SMITHSONIAN MISCELLANEOUS COLLECTIONS
VOLUME 144, NO. 1

Charles D. and Mary Vaux Walcott
Research Fund

A FURTHER STUDY OF THE LOWER EOCENE MAMMALIAN FAUNAS OF SOUTHWESTERN WYOMING

(With 14 Plates)

By
C. LEWIS GAZIN
Curator, Division of Vertebrate Paleontology
United States National Museum
Smithsonian Institution

(Publication 4474)

CITY OF WASHINGTON
PUBLISHED BY THE SMITHSONIAN INSTITUTION
JANUARY 17, 1962

PORT CITY PRESS, INC.
BALTIMORE, MD., U. S. A.

CONTENTS

ILLUSTRATIONS

Plates

(All plates follow page 98.)

Figures

Charles D. and Mary Vaux Walcott Research Fund

A FURTHER STUDY OF THE LOWER EOCENE MAMMALIAN FAUNAS OF SOUTHWESTERN WYOMING[1]

By C. LEWIS GAZIN
Curator, Division of Vertebrate Paleontology
United States National Museum
Smithsonian Institution

(With 14 Plates)

INTRODUCTION

Continued exploration for the Smithsonian Institution of the early Tertiary deposits of the Wyoming region has included further investigation of the lower Eocene sequence in the southwestern part of the State. Collections described by the author in 1952 were derived principally from the Knight beds along the Green River in the vicinity of La Barge and Big Piney in Sublette County, although scant remains from other localities and horizons were discussed. Particular attention to the less well represented occurrences has since resulted in considerably larger collections furnishing us with much better information on various faunas and their age relationships.

The later work in this area by the author's field party was directed in a large measure toward increasing the faunal representation from the New Fork beds above the Tipton tongue in the northerly part of the Green River Basin. Repeated search with the development of quarries in the lowest levels of the Knight near Bitter Creek Station in the Washakie Basin proved fruitful in adding significantly to the collections made here by Cope in 1872 and by Marsh in 1876 and 1882. Work in the Washakie Basin has also included systematic search of the Cathedral Bluffs beds and of the higher levels of the Knight below the Tipton tongue of the Green River formation in selected areas, particularly in the eastern portion. Moreover, detailed examination was made of widely scattered exposures of the Knight in

[1] Study of early Tertiary mammals is currently aided by a grant from the National Science Foundation.

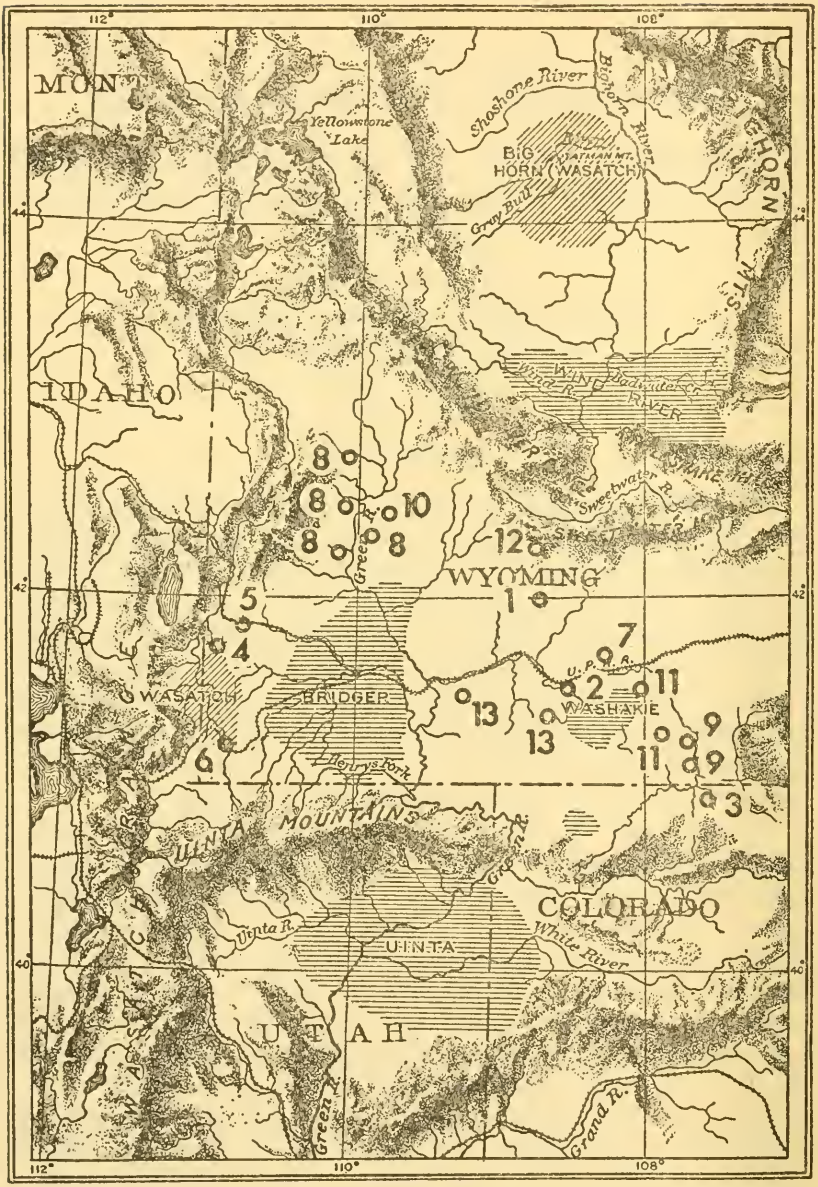


FIG. 1.—Map of southwestern Wyoming and portions of adjacent States showing Eocene basins of deposition, with fossil localities in Wasatch formation numbered as follows: 1, Red Desert; 2, Bitter Creek; 3, Four Mile Creek; 4, W. of Elk Mountain; 5, Fossil Butte; 6, Knight Station; 7, Tipton Butte; 8, La Barge; 9, Dad; 10, New Fork; 11, Cathedral Bluffs; 12, Oregon Buttes; 13, Rock Spring uplift (both flanks). (Map reproduced from Osborn, U. S. Geol. Surv. Monogr. 55, figs. 9, 49, 1929.)

the Fossil Basin, uncovering new localities in the local basin to the west and southwest of Elk Mountain in addition to those previously known around Fossil Butte and in the vicinity of Knight Station. A summary of these investigations was prepared for the 1959 guidebook of the Intermountain Association of Petroleum Geologists for their field conference relative to the Wasatch and Uinta Mountains.

ACKNOWLEDGMENTS

Among the many who have been of assistance to me in this restudy of these faunas, I am particularly indebted to the following:

Dr. Joseph T. Gregory, while at Yale University, kindly turned over to me for inclusion in this investigation the interesting collection of unstudied materials made near Bitter Creek by O. C. Marsh's parties. Dr. Peter Robinson supplemented this by sending me from time to time occasional specimens of this collection later encountered during his curatorial work on the Eocene mammals of the Marsh Collection. Dr. Glenn L. Jepsen, in addition to permitting me access to various lower Eocene collections at Princeton University, was most helpful in lending me for review the collections of lower Eocene mammals from the Washakie Basin. The latter were made by Dr. William J. Morris and included specimens representative of both the Dad and Cathedral Bluffs faunas. Dr. Malcolm C. McKenna, while a student at the University of California, sent me for study a collection of teeth that his party made in beds beneath the Tipton tongue near Dad, during the time of their work at the Four Mile Creek locality in nearby Colorado. I was also permitted, through the kindness of Drs. M. Graham Netting and J. LeRoy Kay, to examine the Dad locality materials collected by Kay. These were the specimens reported but not seen by me in 1952. More recently I have been privileged to examine for report several small collections made by Henry W. Roehler of the Mountain Fuel and Supply Co. from a series of carefully documented localities in lower Eocene strata of various horizons on the flanks of the Rock Springs uplift. Dr. Paul O. McGrew of the University of Wyoming has also aided in furnishing me with selected artiodactyl and primate specimens of particular interest that University of Wyoming parties obtained at various localities in the region.

During the faunal study I have been permitted unrestricted access to the type and other comparative materials in the collections of the American Museum, through the courtesy of Drs. George G. Simpson, Edwin H. Colbert, and Bobb Schaeffer. Mrs. Rachel H. Nichols,

former scientific assistant, was particularly helpful in locating specimens and arranging for loan of materials.

As in previous years I was assisted in the field during the more recent investigations of 1953 to 1959 by Franklin L. Pearce, chief of our laboratory of vertebrate paleontology, with the additional help of Theodore B. Ruhoff in 1956. In 1953 George Pipiringos of the U. S. Geological Survey kindly conducted us to various fossil localities that he and Dr. R. W. Brown had located the year before. These included the Red Desert locality east of Steamboat Mountain and sites near Tipton Butte, from which collections had been sent to me for identification and report in 1952, but too late for my paper of that year.

Most important to the value of this study are the incomparable pencil drawings prepared for the accompanying plates by Lawrence B. Isham, staff illustrator for the Department of Geology in the U. S. National Museum.

GEOLOGIC RELATIONS

Important new information on the geologic ages and sequence of early Tertiary formations in the southwestern part of Wyoming, particularly in the Fossil Basin and adjacent parts of Utah, necessitates a restatement of geologic relations, modifying the summary and definitions of usage presented in 1952. Much of this relates to demonstration by Tracey and Oriel (1959) that the Fowkes formation is stratigraphically higher than the Knight and a revision by Bradley (1959) of the nomenclature and relationships of members of the Green River formation in the Wyoming area. Further information on ages of various horizons in this sequence likewise calls for additional discussion.

Evanston formation.—The earliest formation in the Fossil Basin including strata of Tertiary age is the Evanston. Fossil mammal materials encountered (Gazin, 1956a) near Fossil Station on the Union Pacific Railway demonstrate that the uppermost beds of this unit are Tiffanian Paleocene in age. Tracey and Oriel (1959) found ceratopsian dinosaur materials in the lower part of the formation, showing that beds as old as upper Cretaceous are also included.

Wasatch formation.—The original definition of Wasatch by Hayden (1869) can only be interpreted as including the section of essentially reddish or variegated beds extending from near Carter, Wyo., to the "Narrows" of Echo Canyon in Utah. Moreover, Hayden's selection of the term "Wasatch" cannot be interpreted as implying a type sec-

tion within any narrowly restricted area at the railroad station of that name.

Veatch's revision (1907) of the term "Wasatch," while seemingly a logical arrangement from the information forthcoming at that time,

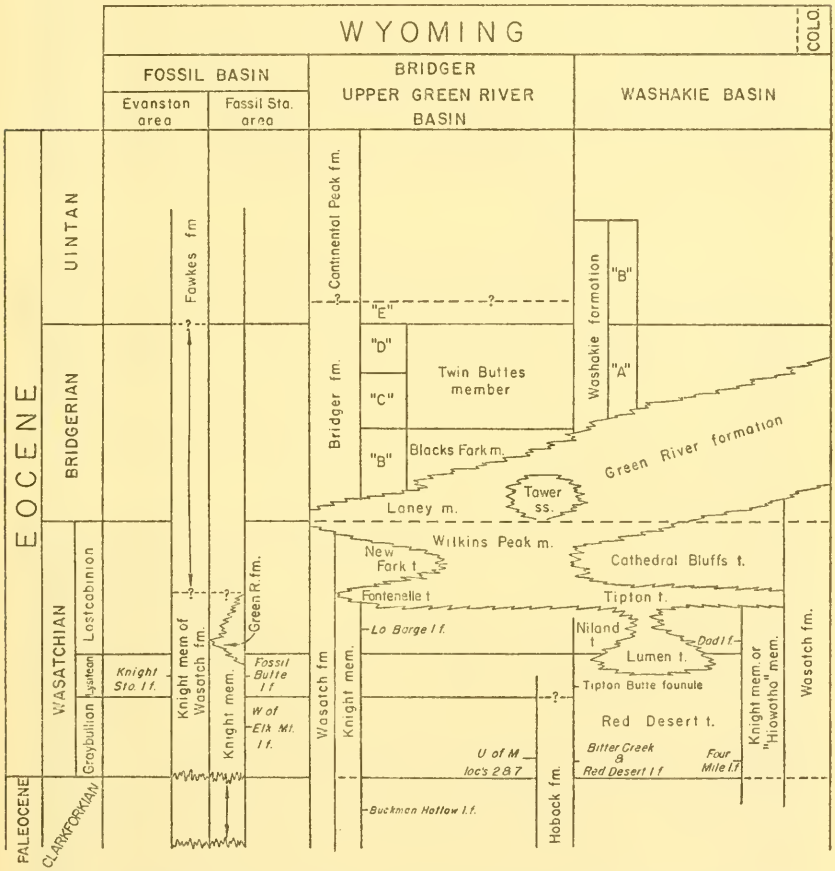


FIG. 2.—Chart showing approximate relations of the various stratigraphic units, ages, and faunal horizons of the Wasatch and other early Tertiary formations of southwestern Wyoming. (Modification of a portion of the chart prepared by author for Eocene Subcommittee of the Society of Vertebrate Paleontology Committee on Nomenclature and Correlation of the Continental Cenozoic.)

involved certain errors that much alter conception of the sequence. The three formations that he proposed as comprising the Wasatch group were, in ascending order, Almy, Fowkes, and Knight. As mentioned above, the Fowkes, consisting in a large measure of gray to white volcanic ash, is now known to be younger than the Knight,

and hence not included within the group of reddish beds that were involved in the original definition of Hayden. Secondly, Veatch considered that the reddish and essentially conglomeratic beds in Echo Canyon correlated with his Almy. Much of the sequence exposed in Echo Canyon is unconformably beneath the Tertiary, and in a recent paper by Williams and Madsen (1959) the older beds have been named the Echo Canyon conglomerate. They report fossils identified by Cobban as demonstrating a Cretaceous age, possibly late Niobrara. These exposures, it may be recalled, are those most glowingly described by Hayden, and are as much a part of the original Wasatch as is the Knight. This is, of course, an unwarranted extension of the group concept.

The U. S. Geological Survey and others have often extended use of "Wasatch" to designate reddish or variegated beds in many remote areas and basins not a part of the basin of deposition for which Wasatch was originally proposed. This practice is, of course, unacceptable by standards based on probable formation continuity, and by such designation the geologist can only be implying a color resemblance, or more often than not he is using it as a time term to indicate an early Eocene(?) age.

The term "Wasatch" no doubt should be abandoned but it has become so deeply entrenched in the literature that this may not be feasible. Redefinition to exclude the Echo Canyon conglomerate would, in general, conform to later usage in southwestern Wyoming. This would involve beds that have been described by Veatch as Almy and Knight in the Fossil Basin, but exclude, of course, the Evanston formation. The Almy is nearly unfossiliferous in the type area and although it appears to occupy a position stratigraphically between the Evanston and Knight, suggesting an uppermost Paleocene or Clarkforkian age, it is regarded by Tracey and Oriel (oral communication) as probably no more than a coarser or marginal facies of the Knight.[2] Wasatch in this manner is restricted to scarcely more than formation significance in the Fossil Basin, and probably also in the adjacent part of Utah.

[2] During the 1961 field season, after this paper had gone to press, determinable remains of fossil mammals were encountered by Franklin L. Pearce, Steven S. Oriel, and myself in beds mapped by Veatch as Almy on the north side of Red Canyon just to the east of the town of Almy. Several genera are recognized and an early Eocene age is evident, demonstrating that the "Almy" in its typical area is a coarser facies of the Knight. Details of the occurrence, the fauna represented and conclusions to be drawn are being prepared as a separate geological note by Tracey, Oriel, and myself.

The foregoing, together with a recent decision (Feb. 24, 1960) of the Geologic Names Committee of the U. S. Geological Survey to recognize "Wasatch formation" in preference to "Knight formation" for the concerned beds in southwestern Wyoming, has led me to revise usage in this paper from that adopted in my 1952 and 1959 reports on the faunas, complying to this extent with nomenclature henceforth to be used by the U. S. Geological Survey. The term Knight, however, I have retained in this study to designate a member of the Wasatch formation. It is restricted from my earlier usage in the Green River and Washakie Basins to include only the lower Eocene portion of the Wasatch that is beneath the Tipton tongue (see fig. 2), excluding the Cathedral Bluffs tongue of the Wasatch and its equivalent New Fork tongue.

The type section of the Knight, as defined by Veatch, is in the Fossil Basin; and the unit in this general area has been demonstrated to include beds from lowest Eocene to at least as high as Lysite, but whether or not strata of Lost Cabin equivalence are present has not been shown. The sequence does involve these later beds in the Green River and Washakie Basins and hence does not appear to be entirely equivalent. Nevertheless, the two sequences are essentially continuous to the east of Evanston and there would seem to be no logical reason for separate designation in any of the complex of adjoining basins having contiguous early Eocene deposition in the southwestern part of the State.

Wasatchian.—Although recognizing the term "Wasatch" to be variously misused and adopting it only as a group term, the Society of Vertebrate Paleontology's committee on Nomenclature and Correlation of the North American Continental Tertiary in 1941 (Wood, et al.) proposed and defined the term "Wasatchian" as an arbitrary time or age designation to include the lower part of the Eocene, older than Bridgerian or middle Eocene. The term "Wasatchian" is clearly limited by definition to the Eocene and is not intended to include the Paleocene portion of time that seems evident for earlier strata that might be included in the Wasatch formation.

Green River formation.—W. H. Bradley in 1959 revised the stratigraphic nomenclature of the Green River formation in Wyoming. Recognizing that the "Laney" of the Bridger Basin interfingered with the Cathedral Bluffs tongue northeast of White Mountain and was hence stratigraphically older than the type Laney in the Washakie Basin which overlies the type Cathedral Bluffs, he gave the new name "Wilkins Peak" member to the "Laney" of the Bridger Basin. At

the same time he concluded that his Morrow Creek member, which overlies the Wilkins Peak, must then be equivalent to the type Laney and should therefore be abandoned.

From this it is seen that in the Bridger or Green River Basin the New Fork tongue, which is evidently equivalent to the Cathedral Bluffs tongue, overlies the Fontenelle or Tipton tongue, interfingers with the Wilkins Peak and is overlain by the Laney member of the Green River. Evidently the Wilkins Peak member is present only in the Bridger Basin, so that to the east of the Rock Springs uplift the widespread Cathedral Bluffs tongue overlies the Tipton tongue and is overlain by the Laney member.

THE MAMMALIAN FAUNAS

The various Mammalia encountered at the several general localities and horizons in the lower Eocene beds of southwestern Wyoming are included together in the following composite list and checked to show representation in the more important localities for these horizons.

OCCURRENCES AND FAUNAL CORRELATIONS

The various collecting localities included in the apposing list, for the most part rather general areas representing subdivisions of Wasatchian time, are discussed in following sections. To these, however, are added consideration of the Four Mile Creek localities in Colorado that were studied by Malcolm C. McKenna, the series of localities in stratigraphic sequence on the flanks of the Rock Springs uplift that were systematically developed by Henry W. Roehler, and a few occurrences of lesser faunal importance that seem worthy of mention.

Red Desert.—The locality referred to as Red Desert in the attendant check list is a small area of buff, course-grained sandstone which outcrops in about sec. 12, T. 23 N., R. 100 W., approximately 14 miles east of Steamboat Mountain to the north of the Rock Springs uplift. The horizon here represented is near the base of Pipiringos's Red Desert tongue and judged by him to be about 200 feet above the Eocene-Paleocene contact. The small patch of sandstone shows much evidence of wind erosion, and the rather fragmentary materials obtained, consisting mostly of isolated teeth, would appear to be a part of a residual concentration of coarser particles left by the wind.

The fauna represented includes such characteristic Wasatchian forms as *Pelycodus, Esthonyx, Phenacodus, Hyracotherium,* and *Diacodexis* but evidence for an early Gray Bull equivalence is seen in the condylarth *Haplomylus speirianus.* A correspondence to the Four

	Red Desert	Bitter Creek	W. of Elk Mt.	Fossil Butte	Knight Station	La Barge	Dad	New Fork	Cathedral Bluffs
Marsupialia:									
Peratherium edwardi Gazin	..	..	..	..	..	X	..	..	..
Peratherium chesteri Gazin	..	..	..	..	..	X	..	..	?
Peratherium morrisi, new species	..	..	..	..	..	..	..	..	X
Insectivora:									
Diacodon, cf. *alticuspis* Cope	..	..	..	X	..	..	..	..	..
Palaeictops, cf. *tauri-cinerei* (Jepsen)	..	X	..	..	..	..	..	..	..
Palaeictops pineyensis (Gazin)	..	..	..	..	..	X	..	..	..
Leptictid, undet.	..	..	..	..	..	..	X	..	..
Amaramnis gregoryi, new genus and species	..	X	..	..	..	..	..	..	..
Palaeosinopa, cf. *didelphoides* (Cope)	..	..	..	..	..	..	..	X	X
Palaeosinopa, sp.	..	X	..	..	..	..	..	..	..
Apatemys hürzeleri, new species	..	..	..	..	..	X	..	..	..
Primates:									
Pelycodus, cf. *trigonodus* Matthew	X	X	X	..	..	..	..	..	..
Pelycodus, near *P. jarrovii* (Cope)	..	..	..	X	..	..	..	..	..
Pelycodus practutus, new species	X	X	..	..	..	..	..	..	..
Notharctus limosus Gazin	..	..	..	..	..	X	?	..	..
Notharctus, cf. *nunienus* (Cope)	..	..	..	..	..	..	..	X	..
Notharctus, cf. *venticolus* Osborn	..	..	..	..	..	X	..	X	X
Omomys sheai, new species	..	..	..	..	..	X	..	..	..
Omomys, cf. *vespertinus* Matthew	X	..	..	..	..	..	..	..	..
Chlororhysis knightensis Gazin	..	..	..	..	..	X	X	..	..
Anemorhysis sublettensis (Gazin)	..	..	..	..	..	X	..	..	..
Tetonoides pearcei, new genus and species	..	X	..	..	..	..	..	..	..
Absarokius, near *A. abbotti* (Loomis)	X	..	..	..	..	..	..	..	..
Absarokius noctivagus Matthew	..	..	..	..	..	X	..	..	..
Absarokius witteri Morris	..	..	..	..	..	..	..	..	X
Phenacolemur, cf. *praecox* Matthew	..	X	..	..	..	..	..	..	..
Cynodontomys angustidens Matthew	..	X	..	..	..	..	..	..	..
Cynodontomys knightensis Gazin	..	..	..	..	..	X	..	..	..
Cynodontomys scottianus (Cope)	..	..	..	..	..	..	..	X	..
Cynodontomys, sp.	..	..	..	..	X	..	..	..	..
Tillodontia:									
Esthonyx, cf. bisulcatus Cope	X	..	X	..	..	..	..	..	..
Esthonyx acutidens Cope	..	..	..	..	..	X	..	X	..
Esthonyx, sp.	..	..	..	..	X	..	X	..	..
Trogosus?, cf. *latidens* (Marsh)	..	..	..	..	..	..	..	..	X

	Red Desert	Bitter Creek	W. of Elk Mt.	Fossil Butte	Knight Station	La Barge	Dad	New Fork	Cathedral Bluffs
Taeniodonta:									
Ectoganus, sp.	..	..	..	X	..	..	..	..	..
Undetermined stylinodont	..	..	..	..	..	X	..	..	..
Edentata:									
Pentapassalus pearcei Gazin	..	..	..	..	..	X	..	..	..
Rodentia:									
Paramys excavatus Loomis	..	X	X	..	X	X	..	..	..
Paramys copei Loomis	..	..	..	..	..	X	X	..	X
Paramys major Loomis	..	..	..	..	..	X	X	X	X
Reithroparamys, sp.	..	..	..	X	..	..	..	..	..
Microparamys, sp.	..	..	..	..	..	..	..	..	X
Knightomys senior (Gazin)	..	..	..	..	..	X	..	..	..
Dawsonomys woodi Gazin	..	..	..	..	..	X	..	..	..
Sciuravus wilsoni Gazin	..	..	..	..	..	..	..	X	X
Carnivora:									
Thryptacodon, near T. *antiquus* Matthew	..	..	..	..	..	X	..	..	..
Hapalodectes compressus Matthew	..	..	..	..	..	..	..	X	..
Pachyaena ossifraga Cope	..	X	..	..	..	..	..	..	..
Pachyaena gracilis Matthew	..	..	X	?	..	..	..	..	..
Pachyaena?, sp.	..	..	..	..	..	..	..	X	..
Oxyaena sp.	..	X	..	..	..	X	X	..	..
Ambloctonus major Denison	..	..	..	..	..	X	X	..	..
Prolimnocyon elisabethae Gazin	..	..	..	..	..	X	..	..	..
Prolimnocyon, cf. *antiquus* Matthew	..	..	..	..	..	..	..	X	..
Sinopa, near *S. viverrina* (Cope)	..	..	..	..	..	X	..	..	..
Sinopa, cf., *multicuspis* (Cope)	..	X	X	X	..	..	..	..	..
Sinopa, cf. *vulpecula* Matthew	..	..	..	..	..	X	..	X	..
Sinopa, cf. *strenua* (Cope)	..	..	X	..	..	X	..	..	..
Didymictis protenus (Cope)	..	X	X	..	..	..	?	..	..
Didymictis altidens Cope	..	..	..	X	..	X	..	X	X
Viverravus, cf. *acutus* Matthew	..	X	..	..	..	..	X	..	..
Viverravus lutosus Gazin	..	..	..	..	..	X	..	X	X
Viverravus, cf. *dawkinsianus* (Cope)	..	..	..	..	..	..	..	X	..
Uintacyon asodes Gazin	..	..	..	..	..	X	..	X	..
Miacis, near *M. exiguus* Matthew	..	..	..	..	..	X	..	X	..
Miacis, cf. *latidens* Matthew	..	..	..	..	..	X	..	..	..
Cf. *Vulpavus australis* Matthew	..	..	..	X	..	..	..	..	..
Vulpavus asius Gazin	..	..	..	..	..	X	X	X	..
Cf. *Vulpavus*, sp.	..	X	..	..	..	..	..	..	..
Vassacyon, cf. *promicrodon* (Wortman)	..	..	X	..	..	..	..	..	..

	Red Desert	Bitter Creek	W. of Elk Mt.	Fossil Butte	Knight Station	La Barge	Dad	New Fork	Cathedral Bluffs
Condylarthra:									
Haplomylus speirianus (Cope).....	X	X	X	..	..	..	..	..	..
Hyopsodus loomisi McKenna.....	X	X	..	..	..	..	..	..	..
Hyopsodus cf. *miticulus* (Cope)...	..	X	X	X	..	..	..	..	..
Hyopsodus wortmani Osborn.....	..	..	..	..	..	X	X	X	..
Hyopsodus, cf. *mentalis* (Cope)....	..	..	..	..	..	X	..	X	..
Hyopsodus browni Loomis.....	..	..	..	X	X	..	X	..	X
Hyopsodus, cf. *walcottianus* Matthew	..	..	..	..	..	..	X	X	..
Phenacodus, cf. *primaevus* Cope.....	..	X	..	..	X	..	..	..	..
Phenacodus, cf. *vortmani* (Cope)...	..	..	X	..	..	..	..	..	..
Phenacodus, cf. *brachypternus* Cope.	X	..	..	..	..	..	..	..	..
Meniscotherium, cf. *priscum* Granger	X	X	..	..	..	..	..	..	..
Meniscotherium robustum Thorpe...	..	..	?	?	..	X	..	..	..
Meniscotherium, cf. *chamense* Cope..	..	..	..	..	..	..	..	X	..
Pantodonta:									
Coryphodon radians (Cope).....	..	X	X	X	X	X	X	..	..
Dinocerata:									
Cf. *Bathyopsis fissidens* Cope.....	..	..	..	..	..	..	..	X	..
Perissodactyla:									
Hyracotherium, cf. *angustidens* (Cope)	X	X	X	..	..	..	..	..	..
Hyracotherium vasacciense (Cope)..	..	..	..	X	X	X	X	X	X
Hyracotherium, cf. *craspedotum* Cope	..	..	..	X	..	X	X	X	X
Lambdotherium popoagicum Cope...	..	..	..	..	..	X	X	X	..
Brontotheriid, near *Palaeosyops fontinalis* Cope	..	..	..	..	..	..	..	..	X
Homogalax primaevus (Wortman)..	..	X	..	..	..	..	..	..	..
Isectolophid, near *Homogalax primaevus* (Wortman))	..	..	..	..	..	..	X	..	..
Heptodon ventorum (Cope).....	..	..	..	X	X	X	X	X	..
Hyrachyus, cf. *modestus* (Leidy)....	..	..	..	..	..	..	..	X	X
Artiodactyla:									
Diacodexis, cf. *metsiacus* (Cope)...	X	X	X	..	..	..	..	..	..
Diacodexis, near *D. secans* (Cope)..	..	..	..	..	..	X	?	X	..
Diacodexis, cf. *robustus* Sinclair....	..	..	..	..	..	..	X	..	..
Bunophorus cf. *macropternus* (Cope).	..	..	..	..	..	X	X	..	..
Bunophorus, cf. *etsagicus* (Cope)...	..	..	..	..	..	..	..	X	..
Hexacodus pelodes Gazin.....	..	..	..	..	X	X	X	X	X
Hexacodus uintensis Gazin.....	..	..	..	X	X	..	..	..	..

Mile fauna described by McKenna is suggested by an upper molar referred to primitive *Hyopsodus loomisi,* and by this together with a lower molar of *Pelycodus*(?) *praetutus* and teeth of *Meniscotherium,* cf. *priscum,* a resemblance to the Bitter Creek fauna is also seen.

