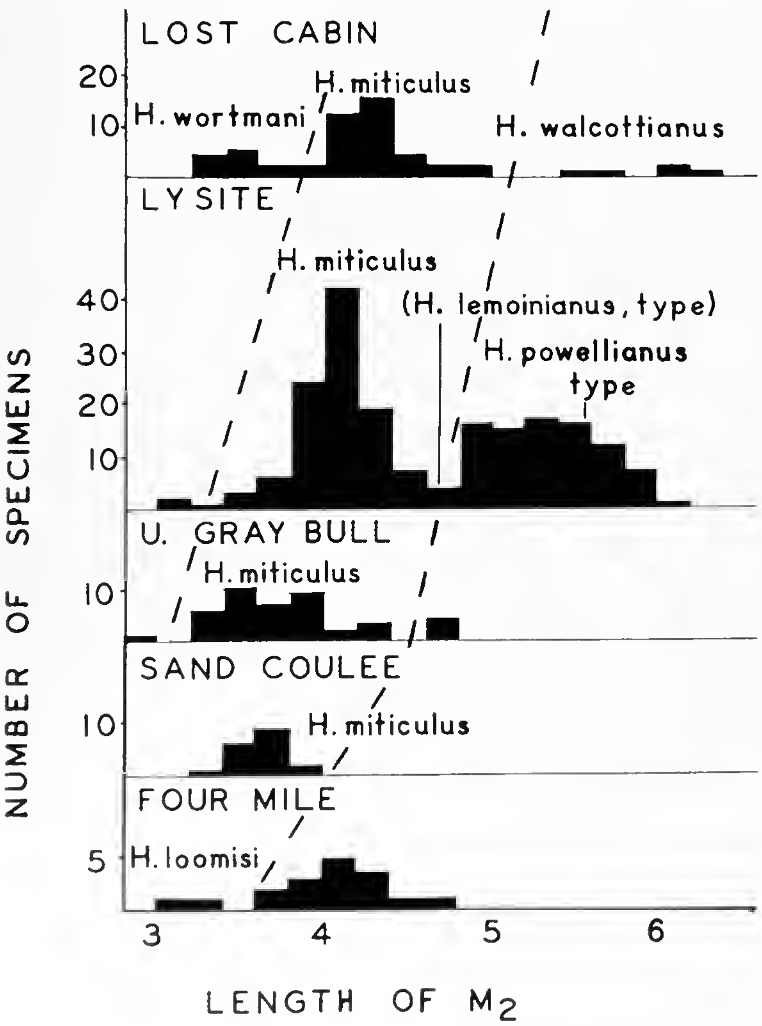

Figure 27. Variation in the length of M_2 in early Eocene samples of *Hyopsodus.* Dashed lines indicate the separation between different lineages of *hyopsodus.*

Family Phenacodontidae
Phenacodus primaevus Cope, 1873

The specimen mentioned by Kelley and Wood (1954), AC 3025, is still the only specimen of this species known from the Lysite deposits in the Wind River Basin. Nothing further can be added to their report of this specimen.

Phenacodus brachypternus Cope, 1882

Only one specimen of this species has been recovered from deposits of Lysite age in the Wind River Basin. This specimen is AMNH 12788, a partial right ramus containing M_2 and part of M_3

TABLE 20. Measurements of Teeth of *H. miticulus* from the Lysite of the Wind River Basin

	N	OR	M	S	V
P^3					
L	3	3.34-3.40	3.36	—	—
W	3	3.15-3.30	3.23	—	—
P^4					
L	5	2.88-3.20	3.06±.07	0.16±.05	5.23±1.66
W	5	4.00-4.50	4.27±.12	0.26±.08	6.09±1.93
M^1					
L	11	3.52-4.20	3.79±.05	0.18±.04	4.75±1.01
W	11	4.30-5.25	4.80±.08	0.28±.06	5.83±1.24
M^2					
L	18	3.62-4.30	4.00±.04	0.19±.03	4.75± .79
W	17	5.10-6.12	5.56±.07	0.29±.05	5.22± .90
M^3					
L	10	2.90-3.40	3.16±.04	0.14±.03	4.43± .99
W	10	4.18-5.20	4.51±.10	0.33±.07	7.32±1.64
P_3					
L	7	2.95-3.40	3.17±.05	0.14±.04	4.42±1.18
W	7	1.90-2.10	2.05±.03	0.08±.02	3.90±1.04
P_4					
L	30	3.10-3.90	3.47±.03	0.17±.02	4.90± .63
W	30	2.22-2.98	2.44±.03	0.16±.02	6.56± .85
M_1					
L	68	3.45-4.35	3.83±.02	0.20±.02	5.22± .45
W	67	2.64-3.58	3.09±.03	0.21±.02	6.80± .60
M_2					
L	101	3.57-4.70	4.07±.02	0.21±.01	5.16± .36
W	100	2.98-3.76	3.40±.02	0.18±.01	5.29± .37
M_3					
L	75	3.94-5.24	4.50±.03	0.25±.02	5.56± .45
W	75	2.58-3.40	3.08±.02	0.17±.01	5.52± .45

TABLE 21. Measurements of Teeth of Lysite Specimens of *Hyopsodus wortmani*

	N	OR	M
P_4			
L	1	—	2.65
W	1	—	2.12
M_1			
L	4	2.95-3.28	3.08
W	4	2.30-2.58	2.45
M_2			
L	4	3.05-3.48	3.24
W	3	2.77-2.95	2.82
M_3			
L	2	3.65-3.67	3.66
W	2	2.42-2.53	2.47