Bitter Creek.—Most significant of the newly worked localities is a prominent hill of north- and westerly-facing exposures approximately a mile and a quarter south of Bitter Creek Station on the Union Pacific Railroad in Sweetwater County. This is surely the locality Cope (1872) referred to as Black Buttes in his description of *Coryphodon armatus.* It is the nearest exposure of Wasatchian materials to the Black Buttes station a few miles to the west, and the topographic feature of that name is still more remote in the older formations of the Rock Springs uplift. Marsh's parties also made collections here in 1876 and 1882, including the specimens he described as *Eohippus pernix.* The Marsh material, except for the hyracothere, has not been previously described. The exposures at this locality are on the west or northwest side of the Washakie Basin and may likewise be considered as on the east flank of the Rock Springs uplift. The locality is in the lowest part of the Knight, but little above the Paleocene. The contact or transition between these sets of beds is obscured locally by the alluvium of Bitter Creek. Fossils were encountered in various lithologic zones, including the thicker sandy marls, where more than one good skull of *Coryphodon* was obtained, but many of the smaller jaws and teeth were found in or adjacent to the thin carbonaceous layers which abound in spines and other fragments of fish.

A fauna of about 24 species of mammals representing 21 genera was recognized in the combined National Museum and Yale University collections. The fauna closely resembles that of the Gray Bull beds in the Bighorn Basin, and the small condylarths *Haplomylus speirianus* and *Meniscotherium,* cf. *priscum,* suggest correlation with the earlier part of Gray Bull series. The genera here are nearly all included in the larger Four Mile fauna and differences in certain of the species represented may in part reflect local conditions or environment. Most noticeable with regard to the Four Mile fauna is the absence of *Meniscotherium,* which so far has not been found in any of the horizons on the east side of the Washakie Basin. This must surely represent a persistent ecological difference.

Four Mile Creek.—To the southeast of the Washakie Basin in the adjacent part of Colorado, but nevertheless within the more general area of the Washakie basin of deposition, a number of localities in

exposures very low in the Knight have yielded remains of a fauna of considerable size. Collecting here was done by University of California parties and the collections, made largely by a washing technique, were described in detail by McKenna (1960). The localities from which these materials were obtained are shown in a map accompanying his report.

The Four Mile fauna is equivalent in age to the early part of the Gray Bull beds, or essentially the Sand Coulee level, in the Bighorn Basin. These collections have not been examined by me, and no direct comparison of the materials with, for example, those from Bitter Creek has been made, so that a comparative listing here seemed inadvisable.

West of Elk Mountain.—Exploration of the Knight was extended to include a variety of localities in the Fossil Basin along the western margin of the State in Lincoln and Uinta Counties. Newly discovered localities in the valley of North Bridger Creek to the west of Elk Mountain, however, while only sparsely fossiliferous, have produced as representative a collection as that obtained at Fossil Butte. The localities are low on a west-facing escarpment that is capped with Green River beds west and southwest of Elk Mountain. The occurrences are scattered along exposures due west of Elk Mountain, where remains were found near the base of the sequence, to about three or four miles farther south, in or near sec. 30, T. 20 N., R. 119 W., where collecting was done at a somewhat higher level. In this area, as near Fossil Station, the Knight is resting directly on the Evanston formation.

About 13 genera of mammals are recognized and remains of one species, *Haplomylus speirianus,* suggesting early Gray Bull although not necessarily Sand Coulee, were found at the locality near the base of the section due west of Elk Mountain. *Vassacyon,* cf. *promicrodon,* found a couple of miles farther south near a specimen of *Phenacodus,* cf. *vortmani,* may also be indicative of Gray Bull time, but not necessarily the earliest part. Although the remaining forms for the most part do not seem to be critical as to horizon, they are, except for a recently discovered specimen of *Meniscotherium,* cf. *robustum,* forms to be expected in levels of Gray Bull equivalence. It may be further noted that *Coryphodon* is more than usually abundant along the lower slopes of the escarpment and some rather good skull and jaw material was obtained.

Fossil Butte.—Fossil Butte derives its name from the well-known fossil fish quarries in the Green River formation that caps this butte

and nearby ridges in the vicinity of Fossil Station on the Oregon Short Line branch of the Union Pacific Railroad. A number of specimens of fossil mammals have been found in the variegated Knight beds beneath the Green River beds around Fossil Butte and adjacent areas. It is here that specimens first found by Princeton University parties in 1939 and 1940 were reported by me in 1952. Smithsonian Institution parties obtained a number of specimens from west-facing exposures in the saddle to the north of Fossil Butte as well as on the more accessible slopes around the south side of the butte.

I am not certain that the remains collected on the slopes of Fossil Butte all represent the same division of Wasatchian time. *Heptodon* has been found only high on the slopes in the somewhat darker red beds close beneath the Green River shales. Also, the tooth portions of *Didymictis* considered to represent *D. altidens* were from a high level. It is clear that these upper slopes are later than Gray Bull and the presence there of *Hyopsodus browni* would suggest Lysite—but finding this species or a form within the same size range in the Dad fauna, in association with *Lambdotherium,* somewhat weakens this particular evidence. The absence of *Meniscotherium,* so abundant in the nearby La Barge localities, had been thought significant but the more recent finding of a maxilla in the saddle to the north of Fossil Butte and a lower jaw portion on the east side would appear to rule out this evidence also; however, the species represented may not be typical *M. robustum* because of the comparatively small size of the teeth. Nevertheless, the absence of *Lambdotherium,* invariably found in beds just below the Tipton tongue of the Green River beds belonging to Lake Gosiute, lends tentative support to a Lysitean age assignment. The remaining forms represented on the higher slopes of the butte, i.e., *Pelycodus,* near *P. jarrovii; Ectoganus,* sp.; *Reithroparamys* sp.; *Sinopa,* cf. *multicuspis;* cf. *Vulpavus australis; Hyopsodus,* cf. *miticulus; Hyracotherium;* and *Hexacodus uintensis* apparently do not furnish critical information. It may be further noted, however, that the species of *Hexacodus* cited is not the same as that in the La Barge fauna.

While there does not appear to be any certain evidence to demonstrate that the lower part of Fossil Butte is older than Lysite, it should be noted that *Coryphodon* seems much more abundant on the middle and lower slopes, much as it is to the west of Elk Mountain and at Bitter Creek. In addition to *Coryphodon,* sp.; *Diacodon,* cf. *alticuspis; Pelycodus,* near *P. jarrovii;* cf. *Pachyaena gracilis;*

Hyracotherium, sp.; and *Hexacodus uintensis* have been found at the lower levels.

Knight Station.—The localities along Bear River to the southeast of Evanston and in the vicinity of Knight Station were discussed in 1952 and further exploration by Smithsonian Institution parties has failed to uncover additional materials of new significance. Granger (1914, p. 203) regarded these beds as equivalent to Lysite in age and to date I find no reason to question seriously this conclusion. Among the forms now recognized in the fauna from this locality there may be listed the following:

Cynodontomys, sp.
Esthonyx, sp.
Paramys excavatus Loomis
Hyopsodus browni Loomis
Phenacodus primaevus Cope
Coryphodon radians (Cope) (etc.)
Hyracotherium vasacciense (Cope) (incl. *H. index*)
Heptodon ventorum (Cope)
Hexacodus pelodes Gazin
Hexacodus uintensis Gazin

Granger's conclusions were based on the presence of *Heptodon,* which distinguished these beds from the Gray Bull level, and on the species of *Cynodontomys* and *Hyopsodus* which he regarded as nearest to Lysite forms of these genera. The *Cynodontomys* specimen may well represent *C. latidens* but the absence of premolars leaves much to be desired. The *Hyopsodus* is of a size that strongly suggests Lysite *H. browni,* but there is recent evidence to indicate that a form of this size is present in the Dad fauna. Elsewhere this has not been found in the La Barge horizon. The two species of *Hexacodus* listed are based on the specimens listed by Van Houten (1945, p. 458) from American Museum labels as *Diacodexis,* sp. These had not been seen at the time of the 1952 report but have since been found and their identity is discussed under the species of *Hexacodus.*

Identifiable remains of mammals are not frequently encountered in the type section of the Knight, but of those found *Coryphodon* seems most conspicuous, with *Heptodon* and *Hyracotherium* represented by remains from more than one individual. The absence of *Lambdotherium,* while entirely inconclusive, permits retention of a Lysite assignment.

Tipton Butte.—A locality near Tipton Butte that has produced a number of isolated teeth was found by Roland W. Brown and George N. Pipiringos in 1952. It is in the SW¼ sec. 23, T. 20 N., R. 96 W., near the top of the Red Desert member described by Pipiringos (1955, p. 100). Recognized among the teeth are a small form of *Cynodontomys* that may be *C. angustidens; Pelycodus?,* sp.; *Es-*

thonyx bisulcatus; Paramys, cf. *excavatus; Vulpavus,* possibly *V. asius; Hyopsodus,* sp.; *Meniscotherium* cf. *robustum;* and *Hyracotherium.* I earlier reported these to Pipiringos as being about equivalent to Lysite or Lost Cabin in age. I believe now, however, that the age is probably not as late as Lost Cabin. It may well be Lysitian or late Graybullian, but the evidence is not critical.

La Barge.—The outstanding occurrence or series of localities in the Knight member is that for the La Barge fauna in the vicinity of La Barge and Big Piney, essentially all in Sublette County. As described in 1952, the horizon of the Knight involved is exposed principally in the various canyons or draws on both sides of the Green River between La Barge and Big Piney and to a point about 12 miles north of Big Piney. Fossil remains were encountered from a few feet to more than a hundred feet below the Tipton (Fontenelle of Donovan) tongue of the Green River. Certain of the more profitable localities in these beds have been revisited on various occasions in later years, particularly that on Muddy Creek near where it is crossed by the highway north from Big Piney.

Most of the 1952 report was devoted to the La Barge fauna, and the evidence relating to its Lostcabinian age considered in detail (1952, pp. 10-12). The significance of the occurrence of the species *Meniscotherium robustum* discussed then has since been modified by various scattered finds in the northern part of the Fossil Basin, and new information on the fauna is afforded by recognition in it of such genera as *Palaeictops, Apatemys, Omomys, Chlororhysis, Knightomys,* and *Dawsonomys* not cited in the earlier list. The number of genera of mammals now identified in the fauna is 31, representing about 40 species, out of an entire number of about 53 genera and approximately 95 species considered in this report for the lower Eocene portion of the Wasatch. This total number does not include early Knight occurrences in Colorado described by McKenna.

Dad.—A long escarpment of Knight exposures beneath the Tipton tongue on the east side of the Washakie Basin, well known to collectors in the Wyoming region, extends along the west side of Muddy Creek and highway U.S. 330 from near Dad P. O. southward, interrupted by several long canyons heading to the west, to the vicinity of Baggs. While specimens have been found in many scattered localities, most of the material collected by the Smithsonian Institution, Carnegie Museum, and University of California parties has been from the large promontory-like exposures near Dad. *Hyracotherium* is particularly common in this area.

The stratigraphic position of the occurrences referred to as the Dad locality appears similar to that for the La Barge area relative to the Tipton tongue, and the faunas represented are similar in the identity of several species. Among those in common may be mentioned *Chlororhysis knightensis, Paramys copei, Paramys major, Ambloctonus major, Vulpavus asius, Hyopsodus wortmani, Coryphodon,* cf. *radians, Hyracotherium vasacciense, Hyracotherium,* cf. *craspedotum, Lambdotherium popoagicum,* and *Heptodon ventorum.* Several of these are not particularly significant as to the horizon of the Knight represented but the occurrence of *Lambdotherium* would seem to limit it to Lostcabinian time. There are, nevertheless, a number of differences that are noteworthy, but which can possibly be attributed to local environment or ecology. The absence of *Meniscotherium,* so abundant in the La Barge fauna—missing from all horizons on the east side of the Washakie Basin—must surely be related to ecology. Not so easily explained perhaps are certain forms that seem rather primitive for this level, such as indicated by the materials that have been tentatively referred to *Didymictis protenus* and *Viverravus acutus,* and the small tooth referred to *Esthonyx.* Moreover, a *Hyopsodus* the size of Lysite *H. browni* is not represented in the rather numerous remains of this genus at La Barge. Particularly surprising is the discovery of isectolophid remains closely resembling *Homogalax.* Too much stress, however, should not be placed on this because of the recognized survival of the isectolophid line into still later Eocene time. The possibility that the lowest exposures along the base of the Baggs-Dad escarpment, where it reaches its greatest height, may include beds older than Lost Cabin should not be disregarded, but unless faulting is involved, surely beds of Gray Bull age would not be exposed so near the Tipton tongue.

New Fork.—Of especial importance are the New Fork or Cathedral Bluffs exposures along Alkali Creek in the same general area as those for the La Barge fauna but somewhat farther east of the Green River. Alkali Creek, a dry stream bed most of the year, is roughly parallel to the Green River, descending northward to where it joins the Green River near its confluence with the New Fork. Exposures of the New Fork beds are typically developed along the south side of the New Fork to the east of Big Piney, and on both sides of Alkali Creek. The most productive localities were found to be the series of buttes on the west side of Alkali Creek from its mouth southward for a few miles, beyond which the fluviatile series

above the Tipton tongue is replaced by interfingering lake deposits belonging to the Wilkins Peak member of the Green River formation.

Since the preliminary statement on this fauna in 1952, 15 genera have been added to the 10 (one of these, *Ambloctonus,* was cited in error) then recognized. These represent the smaller mammals such as insectivores, primates, rodents, artiodactyls, and particularly carnivores, as may be seen in the foregoing list. The fauna is rather closely related to that of the La Barge horizon, and about 16 species survived without change of significance or taxonomic importance the interval of lake encroachment during which the Tipton tongue was formed. Certain species, however, may be regarded as having evolved more appreciably; suggested are those representing *Cynodontomys, Notharctus, Prolimnocyon,* and *Bunophorus.* The ecologic changes that accompanied the lake advance no doubt permitted or are responsible for a certain faunal readjustment, with migrations and certain extinctions evident in the local scene, but because of the climatic factor involved this may have been rather widespread. Notable is the disappearance of *Coryphodon,* possibly also of *Thryptacodon* and *Ambloctonus,* although these are never common and could have escaped collection in the New Fork. A number of small mammals are not recorded later but their marked scarcity or unique representation precludes any generalizations. Newly introduced into the area are such forms as *Hapalodectes, Bathyopsis,* and *Hyrachyus. Meniscotherium robustum* evidently became extinct and was replaced from elsewhere by a form that would appear to be *M. chamense.* A new animal to the Green River Basin in New Fork time may also be *Hyopsodus walcottianus.*

Cathedral Bluffs.—Above the Tipton tongue in the Washakie Basin the Cathedral Bluffs member has been found to be comparatively barren. Exploration by Smithsonian Institution parties has extended from the northwest around the northern and eastern sides of the basin to near the southeastward limit of the exposures, with the finding of but very occasional scattered specimens. Nevertheless, collecting by William Morris for Princeton University has resulted in representation of a fauna of respectable size. Most of the Princeton material from the Cathedral Bluffs is from the zone of outcrop on the northeast side of the basin, as shown on the map accompanying his report (1954).

About 15 genera are now recognized in this fauna, and though the number is not significantly greater than listed by Morris, there have been some changes in the names applied with a different interpreta-

tion of relationships (see Gazin, 1959, p. 135). All of these are discussed in the systematic portion of this paper, as listed in the preceding section. Of these, all but *Peratherium, Trogosus?, Absarokius, Microparamys,* and the brontotheriid near *P. fontinalis* are represented in the New Fork fauna. Only *Trogosus?* and the brontotheriid appear significant in this difference.

I have earlier (1959) discussed the possibility of the Cathedral Bluffs including upwards beds somewhat later than are represented in the New Fork, particularly to the north of the Washakie Basin in the region of the Oregon Buttes and Cyclone Rim. Although this in no way disturbs the probable contemporaneity of the two sets of beds, at least so far as their relation with the Tipton tongue is concerned, it may be noted that New Fork sequence as exposed in the type area is scarcely more than a remnant near its basinward periphery, where it interfingers with the Wilkins Peak. Most of its faunal remains were recovered in the lower part, no great distance above the Tipton (Fontenelle) tongue, except for *Bathyopsis,* which was discovered several miles farther south on Alkali Creek and possibly a little higher in the section.

Investigation, furthermore, of the particular field occurrences of *Trogosus?,* sp., and the brontotheriid, near *Palaeosyops? fontinalis* (earlier listed as *Eotitanops,* sp.), discloses that both were found in sec. 4, T. 15 N., R. 93 W. This is evidently locality 1 on Morris's map (1954, p. 198) and clearly high in the section, as it is near the contact with the overlying Laney shale. Both also have been found in beds mapped as belonging to the Cathedral Bluffs tongue in the Continental Divide Basin farther to the north. The *Trogosus* occurrence reported by Nace (1939, pp. 17, 26-27) was described as occurring 75 feet below the top of the Cathedral Bluffs tongue in the northwest part of T. 26 N., R. 98 W. The brontotheriid near *Palaeosyops? fontinalis* was found by me very near the top of the red beds in the Oregon Buttes area, immediately to the southwest of the Continental Peak at the north margin of Sweetwater County. The significance of the brontotheriid occurrences is discussed in the systematic section of this paper. The implication that a "Bridger A" level is represented is probably meaningless. The *Palaeosyops? fontinalis* type may well have been found in a sandy lens of the Wilkins Peak member. Robinson (MS.) has shown that the Huerfano B fauna, which includes *Palaeosyops? fontinalis,* is associated with a Lost Cabin fauna rather than one truly Bridgerian.

It is now evident that *Trogosus* was not actually in association with

Esthonyx in the Cathedral Bluffs, but the gap between them in their stages of development seems too great for direct continuity in the time permitted. *Palaeosyops? fontinalis,* on the other hand, is scarcely more than a large *Eotitanops.*

Oregon Buttes.—In addition to the brontotheriid, near *Palaeosyops? fontinalis,* and *Trogosus* discussed in the above section on the Cathedral Bluffs, remains of *Notharctus, Hyrachyus,* and a tapiroid which has been thought to represent *Heptodon* have been found in the northwestern part of the Continental Divide Basin, in the general area of the Oregon Buttes and Continental Peak. The Cathedral Bluffs sequence here beneath the lacustrial zone which was mapped as "Morrow Creek" (now Laney) consists essentially of a lower red zone and an upper greenish portion. Part of the specimens collected by us came from a level at about the color change to a few feet higher, but the tapiroid and *Notharctus* came from red beds on the northwest side of Oregon Buttes. These few specimens give no clue as to whether the age represented is that of the Lost Cabin or Bridger beds. The brontotheriid is a trifle more robust than that represented by the Princeton specimen from the Washakie basin, and the *Heptodon*-like tapiroid could be *Helaletes.* The possibility that the color change here represents the transition from Cathedral Bluffs to Bridger makes interesting speculation, particularly since the overlying Laney is so attenuated. It should be noted, however, that much of the New Fork sequence of undoubted Wasatchian age is essentially greenish with locally reddish zones or lenses.

Rock Springs uplift.—In 1952 I reported the discovery by Roland W. Brown of *Meniscotherium robustum* and *Coryphodon* in the Knight a few miles southwest of Rock Springs. Since then Henry W. Roehler, geologist for the Mountain Fuel and Supply Co. in Rock Springs, has discovered a series of small faunules at various horizons in the "Hiawatha" member on the west flank of the uplift near here. These included representation of horizons from earliest Graybullian Eocene to Lostcabinian, with about 930 feet belonging to the Gray Bull equivalent. This was reported by McGrew and Roehler in 1960. A similar sequence of faunules, represented mostly by small isolated teeth, has been found by Roehler on the southeast flank as well, also demonstrating earliest Wasatchian to Lost Cabin time. The lowest faunules here are in beds that strike to the southwest from the Bitter Creek locality. I am particularly indebted to Mr. Roehler for allowing me to study and report on these collections. I look forward to seeing publication of his stratigraphic studies.

SYSTEMATIC DESCRIPTION OF THE MAMMALIA

MARSUPIALIA

DIDELPHIDAE

PERATHERIUM EDWARDI Gazin

No additional material belonging to the larger and more certainly didelphid of the two species in the La Barge fauna referred to *Peratherium* has been encountered in the Knight. The maxilla and jaw representing this species were both found at the Muddy Creek locality about 12 miles north of Big Piney.

PERATHERIUM CHESTERI Gazin

The type lower jaw of this very small species, together with the material of the foregoing form, was discovered at the Muddy Creek locality north of Big Piney. There is, however, a minute jaw in the Princeton University collections (No. 16116) from the Cathedral Bluffs member of the Wasatch to the north of Flat Top Mountain in the Washakie Basin that may be marsupial and possibly represents this species. Morris (1954), in his study of the Cathedral Bluffs fauna, has listed it as *Nyctitherium,* sp. The preserved tooth, as in the La Barge jaw, is the penultimate molar. It is a little smaller and relatively shorter than in the type of *P. chesteri,* but exhibits a similar posterointernally directed hypoconulid, much more lingual in position than in materials that have been referred to *Nyctitherium,* rather more as in marsupials. Confusion as to the identity of the form represented may lie in the appearance of the entoconid, which seems very small and close to the hypoconulid, suggestive in this way of the South American monodelphids although the paraconid and anteroexternal cingulum are not so importantly extended. Examination under ×48 magnification, however, reveals an irregularly pitted area forward from the hypoconulid, indicating that the greater part of the entoconid may be missing through damage, possibly modified by wear. A better forward development of the entoconid strengthens the suggestion of didelphid affinity. The lower jaw is a little less robust and of slightly less depth than in the type of *P. chesteri.* Neither are sufficiently preserved posteriorward to show the nature of the angle.

PERATHERIUM MORRISI, new species

(Plate 1, figure 1)

Type.—Right ramus of mandible with two molars, P.U. No. 16115.

Horizon and locality.—Cathedral Bluffs member, north of Flat Top Mountain, sec. 4, T. 115 N., R. 93 W., Washakie Basin, Wyoming.

Description.—Intermediate in size between *Peratherium chesteri* and *Peratherium edwardi,* but closer to the latter. Talonid basin of lower molars relatively a little shorter and entoconid less developed than in *P. edwardi.*

Discussion.—The specimen designated as the type of *P. morrisi* was listed by Morris as *Peratherium,* cf. *P. marsupium.* The teeth are decidedly smaller than in any of the Bridger *P. marsupium* material in the National Museum collections and, as in comparison with *P. edwardi,* the talonid appears relatively shorter. The possibility of the Cathedral Bluffs specimen representing the Bridger species *P. marsupium* seems very questionable.

INSECTIVORA

LEPTICTIDAE

DIACODON, cf. ALTICUSPIS Cope

The Princeton specimen of *Diacodon,* No. 16171, was cited (1952) as coming from about 100 feet below the Green River beds in the vicinity of Fossil Butte in the Fossil Basin. While the Knight here is regarded as Lysite in age, there remains a possibility that the lowest of these, as west of Elk Mountain, may be Gray Bull in age. There is, however, no faunal evidence to show this. No additional material that may be referred to *Diacodon,* cf. *alticuspis,* has been encountered.

PALAEICTOPS, cf. TAURI-CINEREI (Jepsen)

(Plate 1, figure 5)

A portion of a right maxilla with the three molars, U.S.N.M. No. 22122, from the lower Wasatchian horizon at Bitter Creek may well belong to the Gray Bull species *Palaeictops tauri-cinerei* of the Bighorn Basin. The teeth correspond closely in size to those of Jepsen's species, and their structure seems almost identical to that in the type specimen, rather less like *Palaeictops bicuspis* (Cope). In the absence of known upper teeth of *Palaeictops pineyensis,* no comparison with the later Lostcabinian form is feasible, other than to note that the teeth are a little smaller than would be appropriate for good occlusion.

PALAEICTOPS PINEYENSIS (Gazin)

(Plate 1, figure 4)

A small jaw fragment with only P_3 preserved, U.S.N.M. No. 22123, and a maxilla with M_2, U.S.N.M. No. 22444, were collected

since 1952 from the same locality, 12 miles north of Big Piney, as the type of *Palaeictops pineyensis*. P_3 is much longer and exhibits a small anterior, conical cuspule, rather better defined than in *P. tauri-cinerei*, but not as highly placed on the primary cusp as in Lost Cabin *Parictops multicuspis*. The cuspule on the posterior slope of the primary cusp is also conical and well defined, possibly better developed than the posterior or talonid cusp which has been nearly obliterated by wear.

LEPTICTID?, genus and species undetermined

An isolated lower molar from low in the Knight to the east of Steamboat Mountain might be M_1 of a leptictid. It is a slender tooth with an elongated trigonid portion, but rather unlike *Diacodon* or *Palaeictops*.

A small jaw in the University of California collection from the Dad locality, No. 43759, exhibits the greater portion of the last two molars. It is much smaller than the foregoing and may be leptictid or possibly nyctitheriid, although resemblance to Bridger forms of the latter seems remote. Damage to critical portions of the teeth leaves much to be desired in attempting a detailed study.

ERINACEIDAE?

Cf. ENTOMOLESTES, sp.

Isolated teeth that compare very closely with some illustrated by McKenna (1960, figs. 25c, 26) were found by Henry Roehler at various levels in the Knight sequence around the Rock Springs uplift. One upper molar is from west of Rock Springs at a level about 1,195 feet below the Tipton tongue. Roehler considers this to be about Graybullian in age. Another upper tooth found to the southwest of Rock Springs at about 751 feet below this tongue of Green River may be Lysitean although there seems to be no certain evidence of this. A lower jaw fragment with M_3, which he found above the base of the Tipton tongue on Table Rock to the East of the Rock Springs uplift, is surely Lostcabinian in age.

McKenna (1960, p. 58) has included *Entomolestes* in the family Amphilemuridae, which he regards as insectivore. While this arrangement may be entirely correct, I understand that these and related forms are currently under study by Robinson and by McKenna, so that, until these studies are completed, I have tentatively used the classification employed by Simpson (1945, p. 49). Attention should perhaps be called here to an oversight in Simpson's

citation, in which it is indicated that *Entomolestes* is only lower Eocene in age. This should have included middle Eocene as well, which is the age of the type species.

PANTOLESTIDAE

AMARAMNIS,[2a] new genus

Type.—*Amaramnis gregoryi,* new species.

Generic characters.—Resembling *Palaeosinopa* but lower molars much more slender, and anteroposteriorly elongate trigonids of M_2 and M_3 exhibit more acute anteroexternal angle between paraconid and anterior crest from protoconid. Paraconid more closely joined to metaconid. Talonid basin shallower, cusps less elevated and anterior crest from hypoconid less oblique.

AMARAMNIS GREGORYI,[3] new species

(Plate 1, figure 2)

Type.—Left ramus of mandible with M_2-M_3, Y.P.M. No. 14702.

Horizon and locality.—Lowest beds of Knight member, Gray Bull (Sand Coulee) equivalent, 1¼ miles south of Bitter Creek Station, Sweetwater County, Wyo.

Specific characters.—Size near Gray Bull *Palaeosinopa lutreola* Matthew. Specific characters not otherwise distinguished from those cited for the genus.

Description.—*Amaramnis gregoryi* is represented only by the type lower jaw, but the peculiarities of the two preserved lower molars readily distinguish it. Although the molars are about the length of those in the type (A.M. No. 15100) of *Palaeosinopa lutreola,* their width is very much less. Perhaps the most noticeable feature of the teeth is the decidedly pentacodontine character of the trigonid portion. The anteroposteriorly elongate trigonid shows a very sharp flexure of the paraconid from the anterior crest of the protoconid, much as in *Pentacodon* and *Coriphagus,* more acute than in *Palaeosinopa.* The cusp arrangement of the talonid, however, more closely resembles that of *Palaeosinopa* and *Pantolestes* with the prominently developed hypoconulid. The basin of the talonid is relatively shallower than in the forms examined, and the crista obliqua is directed more forward, somewhat as in *Pantolestes,* quite unlike *Pentacodon* and *Coriphagus.* M_3 is not reduced as in *Pentacodon* and *Coriphagus*

[2a] From Latin, *amarus, a,* bitter, and *amnis,* small river or stream; with reference to Bitter Creek.

[3] Named for Dr. Joseph T. Gregory who graciously permitted me to study the Marsh Bitter Creek collection.

and the talonid portion is much more elongate as in *Palaeosinopa* and *Pantolestes*.

MEASUREMENTS IN MILLIMETERS OF POSTERIOR LOWER MOLARS IN SPECIES OF *Palaeosinopa* AND *Amaramnis*

	P. lutreola A.M. No. 15100 Type	*A. gregoryi* Y.P.M. No. 14702 Type
M_2, anteroposterior diameter : transverse diameter....	3.4 : 2.8	3.4 : 2.3
M_3, anteroposterior diameter : transverse diameter....	4.0 : 2.8 [a]	3.6 : 2.2

[a] Approximate.

PALAEOSINOPA, cf. DIDELPHOIDES (Cope)

The lower cheek teeth of the right side, including P_2-M_3 (U.S.N.M. No. 22453), associated with fragments of the jaw, undoubtedly of *Palaeosinopa,* were found in the New Fork tongue. The lower molars, the first two of which are badly worn so that their length may be slightly less than normal, measure 15 mm. This is very near the measurement of 15.5 mm. given by Matthew (1918) for a specimen of *Palaeosinopa didelphoides.*

Comparison of the New Fork specimen with Bridger *Pantolestes longicaudus* shows the two to be rather close. The premolars are a little longer and more slender, and on M_3, which is the least worn molar, the paraconid is higher and more lingual in position than in the Bridger specimens observed.

A single lower molar (U.S.N.M. No. 22251), possibly M_2, from the Cathedral Bluffs tongue on the east side of the Washakie Basin is referred tentatively to Cope's Lost Cabin species. It is about the size of M_2 in the New Fork specimen and has the dimensions given by Matthew (1918, table, p. 590) for this tooth in *P. didelphoides.* It resembles in detail M_2 in the specimen that he figured (1918, fig. 16). Nevertheless, it should be noted that with this very limited material there is little that can be observed to distinguish the Cathedral Bluffs form from Bridger *Pantolestes longicaudus.*

MEASUREMENTS IN MILLIMETERS OF TEETH IN LOST CABIN AND NEW FORK SPECIMENS OF *Palaeosinopa*

	P. didelphoides A.M. No. 4804 Type	*P.*, cf. *didelphoides* U.S.N.M. No. 22453
P_3, anteroposterior diameter : transverse diameter....		5.0 : 2.1
P_4, anteroposterior diameter : transverse diameter....		5.4 : 2.5
M_1, anteroposterior diameter : transverse diameter....	5.2 : 3.4	5.0 : 3.5
M_2, anteroposterior diameter : transverse diameter....	5.5 : 3.9	5.1 : 4.0
M_3, anteroposterior diameter : transverse diameter....	6.3 : 3.6	5.5 : 3.2

PALAEOSINOPA, sp.