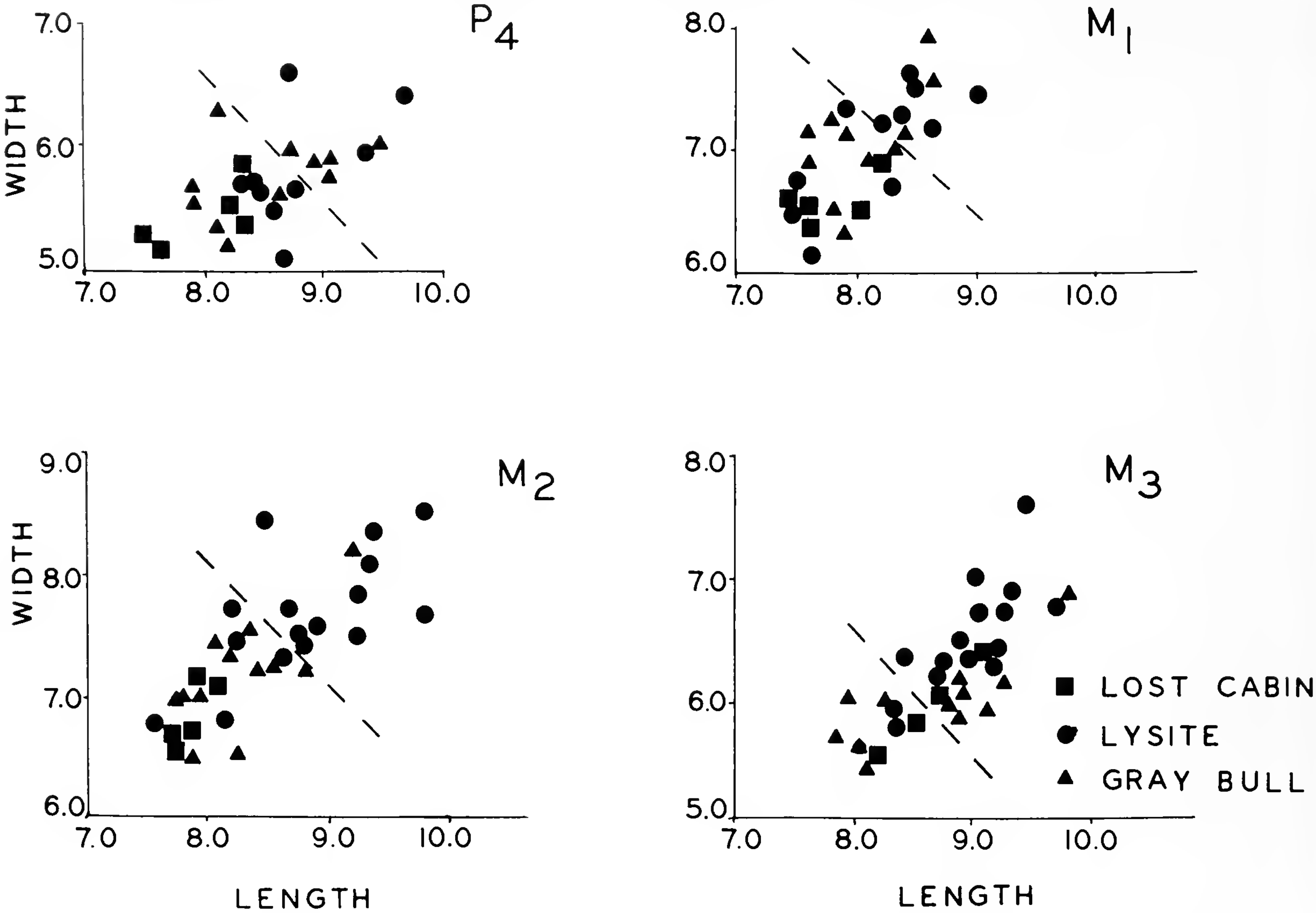

Figure 29. Scatter diagrams of length-width measurements of teeth of *Phenacodus vortmani*. The separation that was made between this species and larger *P. copei* by earlier authors is indicated by dashed lines.

and is probably the specimen on which Van Houten (1945) based the presence of this species in the Lysite. Although the fragmentary nature of this specimen makes positive identification difficult, it appears to be correctly assigned to this species rather than to *P. vortmani* or *Ectocion*. The lower fourth premolar from the Lysite referred to this species by Kelley and Wood (1954) is a lower third premolar of *Hyracotherium*.

Phenacodus vortmani (Cope, 1880)
Table 22, Figure 29

Cope (1884) referred to *P. vortmani*, the type of which is from the Lost Cabin deposits of the Wind River Basin, several larger specimens of *Phenacodus* from the Gray Bull of the Big Horn Basin, including one nearly complete skeleton. Granger (1915), on examination of the large Lost Cabin sample of *P. vortmani* collected by the American Museum in 1905 and 1909, noted the absence of any specimens in this sample as large as the larger Gray Bull specimens referred to *P. vortmani* by Cope, and decided that these larger specimens represented a new species. He described this species as *P. copei*, referring to it Gray Bull and Lysite specimens that were larger in size than the Lost Cabin specimens of *P. vortmani*. He retained the specimens from the Gray Bull and Lysite that agreed in size with the Lost Cabin sample of *P. vortmani* in this species. This division between these two species is indicated in Figure 29. Although Granger in his description of *P. copei* noted some morphological differences between this species and *P. vortmani*, these are differences correlated with size. There is complete intergradation in these characters between the two species. The delineation between these species that was made by Granger and that has been followed by various authors since 1915 is, therefore, considered here to be completely arbitrary separation between the large and small members of a single species. Coefficients of variation calculated on all specimens of *Phenacodus* referred to these two species from the Lysite, Gray Bull and Lost Cabin horizons are about the same as those calculated for the Lysite sample alone (Table 22). The amount of variation found in the Lysite sample and in such a combined sample is not greater than that found in many other early Eocene populations. Because it is impossible to separate the Lysite sample into two species except arbitrarily by size, and because the total sample contains an amount of variation not in excess of that found in many demes, I am referring all the Lysite specimens of *Phenacodus* in this size range to *P. vortmani,* the first described species, and, considering *P. copei* to be a synonym for *P. vortmani.*

In the past it has been assumed that *P. copei* and *P. vortmani* were present throughout the early Eocene, the larger *P. copei* dying out before Lost Cabin times, and a smaller *P. vortmani* surviving into the Lost Cabin. If one considers *P. copei* to be a synonym of *P. vortmani,* as I have done, the question arises as to why only small forms are found in deposits of Lost Cabin age. This is apparently due to a decrease in size within the lineage. Further evidence for this is that the largest specimens of *Phenacodus* in the Lysite are found near the base of these deposits.

Order Pantodonta
Family Coryphodontidae
Coryphodon molestus (Cope, 1874)

This family is currently under revision by Dr. Simons of Yale University. The Lysite specimens of *Coryphodon* are rather poor, consisting mostly of isolated incisors, premolars and fragments of molars. Only three good dentitions are known from the Lysite, PU 16821, 16818; and AMNH 14808, which, Dr. Simons informs me, should be referred to *C. molestus.* A partial skeleton which lacks the skull, catalogued as AC 2819, adds nothing to what is already known of the skeleton of this genus.

Order Dinocerata
Family Uintatheridae
Probathyopsis lysitensis Kelley and Wood, 1954
Table 23, Figure 30

During the summers of 1962 and 1963 the author discovered additional material belonging to the type specimen of this species, including the missing parts of some of the teeth discovered by Kelley in 1951. It is evident from this additional

TABLE 22. Measurements of Teeth of *Phenacodus vortmani* from the Lysite

	N	OR	M	S	V
P^3					
L	5	6.70- 7.65	7.16±.18	0.41±.13	5.73±1.81
W	5	6.60- 7.00	6.82±.08	0.18±.06	2.64±0.84
P^4					
L	6	7.15- 7.55	7.37±.07	0.17±.05	2.31±0.67
W	6	8.50- 9.10	8.84±.09	0.22±.06	2.49±0.72
M^1					
L	6	7.78- 8.30	8.12±.08	0.19±.05	2.34±0.68
W	6	10.30-13.00	11.39±.39	0.96±.28	8.43±2.44
M^2					
L	6	7.65- 8.25	7.83±.10	0.24±.07	3.06±0.88
W	6	10.60-11.30	10.99±.11	0.28±.08	2.55±0.74
M^3					
L	5	5.90- 6.55	6.17±.12	0.28±.09	4.54±1.44
W	5	8.10- 9.50	8.68±.24	0.55±.17	6.34±2.01
P_3					
L	3	7.90- 8.50	8.17	—	—
W	3	5.00- 5.10	5.05	—	—
P_4					
L	13	8.30- 9.67	8.87±.12	0.43±.08	4.85±0.95
W	13	5.05- 6.50	5.90±.12	0.43±.08	7.29±1.43
M_1					
L	23	7.45- 9.30	8.48±.11	0.55±.08	6.48±0.95
W	21	6.10- 8.55	7.29±.11	0.53±.08	7.27±1.12
M_2					
L	17	7.55- 9.80	8.83±.15	0.61±.10	6.91±1.18
W	17	6.80- 8.43	7.68±.12	0.49±.08	6.38±1.09
M_3					
L	18	8.30- 9.70	8.98±.10	0.41±.07	4.56±0.76
W	16	5.78- 7.59	6.50±.11	0.44±.08	6.77±1.20

material that in the original description of this species P_3 and P_4 were misidentified as P_4 and M_1 respectively. For this reason the type specimen, including the new material belonging to it, has been refigured and is redescribed below.

Type: AC 11167, isolated teeth including the left P_3-M_3 and a right P_3-M_3. The talonid if the right M_2 is missing.

Hypodigm: Type and AC 3870, two jaw fragments, both of which contain single teeth that appear to be deciduous P_3's, one left, one right.

Horizon and Locality: Lysite Member of the Wind River Formation, early Eocene of Wyoming. The type specimen was collected by D. R. Kelley in 1951 and by D. A. Guthrie in 1962 and 1963 from reddish shales a quarter mile southeast of locality 3, but at the same level. The referred specimen was collected by Loomis in 1903, presumably from locality 6.

Diagnosis: Paraconid shelves somewhat smaller than in *P. praecursor* and much smaller than in *P. newbilli.* The ridge between the hypoconulid and the metaconid is less developed than in other species of *Probathyopsis,* approaching *Bathyopsis* in this respect. This species is similar in size to other species of *Probathyopsis* but M_2 and the premolars are widest at the talonid rather than at the trigonid as in other members of this genus.

Discussion: The teeth in the referred specimen, which were considered M_1's by Kelley and Wood (1954: Fig. 10) are unworn, have thin enamel and widespread roots and have the same pattern as P_4 in the type specimen, although they are smaller. For these reasons they are considered as deciduous premolars, probably deciduous P_3's. All teeth in the type specimen exhibit severe interdental wear with M_1 worn the most. Measurements of the teeth, uncorrected for wear, are presented in table 23. Kelley and Wood's remarks on the P_4 of this species are accurate except for their size comparisons as they were based on the smaller but identically patterened P_3. Their comments on M_1 were based on P_4 and are inaccurate. The newly discovered M_1's are too worn to allow any accurate description of this tooth, but it is generally similar to M_2.

Order Perissodactyla
Family Equidae
Genus *Hyracotherium*

Kitts' (1956) revision of this genus, while bringing order to what was previously taxonomic chaos, seems to have slightly over-simplified the taxonomy of this group. Gazin (1952) noted that two species of *Hyracotherium* were common in the La Barge Fauna of the Knight Formation and that these species were separable from one another on the basis of size. He referred the larger species to *H. vasacciense* and the smaller species to *H. index,* noting that the type specimens of both these species are from the Knight Formation. Kitts (1956) considered *H. index* to be a synonym for *H. vasacciense* because the type of *H. index* is just slightly smaller in size than the smallest members of the Lysite population of *H. vasacciense.* However, *H. vasacciense* was increasing in size during the early Eocene (Fig. 31) and by the Lost Cabin is clearly larger in size than *H. index.* Kitts agreed with Gazin that the La Barge fauna contained two species of *Hyracotherium* and that the larger one was *H. vasacciense.* He noted that the smaller sized species was closer to *H. angustidens,* a Gray Bull species, in molar pattern than it was to any other species of *Hyracotherium,* but referred this species to *H. vasacciense* also, noting that this made the La Barge sample of *H. vasacciense* distinctly bimodal. I feel that the similarity of the small La Barge species to *H. angustidens* is due to the correlation between increase in molar complexity and increase in tooth size that is found in this genus rather than to conspecificity of the two species. That the small species of *Hyracotherium* from the La Barge should be referred to *H. angustidens* seems highly unlikely as this would require a reversal of the evolutionary trend towards size increase that is common to this genus (Fig. 31). The referral of the specimens in the distinctly bimodal sample of *Hyracotherium* from the La Barge to a single species is clearly incorrect taxonomic procedure. Two species of *Hyracotherium* are represented in this sample and they are clearly separable on the basis of size. I am, therefore, resurrecting the name. *H. index* as the correct taxon for the small species of *Hyracotherium* found in the Lost Cabin and its equivalent.[6]

[6]It could be argued from Figure 31 that *H. index* must have descended from larger ancestors. If this were the case, then it might be best to consider the small La Barge species of *Hyracotherium* as *H. angustidens.* However, it is my belief that the sample referred to here as *H. index* represents the remains of a population that migrated into Wyoming during Lostcabinian time, and whose ancestors are not to be found in any known sample of *H. angustidens* or *H. vasacciense.* Whether this interpretation is correct or not might be determined by an analysis of the sample such as that done by Olsen and Miller (1958) for *Hyopsodus.*

TABLE 23. Measurements of Teeth of *Probathyopsis lysitensis*, Type Specimen, AC 11167

	LEFT	RIGHT
P_3		
L	13.9	13.5
W	8.8	9.0
P_4		
L	14.8	14.2
W	10.2	10.3
M_1		
L	13.1	13.3
W	8.9	8.6
M_2		
L	17.1_a	—
W	12.0_a	12.5
M_3		
L	23.0	22.8
W	14.7	15.0

Kitts' (1956) recognition of subspecies in *Hyracotherium* is not followed here. Some samples of *Hyracotherium,* such as that from the Lysite, are known to consist of specimens collected from a vertical section of not more than 200 feet of deposit. For other samples, such as that collected from the Largo of New Mexico, the locality data are poor and the specimens may have come from a vertical section much thicker, and in no case is the amount of time represented by the deposits known. Because of this great variation in the age of some samples of *Hyracotherium* and because of our resultant lack of knowledge as to their relative ages and as to the normal morphological variation in isochronus samples, the use of subspecific terminology at present seems premature.

Hyracotherium vasacciense (Cope, 1872)
Tables 24 and 25, Figures 31 and 32

Except for a few large specimens and a few small specimens, here referred to *H. craspedotum* and *H. index* respectively, all the Lysite specimens of *Hyracotherium* are referrable to this species. This includes most of the 24 specimens referred to *H. craspedotum* by Kelley and Wood (1954). These authors state (p. 359), in reference to these specimens that: "The population of larger individuals is closer in anteroposterior diameter to the Lost Cabin *H. vasacciense venticolum* than to the New Mexican *H. cristonense.* However, the cusp pattern of the teeth of the larger Lysite forms is closer to that characteristic for *H. cristonense.* Kitts informs us that this material seems identical to the larger Lost Cabin horse, which should be called *H. craspedotum,* and that name is therefore used for the larger Lysite horse, even though it is considerably smaller than the type of the Lost Cabin species." However, Kitts (1956) later considered *H. cristonense* as a synonym for *H. angustidens.* Most of these 24 specimens are clearly smaller than the type of *H. craspedotum* and an examination of the much larger sample of Lysite horses currently available for study indicates that, while these specimens are at the large end of the size range for the Lysite sample of *H. vasacciense,* they are not separable from that species. All of Kelley and Wood's figures of *Hyracotherium* are, therefore, of *H. vasacciense,* and give an indication of the variation found in the Lysite sample of this species. Measurements of the complete Lysite sample of *Hyracotherium* are presented in Table 24, and measurements of samples from three levels within the Lysite deposits are presented in Table 25. The increase in size that occurs in this species during Lysite time, as indicated by Table 25, accounts for the large observed ranges found in Table 24. This increase in tooth size found in *H. vasacciense* in the Lysite is observed in all teeth, not just the more posterior ones as was the case in *Hyopsodus powellianus.* This suggests that an increase in general body size was being selected for rather than just an increase in occlusal surface on the cheek teeth.