Several isolated teeth of *Palaeosinopa* from the Bitter Creek locality in both the National Museum and Marsh collection indicate a species decidedly smaller than Gray Bull *P. veterrima.* They are only a little smaller than in *P. didelphoides,* but the type of Cope's species is from the Lost Cabin beds, so that there may be some doubt as to its presence in the lowest horizon of the Knight. The isolated upper molars from Bitter Creek are relatively much narrower than in *P. veterrima* and show much less development of the cingulum. Two lower premolars, Y.P.M. No. 14700, are a little shorter than in *P. veterrima* and much more slender. Matthew cites narrower lower molars for *P. didelphoides* but the dimensions he gives for M_2 (1918, p. 590) would indicate that this tooth is relatively wider than in *P. veterrima.* The Bitter Creek teeth may well represent a distinct species but the materials known are clearly inadequate for diagnosis under the circumstances.

APATEMYIDAE

APATEMYS HÜRZELERI,[4] new species

(Plate 2, figure 7)

Type.—Right ramus of mandible with I, M_2, and the talonid portion of M_1, U.S.N.M. No. 22386.

Horizon and locality.—La Barge faunal horizon (Lost Cabin equivalent), 12 miles north of Big Piney, Sublette County, Wyo.

Specific characters.—Size appreciably larger than Gray Bull *Teilhardella chardini* Jepsen, close to Bridger *Apatemys bellulus* Marsh, but molars distinctly narrower.

Description.—Only the type lower jaw of *Apatemys hürzeleri* is known. Much of the bone is missing but the incisor is complete. Also the second molar and the posterior portion of the first are preserved. I am in agreement with McKenna that this form should be referred to *Apatemys* rather than *Teilhardella.*

The large lower incisor is decidedly procumbent. Its crown portion shows enamel on the outer surface and on the lower or anterior part of the medial side. Along the outer margin of the concave upper surface of the tooth crown the upper margin of the outer enamel shows slight or subdued serration. The dorsoventral and transverse diameters of this tooth just posterior to the crown, about where the tooth would emerge from the alveolus, are 2.5 and 1.4 mm. respec-

[4] Named for Dr. Johannes Hürzeler in recognition of his work on apatemyids.

tively. In the type of Gray Bull *Teilhardella chardini* these measurements, near the same position, are about 2.05 and 1.15 mm.

The bone of the jaw is broken away anterior to the forward root of M_1, so that there is no information concerning the roots of P_4. M_2 is characterized by a comparatively high crest formed by the protoconid and metaconid, but the anterior crest of the trigonid is very subdued and the paraconid is decidedly weaker than evident in later apatemyids. The talonid basin, moreover, is rather shallow. M_2 is much larger than would have been included in the type of *T. chardini* (P.U. No. 13236). Its anteroposterior and transverse measurements are 2.0 and 1.3 mm. respectively. No direct comparison with this earlier apatemyid is feasible as only P_4 and M_3 are preserved in the Princeton specimen. Nevertheless, the combined length of M_1 and M_2 as measured at the alveoli can be compared, and in *T. chardini* this is 2.7 mm. whereas in *A. hürzeleri* it is 3.4 mm.

A. hürzeleri is rather close in size to Bridger *Apatemys bellulus*. The incisor has about the same dimensions at the alveolus as in A.M. No. 12048 and M_2 is about the same length as in A.M. No. 12048 or as in Marsh's type, Y.P.M. No. 13513. Its width, however, is very much less. Also in *A. hürzeleri* the paraconid of M_2 is distinctly lower and weaker, the crest of the talonid in both M_1 and M_2 is lower and the outer walls of the teeth do not bulge outward at the cingulum so markedly as in the type of *A. bellulus*.

The La Barge form is only a little larger than the earlier and geographically more remote *Teilhardella whitakeri*. The dimensions of M_2 given by Simpson (1954, p. 4) are 1.7 and 1.2 mm. for the anteroposterior and transverse diameters respectively. Moreover, the depth of jaw below M_2 on the lingual side is given as 3.6 mm. This depth in the La Barge specimen is 4.8 mm.

PRIMATES

NOTHARCTIDAE

PELYCODUS, cf. TRIGONODUS Matthew

Three lower jaw portions and a third upper molar from the Bitter Creek locality seem close to the species *Pelycodus trigonodus* that Matthew described from the Gray Bull horizon in the Bighorn Basin. The lower molars are indistinguishable from those in Gray Bull lower jaws in the National Museum collection referred to this species. P_4 in U.S.N.M. No. 22256, however, seems relatively a little larger than noted in the Gray Bull specimens; nevertheless, in Y.P.M. No. 14075 the correspondence in the size of this tooth is very close.

Fragments of a pair of lower jaws (U.S.N.M. No. 22258) with M_2 and M_3 from the lower part or Gray Bull horizon of the Knight escarpment to the southwest of Elk Mountain in the Fossil Basin correspond closely to the above Bitter Creek material and are also tentatively referred to *P. trigonodus*. Possibly isolated teeth from the Red Desert locality east of Steamboat Mountain represent the same species. Their size is in accordance.

PELYCODUS, near P. JARROVII (Cope)

Four jaws and a maxilla from the slopes of Fossil Butte in the Fossil Basin nearly all exhibit distinctly larger teeth than in the Bitter Creek specimens. These may also represent *Pelycodus trigonodus* but would appear to represent at least a more advanced mutant. The larger of these can be closely matched in proportions of teeth in Gray Bull materials tentatively identified as *Pelycodus jarrovii*. There may be some doubt, however, as to whether *P. jarrovii*, originally based on New Mexican material, should be recognized in Wyoming, but if it is, earlier *P. trigonodus* may be distinguished from it on scarcely more than an arbitrary size range, or, as in the case of Bridger *Notharctus tenebrosus* and *Notharctus robustior*, by an arbitrary stratigraphic limit. It may be further noted that the species of *Pelycodus* represented in the exposures around Fossil Butte exceeds in size *Notharctus limosus* of the La Barge fauna, but not *N. venticolus*.

The maxilla (U.S.N.M. No. 22259) from the saddle to the north of Fossil Butte is rather close in size to the type of *P. trigonodus*, but shows better evidence for a hypocone on the molars. In the latter respect it can be closely matched in somewhat larger Bighorn Basin specimens referred to *P. jarrovii*. It is particularly close in both size and development of a hypocone crest to A.M. No. 4174 labeled "small form of *Pelycodus jarrovii*" from an undetermined level in the Bighorn Basin.

PELYCODUS? PRAETUTUS,[5] new species

(Plate 4, figures 2-4)

Type.—Right ramus of mandible with P_3 (incomplete)-M_2, U.S.N.M. No. 22262.

Horizon and locality.—Gray Bull (Sand Coulee) equivalent of Knight, 1¼ miles south of Bitter Creek Station, Sweetwater County, Wyo.

---

[5] From Latin, *prae*, before, and Cope's species *P. tutus*.

Specific characters.—Much smaller than *Pelycodus? tutus* Cope, but resembles it in most of the following: Lower molars elongated. Trigonid decidedly narrow with paraconid well separated from metaconid in both M_1 and M_2. Talonid basin broad, deep, and comparatively smooth. Posterior crest from hypoconid swings down to cingulum posterointernally and is separated from the entoconid by a deep notch. Entoconid high, relatively conical and forward in position. It joins the metaconid by a high, laterally flexed crest.

Material.—In addition to the type (pl. 4, fig. 4) there is a portion of the left ramus of a mandible with P_2-P_4 (Y.P.M. No. 14697; pl. 4, fig. 2) and a jaw fragment with M_3 (Y.P.M. No. 14698; pl. 4, fig. 3), probably not of the same individual, in Marsh's collection from the Bitter Creek locality. An isolated lower molar, evidently M_2, from the Red Desert locality east of Steamboat Mountain, also belongs to this form.

Discussion.—The characters of the lower molars, first noted by Cope (1877, p. 141) and later by Matthew (1915c, p. 441) for *Pelycodus tutus,* and here observed in *P.? praetutus,* are so very distinctive in comparison with Gray Bull, Lysite, and other San Jose and lower Knight material that there might seem justification in recognizing a distinct genus, were it not for the striking variability of these features in later *Notharctus.* While the paraconid seems progressively lowered or reduced in much of the material of *Notharctus,* the talonid largely retains the form seen in *Pelycodus trigonodus* but with the greater isolation of the entoconid from the posterior crest, particularly in M_2, approaching, although not quite reaching, the condition seen in *P.? tutus* and *P.? praetutus* as an extreme. Nevertheless, typical *Pelycodus* apparently exhibits greater stability in these features and the *P.? praetutus–P.? tutus* line seems rather distinctive in comparison with contemporaries.

NOTHARCTUS LIMOSUS Gazin

(Plate 4, figure 5)

Several additional jaws, maxillae, and isolated teeth belonging to *Notharctus limosus* have been obtained from Knight exposures beneath the Fontenelle tongue in the vicinity of Big Piney and La Barge. These do not, however, yield any new information beyond that covered in the earlier report.

A maxilla (P.U. No. 16123) with M^1-M^3, collected by Morris from Knight beds beneath the Tipton tongue near Dad, Wyo., resembles *N. limosus* in general form and in the relative width (trans-

versely) of the upper molars but is appreciably smaller, being more nearly comparable in size to *Pelycodus ralstoni.* The length of the upper molar series in this specimen is 10.8 mm., whereas in *N. limosus,* U.S.N.M. No. 19293, the comparable measurement is 12.8 mm. Moreover, both the hypocone and mesostyle in the Princeton specimen may be just a little less developed. The precise horizon for this specimen is not known; possibly it came from low in the section.

A maxilla and jaw fragment found by Henry W. Roehler about 416 feet below the Tipton tongue on the southeast flank of the Rock Springs uplift may well represent *N. limosus.* While P^4 in the maxilla is a little larger than this tooth in the figured specimen (1952, pl. 1, fig. 6) of *N. limosus,* the molars correspond rather closely. Moreover, M_2 in the jaw fragment has a length comparable to that in specimens of *N. limosus,* which is less than in *N. nunienus,* but its relative width seems unusual for either form.

NOTHARCTUS, cf. NUNIENUS (Cope)

Various lower jaws and isolated teeth of *Notharctus* found in the New Fork beds are consistently larger than any of the specimens representing *Notharctus limosus* in the La Barge fauna. These may well represent the Lost Cabin species *N. nunienus.* The size of the teeth compares very favorably with Cope's species.

NOTHARCTUS, cf. VENTICOLUS Osborn

The material representing the larger species of *Notharctus, N.,* cf. *venticolus,* in the La Barge fauna has been increased by about six lower jaw portions and two maxillae. Only one or possibly two jaw fragments with single teeth appears to be of the same species in the New Fork fauna. However, a lower jaw (U.S.N.M. No. 22254) with M_1 and M_2 and two isolated molars from the Cathedral Bluffs tongue near Flat Top Mountain on the east side of the Washakie Basin seem almost identical to certain of the La Barge specimens of this form. No. 22254 is only slightly larger than the type of *N. venticolus.* The specimen (P.U. No. 16109) cited by Morris (1954, p. 197) as *Notharctus,* sp., from the Cathedral Bluffs, was cataloged in the Princeton collections as *Notharctus venticolus.* It exhibits an M_2 that can also be closely matched in the La Barge material of *Notharctus,* cf. *venticolus,* although it is a little smaller than in No. 22254 from these beds.

NOTHARCTUS, sp.

A lower jaw (U.S.N.M. No. 22255) with P_3-M_2 from beds believed to be a part of the Cathedral Bluffs tongue, on the northwest

side of Oregon Buttes, is only a little larger than the New Fork material referred to *N. nunienus,* but seems too small for *N. venticolus.* The teeth can be matched for size in Bridger material of *Notharctus tenebrosus,* and nearly matched in general form of the molars, but the identity is rather uncertain and such an assignment would be unwarranted.

OMOMYIDAE

OMOMYS SHEAI,[6] new species

(Plate 2, figures 3 and 4)

Type.—Right ramus of mandible with M_2-M_3, U.S.N.M. No. 22384.

Horizon and locality.—La Barge local fauna, Lost Cabin equivalent, 12 miles north of Big Piney, Sublette County, Wyo.

Specific characters.—Size of lower molars between Gray Bull *Omomys vespertinus* Matthew and Lysite *Omomys minutus* Loomis. Trigonid of lower molars a little less elevated and a little better basined than in *O. vespertinus.* Talonid basin relatively narrower.

Description.—Although intermediate in size between *Omomys vespertinus* and *Omomys minutus, Omomys sheai* is close to *O. vespertinus* and might well fall within the size range of the latter, recalling the variation in this respect of Bridger *Omomys carteri.* The crowns of the teeth, however, seem to be a little more advanced in the direction of *Omomys carteri* in that the trigonids of the lower molars do not appear to be as elevated on the outer sides and their apices show a tendency toward distinct basining seen in Bridger material.

A second jaw portion (U.S.N.M. No. 19197; pl. 2, fig. 3) with only M_3, was questionably referred to *Absarokius* in 1952 (p. 24). The tooth is nearly identical in size to this molar in the type of *O. sheai* and may well represent this species. It differs only in that the trigonid is slightly shorter, anteroposteriorly, and the paraconid is somewhat weaker and a little more medial in position.

Loomis's *Omomys minutus* (pl. 2, fig. 5) would seem correctly allocated to *Omomys* although nothing is known of the premolars of this decidedly small species. The molars exhibit high and delicate-appearing cusps and the trigonid is rather elevated in comparison with the better-known middle Eocene material. Although it has a stratigraphic position intermediate between the type of *O. vesper-*

[6] Named for George Shea of Billings, Mont., who graciously aided in the field in 1949.

tinus and Knight *O. sheai,* it does not form an intermediate stage between them. It is of further interest to note that the talonid basins in the lower molars of all the Wasatchian *Omomys* materials are somewhat elongated, but rather less so than in Bridgerian materials. They do not appear, however, to be relatively so short as in upper Wasatchian *Loveina* (pl. 2, fig. 1). The trigonid pattern clearly separates *O. minutus* from *Anemorhysis.*

OMOMYS, cf. VESPERTINUS Matthew

(Plate 5, figure 2)

A lower jaw fragment with M_1 and M_2 in the University of Wyoming collection (No. 1647) from the Red Desert locality east of Steamboat Mountain is a little larger than *Omomys sheai.* M_2 is very much like that in *O. sheai,* but its length is nearly the same as that in Graybullian *Omomys vespertinus,* which is more nearly equivalent in age. The width of the talonid portion of the tooth, however, is a little less than in *O. vespertinus,* and relatively a little narrower than in *O. sheai,* although the difference here is less evident. Suggestive of *O. vespertinus* is the somewhat higher outer wall of the lower molars than in *O. sheai.*

MEASUREMENTS IN MILLIMETERS OF LOWER MOLARS IN WASATCHIAN SPECIES OF *Omomys*

	O. vespertinus A.M.N.H. No. 16835 Type	*O. minutus* A.C.M. No. 3365 Type	*O. sheai* U.S.N.M. No. 22384 Type
M_1-M_3 length	7.8	5.8	
M^1, anteroposterior diameter: transverse diameter	2.6 : 2.0	2.0 : 1.6[a]	
M_2, anteroposterior diameter: transverse diameter	2.4 : 2.0	1.9 : 1.6	2.2 : 1.8
M_3, anteroposterior diameter: transverse diameter	2.7 : 1.7	2.2 : 1.3	2.6 : 1.5

[a] Approximate.

CHLORORHYSIS KNIGHTENSIS Gazin

(Plate 2, figure 2; plate 12, figure 10)

This interesting omomyid in the La Barge fauna was described in 1958 from the anterior portion of a lower jaw exhibiting C-P_4, but the molars were not then known. It was considered close to *Loveina* but differences in P_3 and P_4, particularly in the absence of a postero-internal crest extending from the primary cusp of P_3, and in the

weaker posterointernal crest and weaker and much lower position of the metaconid of P_4, as discussed in 1958 (p. 27), seemed to warrant separate recognition.

A lower jaw (U. of C. No. 46705) from the Dad locality, recently sent to me by McKenna, surely represents this species. It was found about 6.9 miles north of Baggs in a yellow weathering claystone approximately 100 feet below the Tipton tongue. P_4 in this specimen is so completely like that in the type of *Chlororhysis knightensis* that I have no hesitancy in referring it to this form. It seems, moreover, to demonstrate the characters of the lower molars not previously known.

M_1 in the Dad specimen (pl. 12, fig. 10) is a little smaller than in *Loveina zephyri* and the posterior wall of the trigonid where it is joined by the crista obliqua is simpler and more nearly flat. In *Loveina* the posterior wall of the trigonid is offset and the crista obliqua joins it in the deepest part of the indentation. Also, the posterior wall lingual to the crista obliqua is more rugose or plicate. The talonid basin of M_1 in *Chlororhysis* is shallower and the surrounding crest is smoother with less emphasis on the separate cusps. In *Loveina* the hypoconulid of M_1 is separated from the nearby hypoconid by a notch which is essentially missing in *Chlororhysis*. Moreover, the pair of crests from both the protoconid and hypoconid in *Loveina* seem to form a sharper V. In *Chlororhysis* these form a more blunt angle or a better U shape.

The trigonid is damaged in M_2 of the Dad specimen but the talonid exhibits essentially the same broad but shallow basin and comparatively even surrounding crest as in M_1. M_3 is about the length of M_2 but noticeably narrower with a rapidly tapering talonid. The trigonid portion of M_3 is relatively short anteroposteriorly but exhibits a small paraconid in a nearly lingual position.

A second specimen from La Barge, a jaw fragment with only M_1 (U.S.N.M. No. 22385), had been cataloged as *Loveina zephyri* but it shows a much closer correspondence to the M_1 in the Dad specimen of *Chlororhysis knightensis*. It seems advisable at this point, in view of the rarity of *Loveina zephyri* specimens, to note that the Lost Cabin lower jaw, U.S.N.M. No. 18439, described by White (1952, p. 193) as belonging to *L. zephyri,* is undoubtedly of *Absarokius noctivagus,* so that the information there furnished regarding posterior molars does not apply to Simpson's species.

It is of further interest to note that although *Chlororhysis* is near *Loveina,* which seems rather typically omomyid, the differences

from it, though not great, are rather generally toward the anaphomorphids, somewhat suggestive of *Absarokius* in the character of P_4 although this tooth is not nearly so enlarged. This would seem to add another instance to the maze of developmental trends that tend to complicate taxonomy, emphasizing its arbitrary nature, particularly noticeable in the Primate order.

MEASUREMENTS IN MILLIMETERS OF LOWER TEETH IN *Chlororhysis knightensis*

	U.S.N.M. No. 22385	U.S.N.M. No. 21901 Type	U. of C. No. 46705
C, anteroposterior diameter at cingulum		1.1	
P_2, anteroposterior diameter: transverse diameter		1.3 : 1.0	
P_3, anteroposterior diameter: transverse diameter		1.8 : 1.4	
P_4, anteroposterior diameter: transverse diameter		2.0 : 1.7	2.0 : 1.8
M_1, anteroposterior diameter: transverse diameter	2.1 : 1.7		2.2 : 1.7
M_2, anteroposterior diameter: transverse diameter			2.3[a] : 1.7
M_3, anteroposterior diameter: transverse diameter			2.4 : 1.5

[a] Approximate.

ANAPTOMORPHIDAE

ANEMORHYSIS SUBLETTENSIS (Gazin)

(Plate 3, figure 1)

Following description of *Anemorhysis sublettensis* (1952, p. 24) as a possible form of *Paratetonius,* it was realized that the type of *Paratetonius, P. steini,* was not distinct from *Tetonius homunculus.* As a consequence the name *Anemorhysis* was proposed (1958, p. 25) for the La Barge form and to this genus was allocated the Lysite species *"Tetonius" musculus* Matthew (pl. 3, fig. 2). No new material of *A. sublettensis* has come to light but specimens representing a form that may be closely related were found in the lowermost beds of the Knight near Bitter Creek. These are described below.

TETONOIDES,[7] new genus

Type.—Tetonoides pearcei, new species.

Generic characters.—Resembling *Tetonius* but P_4 relatively much

[7] From its resemblance to *Tetonius.*

smaller and lower crowned, with much better-developed paraconid and metaconid, better-defined talonid and well-defined external cingulum. Lower molars *Tetonius*-like but labial wall with a relatively much shorter slope and a well-developed cingulum. Apex of trigonid in lower molars transversely narrower and less compressed anteroposteriorly than in *Anemorhysis*.

TETONOIDES PEARCEI,[8] new species

(Plate 3, figures 3-5; plate 5, figure 1)

Type.—Right ramus of mandible with P_3-M_2, U.S.N.M. No. 22426.

Horizon and locality.—Lowest beds of Knight member, Gray Bull (Sand Coulee) equivalent, 1¼ miles south of Bitter Creek Station, Sweetwater County, Wyo.

Specific characters.—Size of teeth very close to those of *"Tetonius" tenuiculus* Jepsen, but paraconid and metaconid of M_2 and M_3 distinctly closer together, and anterior crest from protoconid on these teeth with greater anteroexternal deflection.

Material.—In addition to the type (pl. 5, fig. 1), which includes the posterior premolars as well as the anterior molars, there are two jaws that exhibit all three molars (U.S.N.M. No. 22382, see pl. 3, fig. 4; and U.S.N.M. No. 22799), a jaw with only M_2 but exhibiting the anterior alveoli (U.S.N.M. No. 22383, see pl. 3, fig. 3), and a jaw portion with P_3 and P_4 (Y.P.M. No. 14084, see pl. 3, fig. 5) and the more forward alveoli. All of these except for No. 22799 were found at the Bitter Creek locality. No. 22799 was collected by Henry W. Roehler from a level 1,126 feet below the Tipton tongue on the west side of the Rock Springs uplift, in association with *Haplomylus*.

Among the Gray Bull materials with which comparisons were made are three lower jaws that beyond doubt represent Jepsen's *"Tetonius" tenuiculus* which I am here referring to *Tetonoides*. One of these, A.M. No. 15066 with P_4-M_2 (pl. 3, fig. 6), questionably referred by Matthew to *"Tetonius" musculus*, is, as Jepson's type, from low in the Gray Bull. A specimen in the National Museum, U.S.N.M. No. 19154 (pl. 3, fig. 7), with M_2 and M_3 from Elk Creek, also may well be from low in the Gray Bull but this is uncertain. A third lower jaw was recently observed in the collections at Princeton University. The molars in these jaws bear a strong resemblance to those in *Tetonius homunculus*, but with the differences noted above, and are of a size to occlude well with the type upper teeth of *Tetonoides tenuiculus*. Additional correspondence with the type of *T. tenuiculus*

[8] Named for Franklin L. Pearce who aided me on so many field expeditions.

is seen in the relatively smaller fourth premolar than in *Tetonius homunculus.*

Description.—The formula for the lower dentition of *Tetonoides pearcei* is $\frac{2}{2}, \frac{1}{1}, \frac{3}{3}, \frac{3}{3}$. The anterior incisor is enlarged but moderately erect, as in *T. homunculus,* and the second of the two incisors is small with its elongate root posterolateral to the other. The canine alveolus is of moderate size with a more nearly circular outline than the others. An alveolus for a P_2 is only a little smaller than that of the canine in the type and in Y.P.M. No. 14084, but anteroposteriorly more flattened in U.S.N.M. No. 22383. The presence of P_2 in *T. pearcei* is a rather primitive feature in comparison with *Tetonius homunculus,* as it is for anaptomorphids in general, and may well be suspected for *T. tenuiculus* also, although none of the known lower jaws of the latter is sufficiently complete to determine this feature. Larger *T. homunculus* with its relatively larger P_4 shows no evidence of a P_2. P_3 in *T. pearcei* is two-rooted and only a little smaller than P_4. It lacks the metaconid seen on P_4, and the small paraconid is not deflected inward as in P_4. P_4 has the relatively very small size characterizing *T. tenuiculus,* but the outer wall at the cingulum is a little longer anteroposteriorly. The paraconid appears a little higher on P_4 and the metaconid lower and perhaps less developed than in *T. tenuiculus,* as represented by A.M. No. 15066. The talonid of P_4 is much alike in the two species. It is of further interest to note that the external cingulum of P_4, and of the lower molars as well, is better developed in both *T. pearcei* and *T. tenuiculus* than in *T. homunculus.* Usually P_4 and M_1 in *T. homunculus,* with their vertically more elongate outer wall, show little or no evidence of the external shelflike cingulum conspicuous in the smaller form.

Although the lower jaws of *Tetonoides pearcei* and *T. tenuiculus* are alike in certain details, including size, in which they differ from *T. homunculus,* the molar trigonids (M_2 and M_3) appear to be significantly different between the two smaller species. While the inner and outer walls of the crowns converge upward, almost as noticeably as in *T. homunculus,* so that the apex of the trigonid is relatively narrow—in comparison, for example, with *Anemorhysis sublettensis*—the paraconid in *T. pearcei* is rather closer to the metaconid than it is in *T. tenuiculus.* In this respect the crown resembles *Anemorhysis.* Also it was noted that the crest from the protoconid in the posterior lower molars makes a more pronounced anteroexternal deflection as it extends from the protoconid to the anterior margin of the paraconid. This condition, together with the shorter distance between the apices

of the paraconid and metaconid, gives the trigonid a somewhat less triangular appearance than in *T. tenuiculus*.

Were it not for the more noticeable upward convergence of the inner and outer walls of the lower molars, *T. pearcei* might well have been referred to *Anemorhysis*. *A. sublettensis*, a slightly smaller form, otherwise shows a shorter and broader trigonid and a relatively longer talonid. Anteroposterior development of the talonid also characterizes P_4 in *A. sublettensis*. M_3 in *Anemorhysis muscula* is very close in size to this tooth in *T. pearcei* (U.S.N.M. Nos. 22382 and 22799), and although M_3 is not known in *A. sublettensis*, the anteroposteriorly shorter trigonid and slightly more erect outer wall of the protoconid strongly suggest that *A. muscula* is more properly referred to *Anemorhysis* than to *Tetonoides*. I strongly suspect that *Tetonoides* is close to the line of development for *Anemorhysis*.

MEASUREMENTS IN MILLIMETERS OF LOWER TEETH OF *Tetonoides pearcei* AND *Tetonoides tenuiculus*

	T. pearcei			*T. tenuiculus*	
	Y.P.M. No. 14084	U.S.N.M. No. 22382	U.S.N.M. No. 22383	A.M. No. 15066	U.S.N.M. No. 19154
P_2-P_4 (at alveoli)	2.8		2.7		
M_1-M_3, inclusive		5.4			
P_3, anteroposterior diameter: transverse diameter	1.3 : 1.0				
P_4, anteroposterior diameter: transverse diameter	1.5 : 1.3			1.5 : 1.4	
M_1, anteroposterior diameter: transverse diameter		1.8 : 1.5		1.8 : 1.6	
M_2, anteroposterior diameter: transverse diameter		1.7 : 1.6	1.8 : 1.6	1.8 : 1.7	1.7 : 1.6
M_3, anteroposterior diameter: transverse diameter		2.2 : 1.4			2.1 : 1.3

ABSAROKIUS, near A. ABBOTTI (Loomis)

(Plate 5, figure 3)

A lower jaw from the Red Desert area, that McGrew assures me is from the Gray Bull level, is found to represent *Absarokius* rather than *Tetonius*. The specimen (U. of Wyo. No. 1644, see pl. 5, fig. 3), collected by Henry W. Roehler in SW¼NE¼ sec. 10, T. 24 N., R. 100 W., includes P_3-M_3 and exhibits all the alveoli anterior to P_3. The molar teeth are relatively small but can be matched in a particularly small specimen of *A. abbotti* (A.M. No. 14672) from the Lysite, but P_4 in the Red Desert specimen is a little larger. The relatively

larger size of P_4 is rather suggestive of Lost Cabin *Absarokius noctivagus*. This combination of characters indicates, if the horizon is correctly recorded, that the development of P_4 may be rather variable and not so orderly with respect to horizons of Wasatchian time.

The University of Wyoming specimen has two incisor alveoli, the first of which may be a trifle larger and more nearly circular in outline than the second. The canine alveolus is distinctly larger than that for the second incisor but evidently no greater is size than that for the anterior root of P_3. None of these are comparable to that for the enlarged anterior tooth in *Tetonius*. Between the canine alveolus and the anterior root of P_3 there may possibly be an extremely flattened alveolus for a P_2, only slightly narrower transversely than that for the canine. P_3 would appear from outside the jaw to have two well-defined roots.

MEASUREMENTS IN MILLIMETERS OF TEETH IN LOWER JAW OF *Absarokius*, near *A. abbotti*, U. OF WYO. NO. 1644

M_1-M_3, length of lower molars	6.1
P_3, anteroposterior diameter : transverse diameter at cingulum	1.5 : 1.8
P_4, anteroposterior diameter : transverse diameter at cingulum	2.4 : 2.5
M_1, anteroposterior diameter : transverse diameter at cingulum	2.3 : 1.8
M_2, anteroposterior diameter : transverse diameter at cingulum	2.0 : 1.7
M_3, anteroposterior diameter : transverse diameter at cingulum	2.1 : 1.4

ABSAROKIUS NOCTIVAGUS Matthew

(Plate 4, figure 1)

Among the more recently acquired materials representing *Absarokius noctivagus* is a maxilla (U.S.N.M. No. 22264) with P^3-M^3 from the locality 12 miles north of Big Piney. P^2, a very small, peglike tooth, was present in maxilla when found, but unfortunately it has since been lost. P^3, much smaller than P^4, is seen to be three-rooted with a prominent deuterocone and the talon is somewhat expanded posteriorly, almost as in P^4. This specimen, as well as the immature lower jaw previously described (1952, p. 24), was discussed in 1958 (pp. 73-74) in connection with the possible dental formula characterizing anaptomorphids. The lower jaw was illustrated in 1958 (pl. 14, fig. 8), whereas a drawing of the upper dentition is included here (pl. 4, fig. 1).