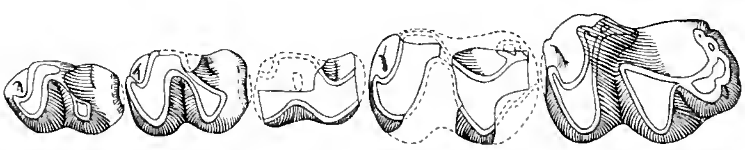

Figure 30. Probathyopsis lysitensis. Type, AC 11167, left P_3-M_3. Crown view. X 0.8. Parts of teeth indicated by dashed lines are restored from the right side.

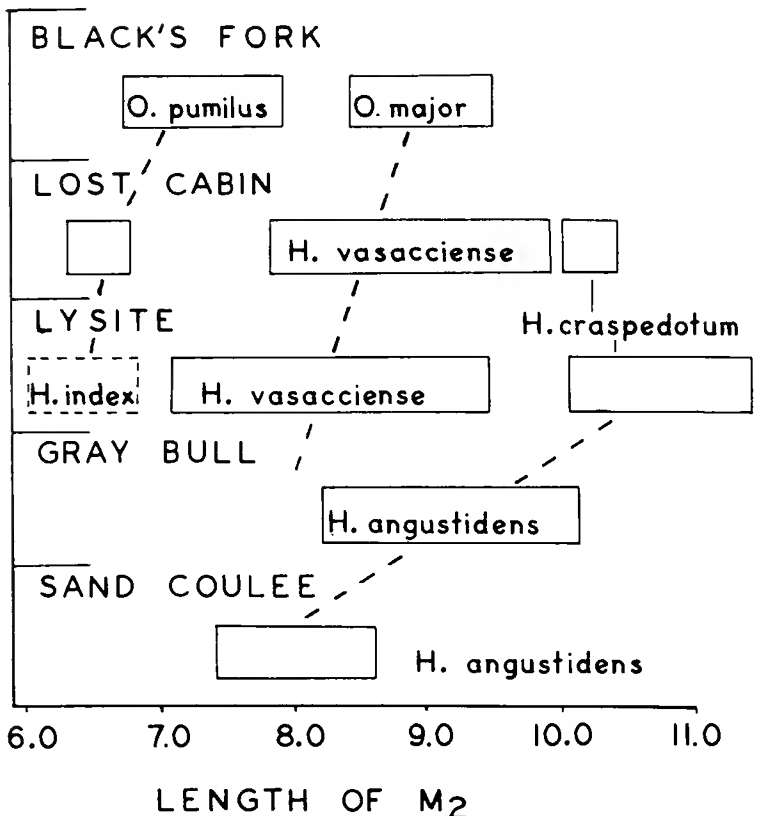

Figure 31. Observed ranges of M_2 length in several Wyoming samples of *Hyracotherium* and *Orohippus*. Dashed lines indicate the phylogeny suggested in this paper.

Kitts (1956) felt that *H. vasacciense* was probably derived from *H. angustidens*. The individuals of *H. angustidens* from the Gray Bull of the Big Horn Basin, however, are clearly too large to have been directly ancestral to the northern Wyoming samples of *H. vasacciense* (Fig 31). The sample of *H. angustidens* from the Almagre Member of the San José Formation in New Mexico contains smaller individuals than does the Big Horn Gray Bull sample and agrees more in size with what would be expected in the species ancestral to the Lysite population of *H. vasacciense*. The morphological similarity between this Almagre sample, previously designated *H. cristonense*, and the Lysite sample has already been noted by Kelley and Wood (1954).

Kitts (1957) also felt that *H. craspedotum* was probably ancestral to *Orohippus major* and that *H. vasacciense* was probably ancestral to *O. pumilus*. These probable relationships were based on similarity of cusp pattern between these pairs of species, especially in the premolars. However, from a size comparison of these four species of *Hyracotherium* and *Orohippus* (Fig. 31) it seems more likely that *H. vasacciense* gave rise to *O. major* and that *H. index* gave rise to *O. pumilus*.

Hyracotherium index (Cope, 1873)
Table 26, Figures 31 and 32

Several isolated upper molars from the Lysite seem too small to belong to *H. vasacciense*. They are distinctly smaller than contemporaneous *H. vasacciense*, as indicated in Figure 32, and as they agree in both size and molar pattern with the type of *H. index*, they are here considered to belong to this species.

These specimens, here referred to *H. index* (AC 2928, 2933, 10133, 10163, 10181), are statistically inseparable in size from the basal cliff sample of *H. vasacciense* and this accounts for their being overlooked by previous workers who considered the Lysite horses as a whole, not treating the collections by levels. The specimens of *H. index*