ABSAROKIUS WITTERI Morris

The Cathedral Bluffs species described by Morris is clearly larger and with a more inflated-appearing P_4 than in *Absarokius noctivagus*.

Also, as Morris has pointed out, the molar talonid basins are more strongly crenulated. Only the type specimen, a lower jaw (P.U. No. 14972), has been discovered. The three species *A. abbotti, A. noctivagus,* and *A. witteri* would seem to present a gradational sequence characterized principally by the development of P_4, except for the rather unusual specimen from the early Wasatchian of the Red Desert.

UINTASOREX, cf. PARVULUS Matthew

(Plate 5, figure 4)

A minute jaw fragment with M_2 and M_3 (U. of Wyo. No. 1646), lent to me by Paul McGrew, is described as coming from a locality of Lost Cabin age in the Red Desert region. The specimen corresponds well in size with the type of *Uintasorex parvulus* (A.M. No. 12052) although the same teeth are not included. It is about intermediate in size of the posterior molars between the Yale specimen (No. 13519) and jaw portions from the "Upper Fossiliferous Horizon" of the Green River at the Powder Springs locality in the Uinta Basin. Correspondence to *Uintasorex* is seen in the anteroposteriorly abbreviated trigonid, the large *Omomys*-like talonid and the distinctive *Cynodontomys*-like notch between the entoconid and closely adjacent hypoconulid of M_2. It resembles the Green River material somewhat more than the Yale Bridger specimen in the less constricted and less projecting hypoconulid of M_3, but perhaps differs from both in less evidence of an external cingulum on the two molars.

This form is clearly related to, but much smaller than, McKenna's (1960) *Niptomomys doreenae* from the Four Mile fauna, although the latter has relatively wider talonid basins. A somewhat closer correspondence is seen to the specimen described as Cf. *Niptomomys doreenae* in the less widely expanded talonid basins and in the appearance of the cingulum, but differs from it in that Cf. *Niptomomys doreenae,* though smaller than the Four Mile type, is somewhat larger than the Red Desert specimen and shows a more discernable, lingually placed paraconid on both of the molars, which, incidentally, look very much alike.

PHENACOLEMURIDAE

PHENACOLEMUR, cf. PRAECOX Matthew

(Plate 2, figure 6)

Phenacolemur is so far represented in the Knight only in the Bitter Creek fauna. A single specimen (Y.P.M. No. 14062), a lower jaw portion with M_2 and the posterior crest of the talonid of M_1, is pre-

served. Some of the bone is missing along the lower part of the jaw, exposing the root portion of the enlarged incisor. The jaw is rather close in size to contemporary material of *Phenacolemur praecox* from the Bighorn Basin and may be tentatively referred to this species. It does, however, show differences worthy of comment. The trigonid of M_2 seems a little narrower and the protoconid and metaconid are more conical and less developed as a transverse crest. Also, the talonid basin is slightly longer and shallower, and there is less of a notch anterior to the entoconid. Although these and certain other related features seem rather important, there would appear from Simpson's discussion (1955) to be considerable variation in Gray Bull materials included in *P. praecox*. Should it be demonstrated, however, that the distinctive features of the Bitter Creek specimen were persistent in a larger sample, their significance might be on a generic level.

MIXODECTIDAE

CYNODONTOMYS ANGUSTIDENS Matthew

(Plate 1, figure 6)

Cynodontomys material from the lower part of the Knight member near Bitter Creek Station includes a maxilla with M^1 and M^2 (U.S.N.M. No. 22121) and a lower jaw with M_1 and M_2 (U.S.N.M. No. 22446) collected by Smithsonian Institution parties and, in addition to a couple of isolated teeth, a lower jaw with P_3-M_3 (Y.P.M. No. 14696) collected by Marsh's party. These specimens seem almost certainly to be of *Cynodontomys angustidens* described by Matthew on Gray Bull Material.

The upper molars in U.S.N.M. No. 22121 (pl. 1, fig. 6) lack the mesostyle seen in later species, although the external cingulum rises slightly at about this position. M^1 is very much like that in the specimen of *C. angustidens* figured by Matthew (1915c, p. 477, fig. 48) but is somewhat smaller and exhibits a slightly weaker hypocone.

The fourth premolar of the lower series in the Yale specimen is a little broader than in the type of *C. angustidens* and shows a moderately well-developed metaconid that is rather close to the protoconid and not as high. It is, however, a little higher and more widely separated from the protoconid than in the type. The talonid of P_4 has a decidedly narrow basin but exhibits a distinct hypoconid and entoconid. There appears, however, to be no evidence for a hypoconulid. The lower teeth in Y.P.M. No. 14696 are distinctly smaller than in the type of *Cynodontomys latidens* and the metaconid of P_4 is not as large and upstanding.

An isolated M_3 from north of Tipton Butte corresponds closely in size to the above material and suggests that the beds in that area may be relatively low in the Knight.

CYNODONTOMYS KNIGHTENSIS Gazin

(Plate 1, figure 7)

In addition to 11 lower jaws, 4 maxillae have been added to the collection representing *Cynodontomys knightensis* in the La Barge fauna. These were obtained in 1953, 1954, and 1959, all from the Muddy Creek locality 12 miles north of Big Piney, Wyo. Two of the maxillae, U.S.N.M. Nos. 22106 (pl. 1, fig. 7) and 22107, include P^4-M^3 complete. P^4, though smaller than in *C. scottianus,* exhibits a slightly more constricted lingual portion than shown in the specimen figured by Matthew (1915c, p. 472, fig. 42). This tooth, however, shows much less disparity in size and possibly a better separation of the primary cusp and tritocone (paracone and metacone) than in *C. latidens.* The molars, moreover, exhibit a conspicuous mesostyle and the hypocone on M^1 and particularly M^2 is well developed.

CYNODONTOMYS SCOTTIANUS (Cope)

(Plate 1, figure 8)

Five lower jaws, together with portions of both maxillae of a sixth individual, have been found in the New Fork beds to the east of Big Piney, Wyo. The teeth in all these are fully as large as in typical *Cynodontomys scottianus* of the Lost Cabin beds, distinctly larger than in *Cynodontomys knightensis,* which occurs beneath the Green River tongue separating the two horizons in this area.

The maxillae above referred to (U.S.N.M. No. 22117; pl. 1, fig. 8) include P^1-P^4 on one side, as well as M^2, and P^4-M^3 on the other. P^1 and P^2 are simple, nearly equal teeth with partially divided roots. P^3 is a triangular, three-rooted tooth with a very small deuterocone and no tritocone. The latter may not be significant however, because, although Matthew (1915c, p. 474, fig. 44) shows the tritocone on P^3 of a specimen of *Cynodontomys latidens,* it is not invariably present in Bridger *Microsyops.* P^4 is comparable in size with M^1 but shows a noticeably longer labial portion and a relatively narrower lingual portion than illustrated by Matthew (1915c, p. 472, fig. 42). This tooth is much like that in earlier *C. knightensis* but with a relatively more robust primary cusp. The upper molars in U.S.N.M. No. 22117 are a little larger than in observed Lost Cabin material of *C. scottianus,* except for a specimen in the American Museum col-

lections (A.M. No. 2969) labeled *"C. scottianus* but a little larger," and the hypocone is noticeably weaker. The hypocone, particularly that of M_2, is much weaker than in *Cynodontomys knightensis.*

The New Fork jaw material referred to *Cynodontomys scottianus* is comparatively robust and P_4 relatively large, particularly in the breadth of this tooth in two individuals. In comparison with *Cynodontomys knightensis,* P_3 is large but with an actually smaller talonid. The trigonid portion of P_4 appears more robust and with relatively greater anteroposterior development than in the earlier species. The metaconid is more posterior relative to the protoconid than is usual in *C. knightensis;* moreover, the talonid of this tooth is highly variable and shows a cusp arrangement that does not so nearly conform to that of the molars. The New Fork species is evidently much smaller than *Cynodontomys lundeliusi* White.

CYNODONTOMYS, sp.

The lower jaw from Knight Station (A.M. No. 12836), which Granger considered as suggesting Lysite, has been labeled *Cynodontomys latidens?.* As indicated in 1952, the absence of premolars leaves some doubt as to the specific reference. Its size, however, is about right for that species.

TILLODONTIA

ESTHONYCHIDAE

ESTHONYX, cf. BISULCATUS Cope

Isolated upper teeth of *Esthonyx,* which may be referred to *E. bisulcatus,* were found by George Pipiringos at a locality just to the north of Tipton Butte and much farther north at a lower level in the Knight east of Steamboat Mountain, A lower molar, collected by our 1954 expedition from the lowest beds of the Knight exposed to the west of Elk Mountain in the Fossil Basin, may also be of this species.

ESTHONYX, cf. ACUTIDENS Cope

(Plate 1, figure 3)

Two more isolated teeth from localities to the south of Big Piney have been added to the materials representing the larger species of *Esthonyx* in the La Barge fauna.

Additional esthonychid materials from the New Fork member, including a lower jaw (U.S.N.M. No. 22124; pl. 1, fig. 3) with Dp_4 and the first two molars, shows that a somewhat larger variant of *Esthonyx acutidens* than that in the La Barge fauna is represented in the New Fork fauna. The lower molars are noticeably high crowned and the talonid portions are large, as characteristic of the Lost Cabin species. The teeth in No. 22124 are of a size that permits good occlusion with upper teeth in the rostral portion of a skull from the Lost Cabin figured in 1953 (Gazin, p. 26, fig. 8).

ESTHONYX, sp.

An upper fourth premolar in the Princeton collection, No. 16129, is reported to be from the "Hiawatha" member exposed north of Baggs, Wyo., on the east side of the Washakie Basin. It is comparatively small for *Esthonyx acutidens,* smaller than would be expected in the Dad local faunule, and the tritocone is rather weakly defined for either *E. acutidens* or *E. bisulcatus.* The horizon in the "Hiawatha" member is not given. Possibly the specimen came from beds as low as those worked by McKenna to the south of Baggs.

No further material of *Esthonyx* than that mentioned in 1952 was found in the type section for the Knight near Knight station.

TROGOSUS?, cf. LATIDENS (Marsh)

The last upper molar of the large tillodont *Trogosus* was recorded by Morris (1954, pl. 21, fig. 1) as coming from the Cathedral Bluffs member of the Wasatch on the east side of the Washakie Basin, sec. 4, T. 15 N., R. 93 W. The tooth was originally identified by me and thought to be strong evidence of a Bridgerian age for the Cathedral Bluffs beds. An earlier record in which a similar isolated tooth of an advanced tillodont, possibly of the same form, collected by Nace (1939) in beds regarded as Cathedral Bluffs in the Red Desert region to the north, was identified by Simpson as *"Tillotherium"* and likewise believed to be Bridgerian. I am now convinced, from the evidence presented by the associated fauna, that the Cathedral Bluffs beds are of Lostcabinian or late Wasatchian age and that *Trogosus* was not restricted to Bridgerian time but evidently appeared earlier, although there is no evidence to show that it was actually associated in the same horizon with *Esthonyx.* There would seem to be, however, too much difference between these forms in the Cathedral Bluffs to postulate evolution in situ.

TAENIODONTA

STYLINODONTIDAE

ECTOGANUS, sp.

(Plate 12, figure 7)

Three lower teeth, including Dp_4 and portions of two molars, seem almost certainly to represent *Ectoganus*. They were found on an exposure of Knight in the Fossil Basin, immediately to the west of the saddle which separates Fossil Butte from the Green River capped table to the north. The Dp_4 corresponds very closely to this tooth in the type of *E. gliriformis,* as well as to a Dp_4, showing only slightly greater wear, in the jaw belonging to the Gray Bull skull (U.S.N.M. No. 12714) that I described in 1936. The two molar teeth are incomplete but show no wear, so that I suspect they may be M_2 and M_3 rather than M_1 and M_2 as here illustrated (pl. 12, fig. 7). There is some suggestion in the height of cusps, distribution of enamel, and separation of roots that the teeth may be very slightly higher crowned, Dp_4 as well as the molars, than in the type or in the Gray Bull specimen. It is of further interest to note that the tooth thought to be M_3 shows a slight paraconid and a hypoconulid somewhat as in the teeth figured by Wortman (1897, fig. 24) as *"Calamodon simplex."* None of the comparatively unworn molars in U.S.N.M. No. 12714 shows evidence of a hypoconulid. This is evidently a variable feature.

Undetermined STYLINODONT

No further information is forthcoming as to the generic identity of the stylinodont skeleton from the locality in the La Barge horizon north of Big Piney, described in 1952. It may well be *Stylinodon,* as this genus has been recorded in Lost Cabin beds of the Wind River Basin, as well as in the Bridger formation. There is no certainty, however, that earlier *Ectoganus* did not persist as such into later Wasatchian time.

EDENTATA

EPOICOTHERIIDAE?

PENTAPASSALUS PEARCEI Gazin

There has been no additional material discovered of this small armadillolike edentate in the La Barge fauna, although a metacarpal of a somewhat longer-toed form in the Bitter Creek fauna is discussed below.

Undetermined palæanodont edentate

Dr. Peter Robinson has recently brought to my attention an edentate toe bone that he encountered during his curatorial work on the Eocene collections at Yale Peabody Museum. It has Marsh's field No. 888 and was collected by J. Heisey in 1876 at Bitter Creek. The specimen is a third metacarpal from the left foot. The proximal extremity very closely resembles that in McIII of *Pentapassalus pearcei* and has about the same diameter. It is, however, about 25 percent longer, the shaft appears a little more slender, and the tubercle for the pars brevis of the extensor muscle is not nearly so robust. In comparison with the forefoot of much larger *Metacheiromys dasypus* figured by Simpson (1931) the dorsal margin of the proximal articular facet does not appear to be deflected so far distally on the shaft, and the lateral portion of the proximal extremity shows very little surface for articulation with the unciform.

RODENTIA

PARAMYIDAE

Most of the paramyid material from the various localties and horizons in the Wasatch has been examined by Dr. A. E. Wood, as a part of his study of this rodent family, and recognition of the following genera and species result from identifications he has furnished me of the better materials.

PARAMYS EXCAVATUS Loomis

(Plate 4, figure 8)

This comparatively small species of *Paramys* would appear to be represented only in the La Barge and lower levels of the Knight. Two lower jaws were obtained from the exposures low on the escarpment to the west and southwest of Elk Mountain in the Fossil Basin and one jaw (see pl. 4, fig. 8) came from the Bitter Creek locality. A lower jaw in the collection of Miller and Granger shows this species is represented in the horizon at Knight Station. Five lower jaw portions and a maxilla have been added to the La Barge collection, so that the species is now represented by 10 specimens in the later fauna.

PARAMYS COPEI Loomis

Paramys copei is rather well represented in the La Barge fauna and two additional jaws and a maxilla have been added to the collection since 1952.

Specimens from the Washakie Basin that I have tentatively referred to this species include a left mandibular ramus with M_1-M_3, U.S.N.M. No. 22419, and an isolated lower molar in the University of California collection from the Knight escarpment beneath the Tipton tongue between Dad and Baggs, Wyo. There is, moreover, a specimen, U.S.N.M. No. 22420, that includes a jaw portion and three associated lower teeth from the Cathedral Bluffs on the west side of the basin, that may be this species.

PARAMYS MAJOR Loomis

A maxilla with P^4 and M^1 (U.S.N.M. No. 22414) collected at the Muddy Creek locality north of Big Piney in 1954, has teeth of a size that indicate that a third specimen now represents large *Paramys major* in the La Barge fauna. Two lower jaws in the Princeton collection (Nos. 16106 and 16127), from beneath the Tipton tongue south of Dad, are also surely of this species.

I have not found this species in Knight beds older than Lost Cabin, but the New Fork beds above the Fontenelle tongue have produced at least five specimens that would appear to be referable to it. From the Cathedral Bluffs of the Washakie Basin a single isolated upper tooth in the Princeton collection corresponds well in size.

REITHROPARAMYS, sp.

A single lower jaw with only M_2 preserved, U.S.N.M. No. 22380, from the saddle north of Fossil Butte in the Fossil Basin, is regarded by Wood as representing a species of *Reithroparamys,* near a form that he is describing as new in his forthcoming study of the family.

MICROPARAMYS, sp.

A lower jaw in the Princeton collection from the Cathedral Bluffs beds, U.P. No. 16112, is recognized by Wood as representing this genus. Description of the species represented is to appear in his report.

SCIURAVIDAE

KNIGHTOMYS SENIOR (Gazin)

(Plate 5, figures 5 and 6)

The genus *Knightomys* was proposed (Gazin, 1961) for the La Barge species that had originally been described as *Tillomys senior* in 1952. The generic characters may again be summarized as follows: Lower cheek teeth anteroposteriorly short, broad across talonid and

very low crowned. Cusps low and conical. Talonid basin large but very shallow and trigonid basin scarcely discernable. Except for posterolophid, the transverse lophs are comparatively weak and ill defined. The mesoconid is clearly defined and there is a distinct hypoconulid.

New material of *Knightomys senior* includes a pair of lower jaws (U.S.N.M. No. 22415) with P_4-M_2 on right and M_2-M_3 and a part of M_1 on the left ramus. The upper teeth are not known. P_4 is narrow across the trigonid but was evidently bicuspid. The talonid of this tooth has a shallow basin and the entoconid is simple and conical. A slight ectolophid and better-defined posterolophid join the hypoconid of P_4 in the type, U.S.N.M. No. 19308, but these are scarcely evident in No. 22415. There is no mesoconid on P_4. The molar trigonids are low and anteroposteriorly short with only the slightest evidence of an anterolophid or even a cingulum, and this only on M_1. Although the teeth in neither of the two preserved specimens are unworn, the saddle between the protoconid and metaconid, except for a slight depression in M_1, shows no evidence of a trigonid basin. The ectolophid is very weak but the conical mesoconid is distinct. This cusp does not have a crest extending lingually. The entoconid is nearly conical but does have a weak crest extending a short distance into the basin toward the hypoconid, but falls far short of reaching this cusp. The hypoconid sends a more distinctive posterolophid posterointernally, clearly separated from the entoconid and its weak spur. The posterolophid is moderately worn on the specimens at hand but there is clear evidence of a distinct hypoconulid.

Material of *Knightomys senior* seems without doubt to be closer to *Tillomys? parvidens* than to any other sciuravid. However, comparison with M_2 in U.S.N.M. No. 17701 of *T.? senex* from the lower Bridger and with the figure of the type of *T.? parvidens,* Y.P.M. No. 13350, given by R. W. Wilson (1938, fig. 12), reveals that *K. senior* has lower-cusped teeth with less development of transverse lophids. M_2 is only slightly smaller than in the Bridger material at hand, but the trigonid appears less elevated and shorter anteroposteriorly. Also, the mesoconid is more nearly conical and the posterolophid does not project so far lingually. The teeth of *Tillomys senex,* figured by Wilson (1938, fig. 10), seem more remote, as the weak spur from the entoconid in *K. senior* does not reach the hypoconid or the posterolophid as in the American Museum specimen. It should be noted, however, that this *T. senex* specimen shows more advanced wear. As observed by Wilson, *Tillomys? parvidens,* and I

might add *Knightomys senior,* shows a development between paramyids and typical sciuravids. The resemblances would seem to be toward, for example, the Cathedral Bluffs *Microparamys* and decidedly away from such forms as *Mysops.*

DAWSONOMYS WOODI Gazin

(Plate 5, figure 7)

Dawsonomys woodi was proposed (Gazin, 1961) as a new genus and species for the La Barge form represented by the lower jaw (U.S.N.M. No. 19309) that was cited in 1952 as *"Sciuravus,* possibly *S. depressus* Loomis." The generic characters may again be summarized as follows: Cusps of teeth low, but with metaconid of P_4 high and well forward. Trigonid of M_1 broad and anteroposteriorly compressed, but with small, distinct trigonid basin. Talonid basin large and comparatively shallow. Ectolophid low with distinct mesoconid. Entoconid low and lophid from entoconid low but well defined and joins hypoconid. Posterolophid extends nearly to lingual margin and close to but sharply separated from the crest extending buccally from the entoconid.

The species was observed to be appreciably smaller than *Sciuravus nitidus* but diagnostic characters at this level were not otherwise distinguished from those cited as characterizing the genus.

Direct comparison of the type of *Dawsonomys woodi* with the lower jaw that Loomis cited as a cotype of *"Sciuravus" depressus* has indicated that they do not represent the same species and clearly not the same genus. M_1 in the Lysite jaw (A.C.M. No. 458, see pl. 5, fig. 9) has a much narrower trigonid, a larger talonid basin, and the mesoconid is more marginal in position. The most noticeable difference, however, is in the lophid from the entoconid which is weaker, much closer to the posterolophid, and appears scarcely more than a slight bifurcation of the posterolophid at the hypoconulid. In the latter respect the Lysite jaw rather resembles M_1 in the Cathedral Bluffs *Microparamys* jaw (P.U. No. 16112).

Loomis's type of *"Sciuravus" depressus* is a skull (A.C.M. No. 432) portion with three molars preserved (see pl. 5, fig. 8) and while no direct comparison between *D. woodi* and the upper teeth of *"S." depressus* can be made, the pattern of the latter seems surely sciuravid rather than paramyid. The crests of the upper teeth are subdued, but I note that the metaconulid joins the metaconid, possibly somewhat more as in *Taxymys* than as in *Sciuravus.* Kelley and Wood (1954) have noted that Loomis's species does not belong to *Sciuravus.*

Dawsonomys woodi is a much larger form than *Knightomys senior* and is distinctly more *Sciuravus*-like, but like *K. senior* its teeth have lower cusps and relatively larger talonid basins than *Sciuravus nitidus*. P_4 in *D. woodi* has a well-developed protoconid and metaconid, rather widely separated and decidedly oblique in arrangement. The talonid has a large but shallower basin than in *S. nitidus*. There does not appear to be a mesoconid on this tooth, but the crest extending buccally from the entoconid is somewhat more molarlike than noted in the Bridger species.

Measurements of teeth of *Dawsonomys woodi* have been included with those of *Sciuravus wilsoni*.

SCIURAVUS WILSONI Gazin

(Plate 4, figures 6 and 7)

The type specimen of *Sciuravus wilsoni* is the right ramus of a mandible with P_4-M_2 (U.S.N.M. No. 22425), found in the New Fork horizon on the west side of Alkali Creek, near the center of T. 29 N., R. 110 W., in Sublette County, Wyo. The species, described as new in 1961, was characterized as being intermediate in size between *Sciuravus nitidus* and *Sciuravus bridgeri,* close in this respect to *Dawsonomys woodi* of the La Barge fauna. Talonid basins of the lower molars are smoother and less complicated than in the Bridger forms. No trace of a mesolophid or a crest from the mesoconid was noted, and there is little or no evidence of a metastylid. Teeth were cited as being in general less progressive in appearance than in *S. nitidus*.

The size of the teeth in the type of *Sciuravus wilsoni* is much less than in the bulk of the Bridger material referred to *Sciuravus nitidus* but only slightly less than in specimens of the least size included in that species. The teeth are, however, significantly larger than in the type of *Sciuravus bridgeri*. In details of the tooth crowns *S. wilsoni* makes a much closer approach to *Sciuravus nitidus* than does earlier *Dawsonomys woodi*. The higher cusps and deeper folding of basins and valleys closely resembles that in *S. nitidus*. The talonid basins, however, are uncomplicated, as the mesolophid is lacking, and in the type there is no metastylid, features that may be developed to varying degrees in the Bridger material.

In addition to the type lower jaw there is a right maxilla, U.S.N.M. No. 22424, with M^1-M^3 somewhat worn, from the same locality. It corresponds closely in size for proper occlusion with teeth in the type of *S. wilsoni*. Although wear has reduced the principal lingual cusps to confluent or nearly confluent enamel lakes, the buccal wall and cusps are essentially like those in *S. nitidus*.

Several isolated sciuravid teeth from the Cathedral Bluffs (in a vial accompanying a *Notharctus* jaw, P.U. No. 16109) are tentatively referred to *S. wilsoni.* These are a part of the evidence cited by Morris (1954, p. 199) as indicative of a Bridgerian age. Some of the lower teeth are a little larger than in the New Fork jaw, and in certain of them there is noted a little better evidence for a metastylid. Nevertheless, they resemble those in *S. wilsoni* in having a somewhat less progressive appearance than in *S. nitidus.* An upper molar in this assortment of teeth from the Cathedral Bluffs is about the size of those in the New Fork maxilla but is much less worn, and it is observed that the metaloph is not so deflected anteriorly, resulting in a relatively smaller basin between the metaloph and posterior cingulum than in *S. nitidus.* There is, of course, no certainty that the teeth are all of the same sciuravid.

MEASUREMENTS IN MILLIMETERS OF UPPER AND LOWER TEETH IN WASATCHIAN SCIURAVIDS *

	"Sciuravus" depressus A.C.M. No. 432 Type	*Sciuravus wilsoni* U.S.N.M. No. 22424
Length, M^3-M^3, inclusive	5.4	5.5
M^1, anteroposterior diameter : transverse diameter	1.7 : 1.8	1.7 : 2.0
M^2, anteroposterior diameter : transverse diameter	1.7 : 1.8	1.8 : 2.1
M^3, anteroposterior diameter : transverse diameter	1.9 : 1.7	2.0 : 2.0

	"Sciuravus" depressus A.C.M. No. 458 "Cotype"	*Dawsonomys woodi* U.S.N.M. No. 19309 Type	*Sciuravus wilsoni* U.S.N.M. No. 22425 Type
Length, P_4-M_2, inclusive			5.7
P_4, anteroposterior diameter : transverse diameter		1.9 : 1.5	1.9 : 1.6
M_1, anteroposterior diameter : transverse diameter	1.9 : 1.7	2.0 : 1.8	2.0 : 1.8
M_2, anteroposterior diameter : transverse diameter			2.1 : 1.9

* Measurements of the type of *Knightomys senior* were given in 1952 (p. 49).

CARNIVORA

ARCTOCYONIDAE

THRYPTACODON, near T. ANTIQUUS Matthew

No additional material of *Thryptacodon,* beyond that from the La Barge horizon described in 1952, has been encountered in any of the Knight horizons.

MESONYCHIDAE

HAPALODECTES COMPRESSUS Matthew

(Plate 8, figure 6)

Portions of both rami of a mandible of the rare mesonychid *Hapalodectes compressus* were found in the New Fork beds on Alkali Creek (Sublette County). The teeth of this specimen, U.S.N.M. No. 22447, are somewhat damaged but a sufficient portion of each remains to demonstrate their exceedingly slender character. Comparison with the type of *H. compressus* (A.M. No. 12781) from the Lysite shows that the New Fork specimen is comparable in length of teeth and in the depth and slenderness of the jaw, and would not be confused with heavier-jawed *Hapalodectes leptognathus*. The teeth, if anything, are more slender than in the *H. compressus* type, or even than in the Lost Cabin jaw (A.M. No. 14748) that Matthew noted as having more slender teeth and a shallower jaw than the type.

PACHYAENA OSSIFRAGA Cope

A number of broken pieces of skull and associated jaw and tooth portions (U.S.N.M. No. 22449) from the Bitter Creek locality are referred to Cope's New Mexican species *Pachyaena ossifraga*. Among these is the greater part of an upper molar, lacking only the deuterocone, that corresponds remarkably well in size and various other details with Cope's type (U.S.N.M. No. 1096), presumably an M^1.

PACHYAENA GRACILIS Matthew

About 15 associated teeth (U.S.N.M. No. 22448) of *Pachyaena* were found in the Gray Bull equivalent of the Knight near the base of the escarpment west of Elk Mountain in the Fossil Basin. These compare very closely in size with various teeth in the type of *Pachyaena gracilis* (A.M. No. 15728) from the Gray Bull beds in the Bighorn Basin. Their size, nevertheless, is but little less than in the *P. ossifraga* material. An upper molar, possibly M^1, in addition to smaller size, shows somewhat less development of the metacone than in the type of *P. ossifraga*.

An incomplete lower cheek tooth from low on the slope of Fossil Butte may also represent *P. gracilis*. It is, however, rather small and somewhat suggestive of earlier *Dissacus*.

PACHYAENA?, sp.

No additional material believed to represent *Pachyaena*, other than the two specimens reported in 1952, has been found in the New Fork

beds. Matthew (1915b, pp. 87-88) did not encounter this genus in beds later than Gray Bull. although Loomis reported it from later beds in the Bighorn Basin. The two lower teeth from the New Fork horizon were thought to be of a size appropriate for *P. gracilis.* They could, nevertheless, be referred with equal conviction to *P. ossifraga.*

OXYAENIDAE

OXYAENA, sp.

Further material of *Oxyaena* in the collections from the La Barge horizon includes a P_4 and the anterior part of M_2 associated (U.S.N.M. No. 22450). The premolar is as long as in *Oxyaena forcipata* but both teeth are a little more slender. They are also slightly more rugose than in the type material. Comparison with *Oxyaena pardalis* is difficult, inasmuch as the critical talonid portion of the molar is not preserved; but size would appear to exclude this Lost Cabin species, as well as *Patriofelis* (*Protopsalis*) *tigrinus,* from consideration.

The earlier (1952) described specimen of *Oxyaena,* a first lower molar in the Princeton collection (No. 16176) from near La Barge, was regarded as more nearly comparable in size to *Oxyaena lupina.* There is no certainty, of course, that the two La Barge specimens represent the same species. So far as the other horizons are concerned, only an isolated lower premolar from the Bitter Creek locality and another from the Dad locality are believed to be *Oxyaena.* The Bitter Creek tooth corresponds very closely in size and other details to P_3 in the type of *Oxyaena lupina.* In the absence of other evidence, however, recognition of *Oxyaena lupina* in the Bitter Creek fauna would not be warranted. The Dad tooth may be P_2 and corresponds well, except for a little greater width, with this tooth in *Oxyaena forcipata,* the possibility, however, of its representing *Patriofelis* should not be overlooked.

AMBLOCTONUS, cf. MAJOR Denison

To the National Museum materials representing *Ambloctonus* there have been added an M_1, with the top of the trigonid missing, and an incomplete premolar from the La Barge horizon in the Big Piney area. These may well belong to the same species as that represented by the Princeton jaw (P.U. No. 14720) described in 1952. A lower premolar, probably P_3 in the Princeton collection from the Dad locality (P.U. No. 16125) seems also to represent Denison's (1938) Lost Cabin species *Ambloctonus major.*

LIMNOCYONIDAE

PROLIMNOCYON ELISABETHAE Gazin

(Plate 6, figure 6)

New material of *Prolimnocyon elisabethae* includes a right maxilla (U.S.N.M. No. 22454) with P^4 and M^4 from the Muddy Creek locality 12 miles north of Big Piney, in the La Barge horizon. The teeth are almost identical to those in U.S.N.M. No. 19348 figured in 1952 so that no new information is added. Moreover, Kelley and Wood (1954) have referred to this small though advanced species a right maxilla with P^4-M^3 from the Lysite horizon in the Wind River Basin.

No dimensions for the teeth of *P. elisabethae* were given with the original description. These are included in the table of measurements accompanying the discussion of the following species.

PROLIMNOCYON, cf. ANTIQUUS Matthew

(Plate 6, figure 5)

A pair of lower jaws, U.S.N.M. No. 22452, much more robust and with larger teeth than *Prolimnocyon elisabethae* were encountered in the New Fork horizon of the Wasatch. Both jaws are preserved from the canine alveolus to about the masseteric fossa. The left ramus included P_4-M_2, whereas the right ramus has preserved only P_2, M_2, and the heel of M_1. The length of the tooth row is about the same as in the type of *Prolimnocyon antiquus,* and like this species, as well as *P. elisabethae,* has a single alveolus for the root of M_3. Unlike *P. elisabethae,* which has a very slender and shallow jaw, the depth of the New Fork jaws is even greater than in *P. antiquus.* They are not comparable in this respect, however, to Gray Bull *Prolimnocyon robustus.* The weakness of the parastylid on P_4 is also more as in Lost Cabin referred material of *P. antiquus* than as in *P. elisabethae.* M_1 is more slender than the tooth accompanying the type of *P. antiquus.* Matthew evidently has this accompanying tooth shown in the position of M_1 in the drawing of *P. antiquus,* but I am convinced that this loose tooth does not represent *Prolimnocyon* but belongs to *Vulpavus.* The talonid portion of M_2 is also a little more slender than in the preserved portion of this tooth in the type of *P. antiquus.*

MEASUREMENTS IN MILLIMETERS OF LOWER TEETH IN SPECIMENS OF *Prolimnocyon*

	P. atavus A.M. No. 16816 Type	*P. elisabethae* U.S.N.M. No. 19350 Type	*P. antiquus* A.M. No. 14768 Type	*P. antiquus* U.S.N.M. No. 22452
P_1-M_3 (at alveoli)		35.0	41.0	40.0
P_1-P_4 (at alveoli)		20.6	25.3	25.0
M_1-M_3 (at alveoli)	14.0	14.0	15.5	15.0
P_2, anteroposterior diameter: transverse diameter		5.0 : 2.1		4.9 : 2.1
P_3, anteroposterior diameter: transverse diameter		5.4 : 2.0		
P_4, anteroposterior diameter: transverse diameter		5.8 : 2.6		6.3 : 2.9
M_1, anteroposterior diameter: transverse diameter	6.2 : 3.4	5.9[a] : 3.0[a]		6.4 : 3.5
M_2, anteroposterior diameter: transverse diameter	6.4 : 4.2	6.8 : 3.5		7.0 : 4.0
M_3, anteroposterior diameter: transverse diameter	2.6 : 1.7			

[a] Approximate.

HYAENODONTIDAE

SINOPA, possibly S. VIVERRINA (Cope)

(Plate 6, figure 3)

A pair of lower jaws (U.S.N.M. No. 22456) of a decidedly small species of *Sinopa* was found in the La Barge level of the Knight beds about 12 miles north of Big Piney. Most of the teeth are preserved although some are slightly damaged. Direct comparison with Cope's type of the New Mexican species *Sinopa viverrina* is not feasible because, not only were there no lower teeth included, but the palatal portion, exhibiting the upper dentition figured by Cope (1877, pl. 38, fig. 1), has been missing from the type material (U.S.N.M. No. 1022) for some time. Nevertheless, from the measurements given by both Cope and Matthew for these upper teeth, it seems that the proportions of the lower teeth in the Knight specimen are entirely compatible for proper occlusion.

The lower molars in No. 22456 are characterized by talonids having a very weak, posteriorly placed entoconid and almost no lingual crest or ridge forward from the entoconid position. The talonid basin slopes steeply to the lingual margin of the tooth, reaching a climax in M_3 where the narrow, elongate talonid is essentially without a basin. It may be further noted that the anterior premolars follow the canine

with very short or almost no diastema in comparison with jaws from the same horizon tentatively referred to *Sinopa vulpecula.*

SINOPA, cf. MULTICUSPIS (Cope)

(Plate 6, figure 4)

A Bitter Creek lower jaw (U.S.N.M. No. 22459) with M_1 and M_2 preserved is tentatively referred to *Sinopa multicuspis.* The lower teeth in the Bitter Creek jaw occlude very well with the upper molars in the type and are not significantly different in size from teeth in New Mexican specimens referred by Cope to this species. A correspondence was also noted in size of teeth to the type of *Sinopa secundaria,* although the latter has more slender lower jaws. On the other hand, *Sinopa mordax* has deeper jaws and a more reduced M_3 than indicated in the Bitter Creek specimen. Considering the wide range of sizes and characters shown in materials of *Sinopa* and the plethora of species that have been proposed, *S. mordax* may not actually be distinct from *S. multicuspis.* A careful reexamination of all the materials of *Sinopa* is much needed, as the present taxonomic arrangement seems illogical.

To *Sinopa multicuspis* is also tentatively referred a right maxilla, with portions of two molars, U.S.N.M. No. 22460, from high on Fossil Butte and fragments of isolated teeth from this locality and from west of Elk Mountain in the Fossil Basin.

SINOPA, cf. VULPECULA Matthew

(Plate 6, figures 1 and 2)

The best of the Knight material (U.S.N.M. No. 19347) compared to Matthew's small Lost Cabin species was described in 1952. A couple of specimens that represent the same species have been added to the La Barge collection but these do not furnish new information.

Two maxillary portions, one of these with P^4 and the other (U.S.N.M. No. 22462) with M^2 and M^3, from the New Fork tongue are also thought to be of *Sinopa vulpecula.* The teeth are no larger than in *Sinopa multicuspis* but the molar talons seem more robust. In this connection it may be noted that the talonids of the lower molars in the La Barge material compared to *S. vulpecula* also seemed relatively broader than in the various Knight materials that were referred to *S. multicuspis.*

SINOPA, cf. STRENUA (Cope)

No additional material of a larger species thought to represent *Sinopa strenua* was encountered in the La Barge-Big Piney area, but

an assortment of associated upper and lower teeth with jaw and other fragments (U.S.N.M. No. 22461) from the earlier or Gray Bull equivalent about 4 miles to the southwest of Elk Mountain in the Fossil Basin may also represent this species. The upper teeth of this specimen are noticeably larger than in either *Sinopa multicuspis* or *S. vulpecula,* whereas the lower teeth compare very favorably with the type of *S. strenua.*

MIACIDAE

DIDYMICTIS PROTENUS (Cope)

(Plate 7, figure 3)

Among the materials that might logically be referred to earlier Wasatchian *Didymictis protenus* is a lower jaw portion with P_4 and M_1 (U.S.N.M. No. 22457) from the Bitter Creek locality. The size of M_1 appears to be close to that in Cope's type from New Mexico, as measured at the roots, inasmuch as only the talonid portion of this tooth is preserved in the type (U.S.N.M. No. 1092). P_4, however, is a little larger. Its principal cusp, moreover, is a little higher. Simpson (1937, p. 14) has noted considerable variation in size of materials in the Gray Bull referred to *D. protenus.*

This species seems also to be represented by tooth fragments from the Gray Bull equivalent of the Knight west of Elk Mountain in Fossil Basin.

A remarkably good skeleton of *Didymictis* (P.U. No. 14917) from about 15 miles north of Baggs, Wyo., is in the Princeton collection. It is from the Knight beds just below the Tipton tongue, but is unusually small for this horizon. Measurements of the teeth are only a trifle larger than in the type of *D. protenus* to which it is very tentatively referred. The possibility of its falling near the lower limit of the range in size for the small mutant of *D. altidens* should be considered. Nevertheless, its size is well below the range noted for the La Barge materials. The specimen is to be described in detail elsewhere.

DIDYMICTIS ALTIDENS Cope

(Plate 7, figures 1 and 4)

The reasons for referring the La Barge *Didymictis* materials to *D. altidens* were discussed in 1952. The few specimens added to this collection since that time furnish no further information. The sample shows somewhat less variability than the Gray Bull materials,

and in comparison with the type of *D. protenus* the La Barge form exhibits distinctly larger teeth and much deeper jaws.

Among the newer collections from the New Fork tongue there is, in addition to several isolated tooth fragments, a large jaw (U.S.N.M. No. 22458) with damaged teeth associated with some fragments of a skull. These are of a form averaging larger than that represented by the La Barge materials, as might be expected in single species showing progressive increase in size.

As isolated M_1 in the Princeton collection from the Cathedral Bluffs (P.U. No. 16113), here figured (pl. 7, fig. 4) in comparison with La Barge and Bitter Creek specimens, is scarcely larger (only 0.2 mm. longer at the roots) than this tooth in the New Fork jaw. It would appear to be close to typical *D. altidens.*

Some fragments of teeth from the higher slopes of Fossil Butte are of a moderately robust form, tentatively referred to *D. altidens.* This is in keeping with the interpretation proposed by Simpson (1937, p. 15) that Matthew's Lysite subspecies (mutant) should probably be included in *D. altidens.*

VIVERRAVUS, cf. ACUTUS Matthew

(Plate 7, figure 9)

A right ramus of the mandible with P_4 and M_1 (U.S.N.M. No. 22465) and a second specimen with only P_4 from the Bitter Creek locality are found to be of a species of *Viverravus* distinct from *V. lutosus* of the later horizons of the Wasatch. The teeth are smaller, particularly the premolars, than in *V. lutosus,* and the talonid basin of the carnassial appears relatively narrower. The two specimens correspond more closely to *Viverravus acutus,* and P_4, particularly in the second specimen, is very little different in size. M_1 in No. 22465, however, appears somewhat smaller and relatively more slender than this tooth, which is incomplete, in the lower Gray Bull or Sand Coulee type. The teeth in all but one of the other Gray Bull jaws observed are indeed larger than in the type. Nevertheless, the differences are not great and the Bitter Creek materials may be tentatively referred to this species, although they may possibly represent a small mutant.

A lower carnassial in the collections of the University of California (No. 43821) from the Knight about 11 miles north of Baggs, Wyo., and between 100 and 150 feet below the Tipton tongue is surprisingly close to M_1 in the above Bitter Creek jaw. It cannot be referred to *V. lutosus* although the horizon represented seems characterized by that species. It is also tentatively allocated to *V. acutus.*

VIVERRAVUS LUTOSUS Gazin

(Plate 7, figures 5 and 7)

Fragments of three jaws and a maxilla, each with a single tooth, have been added to the materials representing *Viverravus lutosus* in the La Barge fauna. The species is now also represented by a lower jaw (U.S.N.M. No. 22464) with M_2 and the talonid portion of M_1 from the New Fork tongue (pl. 7, fig. 7). The preserved part of M_1 agrees very closely with this tooth in the type but M_2 is perhaps a trifle smaller than in certain referred specimens from the Muddy Creek locality north of Big Piney. It is also noted that the Cathedral Bluffs lower jaw (P.U. No. 16107) that Morris (1954) referred to *Viverravus gracilis* is much closer to *V. lutosus*. Both P_4 and M_1 in the Princeton specimen have the same overall dimensions as these teeth in the type of *V. lutosus* and seem identical to them, but the alveolus for P_3 appears to be slightly longer. Matthew's (1909, p. 361) measurements of the type of Bridger *V. gracilis* suggest that the lower carnassial was relatively much broader than in the Cathedral Bluffs jaw.

VIVERRAUS, cf. DAWKINSIANUS (Cope)

A second and larger species than *Viverravus lutosus* in the New Fork fauna is indicated by portions of a lower jaw with only M_2 preserved (U.S.N.M. No. 22467). The tooth is undoubtedly viverravid but its size and that of the more forward alveoli is decidedly greater than in *V. lutosus*. In this respect it is near *V. dawkinsianus,* to which it may be referred. However, it differs from that species, so far as can be determined, only in the depth of the lower jaw. The jaw is a little more robust than in *V. lutosus* but is not as deep as in typical Lost Cabin *V. dawkinsianus*.

UINTACYON ASODES Gazin

(Plate 7, figures 6 and 8)

While no new materials of *Uintacyon asodes* have been found in the La Barge horizon, a comparatively robust jaw that may be referred to this species was found in the New Fork tongue. The specimen (U.S.N.M. No. 22468; pl. 7, fig. 6) includes P_2 and P_4 to M_2 inclusive. The carnassial is a little wider, but P_2 is more reduced, as may be inferred from the better spacing of the roots of this tooth in the type. The large size of the molars that characterizes *U. asodes* in comparison with *Uintacyon massetericus* is further demonstrated

in M_2 of the New Fork specimen. Measurements of teeth in the two Wasatch specimens are given below, together with those for the type of *U. massetericus*.

MEASUREMENTS IN MILLIMETERS OF LOWER TEETH IN SPECIMENS OF *Uintacyon*

	U. massetericus	*U. asodes*	
	A.M. No. 4250 Type	U.S.N.M. No. 19351 Type	U.S.N.M. No. 22468
P_4, anteroposterior diameter: transverse diameter	6.0:2.9	6.1:3.3	5.8:3.5
M_1, anteroposterior diameter: transverse diameter	6.9:4.8	7.5:5.5	7.9:5.9
M_2, anteroposterior diameter: transverse diameter	4.2:3.6		6.0:5.1

MIACIS, near M. EXIGUUS Matthew

Included among the more recent collections made from the New Fork tongue is a lower jaw fragment with M_2 and most of M_1 (U.S.N.M. No. 22469), clearly of *Miacis* but representing a species distinctly smaller than *M. latidens*. In size it cannot be distinguished from *Miacis exiguus*, although all the heretofore described materials of this species have been recorded only from Gray Bull levels. The only feature seen in the two teeth that might be regarded as distinctive is a more forward position of the paraconid of M_2. This was noted in comparison with La Barge materials of *M.*, cf. *latidens* as well as with Gray Bull specimens of *M. exiguus*.

An isolated lower carnassial in the La Barge collection, too small to be included in *Miacis latidens*, may represent the same species as that present in the New Fork fauna. The form of its talonid, however, more closely resembles that of the other, much larger La Barge specimens.

MIACIS, cf. LATIDENS Matthew

(Plate 8, figure 1)

The miacid jaws (U.S.N.M. No. 19335) described in 1952 and tentatively referred to Matthew's Lost Cabin species *Miacis*, cf. *latidens*, exhibit a well-preserved and nearly complete cheek tooth series on the left side, illustration of which is included in this report. No further materials that may represent this species have been encountered.

Cf. VULPAVUS AUSTRALIS Matthew

(Plate 8, figure 5)

A single upper molar (U.S.N.M. No. 22474), much larger than in the Bitter Creek maxilla thought to be of *Vulpavus,* was found in association with *Heptodon* high on the slope of Fossil Butte. The tooth is rather close in size to M^1 in the Gray Bull specimen (A.M. No. 16954) referred to *V. australis.* The protoconule, however, is a little less lingual and the cingulum is not as heavy. A slight mesostyle on No. 22474 cannot be determined for M^1 of No. 16954 because of slight damage to this portion of the tooth, but it is lacking in M^2 of the Gray Bull specimen.

VULPAVUS ASIUS Gazin

(Plate 8, figures 2 and 3)

Three additional specimens of *Vulpavus asius* bring the total to 11 that now represent this species in the La Barge fauna. One of these (U.S.N.M. No. 22470), a lower jaw including the first two molars, was collected by Privrasky west of Big Piney. The other two are isolated M_2's from 12 miles north of Big Piney. Mention should also be made of an incomplete lower molar, surely of this species, from approximately 150 feet beneath the Tipton tongue about 13 miles north of Baggs, Wyo., one of the more productive localities for material of the Dad fauna.

A somewhat larger mutant, evidently of *Vulpavus asius,* is represented by four specimens from the New Fork tongue. One of these, U.S.N.M. No. 22471, includes both rami of the mandible and representation of P_4-M_2. A composite of the teeth from both sides is shown for the left ramus in plate 8 (fig. 2) in comparison with the type (fig. 3) from the La Barge faunal level 12 miles north of Big Piney. The teeth in No. 22471 are among the larger for the New Fork mutant, which average a little larger than in the La Barge form. The observed ranges in size, however, do overlap. The depth of the jaw in No. 22471 is about the same as in the La Barge type.

The New Fork mutant makes a close approach in size to contemporary Lost Cabin *Vulpavus canavus* as represented, for example, by the comparatively small type specimen of *V. brevirostris* (Cope), and the lengths of the lower molars in No. 22471 can be nearly matched in certain of the Wind River specimens. P_4, however, is distinctly smaller and all the teeth are relatively narrower. The New Fork materials might have been allocated to *V. canavus* but they are

closer to *V. asius,* geographically as well as in form, so that it seems preferable to regard them as a progressive mutant of *V. asius.* Their stratigraphic position, of course, precludes regarding them in an ancestral relationship to *V. canavus.*

Cf. VULPAVUS, sp.

(Plate 8, figure 4)

A right maxillary fragment with M^1 and M^2, U.S.N.M. No. 22473, from Bitter Creek closely resembles in the form of the two molar teeth a specimen of *Vulpavus australis* (A.M. No. 16954) from the Bighorn Basin but is distinctly smaller, and the inner cingulum, though worn, appears a little weaker. Matthew did not discuss or figure upper teeth of *Vulpavus* but it would appear from these teeth that there is somewhat less disparity in size between M^1 and M^2 and possibly the external shelflike cingulum is not as expanded as in *Miacis.*

VASSACYON, cf. PROMICRODON (Wortman)

A portion of the left ramus of a mandible, U.S.N.M. No. 22451, from the Gray Bull horizons southwest of Elk Mountain in the Fossil Basin represents beyond doubt, Matthew's genus *Vassacyon.* Only P_4 and the talonid portion of the lower carnassial are included, but these together with alveoli for other molars correspond closely in size to Gray Bull *V. promicrodon.* The distinguishing feature in this specimen, demonstrating that it represents *Vassacyon,* is seen in the molar talonid. The heel of M_1, though having a well-defined lingual basin, has a comparatively high median crest. The basin is not as large and broad as in *Miacis* or *Vulpavus* and the crest is more trenchant. The median crest suggests *Uintacyon,* but this is denied by the much better-defined basin. Moreover, the jaw is relatively deep and robust as in *Vassacyon promicrodon.*

CONDYLARTHRA

HYOPSODONTIDAE

HAPLOMYLUS SPEIRIANUS (Cope)

(Plate 9, figures 1-4)

Haplomylus speirianus, as pointed out by Matthew (1915b, p. 314), is characteristic of the lower part of the Gray Bull and has not been found in the upper Gray Bull, Lysite, or Lost Cabin beds. This species is now recognized in the materials from several localities in the lower part of the Knight sequence. In addition to isolated upper and lower

teeth, there is a maxilla with M^1 and M^2 (Y.P.M. No. 14077; see pl. 9, fig. 1) from Bitter Creek that can be closely matched in Gray Bull materials from the Bighorn Basin. Lower jaws (U.S.N.M. Nos. 22429 and 22427; see pl. 9, figs. 2, 4) from the Knight exposures at the base of the escarpment west of Elk Mountain in the Fossil Basin have anterior molars comparable to those in larger Gray Bull materials, but M_3 in both is actually and relatively smaller than in all but one of the U.S.N.M. jaws from the Gray Bull with this tooth preserved. A lower jaw with P_4 and M_1 (U.S.N.M. No. 22428; see pl. 9, fig. 3) from the Red Desert locality east of Steamboat Mountain can also be matched in Gray Bull specimens, but only among those having the smallest teeth.

There is considerable variation in tooth size in various Gray Bull materials referred to *Haplomylus speirianus*. Simpson (1937, p. 22), however, has shown that the materials from the Sand Coulee or lowest Wasatchian levels average distinctly smaller than those from the Gray Bull proper, although there is an overlapping in range. Teeth decidedly smaller than any of those in the National Museum Gray Bull sample were found very low in the Knight at a locality southeast of the Rock Springs uplift, approximately 20 miles southwest of Bitter Creek Station, by Henry W. Roehler of the Mountain Fuel and Supply Co. This must surely be the Sand Coulee level.

HYOPSODUS LOOMISI McKenna

(Plate 9, figures 5-7)

The species *Hyopsodus loomisi* as proposed by McKenna would appear to be a substitution for *Hyopsodus simplex* to include much that had been attributed to that species but which was not determinable in a lower jaw, or not actually distinctive of the type specimen. Most of the characters attributed to *Hyopsodus simplex* are highly variable throughout the lower Eocene but appear more consistently evident in the earliest Gray Bull specimens. The characters selected by McKenna as diagnostic for *H. loomisi* include the weakness of the hypocone and near absence of an external cingulum of the upper molars, which when coupled with small size would seem indicative of a distinct species, or at least of a primitive mutant of the Graybullian form referred to *H. miticulus*.

Several very small jaws in the Bitter Creek collection are believed to be this species, but only one upper molar conforms to the description. Other Bitter Creek maxillae show better development of the hypocone and external cingulum. Among the very small lower jaws

I note that although the paraconid is persistent on M_1 and occasionally on M_2, the entostylid is rather variable. The presence of an entostylid would not seem to be necessarily an advanced character, because, although it is rather common in the Bighorn Gray Bull materials, it is usually weak or absent in the La Barge Knight specimens.

An isolated upper molar from the Red Desert locality east of Steamboat Mountain may also be referred to *Hyopsodus loomisi,* but the species does not seem to be represented in the Fossil Basin collections from west of Elk Mountain.

HYOPSODUS, cf. MITICULUS (Cope)

Jaws, maxillae, and isolated teeth that may be referred tentatively to *Hyopsodus miticulus* are included in the collections from the horizons of lower Gray Bull equivalence in the Knight. Reference of these, however, to the geographically remote New Mexican species may be questionable. Most of the material represents relatively small individuals, corresponding to about the lowest part of the size range determined for Gray Bull materials referred to this species. However, the largest individual represented in the Bitter Creek sample (Y.P.M. No. 14052) is just under the mean for the Gray Bull. Some that seem not referable to *H. loomisi* are smaller than any in the U.S.N.M. Gray Bull sample, but it should be noted that the latter does not include Sand Coulee *Hyopsodus* material.

To *Hyopsodus miticulus* are also referred specimens from the Lysite equivalent in the Fossil Basin, materials that might otherwise have been identified as *Hyopsodus lysitensis* or *Hyopsodus mentalis lysitensis.* In a statistical study of *Hyopsodus,* currently under way, I find that the range of measurements for specimens of the smaller form, generally designated *H. m. lysitensis,* in the American Museum and Princeton University collections from the Cottonwood Draw Lysite, corresponds very well and is included within that for the *H. miticulus* materials from the Gray Bull. I am unable to justify a distinction on size or progressiveness. The frequency distribution for size of teeth in *Hyopsodus mentalis* in a small sample from the Largo beds of New Mexico is discordant with that for the Lysite materials, although Van Houten (1945, p. 434) and Simpson (1948, p. 383) have thought that that Largo may be more nearly Lysite than Lost Cabin in age. I do not think that the Lysite *Hyopsodus,* if contemporaneous, is the same species as that recorded for the Largo.

HYOPSODUS WORTMANI Osborn

Ten more specimens of *Hyopsodus wortmani* encountered in later collections representing the La Barge fauna brings the total for this species up to about 39, much less abundant than *H.*, cf. *mentalis*. Later collections from the New Fork horizon, however, show that *H. wortmani* there outnumbers the larger form about 10 to 6 in the small sample at hand. A single specimen, U.S.N.M. No. 22660, from the collections of the Dad fauna is referred to this species; all the remaining specimens from the exposures beneath the Tipton tongue south of Dad, Wyo., are of the very large species *H. browni* and *H. walcottianus*.

HYOPSODUS, cf. MENTALIS (Cope)

Reference of Lostcabinian materials of *Hyopsodus* to the species *H. mentalis,* while recognizing *H. miticulus* as the name for Gray Bull materials, may well be perpetuating a taxonomic error. It is not improbable that the Wyoming sequence of the forms concerned is evolution in situ, whereas *H. miticulus* and *H. mentalis* are reported to be contemporary in the Almagre of New Mexico, although only *H. mentalis* seems persistent into the Largo beds, according to Matthew's interpretation of the distribution of these species.

Some 70 or more specimens of *Hyopsodus* in the collections representing the La Barge fauna are considered as possibly representing *H. mentalis,* bringing the total for this locality to approximately 146. Not previously recognized in the New Fork fauna, six specimens or about a third of the *Hyopsodus* material from above the Tipton tongue in the La Barge-Big Piney area may also be included in this species. It is interesting to note, however, that of the materials I have seen, none of the specimens representing *Hyopsodus* in the Dad fauna, appears to be in this size range, although the horizon surely corresponds closely in age to that of the La Barge fauna.

HYOPSODUS BROWNI Loomis

The species indicated here is the same as that for which Kelley and Wood (1954, p. 355) have used the name *Hyopsodus powellianus.* Unfortunately, the type of *H. powellianus* is from an unknown horizon in the Bighorn 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 has called *H. walcottianus. Hyopsodus lemoinianus* also has for its type a specimen from an unknown horizon in the Bighorn Basin. *H. lemoinianus* has pri-

ority over *H. powellianus,* and while Matthew placed it in synonymy with *H. mentalis,* it seems to be nearly or quite outside the observed range for this species in the Wind River Lost Cabin and at about the upper limit in the La Barge fauna. It certainly falls near the mean for the Cottonwood Draw Lysite specimens called *H. powellianus.* Nevertheless, in view of the possible confusion at certain levels, probably *H. browni* is the least questionable designation.

In addition to the specimens from near Knight Station in the Fossil Basin that were described as belonging to this species in 1952, I refer also a maxilla with part of M^2 and M^3 from high on the southwest slope of Fossil Butte, in the deeper red beds just beneath the Green River, and a lower jaw with M_2 and part of M_3 from the saddle on the north side of Fossil Butte in the Fossil Basin.

This large species is evidently not represented in the rather abundant *Hyopsodus* specimens from below the Fontenelle or Tipton tongue in the La Barge–Big Piney area. A single specimen (U.S.N.M. No. 22667), however, collected by N. C. Privrasky of the U. S. Geological Survey, from a locality he regarded as near the base of the Knight in this area, is much larger than any of the *Hyopsodus,* cf. *mentalis* material and may tentatively be referred to *H. browni.* In the Dad fauna, on the other hand, associated with *Lambdotherium,* most of the specimens of *Hyopsodus* at hand conform to the size range of *H. browni.* The remaining specimens are quite outside the range and may be included in small *H. wortmani* or very large *H. walcottianus.* Also, above the Tipton tongue of this area, in the Cathedral Bluffs member, Morris (1954, p. 197) has listed *Hyopsodus paulus.* These specimens, consisting of a P^4, an upper molar, and an M_3 are of a larger species than *H. paulus* and may tentatively be referred also to *H. browni.* Their size would not warrant recognizing *H. walcottianus* in the Cathedral Bluffs fauna.

HYOPSODUS, cf. WALCOTTIANUS Matthew

Material from the Knight beds that may appropriately be referred to very large, but rare, *Hyopsodus walcottianus* has been found at localities near Dad, Wyo. A lower jaw with incomplete M_2 and M_3 (U.S.N.M. No. 22663), a maxilla with M^1 and M^2 (U. of Calif. No. 43592) and an isolated M^1 in the National Museum collection from the Knight beneath the Tipton tongue along the escarpment south of Dad appear much too large to be included with the contemporary materials regarded as representing *H. browni.* Also, a single lower jaw with P_4 and M_1 (U.S.N.M. No. 22669) from the New Fork

seems large enough to be included in this species. Matthew in 1915 (b, p. 326) noted only three specimens of *H. walcottianus,* including the type in the collection from the Lost Cabin beds of the Wind River Basin and two from this horizon in the Bighorn Basin.

PHENACODONTIDAE

PHENACODUS PRIMAEVUS Cope

The absence of *Phenacodus* in the abundantly represented La Barge fauna of the Knight was earlier (1952) noted, although the type of *P. primaevus* is from a somewhat earlier horizon along Bear River near Evanston. A well-worn P_4 and lower molar (U.S.N.M. No. 22668), evidently associated, from the Bitter Creek locality compare very closely in size with Gray Bull materials referred to *Phenacodus primaevus.* The lower molar is worn so that its pattern is poorly revealed. The premolar, however, is clearly of *Phenacodus* and can be matched in detail with this tooth in *P. primaevus,* although the posterointernal angle or entoconid portion is broken away.

The lower jaw of *Phenacodus* described in 1952 (p. 61) as coming from beneath the variegated deposits of the Knight about 3 miles east of Fossil Station is now known to be from the Evanston formation (Gazin, 1956b).

PHENACODUS, cf. VORTMANI (Cope)

(Plate 9, figures 8 and 9)

A maxilla with P^4-M^2 and a lower jaw with P_3-M_3, together with other tooth portions belonging to the same individual, representing a small species of *Phenacodus,* were found at a locality to the southwest of Elk Mountain in the Fossil Basin. It is not certain, however, that the horizon represented is as low as the Gray Bull level at the base of the escarpment due west of Elk Mountain. The localities are a couple of miles apart.

The size of the species represented is comparable to *Phenacodus vortmani,* or possibly to *P. copei.* The details of P_3 and P_4 correspond more closely to the description given by Granger (1915, p. 343) for *P. vortmani,* although the horizon represented by the Fossil Basin specimen is in all probability not as late as that for the type. It should be noted, however, that Granger recognized *P. vortmani* in all three levels of Wasatchian time.