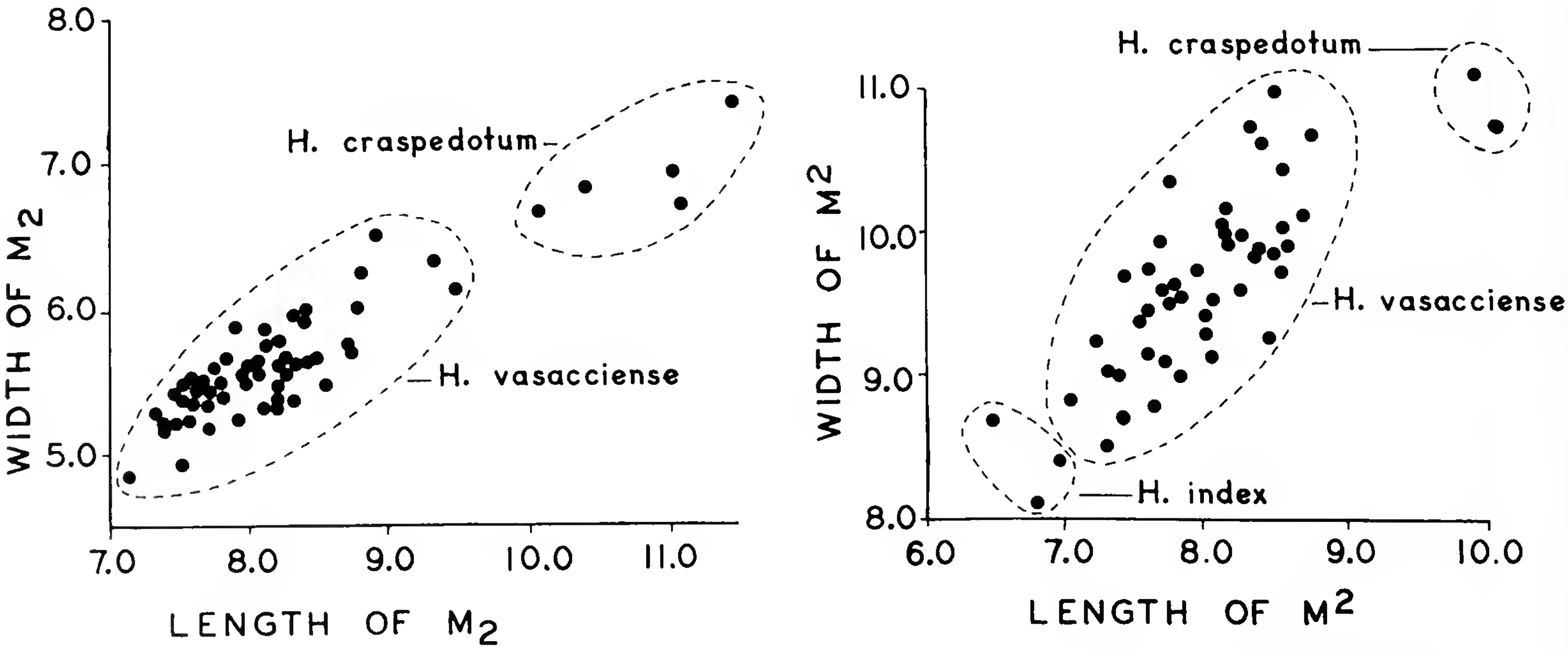

Figure 32. Scatter diagrams of length-width measurements of second molars of *Hyracotherium* from the Lysite Member of the Wind River Formation.

TABLE 24. Measurements of Teeth of *Hyracotherium vasacciense* from the Lysite of the Wind River Formation

	N	OR	M	S	V
P^3					
L	5	6.00- 6.60	6.32±.10	0.23±.07	3.64±1.15
W	5	6.30- 6.77	6.59±.08	0.18±.07	2.73± .86
P^4					
L	22	5.65- 6.95	6.43±.06	0.27±.04	4.20± .63
W	22	7.05- 8.33	7.71±.07	0.35±.05	4.54± .68
M^1					
L	29	6.85- 8.27	7.58±.07	0.38±.05	5.01± .66
W	29	7.80-10.25	8.99±.11	0.58±.08	6.45± .85
M^2					
L	45	7.05- 8.75	7.99±.07	0.45±.05	5.63± .59
W	45	8.50-11.00	9.65±.09	0.58±.06	6.01± .63
M^3					
L	47	6.40- 8.90	7.50±.08	0.55±.06	7.33± .76
W	47	8.18-10.35	9.11±.08	0.55±.06	6.04± .62
P_3					
L	18	5.85- 7.20	6.34±.08	0.35±.06	5.52± .92
W	17	3.55- 4.04	3.89±.07	0.30±.05	7.71±1.32
P_4					
L	44	5.75- 7.50	6.46±.07	0.44±.05	6.81± .73
W	44	3.70- 5.05	4.42±.04	0.29±.03	6.56± .70
M_1					
L	52	6.60- 8.50	7.52±.06	0.44±.04	5.85± .57
W	52	4.50- 5.88	5.16±.04	0.32±.03	6.20± .61
M_2					
L	55	7.05- 9.45	8.05±.07	0.49±.05	6.09± .58
W	55	4.82- 6.50	5.56±.04	0.33±.03	5.94± .57
M_3					
L	58	9.10-12.30	10.50±.09	0.66±.06	6.29± .58
W	59	4.80- 6.50	5.20±.05	0.41±.04	7.88± .73

recognized in this paper, however, were from middle and upper cliff localities and are clearly separable on the basis of size from samples of *Hyracotherium vasacciense* from these levels.

Hyracotherium craspedotum Cope, 1880
Table 27, Figures 31 and 32

Four specimens of *Hyracotherium* in the Amherst collection (AC 2489, 2593, 2594, 2817) are too large to be included in *H. vasacciense*. As these specimens are similar in size and molar development to the Lost Cabin sample of *H. craspedotum*, they are referred to this species. Measurements of these specimens are given in Table 27 and an idea of their size relation to *H. vasacciense* is given in Figure 32. Nearly all the specimens from the type Lysite area referred to this species in earlier publications are considered to belong to *H. vasacciense* and are discussed with that species.

Family Helaletidae
Heptodon calciculus (Cope, 1880)
Table 28

A large number of specimens referrable to this genus have been recovered from the Lysite since Radinsky's excellent review (1963) of the North American Tapiroidea. The variation in size found within this sample, as well as the variation in the crown pattern of the teeth, is of a magnitude usual for a single species. Although the means for the Lysite sample are larger than those for the Lost Cabin species, *H. calciculus*, there is so much overlap in size between these two samples that their separation taxonomically seems unwarranted. Radinsky (1963: 38) referred four isolated upper teeth (AC 11058, 11211, and YPM No. 17066) from the Lysite to *H. posticus* rather than to *H. calciculus* because of the large size of these teeth. While these teeth do fall outside the size range for the Lost Cabin sample of *H. calciculus*, they fall

TABLE 25. Measurements of Samples of Lower Teeth of *Hyracotherium vasacciense* from Three Different Levels within the Lysite of the Wind River Basin

	N	OR	M	S	V
Upper Cliff					
P_4					
L	17	5.80- 7.50	6.50±.11	0.46±.08	7.08±1.21
W	17	3.95- 4.62	4.37±.06	0.25±.04	5.72± .98
M_1					
L	16	6.60- 5.30	7.66±.11	0.42±.07	5.48± .97
W	16	4.50- 5.65	5.31±.09	0.35±.06	6.59±1.16
M_2					
L	14	7.75- 9.45	8.48±.12	0.46±.09	5.42±1.02
W	14	5.35- 6.32	5.78±.09	0.32±.06	5.54±1.05
M_3					
L	18	9.63-12.20	10.67±.16	0.68±.11	6.37±1.06
W	18	4.85- 6.30	5.54±.09	0.38±.06	6.86±1.14
Mid Cliff					
P_4					
L	9	6.00- 7.05	6.49±.13	0.38±.09	5.86±1.38
W	9	3.95- 4.90	4.49±.11	0.33±.08	7.35±1.73
M_1					
L	10	6.82- 7.75	7.42±.12	0.37±.08	4.99±1.12
W	10	4.78- 5.48	5.14±.08	0.26±.06	5.06±1.13
M_2					
L	11	7.40- 8.20	7.91±.08	0.27±.06	3.41± .73
W	11	5.20- 5.87	5.52±.07	0.22±.05	3.99± .85
M_3					
L	12	9.48-12.30	10.53±.23	0.81±.17	7.69±1.57
W	12	4.90- 6.50	5.45±.14	0.47±.10	8.62±1.76
Basal Cliff					
P_4					
L	3	5.80- 6.20	5.93	—	—
W	3	3.96- 4.15	4.09	—	—
M_1					
L	6	6.60- 7.87	7.23±.18	0.45±.13	6.22±1.80
W	6	4.82- 5.08	4.91±.04	0.10±.03	2.04± .59
M_2					
L	9	7.33- 8.50	7.82±.15	0.44±.10	5.63±1.33
W	9	5.15- 5.60	5.43±.05	0.16±.04	2.95± .70
M_3					
L	9	9.80-10.50	10.17±.07	0.21±.05	2.06± .49
W	9	4.80- 5.40	5.20±.06	0.18±.04	3.46± .82

TABLE 26. Measurements of teeth of *Hyracotherium index* from the Lysite of the Wind River Basin

	N	OR	M
P^4			
L	2	6.00-6.12	6.06
W	2	6.90-7.88	7.39
M^1			
L	3	6.50-6.97	6.76
W	3	8.12-8.68	8.40

well within the size range of the Lysite sample of *H. calciculus* and are here referred to this species. The removal of these specimens from *H. posticus* restricts the occurrence of this species to the Lost Cabin and its equivalents.