PHENACODUS, cf. BRACHYPTERNUS Cope

A single upper molar in the collection from the Red Desert locality east of Steamboat Mountain is about the size of an M^1 in *Ectocion*

osbornianum, but evidently does not represent this genus. The cusps are lower and more bunodont and there is much less indication of transverse lophs. Moreover, the enamel is perhaps a little more rugose. Although the more characteristic P_4 of *Phenacodus brachypternus* is not included in the material, it seems probable, nevertheless, that this small species is represented rather than somewhat larger *P. vortmani* or *P. copei.*

MENISCOTHERIIDAE

MENISCOTHERIUM, cf. PRISCUM Granger

(Plate 10, figures 5 and 6)

A small species of *Meniscotherium* in the Bitter Creek fauna is represented by about six specimens. Although the type of *M. priscum* from the Clark Fork beds could not be located in the American Museum collections, the dimensions of the teeth given by Granger (1915, p. 360) are closely comparable to those in the Bitter Creek specimens. Their size is only slightly greater than in the New Mexican form *M. tapiacitis* Cope, but, as noted by Granger, the metastylid of the lower molars is much more prominent in the Wyoming material.

In a comparison of upper cheek teeth in a maxilla from Bitter Creek (see pl. 10, fig. 5) with upper dentitions from later horizons of the Wasatch, it is noted that in addition to smaller size the teeth are relatively short (anteroposteriorly) and broad. The extended lingual portion in each also seems anteroposteriorly compressed.

Isolated teeth of distinctly small size from the Red Desert locality are also referred to this species. Moreover, fossil materials collected by Henry W. Roehler near the base of the Knight sequence at localities on the western and southeastern flanks of the Rock Springs uplift include isolated teeth of this species in association with *Haplomylus speirianus.* The faunal levels represented are about comparable to those at Bitter Creek.

Some very fragmentary material, but including one complete lower molar, of a small *Meniscotherium* was found low on the south-facing escarpment to the west of the saddle north of Fossil Butte. The tooth is almost identical in size with M_2 in the lower jaw (U.S.N.M. No. 22432; pl. 10, fig. 6) from Bitter Creek. The presence of *Meniscotherium* so close in size to *M. priscum* on the slopes on the opposite side of the ravine to the northwest of Fossil Butte is rather indicative of a lower Gray Bull level in this area, lower than the Wasatchian horizon represented in the saddle which has produced remains of *Meniscotherium* more nearly comparable to *M. robustum.*

MENISCOTHERIUM ROBUSTUM Thorpe

(Plate 10, figures 1 and 2)

The distribution of *Meniscotherium robustum* would appear to be characteristic of the upper part of the Knight formation beneath the Tipton tongue and to be nearly limited to the Green River Basin of Wyoming. Its area of greatest abundance is the vicinity of La Barge and Big Piney, but it has been found near Tipton Butte, and to the southeast of the Rock Springs uplift as well as on its western flank. Also, a maxilla and a portion of a lower jaw, which may represent this species or a form near it, were found in the adjacent Fossil Basin at localities high in the Knight beneath the Green River beds on Fossil Butte. Besides these, maxillae and a jaw portion belonging together were discovered in association with a considerable amount of *Coryphodon* material on the escarpment to the west of Elk Mountain. Distribution of the species, however, does not appear to have extended as far east as the Muddy Creek area on the east side of the Washakie Basin. No material of *Meniscotherium* has been observed in any of the several collections from beds beneath the Tipton tongue in the vicinity of Dad and Baggs, Wyo., and this species has not been reported from either the Wind River or Bighorn Basins.

While the vertical range of *Meniscotherium robustum* is limited upward, as far as known, by the Fontenelle or Tipton tongue of the Green River, its distribution downward remains somewhat uncertain. It may well characterize only the Lostcabinian level but if it evolved in situ from the early Graybullian *M.*, cf. *priscum,* of the area, the Lysitean stage of this development has not been clearly demonstrated in the Green River Basin. It is entirely possible that the Fossil Butte specimens which seem near *M. robustum* represent this age. The teeth in the maxilla (U.S.N.M. No. 22670) are larger than in the New Fork *M.*, cf. *chamense,* but are at about the lower limit of the observed range in size for *M. robustum.* Only two maxillae in the La Barge collection have teeth as small. The lower jaw fragment (U.S.N.M. No. 22794) has P_3 and P_4 only slightly larger than in the *M.*, cf. *chamense,* material but the jaw itself is about as robust as in *M. robustum.* It is interesting to note, however, that the specimen from the Fossil Basin locality west of Elk Mountain (U.S.N.M. No. 22795), evidently a Gray Bull level, has teeth fully as large as in *M. robustum.* There is no association here with *M. priscum,* however. Presumably the horizon is not as early as that at Bitter Creek.

MENISCOTHERIUM, cf. CHAMENSE Cope

(Plate 10, figures 3 and 4)

As noted for the La Barge horizon, remains of *Meniscotherium* are found to be exceedingly abundant in the New Fork collections. More than 120 specimens have been added to the 3 reported in 1952, a few of which are beautifully preserved skulls. Partial skeletons are also included in certain instances. Unlike the New Mexican collections, the New Fork materials are surprisingly uniform in size, corresponding very closely in tooth proportions to the type of *Meniscotherium chamense.* Moreover, the range in size of teeth does not appear to overlap that of larger and earlier *Meniscotherium robustum.* Except for the persistent size and age difference there is surprisingly little to distinguish the two species in the Big Piney area. There is a suggestion, however, that the smaller and later form referred to *M. chamense* shows a somewhat less progressive P^3. The talon of this tooth in certain specimens seems simpler with less development of the accessory cuspules.

I do not think that the New Fork species is derived from *M. robustum* in the underlying beds. It is more reasonable to suppose that *M. robustum* was supplanted by the smaller form as a migrant from elsewhere, presumably New Mexico. An excellent specimen obtained by Princeton University (P.U. No. 14875) from Lost Cabin beds north of Moneta in the Wind River Basin compares closely with the type of *M. chamense,* supporting Granger's conclusion that this species is present also in the typical Lost Cabin beds, but his inference from this that the Largo beds are of Lost Cabin age may not follow.

With the relative abundance of *Meniscotherium* in the New Fork fauna it is important to note that no representation of this genus has been found in the Cathedral Bluffs exposures of the Washakie Basin. Morris (1954, p. 199) has used this as evidence supporting a later age for the type Cathedral Bluffs. It seems more than likely, however, that the absence is of ecologic significance rather than necessarily implying later time, inasmuch as *Meniscotherium,* as noted in the preceding discussion, is also missing from the Dad fauna of the underlying beds of the same area, as well as from the nearby and still earlier Four Mile fauna of McKenna.

PANTODONTA

CORYPHODONTIDAE

CORYPHODON RADIANS (Cope)

(Plate 11, figures 1-5; plate 12, figures 1 and 2)

Coryphodon would appear to be most abundantly distributed in the lower levels of the Knight. Remains are of common occurrence at the Bitter Creek locality and at the base of the Knight section west of Elk Mountain in the Fossil Basin. Much highly fragmentary material was noted along the lower slopes of Fossil Butte although the precise level represented here is not certain. Remains are much less frequently encountered in the higher levels in the La Barge–Big Piney area and none has been found in the New Fork and Cathedral Bluffs beds. Extinction may well have coincided with the changes that brought about the Tipton tongue of the Green River.

Coryphodon radians is the first name that has been applied to *Coryphodon* in North America; and since the type material is from the Bear River locality near Evanston, there is no question of its being represented in the Knight in at least one of the faunas for this member. In all probability all the reported materials from the different horizons of the Knight are of this species. However, only one of the skulls in our collection, U.S.N.M. No. 20737 (see pl. 11, fig. 1) from near La Barge shows the spur from the metacone described by Osborn (1898, p. 213) as characterizing *C. radians.* I suspect, however, that this is, as a vestigial feature, highly variable. I note also that the spur extending posteroexternally from the protocone to the posterior cingulum of this tooth must be regarded as variable, because in a skull from Bitter Creek (U.S.N.M. No. 22745; pl. 11, fig. 4) it is exhibited on the right side but not the left.

Two skulls (U.S.N.M. Nos. 22745 and 22748; pl. 11, figs. 4, 5) and an incomplete pair of lower jaws (U.S.N.M. No. 22746, pl. 12, fig. 2) from Bitter Creek could with certainty be referred to Cope's *Coryphodon armatus.* There is no doubt but that this is the place where he obtained the remains of two poorly preserved skulls upon which the species was based. *C. armatus* was the third North American species to be named, and the second, *C. semicinctus,* was placed in synonymy with *C. radians* by Cope himself. *C. armatus* was the type of Cope's genus *Metalophodon* characterized by the unusual appearance of M^2. Earle (1892) regarded *Metalophodon* invalid because of variation in the characters of M^2. I believe, however, that the tooth in this position, as figured by Cope in his Tertiary Vertebrata (1884, pl. 49, fig. 1),

is an M^3 from another individual. The difference between the two M^3's is then a matter of wear and of individual variation. The extent of the difference between them with respect to the posterior spur from the protocone was observed between two sides of the same skull as mentioned above.

The pair of jaws from Bitter Creek (U.S.N.M. No. 22746) includes the three molars. M_3, as in the tooth so identified by Cope (pl. 49, fig. 6) has the posterior crest parallel to the anterior. This condition is quite like that in the lower jaw regarded as associated with the type of *C. radians* (Cope's pl. 46, fig. 2). Lower jaws with a skull (U.S.N.M. No. 21026) from the Gray Bull horizon at the base of the escarpment west of Elk Mountain in the Fossil Basin also show (see pl. 12, fig. 1) this type of M_3. None of the Knight lower jaw material so far observed exhibits the so highly divergent or V-shaped posterior crest characterizing the genotype *C. eocaenus,* and that is comparatively common in Bighorn Basin specimens. The *C. eocaenus* condition exhibited by the Bighorn Basin specimens would appear to be primitive, and more like the Paleocene pantodonts, as pointed out to me by Dr. Elwyn Simons, although the form representing this condition in the Gray Bull fauna of the Bighorn Basin cannot, of course, be ancestral to that at Bitter Creek. Dr. Simons has undertaken a study of *Coryphodon* as a sequel to his study of Paleocene pantodonts, and his much-to-be desired revision of the numerous species of *Coryphodon* and his conclusions on their relationships is eagerly awaited.

DINOCERATA

UINTATHERIIDAE

Cf. BATHYOPSIS FISSIDENS Cope

Further excavation in 1953 at the locality where jaws described as probably representing *Bathyopsis fissidens* (U.S.N.M. No. 19990) were found has yielded considerably more skeletal material. The bone is rather badly shattered but careful preparation has saved about nine presacral vertebrae, including the atlas and axis, together with the sacrum and several rib portions. Representing the forelimbs is the distal part of a humerus, both radii, the greater part of both ulnae, and three carpals. The hindlimbs are represented by the head and condyle of a femur, patellae, a nearly complete tibia, almost all of the right tarsus, and the third metatarsal.

The limb material for the most part is rather flattened by crushing,

although the foot bones, of denser material, have retained much of their original shape. The skeletal portions closely resemble those in Bridger *Uintatherium.* The limb bones, though about two-thirds the length of those in an upper Bridger animal, are relatively much more slender. In comparison with the skeletal material Dorr (1958) has called *Prouintatherium,* I note that the groove between the inner and outer or trochlear and capitellar portions of the distal articular surface of the humerus is more obtuse, approaching *Uintatherium* in this respect. Also, the olecrenon of the ulna curves backward more and the sigmoid notch faces more proximally, as in *Uintatherium.*

The astragalus figured by Dorr belongs to *Coryphodon,* as he suspected. The New Fork astragalus is much like that in *Uintatherium* but shows a somewhat less flattened surface for the tibia, and that for the cuboid and navicular is relatively a little deeper in a dorsoplantar direction and not so wide. The latter surface, moreover, is sharply tilted with respect to the tibial surface and they approach one another at a high angle. In *Uintatherium* these surfaces of the astragalus are more nearly opposite one another. This suggests greater forward tilting of the tibia with respect to the metatarsal direction. An additional feature noted is that an astragalar foramen is not enclosed or completed in the New Fork animal, whereas formation of the foramen seems characteristic of the Bridger animal.

PERISSODACTYLA

EQUIDAE

HYRACOTHERIUM, cf. ANGUSTIDENS (Cope)

(Plate 13, figure 3)

In assigning the Bitter Creek material of *Hyracotherium* tentatively to *H. angustidens,* I have followed Kitts in his belief that the materials from Graybullian beds in both New Mexico and Wyoming represent a definably more primitive stage in this genus than the later Wasatchian specimens. This is without regard for the rather striking range in size observed. Some teeth are as large as any referred to *H. vasacciense* in the La Barge collection and others are smaller than any that I had previously referred to *H. index.* No statistical treatment of this material seemed feasible, as all but about four specimens of the approximately three dozen consist of isolated teeth from various positions.

Three of the isolated teeth are believed to be P^3, as determined from their somewhat less transverse diameter in comparison with their

length than in P^4. In these the primary cusp and tritocone (paracone and metacone) are less widely separated than in P^4, or than in P^3 of later forms. In each the protoloph extending toward the parastyle is not appreciably deflected anterolingually, but shows a distinct enlargement representing the protoconule, certainly more discernable than in the specimen figured by Kitts (1956, fig. 5) for this species. All these, moreover, are of a size commensurate with the smaller La Barge specimens earlier referred to *H. index*. I suspect that there is a considerable amount of variation in the development and position of the protoconule of P^3 in any population of *Hyracotherium* and I have attempted to illustrate this in plate 13 where the specimens in figures 4 to 9 inclusive show increasing significance of the protoconule in the La Barge material of *H. vasacciense*.

It seems more than likely that the comparatively advanced lower Knight form represented at Bitter Creek gave rise to typical *H. vasacciense* of the later Knight beds, possibly in a dichotomous arrangement, such as seems indicated in the La Barge materials (see Kitts, 1956, p. 49; and Gazin, 1952, p. 65) other than those now referred to *H. craspedotum*.

Marsh's type of *Eohippus pernix* is from the Bitter Creek locality. This name was regarded by Kitts as a synonym of *Hyracotherium vasacciense*. It is possible that this interpretation is correct, but it seems more than likely, in the absence of published information to the contrary, that he regarded the Bitter Creek fauna as later than it is.

A few isolated teeth from the Red Desert locality and about 24 specimens from the Lower Wasatchian or Gray Bull level to the west of Elk Mountain in Fossil Basin are also referred tentatively to *H. angustidens*. The latter show a range in size as great as that at Bitter Creek but with a somewhat greater average size. A single maxillary portion exhibits P^3 and P^4 (pl. 13, fig. 3) and these teeth more nearly approximate the nonmolariform condition cited by Kitts for this species.

HYRACOTHERIUM VASACCIENSE (Cope)

Plate 13, figures 1, 2, 4-10)

As revised by Kitts, *Hyracotherium vasacciense* includes among its synonyms *Hyracotherium index*, the second and smaller of the two species described by Cope from the Knight beds of Fossil Basin. Although I have shown that for the La Barge collection M_2, excluding the very large specimens, is clearly bimodal in its proportions, and Kitts (1956, p. 52) has found the same to be true for M_3, the evidence

for this in the more limited and generally more fragmentary remains of *Hyracotherium* at other horizons and localities in the Wasatch is not so easily demonstrated. I am convinced that two forms are represented in the rather striking size range for Wasatch materials now allocated to *H. vasacciense,* but there is the practical matter of separating them in horizons other than at La Barge or Dad (Kitts, 1956, p. 49), because the modes thus postulated would no doubt shift with time. It may be noted that in the smaller as well as the larger of the two La Barge forms included under *H. vasacciense* P^3 is progressive, as Kitts has defined this species. In plate 13, figures 4 and 9 might be interpreted as representing the smaller form.

Nearly 200 specimens from the La Barge horizon in Sublette County are now referred to *H. vasacciense.* Of this number more than a third are in a size range that was earlier included under *H. index.* The smaller specimens are relatively fewer in the Dad fauna, and in the New Fork only 2 of the 33 specimens of *Hyracotherium* are small enough to have been included in *H. index.* However, 10 out of this total are thought, for the most part on the basis of size, to represent *H. craspedotum.* A shift in modes for the New Fork species may also be involved. A somewhat different distribution is noted for the Cathedral Bluffs although only five specimens are known. Three of these are of a size that would have included them with *H. index.* The other two are referred to *H. craspedotum.* Incidentally, none has characters that would justify their inclusion in *Orohippus.* The upper molar associated with P.U. No. 16111 shows no evidence of a mesostyle.

HYRACOTHERIUM, cf. CRASPEDOTUM Cope

(Plate 13, figure 11)

Essentially, the specimens from the Knight that I had tentatively assigned to *Hyracotherium venticolum* are those which Kitts (1956, p. 53) regards as representing *H. craspedotum.* These are for the most part strikingly large specimens, but rather few in number, that seemed beyond the limit for *H. vasacciense.* In two instances, however, maxillary portions are known in which P^3 is of the type described by Kitts as characterizing *H. craspedotum.* One of these, P.U. No. 16173, from Fossil Butte was particularly mentioned by both Kitts (1956, p. 53) and me (as *H. venticolum,* 1956, p. 66) ; and the other is from the Cathedral Bluffs (U.S.N.M. No. 22497; see pl. 13, fig. 11). A second specimen from Cathedral Bluffs is a lower jaw (P.U. field No. 326W) in which the combined length of M_2 and M_3 is

about 20.0 mm. The approximately 10 specimens from the New Fork are mostly isolated teeth of large size.

Hyracotherium craspedotum is evidently a contemporary of *H. vasacciense* but probably derived from earlier *H. augustidens*. *H. vasacciense*, however, may have originated in a somewhat more progressive form than typical *H. angustidens*, such as represented by the material from Bitter Creek. *H. craspedotum* most likely did not give rise to *Orohippus*.

BRONTOTHERIIDAE

LAMBDOTHERIUM POPOAGICUM Cope

(Plate 12, figures 8 and 9)

In the later collecting at the La Barge and New Fork levels, remains of *Lambdotherium* continued to be among the most frequently encountered. With the exception of a well-preserved pair of lower jaws (U.S.N.M. No. 22758) from the Muddy Creek locality 12 miles north of Big Piney, near where the earlier-described (1952, pl. 10) skull was found in 1949, much of the material consists of rather fragmentary jaws and isolated teeth. Some 30 or more specimens were added to the La Barge collection and something over 70 were found in the New Fork beds, which have received rather more attention in late years.

No material of *Lambdotherium* has as yet been encountered in the rather sparsely fossiliferous Cathedral Bluffs beds in the Washakie Basin; however, at least 21 specimens referred to *L. popoagicum* have been seen in collections representing the Dad faunule from beneath the Tipton tongue in the same area. These are for the most part isolated teeth in the collections of Princeton University and the University of California, although in the Princeton collection there is a lower jaw (P.U. No. 16118) with three molars. A single specimen in the National Museum collection (No. 22759) exhibits P_4 and M_1.

BRONTOTHERIID, near PALAEOSYOPS FONTINALIS Cope

The Princeton University specimen (No. 16110) from the Cathedral Bluffs that Morris (1954) and I (1959) have listed as *Eotitanops*, sp., is a right maxillary fragment with Dp^3, Dp^4 and M^1. Comparison of the teeth with those in the type of *Palaeosyops fontinalis* (A.M. No. 5107) shows them to be quite similar and only slightly smaller. The length of the ectoloph portion of M^1, for example, measures 24.0 mm., whereas in the type this dimension is 26.2 mm. Also, M^1

exhibits a small protoconule but no metaconule, as in the type. Whether this specimen should be referred to *Palaeosyops fontinalis* or regarded as a large species of *Eotitanops* is not determined. Although direct comparison is not feasible, M^1 in the Cathedral Bluffs specimen is only a little larger than would be required for good occlusion with the type lower jaw of *Eotitanops princeps*.

An additional specimen, U.S.N.M. No. 22766, that might also be referred to *P. fontinalis* but which is of a somewhat larger individual than the Princeton specimen was found very near the top of the red beds in the Oregon Buttes area, immediately to the southwest of Continental Peak and near its base. The red beds and the overlying greenish sequence here have been mapped as belonging to the Cathedral Bluffs member. The material consists of numerous bone fragments and portions of upper teeth, but with only P^1-P^3 nearly complete and the lingual portions of P^4 and M^1 preserved.

The type of *Palaeosyops fontinalis* was found by Cope "on a bluff on Green River near the mouth of the Big Sandy Creek, Wyoming." Osborn considered the horizon represented as Bridger A, but I have some doubts as to the existence of a distinctive unit of true Bridger beneath that defined by Matthew as "B." The specimen may well have come from a sandy zone or lentil high in the Green River formation, as developed in the Bridger Basin. In any case there is suggestion of an approximate correlation with the upper part of the Cathedral Bluffs member in the Washakie Basin, inasmuch as the locality data for the Princeton specimen show it as coming from a horizon high beneath the Laney shale contact (sec. 4, T. 15 N., R. 93 W., evidently fossil loc. 1 on Morris's map, 1954, p. 198).

Palaeosyops fontinalis is not particularly close to typical Bridger *Palaeosyops,* as indicated by both Cope and Osborn. It is very much smaller than *P. paludosus.* As noted by Peter Robinson in his study of the Huerfano material, *Palaeosyops fontinalis* morphologically resembles *Eotitanops borealis. P. fontinalis* is in all probability an intermediate stage in a line of development from typical *Eotitanops* to *Palaeosyops,* as well as being intermediate in size between *E. borealis* and *P. paludosus.* Whether this stage should be referred to *Paleosyops* or *Eotitanops* seems a rather arbitrary matter. Since the Cathedral Bluffs fauna on other evidence should no doubt be regarded as Wasatchian rather than Bridgerian, one might be justified in allocating *P. fontinalis* to *Eotitanops.*

ISECTOLOPHIDAE

HOMOGALAX PRIMAEVUS (Wortman)

(Plate 12, figures 5 and 6)

Three species of *Homogalax* have been described on Wasatchian materials from the Bighorn Basin and all are about equal in size. In all probability these represent but a single species, although Wortman (1896) has attempted to distinguish between them on the basis of premolar characteristics. The earliest named, *Homogalax semihians* (Cope), was based on a specimen in which there is a small deuterocone on P^2 and said to have a diastema between P^1 and P^2. P^1 is missing but the alveoli are present to show that there was no diastema in this position. However, the molars in the type are badly worn and because the premolars seem relatively small there is no certainty that the specimen actually represents *Homogalax*. A revision of the tapiroids currently under way by Leonard Radinsky at Yale University may resolve this problem. The type of *Homogalax* was designated by Hay as *H. primaevus*—one of two species named by Wortman in 1896 and characterized as lacking a deuterocone on P^2. The other, *H. protapirinus,* was characterized as possessing a strong deuterocone on this tooth. I suspect that this cusp, nearly functionless in a position so far forward in the series, may well have been highly variable in development.

Seven specimens, consisting of maxillae, jaws, and separate teeth, from the Bitter Creek locality represent *Homogalax* and are comparable in size to the named Gray Bull species. None of the Bitter Creek specimens exhibits P^2, but U.S.N.M. No. 22767 (pl. 12, fig. 5) has comparatively well-developed deuterocones on P^3 and P^4, so that it would be reasonable to suppose that this cusp was also present on P^2 in this individual.

ISECTOLOPHID, near HOMOGALAX PRIMAEVUS (Wortman)

Among the materials of *Hyracotherium* and *Heptodon* encountered in the Knight exposures near Dad P. O. are remains of a small perissodactyl that cannot be assigned to either of these genera. About eight or nine specimens are included in the collections at hand and nearly all are from the large promontory of exposures beneath the Tipton tongue to the southwest of the State highway (330) bridge over Muddy Creek. Included are jaws, maxillae, and isolated teeth which represent a species about the size of the larger of the forms of *Hyracotherium* from here.

The very well-defined cross crests and more forward-directed crista obliqua of the lower molars, together with the elongate, uninterrupted transverse lophs of the upper molars, show that these specimens should not be included in *Hyracotherium*. Moreover, a maxillary fragment, U.S.N.M. No. 22788, with P^3 and P^4, shows P^3 to be rather more like *Homogalax* than *Hyracotherium*. It exhibits a very prominent parastyle and the talon is constricted lingual to this. The deuterocone is very high and placed well forward with a high, more laterally directed protoloph which does not join the ectoloph. There is no crest to the tritocone. Kitts (1956) has noted the occasional absence of a crest between the deuterocone and tritocone in P^3 of *Hyracotherium craspedotum* but I do not believe these teeth would otherwise be confused.

The tapiroid upper molars are readily distinguished from *Heptodon* in the more buccally situated metacone, which is decidedly conical and externally ribbed. Moreover, M_3 has a particularly well-developed and somewhat basined hypoconulid portion. The crests of the molars, both uppers and lowers, are rather less elevated than in *Heptodon*.

A rather close correspondence is seen to Graybullian material of *Homogalax primaevus* but with specimens rather near the lower limit in size. The molars, however, are relatively a little lower crowned than in most of the *Homogalax* material examined. A close resemblance is also evident in comparisons with the much larger materials of Bridger *Parisectolophus,* but these later specimens show a relatively longer trigonid portion in the lower molars, with a tendency toward development of a basin approximating that of the talonid.

Heretofore *Homogalax* has been considered as indicative of Graybullian time but now there would appear to be little doubt but that this genus, or a closely related isectolophid, is present in beds of Lost Cabin age, in association with *Heptodon* and *Lambdotherium*. The encountering of such a form in these beds is, of course, not unexpected because of the continuity of this line into Bridgerian and Uintan time.

HELALETIDAE

HEPTODON VENTORUM (Cope)

(Plate 13, figure 12)

Nearly all of the La Barge tapiroid material can, on the basis of size, be regarded as typical *Heptodon ventorum,* although as previously noted (1952) most of these specimens have teeth a little smaller

than in the type, but the correspondence is closer than it is to the type of *H. calciculus.*

With regard to the New Fork materials of *Heptodon,* excluding a very small Dp^4, the average size of teeth in some 20 specimens is distinctly larger, including specimens more nearly corresponding to the type of *H. posticus.* There is, nevertheless, an overlap in range with the La Barge suite. These New Fork materials are surely of a single species but, because of overlapping range, they should probably be regarded as representing a mutation in time. Possibly this could be cited as *H. ventorum* mut. *posticus.*

A similar situation, but with specimens of smaller average size than in the La Barge sample, is noted in the Fossil Basin collections considered as Lysitean in age. Material from the type Knight and from the distinctly reddish beds high beneath the Green River shale on Fossil Butte include the specimens cited in 1952 as *Heptodon ventorum.* Additional material from both localities, including an M_3 from Knight station and four lots of associated tooth fragments from Fossil Butte, corresponds more nearly to the *H. calciculus* type. Again the degree of difference involved here cannot be regarded as more than subspecific and represents a mutation in time. Nevertheless, in considering the upper and lower ranges represented, for example, by *H. ventorum calciculus* and *H. ventorum posticus,* a difference is involved that is surely of full species value. It appears, moreover, that we are faced with an association of these two in the New Fork horizon from which a single very small Dp^4 can scarcely be included with the material of *H. v. posticus.* A small tapiroid seems evident also in the Wasatchian(?) beds to the northwest of the Oregon Buttes, represented by a comparatively small jaw in which the molar teeth have lost most of their enamel. I suspect that Bridger *Helaletes* was derived from a small variant of *Heptodon* and not *H. v. posticus.*

A situation particularly difficult of interpretation is presented by the *Heptodon* materials from the Dad locality. The four specimens from here in the National Museum collections, known to have come from the same horizon, can readily be allocated to *Heptodon ventorum* (s.s.), much as in the case of the La Barge materials. One of these (U.S.N.M. No. 22498; pl. 13, fig. 12) is a well-preserved lower jaw which corresponds rather closely in length of tooth row to the type of *H. ventorum,* although the width of the teeth is a little less. Included in the University of California materials from the Dad area, however, are remains of an immature individual (No. 43703) which includes maxillae, jaws, and some fragmentary limb material of a

distinctly smaller form. Teeth from Dp2 to M2 of both upper and lower series are included and the lower molars are actually a little smaller than in the type of *H. calciculus*. Also in the U. of C. collection is an isolated upper molar of unusually large size. This, however, is described in field notes as coming from float along the base of the escarpment, so that its level is not known, except that it is likely from beneath the Tipton tongue. It would seem here from a limited number of specimens that more than one species is represented, but allocation of material is not readily evident.

A revision of the Eocene tapiroids undertaken by Leonard Radinsky at Yale University should furnish information having a direct bearing on this problem.

HYRACHYIDAE

HYRACHYUS, cf. MODESTUS (Leidy)

(Plate 12, figures 3 and 4)

Hyrachyus is now known to be represented in the Cathedral Bluffs member in the three principal areas in which these beds are exposed. In addition to the specimen which includes the M^3 (U.S.N.M. No. 22771; pl. 12, fig. 3) discussed in 1952, there is another associated lot of tooth fragments from the New Fork beds which includes a complete P^4 (U.S.N.M. No. 22772; pl. 12, fig. 4), and an isolated P_4. The partial dentitions from the Cathedral Bluffs of the Washakie Basin were described and figured by Morris (1954). Not previously recorded is a lower jaw with P_2-M_3 (U.S.N.M. No. 22773), rather poorly preserved however, from the beds mapped as the Cathedral Bluffs member to the southwest of Continental Peak, near the boundary between Sweetwater and Fremont Counties. All these materials can be closely matched with Bridger specimens that have been referred to one or another of the various species that Wood (1934) has placed in synonymy with *Hyrachyus modestus,* a situation entirely comparable to that noted by Wood for the *Hyrachyus* specimens from the Lost Cabin beds of the Wind River Basin. So far no material that can be referred to this genus has been found in the Knight beds below the Tipton tongue.