Order Artiodactyla
Family Dichobunidae
Bunophorus etsagicus (Cope, 1882)

The genera *Bunophorus* and *Wasatchia,* as noted by Sinclair (1914) and Gazin (1952), are clearly separable on the form of M_3, the inflation of the fourth lower premolar, and the extent to which the paraconid is developed on the lower molars. However, in worn lower molars the condition of the paraconid cannot be determined and unless either P_4 or M_3 is present, worn specimens cannot be readily assigned to either *Bunophorus* or *Wasatchia.*

Specimens identifiable as *Bunophorus* on the basis of the three characteristics listed above and as *B. etsagicus* on the basis of size, while fairly common in deposits of Lost Cabin age, have not been previously recorded from deposits earlier in age. The type of *B. etsagicus,* however, was collected by Wortman in 1881 from the Wasatch of the Big Horn Basin, and therefore, presumably came from either Gray Bull or Lysite deposits (see discussion of *Hyopsodus powellianus*). Also, AMNH 17002, a ramus with M_{1-2} from the upper Gray Bull deposits of the Big Horn Basin, and AC 2757, an isolated M_2 from the Lysite of the Wind River Basin, seem referrable here on the basis of size, although their assignment to this genus rather than to *Wasatchia* must remain tentative due to the worn condition of the teeth in these two specimens.

Bunophorus macropternus (Cope, 1882)
Figure 33

Nine specimens from the Lysite of the Wind River Basin are referrable to this species. All of the teeth in these specimens are unworn or nearly so and clearly separable from *B. etsagicus* on the basis of size. This species has not been found in deposits of Graybullian age nor has it been found in Lost Cabin deposits in northern Wyoming although it has been recovered by Gazin from Lost Cabin equivalents in southern Wyoming. The type of this species, collected by Wortman in 1881 from the Wasatch of the Big Horn Basin, is, therefore, probably Lysitean in age

TABLE 27. Measurements of Teeth of *Hyracotherium craspedotum* from the Lysite of the Wind River Basin

	N	OR	M
P^4			
L	1	—	7.58
W	1	—	8.95
M^1			
L	1	—	9.55
W	1	—	11.20
M^2			
L	2	9.95-10.05	10.00
W	2	10.75-11.15	10.95
M^3			
L	2	10.20-10.25	10.22
W	2	11.35-12.45	11.90
P_3			
L	2	—	7.40
W	2	—	4.90
P_4			
L	7	7.40- 8.38	7.78
W	7	5.13- 5.75	5.48
M_1			
L	3	9.00- 9.90	9.47
W	3	6.10- 6.30	6.20
M_2			
L	4	10.02-11.45	10.70
W	4	6.65- 7.40	6.94
M_3			
L	1	—	14.70
W	1	—	7.10

(see also discussion of *Hyopsodus powellianus* above).

Upper molars considered as belonging to this species have been figured by Kelley and Wood (1954) and described by Gazin (1952) and later figured by him (Gazin, 1962). Kelley and Wood considered their specimen as similar to that described by Gazin but an examination of the figures of these two specimens reveals that they are not the same. AC 11194, the specimen figured by Kelley and Wood, has no hypocone while USNM 19212, the La Barge specimen figured by Gazin, has a very prominent one. Three other isolated upper molars belonging to an artiodactyl the size of *B. macropternus* have been found in the Lysite deposits. All of these specimens, two of which are figured here, lack a hypocone. It seems certain that these upper teeth lacking a hypocone belong to *Bunophorus macropternus* as they are the proper size for this species and as other Lysite artiodactyls of this size are rare. The specimens with a hypocone may belong to either *Wasatchia* or *Helohyus* but their membership in *Bunophorus* is also possible, as evidenced by the wide amount of variation in the development of the hypocone found in the related genus *Diacodexis*. Whether they actually do belong to *Bunophorus,* however, cannot be determined on the basis of the known specimens of this species.

Bunophorus sinclairi, Guthrie, 1966
Figure 34

A third species of *Bunophorus* is represented in the Lysite by AC 10093, a lower jaw containing the left M_{1-2}. This species was described by Guthrie (1966). Nothing further can be added to that description.

At present then, there are three known species of *Bunophorus* each belonging to a separate lineage with *B. sinclairi* and *B. macropternus* known from the Lysite and Lost Cabin and *B. etsagicus* known from the Graybull, Lysite and Lost Cabin.

TABLE 28. Measurements of Teeth of *Heptodon calciculus* from the Lysite of the Wind River Basin

	N	OR	M	S	V
P^2					
L	2	6.38- 6.55	6.46	—	—
W	2	6.52- 7.82	7.17	—	—
P^3					
L	5	7.00- 7.77	7.34±.16	0.37±.12	5.04±1.59
W	5	8.18- 9.64	9.20±.30	0.67±.21	7.28±2.30
P^4					
L	8	7.90- 9.40	8.48±.17	0.49±.12	5.78±1.45
W	6	10.53-11.63	11.26±.20	0.50±.14	4.44±1.28
M^1					
L	4	11.00-11.20	11.11±.05	0.10±.03	0.90± .32
W	5	12.55-13.00	12.79±.07	0.15±.05	1.17± .37
M^2					
L	10	11.60-12.90	12.34±.14	0.44±.10	3.57± .80
W	11	13.77-14.70	14.22±.09	0.30±.06	2.11± .45
M^3					
L	7	11.50-13.80	12.40±.29	0.78±.21	6.29±1.68
W	7	12.95-14.90	13.88±.31	0.82±.22	5.91±1.58
P_3					
L	1	—	7.90	—	—
W	1	—	5.50	—	—
P_4					
L	5	8.00- 9.50	8.96±.27	0.60±.19	6.70±2.12
W	5	5.26- 6.84	6.22±.27	0.60±.19	9.65±3.05
M_1					
L	5	9.85-10.50	10.14±.12	0.27±.09	2.66±0.84
W	7	6.62- 8.00	7.32±.18	0.49±.13	6.69±1.79
M_2					
L	7	11.30-12.73	12.02±.17	0.46±.12	3.83±1.02
W	7	7.58- 8.65	8.12±.13	0.36±.10	4.43±1.18
M_3					
L	4	15.33-16.48	15.89	—	—
W	4	8.30- 8.57	8.47	—	—

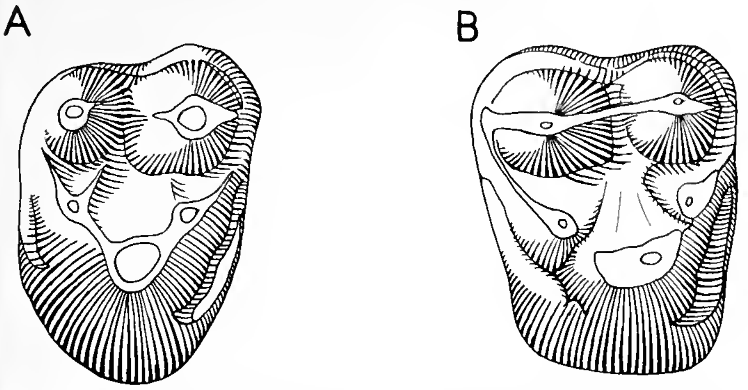

Figure 33. Bunophorus macropternus. A. AC 2757, left M^3. Crown view. X 4. B. AC 11194, right M^1. Crown view. X 4.