ARTIODACTYLA

DICHOBUNIDAE

DIACODEXIS, cf. METSIACUS (Cope)

Five lower jaw fragments, one of these (U.S.N.M. No. 22240) with P_4, M_1, and M_3, and a second (U.S.N.M. No. 22241) with

M_2-M_3, from the Gray Bull horizon of the Knight west of Elk Mountain in the Fossil Basin represent *Diacodexis,* and may well be of the common Wasatchian form of the Bighorn Basin, *Diacodexis metsiacus.* An M_3 in one jaw portion (U.S.N.M. No. 22242) would appear to be large for this species, but it is not as large as that indicated by Sinclair (1914, p. 293) for *Diacodexis robustus.* Reasons for regarding *D. metsiacus* distinct from *D. chacensis* were previously (Gazin, 1952, p. 71) stated.

Isolated teeth from the Gray Bull levels at Bitter Creek Station and in the Red Desert east of Steamboat Mountain may also represent this species, as well as a last lower molar from the Wasatchian of uncertain level just to the north of Tipton Butte.

The two jaws from the type Knight near Knight Station, cited by Van Houten (1945, p. 458; see also Gazin, 1952, p. 72) as *Diacodexis,* sp., have since been located in the American Museum collections and found to be of *Hexacodus.*

DIACODEXIS, near D. SECANS (Cope)

A second specimen in the La Barge fauna representing a species of *Diacodexis* that appears to be somewhat larger than *D. metsiacus* was found to the west of Big Piney by N. P. Privrasky of the U. S. Geological Survey near the area mapped as Almy by Schultz (1914). The jaw (U.S.N.M. No. 22243) contains only the last lower molar, which is slightly larger than that in No. 19218 from 12 miles north of Big Piney. An upper molar (U. of C. No. 43885) from near Dad, however, seems relatively small for this species. Possibly this should have been referred to *D. metsiacus,* but, in the absence of information concerning range in size of teeth of *D. secans,* it is tentatively included here because of the horizon represented. An incomplete M_3 in the New Fork collections may also be included with these as possibly representing *Diacodexis secans.*

DIACODEXIS, cf. ROBUSTUS Sinclair

Some jaw fragments and teeth, including an upper and two lower molars of a large form of *Diacodexis* were found by McKenna's party near Dad, Wyo. The specimens have the University of California number 46707 but evidently they do not all come from the same individual. The teeth are of a size comparable to those from the Gray Bull described by Sinclair (1914) as *Diacodexis robustus.* The relative width of M_1, however, might suggest a closer relationship to much smaller *Diacodexis olseni,* which is a Lost Cabin species. A

large M_2, though, does not appear to be relatively so wide as in *D. olseni.* I suspect that *Diacodexis olseni* may be no more than a variant of *Diacodexis secans,* whereas *D. robustus* would appear to be a distinctive species in Gray Bull time and may have continued on into Lost Cabin time in the Washakie Basin.

BUNOPHORUS, cf. MACROPTERNUS (Cope)

(Plate 14, figures 6 and 8)

An additional lower jaw of *Bunophorus,* cf. *macropternus* exhibiting P_3-P_4 and M_2-M_3 (U.S.N.M. No. 22445) was encountered in 1959 in the Knight beds beneath the Fontenelle tongue in the upper part of the Green River Basin. Also, an isolated M_3 (No. 43823) in the University of California collection from beneath the Tipton tongue south of Dad, Wyo., may well represent the same species. The latter is a little smaller than M_3 in No. 19210 (pl. 14, fig. 8) or No. 22445 from near Big Piney tentatively referred to *B. macropternus,* but is less worn. It shows no evidence of a paraconid.

BUNOPHORUS, cf. ETSAGICUS (Cope)

(Plate 14, figures 7 and 9)

A lower jaw (U.S.N.M. No. 22244) with M_1-M_3 (pl. 14, fig. 9) and an isolated M^3, apparently belonging to a species of *Bunophorus,* were found in the New Fork beds to the east and southeast of Big Piney. Teeth in the lower jaw are only a little longer than those in *Bunophorus,* cf. *macropternus,* from beneath the Fontenelle tongue, but are much broader. They appear also to be possibly a little lower cusped and with less evidence of a cingulum, in addition to a somewhat more inflated appearance.

The M^3 (U.S.N.M. No. 22245; pl. 14, fig. 7), if correctly referred, shows that upper teeth of the New Fork species were slightly larger but with lower and more inflated-appearing cusps than the form in the La Barge fauna.

HEXACODUS PELODES Gazin

(Plate 7, figure 2; plate 14, figures 1-4)

Several more specimens of *Hexacodus pelodes* have been found in the Knight exposures in the vicinity of Big Piney and La Barge, and lower jaw portions that are referred to this species have also been discovered in the New Fork beds (pl. 14, fig. 4). Moreover, a jaw fragment with a single lower molar in the University of California

collection (No. 43799) shows this form to be represented in the Dad fauna from beneath the Tipton tongue in the Washakie Basin, and two last lower molars from the Cathedral Bluffs tongue above, identified by Morris (1954, p. 197) as *Microsus,* I cannot distinguish from this tooth in *H. pelodes.*

The two jaws from the Knight at Knight Station, earlier referred to *Diacodexis?,* sp. (1952, p. 72), have since been located in the American Museum collections and found to represent *Hexacodus.* One of them, A.M. No. 12843, may well be of *H. pelodes,* to judge by the preserved molar, although P_4 is relatively slender and lacks both paraconoid and metaconid, suggesting a distinct species. However, this tooth seems highly variable in *H. pelodes,* between specimens in which the molars cannot be distinguished. In fact, no two P_4's among these have been found that are quite alike.

Of particular interest is the discovery, in recent collections representing the La Barge fauna, of upper teeth that may belong to this small artiodactyl. One specimen is a maxillary fragment with M^1 and M^2 (U.S.N.M. No. 22248; pl. 14, fig. 1) and another an isolated upper molar (U.S.N.M. No. 22434; pl. 14, fig. 3), possibly M^1. A second maxilla regarded as belonging to *Hexacodus pelodes,* found by a University of Wyoming field party (U. of Wyo. No. 1779) in the La Barge horizon, is important in displaying P^3 and P^4 as well as M^2 and part of M^1 (pl. 7, fig. 2). The premolars are comparatively large, as would be expected from consideration of the large and somewhat inflated lower fourth premolar, and exhibit an enamel rugosity more evident than in the molars. The talon, moreover, is broad and prominent in both P^3 and P^4 and has a well-developed deuterocone. No tritocone is present.

Among other Wasatchian artiodactyls, P^3 is known in both *Diacodexis* and *Wasatchia.* In *Diacodexis* this tooth is much more elongate, anteroposteriorly, and the talon is not nearly so well developed. It exhibits, moreover, a more prominent parastyle and a distinctive tritocone, quite unlike *Hexacodus.* Sinclair's illustration of P^3 (1914, fig. 2) in *Wasatchia dorseyana* shows this tooth to be relatively small and with little evidence of a talon. P^4 in No. 1779 is rather less distinctive but in comparison with *Diacodexis* it is seen to have more inflated cusps with a higher saddle between them.

Among Bridgerian artiodactyls, P^3 is recorded only for *Homacodon.* This tooth in *Hexacodus* is more suggestive of *Homacodon* than it is of *Diacodexis,* but the anteroposteriorly broader talon and the absence of a tritocone distinguish it from *Homacodon.* P^4, again, is rather less

distinctive and resembles that in *Helohyus* and *Antiacodon* as well as *Homacodon.* A difference, however, perhaps more noticeable with reference to *Antiacodon* and *Homacodon* than to *Helohyus,* lies in the higher, more inflated appearance of the deuterocone and somewhat less transverse width of the tooth.

The upper molars, as exhibited in U.S.N.M. No. 22248 and U. of Wyo. No. 1779, have a rectangular appearance, rather distinctive in comparison with *Diacodexis.* The protocone, though well developed, is not so large and inflated as in *Diacodexis* and the accessory cusps, the protoconule and metaconule, are larger and more conical than in that genus. Particularly noticeable is the strong development of the cingulum anterointernally and posterointernally, and weakly or not at all across the protocone, giving the talon a square appearance. Anterointernally, the nearly right-angle flexure of the cingulum shows little or no evidence of a cuspule. Posterointernally, the cingulum rises distinctly to form a low, well-separated hypocone with a slight crest extending away from the cingulum toward the metaconule on M^1, but toward the protocone on M^2.

The upper molars, believed to be of *Hexacodus pelodes,* are seen to resemble much more closely those of *Microsus* and *Homacodon* than they do those of contemporary *Diacodexis;* although the hypocone is much less developed and the accessory cusps have better-defined crests than in the Bridger genera. *Homacodon* differs from *Microsus* essentially in more inflated cusps and shows development of the cingulum lingually in upper molars. In the cf. *Hexacodus* specimens the crest from the anterior portion of the metaconule to the anterointernal part of the metacone and the posterior crest from the metaconule to the cingulum are more pronounced. In A.M. No. 12146 of *Microsus cuspidatus* this posterior crest is absent, but in A.M. No. 12696 it is weakly developed. A.M. No. 12696 of *M. cuspidatus* resembles *cf. H. pelodes* in almost every way except in greater development and more conical form of hypocone and generally more subdued crests. It should be noted, moreover, that while the hypocone of cf. *H. pelodes* rises from the cingulum, in certain specimens of *Microsus,* though not all, the cingulum has become developed part way around the hypocone. Furthermore, the anterointernal angle of M_2 in cf. *H. pelodes* is a little less rounded than in *Microsus* and both molars show a slight mesostyle or rise in the cingulum more suggestive of *Antiacodon.*

In *Antiacodon,* as represented by A.M. No. 12043, the cusps of the upper molars are very conical and the hypocone in M_3, at the lingual

extremity of the posterior cingulum, is about the size of the protoconule and metaconule, larger than in cf. *Hexacodus pelodes* but smaller than in *Microsus*. The protocone in *Antiacodon* is relatively larger and does not appear so forward as in either of these. The relative position of the protocone apparently results from the development of an anterointernal cusp at the lingual extremity of the anterior cingulum, immediately anterior to the protocone. It is smaller than the accessory cusps, but rather distinctive.

It would seem from the foregoing that although the lower jaws of *Hexacodus pelodes* most strongly suggest *Antiacodon* among the latter forms, with some variation in the direction of *Microsus,* Knight upper molars thought to be of *Hexacodus* are somewhat more suggestive of *Microsus,* that is, if upper teeth of *Antiacodon* (A.M. No. 12043) are properly referred. Possibly a second genus is represented by the Knight upper teeth, but I am more inclined to believe that variation within the genus, as noted, for example, in the varied development of P_4 in *H. pelodes,* may be sufficient to accommodate ancestry for more than one of the bunodont artiodactyls of the Bridger. With regard to this it may be noted that, although premolars are not known, the lower molars of *H. uintensis,* with their somewhat longer trigonids than in *H. pelodes,* could possibly have given rise to those of *Helohyus.* Bridger *Helohyus,* in addition to greater size, differs from the earlier form, so far as known, only in more inflated cusps with some reduction of the posterior cingulum and its hypoconulid.

MEASUREMENTS IN MILLIMETERS OF UPPER TEETH IN CF. *Hexacodus pelodes*

	U.S.N.M. No. 22248	U. of Wyo. No. 1779
P^3, anteroposterior diameter : greatest transverse diameter		4.3 : 4.3
P^4, anteroposterior diameter : greatest transverse diameter		4.1 : 5.1
M^1, anteroposterior diameter buccally : transverse diameter of anterior portion	4.2 : 4.8	
M^2, anteroposterior diameter buccally : transverse diameter of anterior portion	4.6 : 5.8	4.7 : 5.6

HEXACODUS UINTENSIS Gazin

(Plate 14, figure 5)

A second jaw portion of *Hexacodus uintensis* has been found in the vicinity of Fossil Butte in the Fossil Basin. The preserved M_2 (U.S.N.M. No. 22250) corresponds almost exactly to that in the type

(P.U. No. 16175) and was found at about the same level in the Knight but in the patch of Badlands forming the saddle to the north of Fossil Butte. Also the second of the two jaws from Knight Station, earlier referred to as *Diacodexis*? sp. (1952, p. 72), since located in the American Museum collections and found to be of *Hexacodus,* evidently represents the larger *H. uintensis.* The specimen (A.M. No. 12844) includes M_2 and M_3 and is seen to correspond closely in the form of M_2 to the type. The other specimen, A.M. No. 12843, from Knight Station, as discussed in the preceding section, appears to be of *Hexacodus pelodes.*

A careful search of Gray Bull materials from the Bighorn Basin in both the American Museum and National Museum collections has turned up only one specimen of *Hexacodus* among materials labeled *Diacodexis.* The specimen (A.M. No. 4140) is a lower jaw with M_2 and M_3 and resembles most closely *Hexacodus uintensis* in the relative proportions of the lower molar trigonids. It is interesting to note that this was the specimen selected by Osborn to typify *Trigonolestes* (=*Diacodexis*) *metsiacus* in his "Evolution of Mammalian Molar Teeth" (1907, p. 171, fig. 152B). *Hexacodus* is evidently very rare in the Gray Bull horizon and so far has not been observed in this level of the Knight. It has not been found, or at least not recognized, in any of the horizons of the Wind River Basin, or the higher levels of the Bighorn Wasatchian.

REFERENCES

Bradley, Wilmot H.

1959. Revision of stratigraphic nomenclature of Green River formation of Wyoming. Bull. Amer. Assoc. Petrol. Geol., vol. 43, No. 5, pp. 1072-1075.

Cope, Edward D.

1872. On the dentition of *Metalophodon.* Proc. Amer. Philos. Soc., vol. 12, pp. 542-545.

1873. On the new perissodactyles from the Bridger Eocene. Proc. Amer. Philos. Soc., vol. 13, pp. 35-36.

1877. Report upon the extinct Vertebrata obtained in New Mexico by parties of the expedition of 1874. Rep. U. S. Geogr. Surv. West of 100th Meridian (Wheeler), vol. 4, pt. 2, pp. i-iv, 1-370, pls. 22-83.

1884. The Vertebrata of the Tertiary formations of the West. Book 1. Rep. U. S. Geol. Surv. Terr. (Hayden), vol. 3, pp. i-xxxiv, 1-1009, figs. 1-38, pls. 1-75a.

Denison, Robert H.

1938. The broad-skulled pseudocreodi. Ann. New York Acad. Sci., vol. 37, art. 3, pp. 163-256, figs. 1-32.

DONOVAN, J. H.
1950. Intertonguing of Green River and Wasatch formations in part of Sublette and Lincoln Counties, Wyoming. Wyoming Geol. Assoc., 5th Ann. Field Conf., Southwest Wyoming Guidebook, pp. 59-67, 2 pls.

DORR, JOHN A., JR.
1958. *Prouintatherium,* new uintathere genus, earliest Eocene, Hoback formation, Wyoming, and the phylogeny of Dinocerata. Journ. Paleont., vol. 32, No. 3, pp. 506-516.

EARLE, CHARLES.
1892. Revision of the species of *Coryphodon.* Bull. Amer. Mus. Nat. Hist., vol. 4, No. 1, pp. 149-166, figs. 1-2, 1 table, pls. 75-77.

GAZIN, C. LEWIS.
1936. A taeniodont skull from the lower Eocene of Wyoming. Proc. Amer. Philos. Soc., vol. 76, No. 5, pp. 597-612, figs. 1-2, pls. 1-5.
1952. The lower Eocene Knight formation of western Wyoming and its mammalian faunas. Smithsonian Misc. Coll., vol. 117, No. 18, pp. 1-82, figs. 1-6, pls. 1-11.
1953. The Tillodontia: an early Tertiary order of mammals. Smithsonian Misc. Coll., vol. 121, No. 10, pp. 1-110, figs. 1-38, pls. 1-16.
1956a. The occurrence of Paleocene mammalian remains in the Fossil Basin of southwestern Wyoming. Journ. Paleont., vol. 30, No. 3, pp. 707-711, 1 fig.
1956b. The upper Paleocene Mammalia from the Almy formation in western Wyoming. Smithsonian Misc. Coll., vol. 131, No. 7, pp. 1-18, pls. 1-2.
1958. A review of the middle and upper Eocene primates of North America. Smithsonian Misc. Coll., vol. 136, No. 1, pp. 1-112, 1 chart, pls. 1-14.
1959. Paleontological exploration and dating of the early Tertiary deposits in basins adjacent to the Uinta Mountains. Intermountain Assoc. Petrol. Geol., 10th Ann. Field Conf. Guidebook, pp. 131-138, 1 fig.
1961. New sciuravid rodents from the lower Eocene Knight formation of western Wyoming. Proc. Biol. Soc., Washington, vol. 74, art. 21, pp. 193-194.

GRANGER, WALTER.
1914. On the names of lower Eocene faunal horizons of Wyoming and New Mexico. Bull. Amer. Mus. Nat. Hist., vol. 33, art. 15, pp. 201-207.
1915. A revision of the lower Eocene Wasatch and Wind River faunas. Pt. 3—Order Condylarthra. Families Phenacodontidae and Meniscotheriidae. Bull. Amer. Mus. Nat. Hist., vol. 34, art. 10, pp. 329-361, figs. 1-18.

HAYDEN, FERDINAND V.
1869. Preliminary report (3d ann.) of the U. S. Geological Survey of Colorado and New Mexico, pp. 91-92.

JEPSEN, GLENN L.
1930. New vertebrates from the lower Eocene of the Bighorn Basin, Wyoming. Proc. Amer. Philos. Soc., vol. 69, No. 4, pp. 117-131, pls. 1-4.

1934. A revision of the American Apatemyidae and the description of a new genus, *Sinclairella,* from the White River Oligocene of South Dakota. Proc. Amer. Philos. Soc., vol. 74, No. 4, pp. 287-305, figs. 1-4, pls. 1-3.

Kelley, Dana R., and Wood, Albert E.

1954. The Eocene mammals from the Lysite member, Wind River formation of Wyoming. Journ. Paleont., vol. 28, No. 3, pp. 337-366, figs. 1-15.

Kitts, David B.

1956. American *Hyracotherium* (Perissodactyla, Equidae). Bull. Amer. Mus. Nat. Hist., vol. 110, art. 1, pp. 1-60, figs. 1-10, pls. 1-7.

Loomis, Frederic B.

1905. The Hyopsodidae of the Wasatch and Wind River Basins. Amer. Journ. Sci., vol. 19, pp. 416-424, figs. 1-8.

1906. Wasatch and Wind River primates. Amer. Journ. Sci., vol. 21, pp. 277-285, figs. 1-8.

1907. Wasatch and Wind River rodents. Amer. Journ. Sci., vol. 23, pp. 123-130, figs. 1-7.

Marsh, Othniel C.

1876. Notice of new Tertiary mammals. V. Amer. Journ. Sci., vol. 12, pp. 401-404.

Matthew, William D.

1909. The Carnivora and Insectivora of the Bridger Basin, middle Eocene. Mem. Amer. Mus. Nat. Hist., vol. 9, pt. 6, pp. 291-567, figs. 1-118, pls. 42-52.

1915a. A revision of the lower Eocene Wasatch and Wind River faunas. Pt. 1.—Order Ferae (Carnivora). Suborder Creodonta. Bull. Amer. Mus. Nat. Hist., vol. 34, art. 1, pp. 1-103, figs. 1-87.

1915b. A revision of the lower Eocene Wasatch and Wind River faunas. Pt. 2.—Order Condylarthra, family Hyopsodontidae. Bull. Amer. Mus. Nat. Hist., vol. 34, art. 9, pp. 311-328, figs. 1-10.

1915c. A revision of the lower Eocene Wasatch and Wind River faunas. Pt. 4.—Entelonychia, Primates, Insectivora (part). Bull. Amer. Mus. Nat. Hist., vol. 34, art. 14, pp. 429-483, figs. 1-52, pl. 15.

1918. A revision of the lower Eocene Wasatch and Wind River faunas. Pt. 5.—Insectivora (cont.), Glires, Edentata. Bull. Amer. Mus. Nat. Hist., vol. 38, pp. 565-657, figs. 1-68.

McGrew, Paul O., and Roehler, Henry W.

1960. Correlation of Tertiary units in southwestern Wyoming. Wyoming Geol. Assoc., 15th Ann. Field Conf. Guidebook, pp. 156-158, 1 chart.

McKenna, Malcolm C.

1960. Fossil Mammalia from early Wasatchian Four Mile fauna, Eocene of northwest Colorado. Univ. California Publ. Geol. Sci., vol. 37, No. 1, pp. 1-130, figs. 1-64.

Morris, William J.

1954. An Eocene fauna from the Cathedral Bluffs tongue of the Washakie Basin, Wyoming. Journ. Paleont., vol. 28, No. 2, pp. 195-203, 1 fig., pls. 21-22.

NACE, RAYMOND L.
1939. Geology of the northwest part of the Red Desert, Sweetwater and Fremont Counties, Wyoming. Geol. Surv. Wyoming Bull. 27, pp. 1-51, 6 figs., 3 pls.

NIGHTINGALE, WILLIAM T.
1930. Geology of Vermilion Creek gas area in southwest Wyoming and northwest Colorado. Bull. Amer. Assoc. Petrol. Geol., vol. 14, No. 8, pp. 1013-1040, figs. 1-5, 2 tables.

OSBORN, HENRY F.
1898. Evolution of the Amblypoda. Part 1. Taligrada and Pantodonta. Bull. Amer. Mus. Nat. Hist., vol. 10, art. 11, pp. 169-218, figs. 1-29.
1907. Evolution of mammalian molar teeth. Pp. i-ix, 1-250, figs. 1-215. New York.

PIPIRINGOS, GEORGE N.
1955. Tertiary rocks in the central part of the Great Divide Basin, Sweetwater County, Wyoming. Wyoming Geol. Assoc., Guidebook 10th Ann. Field Conf., pp. 100-104.

SCHULTZ, ALFRED R.
1914. Geology and geography of a portion of Lincoln County, Wyoming. U. S. Geol. Surv. Bull. 543, pp. 1-141, figs. 1-8, pls. 1-11.

SIMPSON, GEORGE G.
1931. *Metacheiromys* and the Edentata. Bull. Amer. Mus. Nat. Hist., vol. 59, pp. 295-381, figs. 1-23.
1937. Notes on the Clark Fork, upper Paleocene, fauna. Amer. Mus. Novitates, No. 954, pp. 1-24, figs. 1-6.
1940. Studies on the earliest primates. Bull. Amer. Mus. Nat. Hist., vol. 77, art. 4, pp. 185-212, figs. 1-8.
1945. The principles of classification and a classification of mammals. Bull. Amer. Mus. Nat. Hist., vol. 85, pp. i-xvi, 1-350.
1948. The Eocene of the San Juan Basin, New Mexico. Amer. Journ. Sci., vol. 246, pp. 257-282, 363-385.
1954. An apatemyid from the early Eocene of New Mexico. Amer. Mus. Novitates, No. 1654, pp. 1-4, 1 fig.
1955. The Phenacolemuridae, new family of early primates. Bull. Amer. Mus. Nat. Hist., vol. 105, art. 5, pp. 415-441, tables 1-6, pls. 30-35.

SINCLAIR, WILLIAM J.
1914. A revision of the bunodont Artiodactyla of the middle and lower Eocene of North America. Bull. Amer. Mus. Nat. Hist., vol. 33, art. 21, pp. 267-295, figs. 1-28.

THORPE, MALCOLM R.
1934. *Meniscotherium robustum* sp. nov. and a discussion of *Hyracops socialis* Marsh. Amer. Journ. Sci., vol. 27, pp. 401-409, figs. 1-6.

TRACEY, JOSHUA I., JR., and ORIEL, STEPHEN S.
1959. Uppermost Cretaceous and lower Tertiary rocks of the Fossil Basin. Intermountain Assoc. Petrol. Geol., 10th Ann. Field Conf. Guidebook, pp. 126-130, 1 fig., 1 table.

VAN HOUTEN, FRANKLYN B.
1945. Review of latest Paleocene and early Eocene mammalian faunas. Journ. Paleont., vol. 19, No. 5, pp. 421-461.

Veatch, Arthur C.
1907. Geography and geology of a portion of southwestern Wyoming. U. S. Geol. Surv. Prof. Pap. No. 56, pp. i-iv, 1-178, figs. 1-9, pls. 1-26.
White, Theodore E.
1952. Preliminary analysis of the vertebrate fossil fauna of the Boysen Reservoir area. Proc. U. S. Nat. Mus., vol. 102, pp. 185-207, figs. 75-79, 1 map.
Williams, Norman C., and Madsen, James H., Jr.
1959. Late Cretaceous stratigraphy of the Coalville area, Utah. Intermountain Assoc. Petrol. Geol., 10th Ann. Field Conf. Guidebook, pp. 122-125, figs. 1-3.
Wilson, Robert W.
1938. Review of some rodent genera from the Bridger Eocene. Pts. I-III. Amer. Journ. Sci., vol. 35, pp. 123-137, 207-222, 297-304, figs. 1-15.
Wood, Horace E., II.
1934. Revision of the Hyrachyidae. Bull. Amer. Mus. Nat. Hist., vol. 67, art. 5, pp. 181-295, figs. 1-15, pls. 20-24.
Wood, Horace E., II, et al.
1941. Nomenclature and correlation of the North American Continental Tertiary. Bull. Geol. Soc. Amer., vol. 52, pp. 1-48, pl. 1.
Wortman, Jacob L.
1896. Species of *Hyracotherium* and allied perissodactyls from the Wahsatch and Wind River beds of North America. Bull. Amer. Mus. Nat. Hist., vol. 8, art. 6, pp. 81-110, 3 tables, figs. 1-18, 1 pl.
1897. The Ganodonta and their relationship to the Edentata. Bull. Amer. Mus. Nat. Hist., vol. 9, art. 6, pp. 59-110, figs. 1-36.

EXPLANATION OF PLATES

Plate 1

MARSUPIAL, INSECTIVORES, PRIMATES, AND TILLODONT FROM THE LOWER EOCENE OF WYOMING

Page

Fig. 1. *Peratherium morrisi*, new species 21
Right ramus of mandible (P.U. No. 16115), type specimen, occlusal and lateral views. 5 × natural size. Cathedral Bluffs, Washakie Basin, Wyoming.

Fig. 2. *Amarammis gregoryi*, new genus and species 24
Left ramus of mandible with M_2 and M_3 (Y.P.M. No. 14702), type specimen, occlusal and lateral views. 4 × natural size. Bitter Creek, Washakie Basin, Wyoming.

Fig. 3. *Esthonyx*, cf. *acutidens* Cope 42
Right ramus of mandible with Dp_4 to M_2 (U.S.N.M. No. 22124), occlusal and lateral views. 1½ × natural size. New Fork, Green River Basin, Wyoming.

Fig. 4. *Palaeictops pineyensis* (Gazin) 22
Right ramus of mandible with P_3 (U.S.N.M. No. 22123), occlusal and lateral views. 4 × natural size. La Barge, Green River Basin, Wyoming.

PLATE 2

PRIMATES AND INSECTIVORE FROM THE LOWER EOCENE OF WYOMING

PLATE 3

PRIMATES FROM THE LOWER EOCENE OF WYOMING

PLATE 4

PRIMATES AND RODENTS FROM THE LOWER EOCENE OF WYOMING

PLATE 5

PRIMATES AND RODENTS FROM THE LOWER EOCENE OF WYOMING

Page

FIG. 2. *Omomys,* cf. *vespertinus* Matthew 32
Right ramus of mandible, M_1-M_2 (U. of Wyo. No. 1647), occlusal and lateral views. 5 × natural size. Red Desert, Continental Divide Basin, Wyoming.

FIG. 3. *Absarokius,* near *A. abbotti* (Loomis) 37
Right ramus of mandible, P_3-M_3 (U. of Wyo. No. 1644), occlusal and lateral views. 4 × natural size. Red Desert, Continental Divide Basin, Wyoming.

FIG. 4. *Uintasorex,* cf. *parvulus* Matthew 39
Right ramus of mandible, M_2-M_3 (U. of Wyo. No. 1646), occlusal and lateral views. 6 × natural size. Red Desert Lostcabinian, Great Divide Basin, Wyoming.

FIGS. 5, 6. *Knightomys senior* Gazin 46
5, Left lower molars, M_2-M_3, and right lower cheek teeth, P_4-M_2 (U.S.N.M. No. 22415), occlusal view. 6, Right ramus of mandible, P_4-M_2 (U.S.N.M. No. 19308), type specimen, occlusal and lateral views. Occlusal views 6 × natural size; lateral view 3 × natural size. La Barge, Green River Basin, Wyoming.

FIG. 7. *Dawsonomys woodi* Gazin 48
Left lower cheek teeth, P_4-M_1 (U.S.N.M. No. 19309), type specimen, occlusal view. 6 × natural size. La Barge, Green River Basin, Wyoming.

FIGS. 8, 9. *"Sciuravus" depressus* Loomis 48
8, Right upper cheek teeth, M^1-M^3 (A.C.M. No. 432), type specimen, occlusal view. 9, Left ramus of mandible with M_1 (A.C.M. No. 458), occlusal and lateral views. Occlusal views 6 × natural size; lateral view 3 × natural size. Lysite, Wind River Basin, Wyoming.

PLATE 6

CARNIVORES FROM THE LOWER EOCENE OF WYOMING

FIGS. 1, 2. *Sinopa,* cf. *vulpecula* Matthew 55
1, Right upper cheek teeth, P^2-M^3 (U.S.N.M. No. 19347), occlusal view. 2, Left ramus of mandible, P_2-M_3(part) (U.S.N.M. No. 19347), occlusal and lateral views. Occlusal views 1½ × natural size; lateral view natural size. La Barge, Green River Basin, Wyoming.

FIG. 3. *Sinopa,* possibly *S. viverrina* Cope 54
Right ramus of mandible, C-M_3(restored from left side) (U.S.N.M. No. 22456), occlusal and lateral views. Occlusal view 1½ × natural size, lateral view natural size. La Barge, Green River Basin, Wyoming.

FIG. 4. *Sinopa,* cf. *multicuspis* (Cope) 55
Right ramus of mandible, M_1-M_2 (U.S.N.M. No. 22459), occlusal and lateral views. Occlusal view 1½ × natural size; lateral view natural size. Bitter Creek, Washakie Basin, Wyoming.