Wasatchia lysitensis Sinclair, 1914

Only one specimen from the Lysite of the Wind River Basin is clearly referrable to this species. This is AMNH 14936, listed as the paratype of this species by Sinclair (1914). The type itself is from the Lysite of the Big Horn Basin.

Wasatchia dorseyana Sinclair, 1914

Kelley and Wood (1954) listed this species as present in the Lysite of the Wind River Basin on the basis of three isolated M_3's in the Amherst collection, one of which they figured. These three teeth are M_2's of *Didymictis protenus*. No specimens referrable to *W. dorseyana* have been found in deposits of Lysite age.

Diacodexis metsiacus (Cope, 1882)
Table 29, Figures 35 and 36

Only one species of *Diacodexis* is present in the Lysite deposits of the Wind River Basin. Variation in size within this species is indicated in Figure 36 and Table 29. Two partial upper dentitions of *Diacodexis* are figured to give an indication of the amount of variation that can occur in molar pattern within the Lysite sample. The upper molars in AC 2411 (Fig. 35B) have what could be considered a large posterior cingulum while those in AC 2417 (Fig 35A) possess a comparatively well developed hypocone.

As indicated in Figure 36, there is considerable overlap in size between the various samples of early Eocene *Diacodexis*. The Gray Bull sample of *Diacodexis*, except for *D. robustus*, has mean tooth measurements that are slightly smaller than those for the Lysite sample. The Four Mile and Lost Cabin samples of *Diacodexis* can be distinguished from each other on the basis of size but are overlapped by both the Lysite and Gray Bull samples. Fewer specimens are known from the Four Mile and Lost Cabin than from the Lysite and Gray Bull samples and the former samples probably do not give as accurate an indication of the size variation found within *Diacodexis* in these horizons as do the samples from the Lysite and Gray Bull. The four samples seem to be of a single lineage of *Diacodexis* that was increasing slowly in size during the lower Eocene and developing a hypocone on the upper molars.

Eight species have been referred to *Diacodexis*. These species and the deposits from which they were recovered are as follows:

D. chacensis (Cope, 1875). San José Formation of New Mexico
D. secans (Cope, 1881). Lost Cabin of the Wind River Basin
D. metsiacus (Cope, 1882), Gray Bull of the Big Horn Basin
D. nuptus (Cope, 1881). Gray Bull? of the Big Horn Basin
D. laticuneus (Cope, 1882). Gray Bull of the Big Horn Basin
D. brachystomus (Cope, 1882). Gray Bull of the Big Horn Basin
D. robustus Sinclair, 1914. Gray Bull of the Big Horn Basin
D. olseni Sinclair, 1914. Lost Cabin of the Wind River Basin

The type of *D. nuptus* is a specimen of *Cynodontomys*. The type of *D. secans* lacks a paraconid and has an oddly shaped talonid, unlike that found in any other member of this genus. This specimen may not belong to this genus. *D. robustus* is larger than any other species of *Diacodexis*. The validity of this species has never been questioned. *D. laticuneus* and *D. brachystomus* were considered by both Sinclair (1914) and Gazin (1952) to be synonyms of *D. metsiacus* and are so considered here. Sinclair (1914) considered *D. metsiacus* as a synonym for *D. chacensis* but, as Gazin (1952) points out, Cope's measurements of the now lost type of *D. chacensis* fall outside of

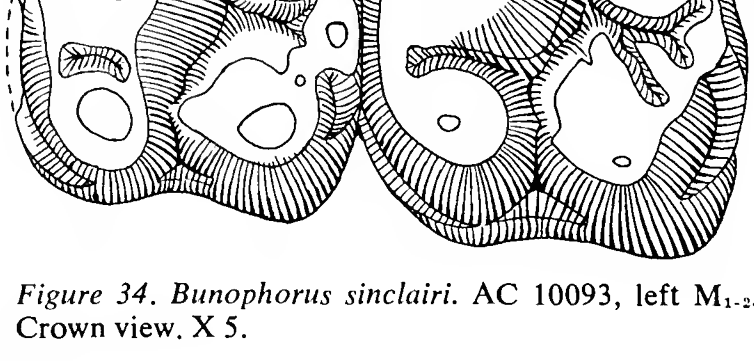

Figure 34. Bunophorus sinclairi. AC 10093, left M_{1-2}. Crown view. X 5.

TABLE 29. Measurements of Teeth of *Diacodexis metsiacus* from the Lysite of the Wind River Basin

	N	OR	M	S	V
P^4					
L	1	—	3.07	—	—
W	1	—	4.25	—	—
M^1					
L	8	3.73-4.35	4.11±.08	0.22±.06	5.35±1.34
W	8	4.90-5.65	5.31±.11	0.30±.08	5.65±1.41
M^2					
L	12	3.81-4.77	4.42±.08	0.29±.06	6.56±1.34
W	12	5.46-6.50	6.01±.09	0.32±.07	5.32±1.09
M^3					
L	5	3.80-4.40	4.20±.11	0.25±.08	5.95±1.88
W	5	5.03-6.50	5.63±.29	0.64±.20	11.37±3.60
P_4					
L	8	4.40-5.45	5.03±.13	0.37±.09	7.36±1.84
W	7	2.29-2.97	2.69±.08	0.21±.06	7.81±2.09
M_1					
L	14	4.10-4.50	4.31±.04	0.15±.03	3.48± .66
W	16	2.92-3.78	3.35±.05	0.22±.04	6.57±1.16
M_2					
L	22	4.24-4.84	4.45±.04	0.18±.03	4.04± .61
W	23	3.52-4.50	4.01±.04	0.21±.03	5.24± .77
M_3					
L	19	5.20-6.37	5.85±.07	0.31±.05	5.30± .86
W	20	3.40-4.11	3.76±.04	0.20±.03	5.32± .84

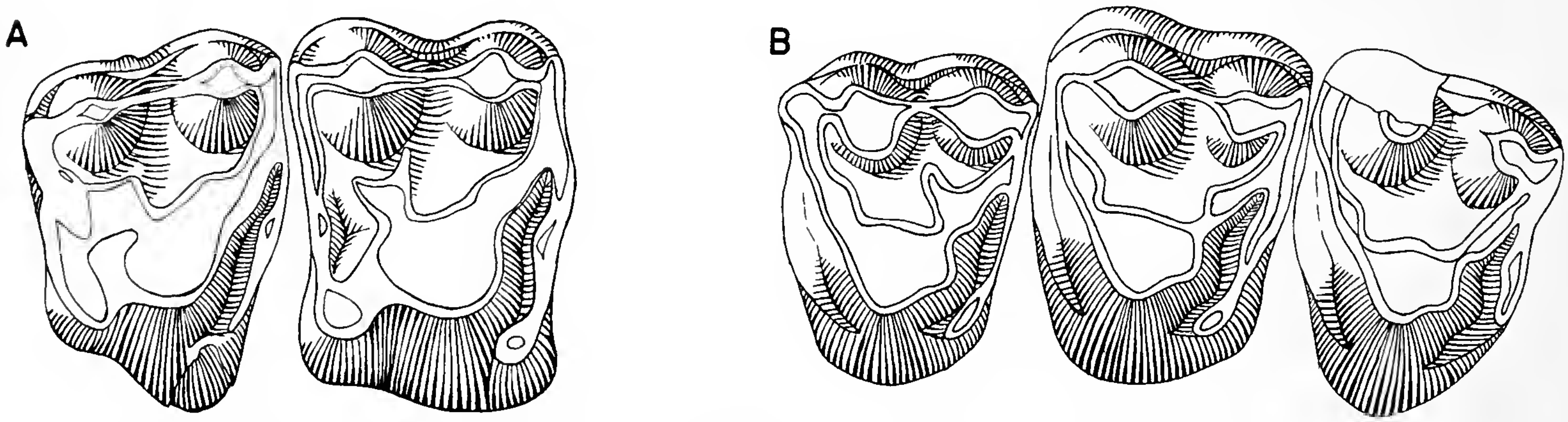

Figure 35. Diacodexis metsiacus. A. AC 2417, right M^{2-3}. Crown view. X 5. B. AC 2411, left M^{1-3}. Crown view. X 5.

the size range for the whole Wyoming sample, as indicated in Figure 36. Only two specimens of *Diacodexis* from New Mexico could be found in the American Museum collections, one of which is the size of the Lysite species, the other the size of Cope's *D. chacensis*. Until more specimens from New Mexico are recovered and the characteristics of the New Mexican sample can be evaluated it seems best not to refer Wyoming specimens to *D. chacensis*.

Three names, then, seem usable in Wyoming: *D. robustus* for the large Gray Bull species, *D. olseni* for the Lost Cabin sample of the smaller lineage, and *D. metsiacus* for the Gray Bull part of this lineage. The Four Mile and Lost Cabin samples could be placed in separate species as

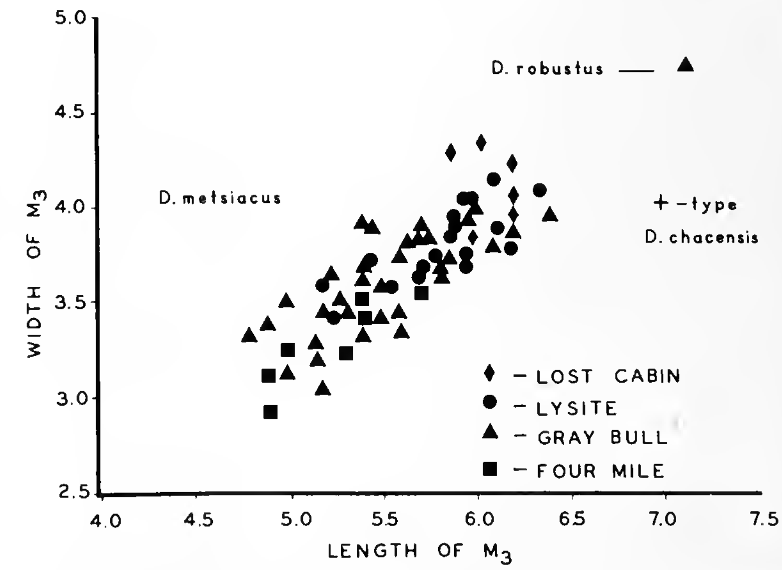

Figure 36. Scatter diagrams of length-width measurements of M_3's of early Eocene specimens of *Diacodexis*.

they do not overlap in size or in hypocone development but, as indicated earlier, knowledge of the variation in these two populations is not complete and the size of the samples of these two populations is small. As the Lysite and Gray Bull samples are nearly inseparable from one another, Gazin's (1952) suggestion that the Lysite sample be referred to the Gray Bull species, *D. metsiacus,* is followed here. I think it would be best at present to refer the Lost Cabin and Four Mile samples to this species also, as isolated specimens from the Lost Cabin cannot be separated from *D. metsiacus* and as the same is true for specimens from the Four Mile.

SUMMARY

The known fauna from the Lysite deposits of the Wind River Basin is large, including 61 mammalian species. Twenty-three of these 61 species are recorded from the Lysite for the first time.

The taxonomy of many of the genera that are represented in the Lysite is outdated and has been amended here according to the biological concept of species. One of the important changes has been the treatment of many of the Lysite species as geographical variants of previously described species from other areas. This treatment of samples that differ slightly from each other as geographical variants in a biological species rather than as two separate species as has often been done previously seems more consistent with the modern concept of species.

Comparison of the fauna from the Lysite deposits of the Wind River Basin with that from the Lysite deposits of the Big Horn Basin indicates that the type Lysite sediments represent only the upper fourth of the Lysite as it is known in the Big Horn Basin. This conclusion, based on the distribution of *Hyopsodus powellianus* in these deposits (see section on Faunal Correlation), is believed to be accurate as these basins are close together and as there is no evidence that any barrier to faunal interchange existed between these two basins at that time. Such an accurate comparison of the Lysite fauna with other faunas of similar age such as those from southern Wyoming, Colorado, and New Mexico has not yet been made. Differences in composition exist between these faunas and the Wind River Lysite fauna, indicating that some barrier to faunal dispersal may have existed between these areas. The existance of such a barrier prevents correlation based on the presence or absence of a single species, as was done between the Wind River and Big Horn Lysite faunas. Correlations in these cases must be based on a comparison of whole faunas. At present, this is impossible as not enough is known about these other faunas or about the geographic variation of early Eocene species.

Indeed, as our knowledge of the geographic variation of species increases, the taxonomy of several of the Lysite species may change. At present, if samples belonging to the same genus from the Lysite and some other geographic area overlap in size and morphology, these samples are considered to belong to the same species. Thus in *Pelycodus, Hyopsodus, Apatemys* and several other genera, species whose types are from New Mexico are recognized as present in Wyoming. If the samples from different geographic areas do not overlap in size and morphology, however, they are referred to separate species. Thus, *Diacodexis chacensis* and *Phenacolemur jepseni,* the types of which are from New Mexico, are not recognized in Wyoming. There is the possibility that in these cases further collecting in intervening deposits will indicate that *Diacodexis chacensis* and *Phenacolemur jepseni* are clinally related to the Wyoming samples here referred to *Diacodexis metsiacus* and *Phenacolemur citatus,* respectively.

The origins of most of the Lysite species can be found in the species from the Gray Bull deposits in the nearby Big Horn Basin. In several instances, however, samples from Gray Bull equivalents to the south of the Wind River Basin seem better ancestors to the Wind River Lysite fauna than do the samples from the Gray Bull beds to the north in the Big Horn Basin. This is particularly evident in *Hyracotherium vasacciense* and *Hyopsodus powellianus.* Of what geological or ecological significance this may be is not known at present, but the problem certainly merits future study.

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