FIG. 5. *Prolimnocyon,* cf. *antiquus* Matthew 53
Left ramus of mandible, P_4-M_2 (restored from right side) (U.S.N.M. No. 22452), occlusal and lateral views. Occlusal view 1½ × natural size; lateral view natural size. New Fork, Green River Basin, Wyoming.

Page

PLATE 7

CARNIVORES AND ARTIODACTYL FROM THE LOWER EOCENE OF WYOMING

PLATE 8

CARNIVORES FROM THE LOWER EOCENE OF WYOMING

PLATE 9

CONDYLARTHS FROM THE LOWER EOCENE OF WYOMING

PLATE 10

MENISCOTHERIUM FROM THE LOWER EOCENE OF WYOMING

PLATE 11

CORYPHODON FROM THE LOWER EOCENE OF WYOMING

PLATE 12

CORYPHODON, PERISSODACTYLS, TAENIODONT, AND PRIMATE FROM THE LOWER EOCENE OF WYOMING

Page

FIGS. 8-9. *Lambdotherium popoagicum* Cope 75
8, Right upper cheek teeth, P^3-M^3 (U.S.N.M. No. 18232), occlusal view. 1½ × natural size. La Barge, Green River Basin, Wyoming. 9, Left lower cheek teeth, P_2(part)-M_3 (U.S.N.M. No. 22793), occlusal view. 1½ × natural size. New Fork, Green River Basin, Wyoming.

FIG. 10. *Chlorohysis knightensis* Gazin 32
Right lower cheek teeth, P_4-M_3 (Univ. Calif. No. 46705), lateral and occlusal views. 5 × natural size. Dad, Washakie Basin, Wyoming.

PLATE 13

HYRACOTHERIUM AND HEPTODON FROM THE LOWER EOCENE OF WYOMING

FIGS. 1, 2, 4-10. *Hyracotherium vasacciense* (Cope) 73
1, Left upper cheek teeth, P^3-M^3 (U.S.N.M. No. 21350), occlusal view. 2 × natural size. New Fork, Green River Basin, Wyoming. 2, Left lower cheek teeth, P_3-M_3 (U.S.N.M. No. 22491), occlusal and lateral views. 2 × natural size. New Fork, Green River Basin, Wyoming. 4, Left upper premolars, P^3-P^4 (U.S.N.M. No. 19738), occlusal view. 2 × natural size. La Barge, Green River Basin, Wyoming. 5, Right upper premolars, P^2-P^4 (U.S.N.M. No. 22403), occlusal view. 2 × natural size. La Barge, Green River Basin, Wyoming. 6, Right upper premolars, P^2-P^4 (U.S.N.M. No. 19745), occlusal view, 2 × natural size. La Barge, Green River Basin, Wyoming. 7, Left upper premolars, P^3-P^4 (U.S.N.M. No. 19744), occlusal view. 2 × natural size. La Barge, Green River Basin, Wyoming. 8, Left upper premolars, P^2-P^4 (U.S.N.M. No. 22494), occlusal view. 2 × natural size. La Barge, Green River Basin, Wyoming. 9, Left upper premolars, P^2-P^4 (U.S.N.M. No. 22495), occlusal view. 2 × natural size. La Barge, Green River Basin, Wyoming. 10, Right upper premolars, P^3-P^4 (U.S.N.M. No. 22496), occlusal view. 2 × natural size. Dad, Washakie Basin, Wyoming.

FIG. 3. *Hyracotherium* cf. *angustidens* (Cope) 72
Left upper premolars, P^3-P^4 (U.S.N.M. No. 22492), occlusal view. 2 × natural size. Elk Mountain, Fossil Basin, Wyoming.

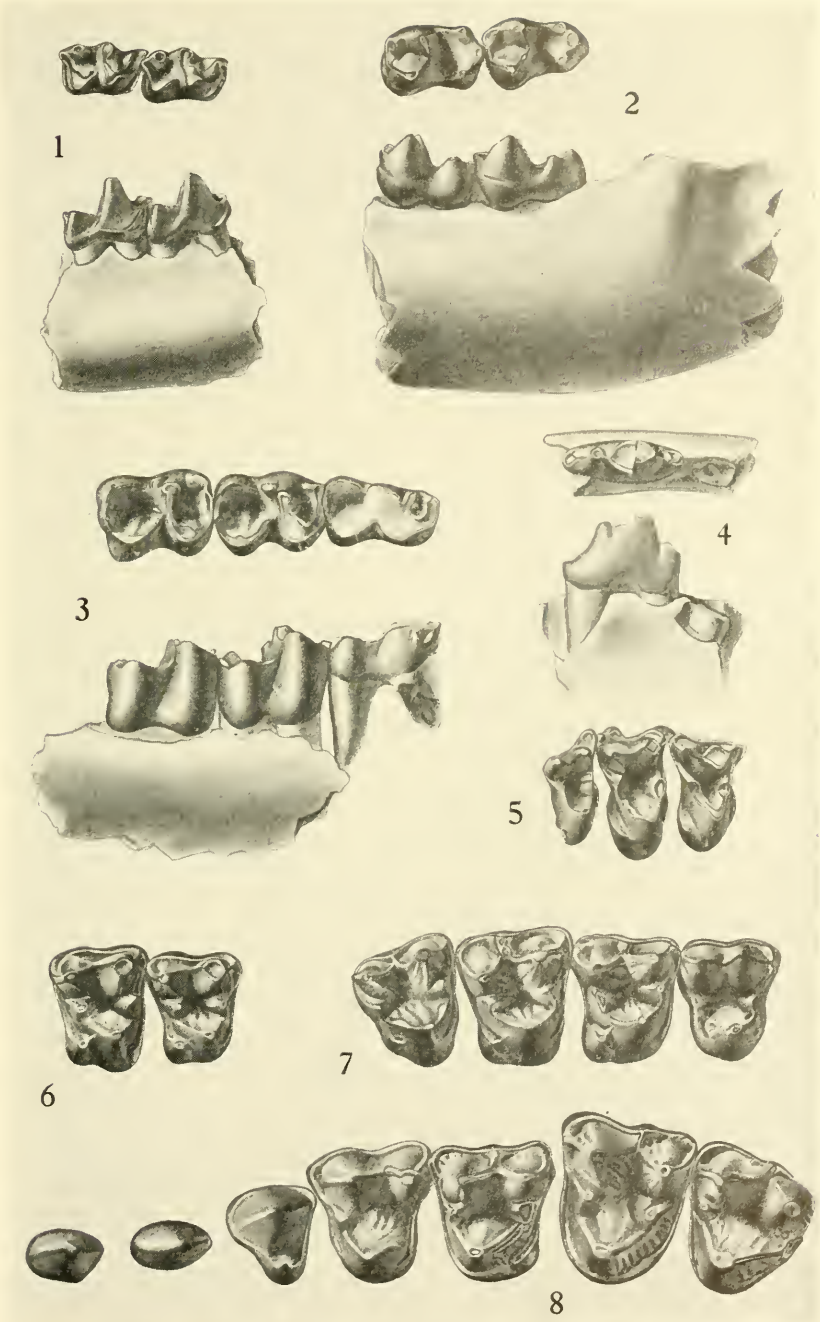
FIG. 11. *Hyracotherium* cf. *craspedotum* Cope 74
Left premolars, P^3-P^4 (U.S.N.M. No. 22497), occlusal view. 2 × natural size. Cathedral Bluffs, Washakie Basin, Wyoming.

FIG. 12. *Heptodon ventorum* (Cope) 78
Right cheek teeth, P_3-M_3 (U.S.N.M. No. 22498), occlusal and lateral views. 1½ × natural size. Dad, Washakie Basin, Wyoming.

PLATE 14

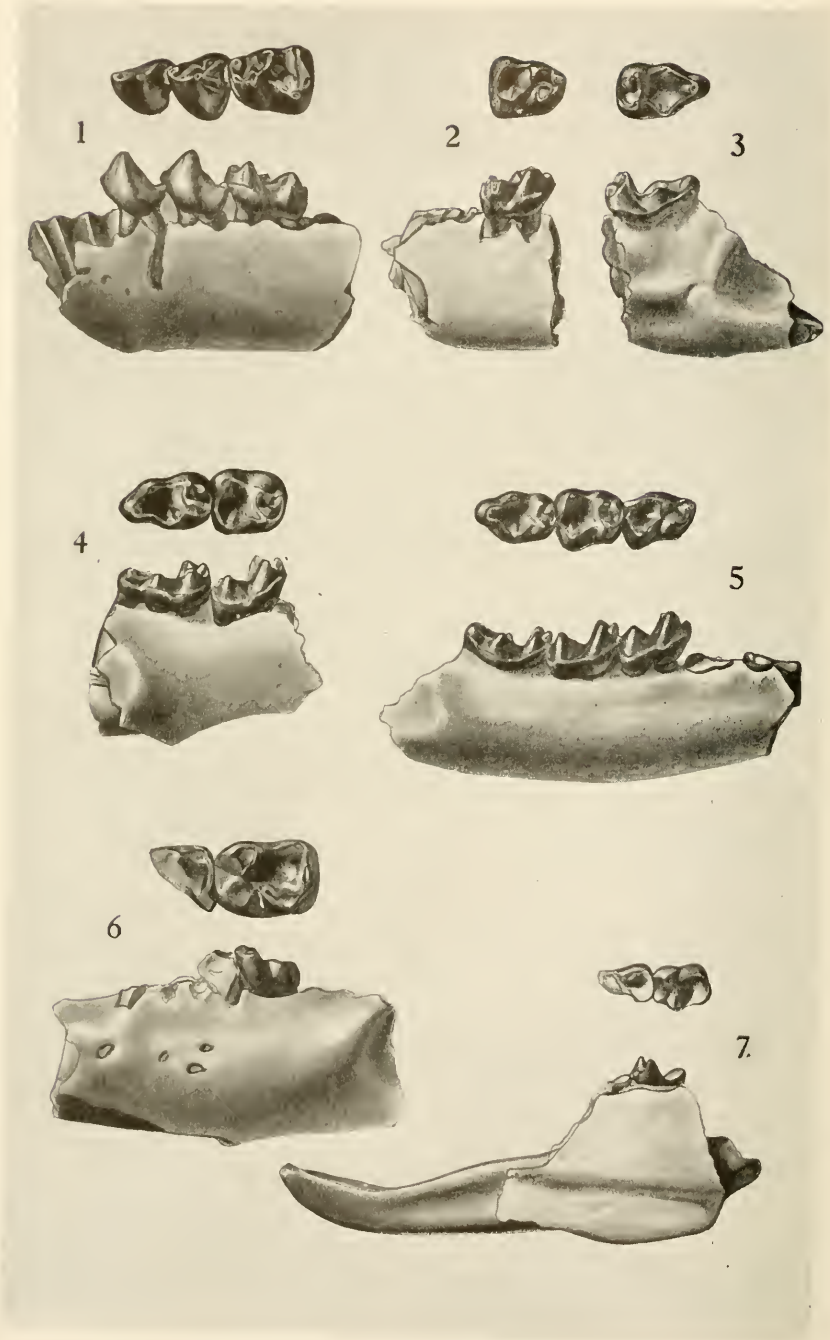
HEXACODUS AND BUNOPHORUS FROM THE LOWER EOCENE OF WYOMING

FIGS. 1, 3. Cf. *Hexacodus pelodes* Gazin 82
1, Left upper molars, M^1-M^2 (U.S.N.M. No. 22248), occlusal view.



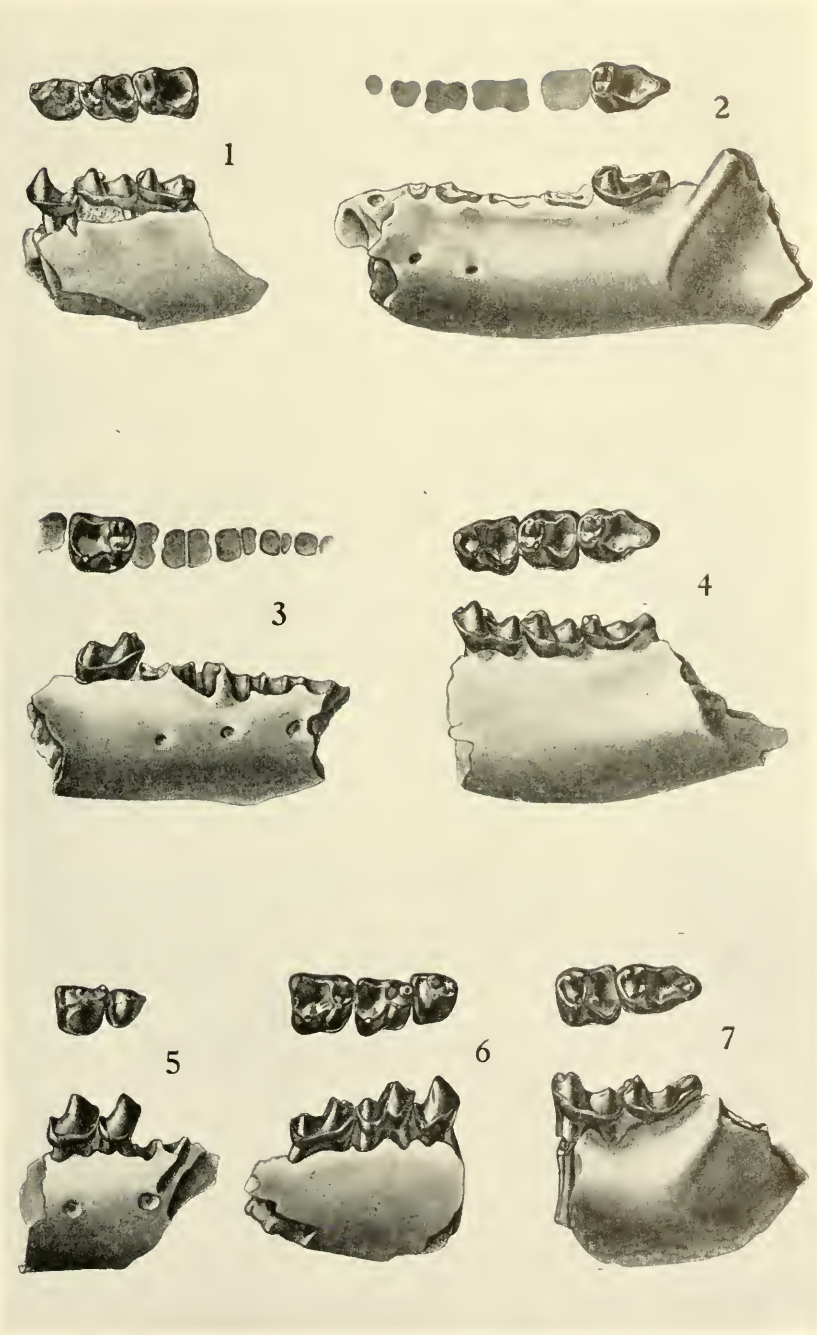
MARSUPIAL, INSECTIVORES, PRIMATES, AND TILLODONT FROM THE LOWER EOCENE OF WYOMING

(SEE EXPLANATION OF PLATES AT END OF TEXT.)



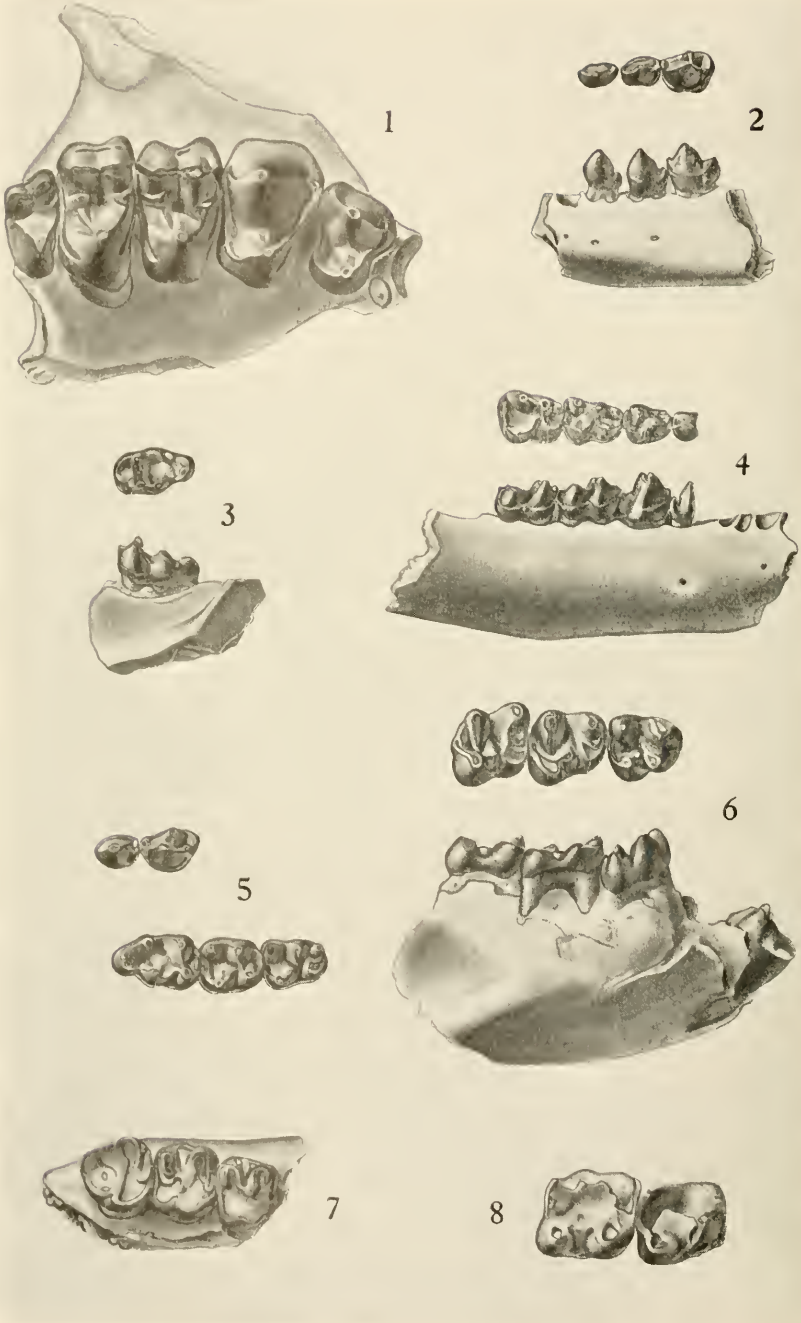
PRIMATES AND INSECTIVORE FROM THE LOWER EOCENE OF WYOMING

(SEE EXPLANATION OF PLATES AT END OF TEXT.)



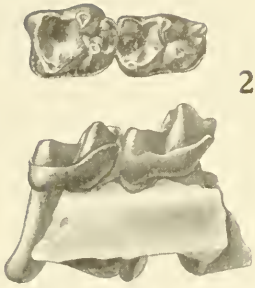
PRIMATES FROM THE LOWER EOCENE OF WYOMING

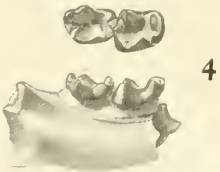
SEE EXPLANATION OF PLATES AT END OF TEXT.)

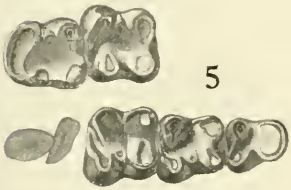


PRIMATES AND RODENTS FROM THE LOWER EOCENE OF WYOMING

(SEE EXPLANATION OF PLATES AT END OF TEXT.

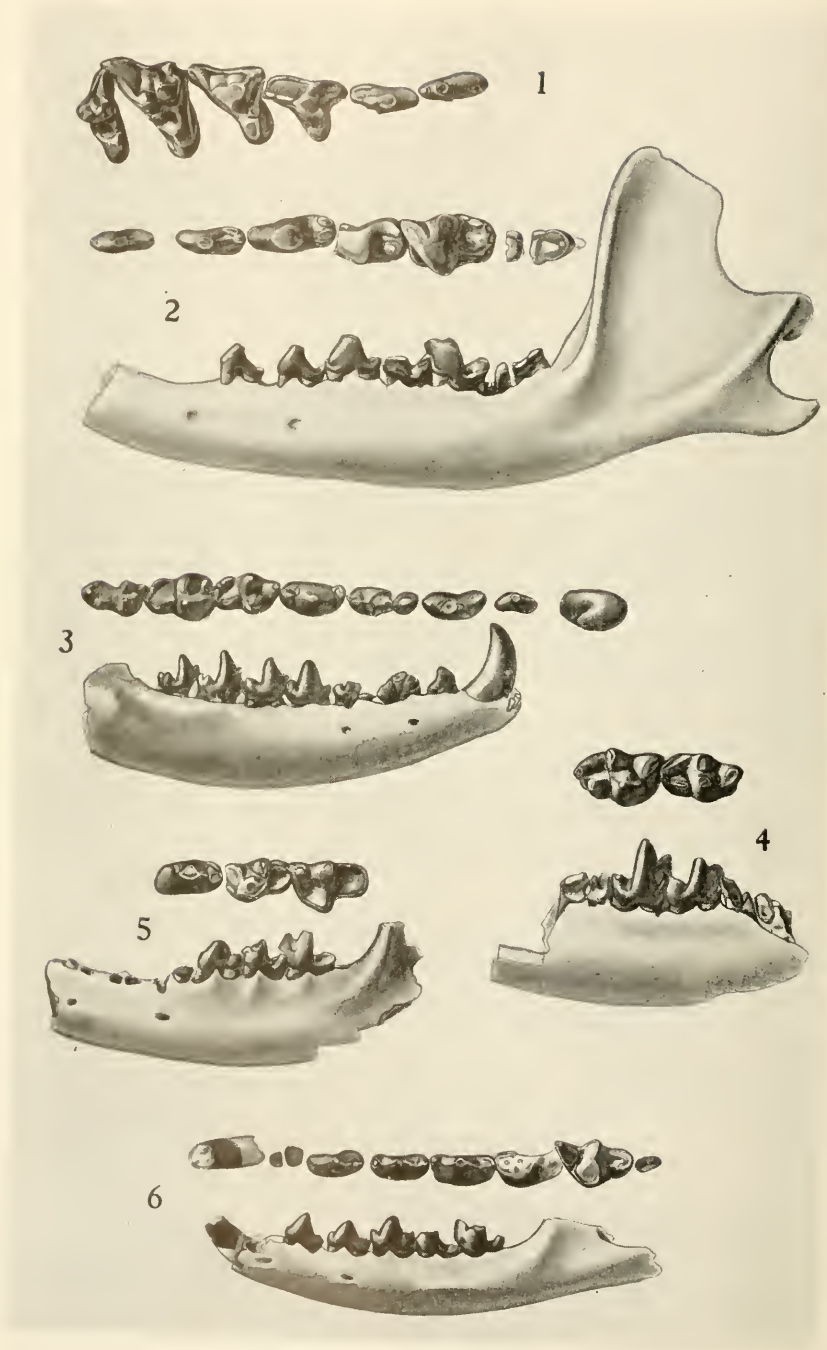






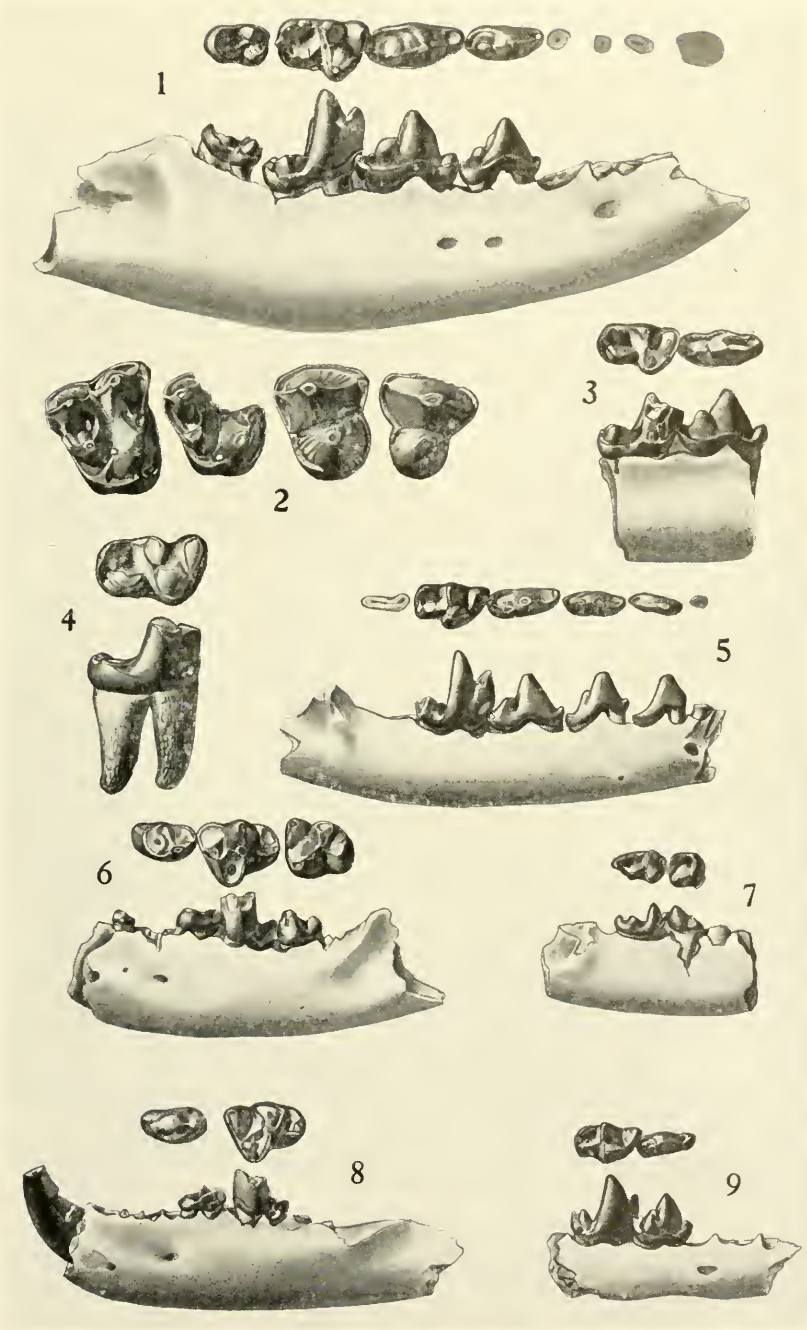
PRIMATES AND RODENTS FROM THE LOWER EOCENE OF WYOMING

(SEE EXPLANATION OF PLATES AT END OF TEXT.)



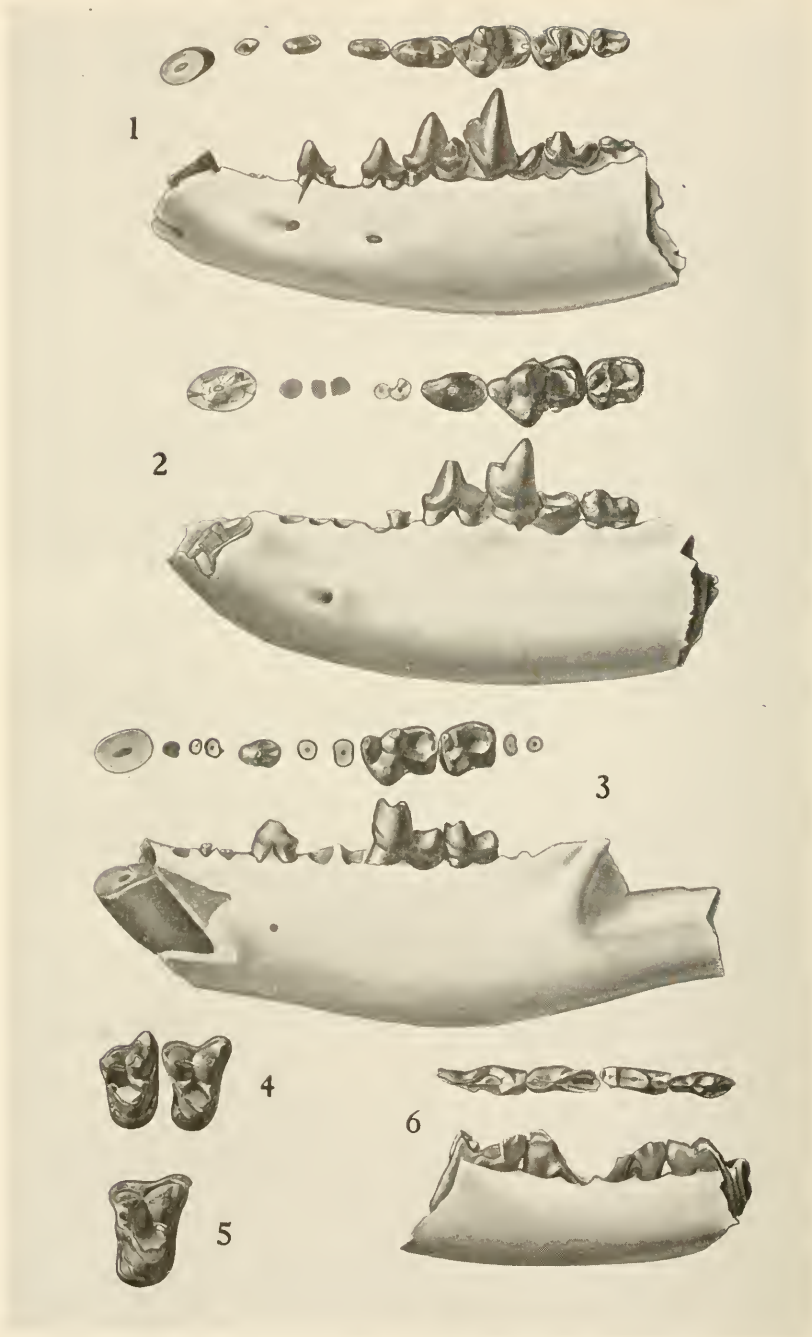
CARNIVORES FROM THE LOWER EOCENE OF WYOMING

(SEE EXPLANATION OF PLATES AT END OF TEXT.)



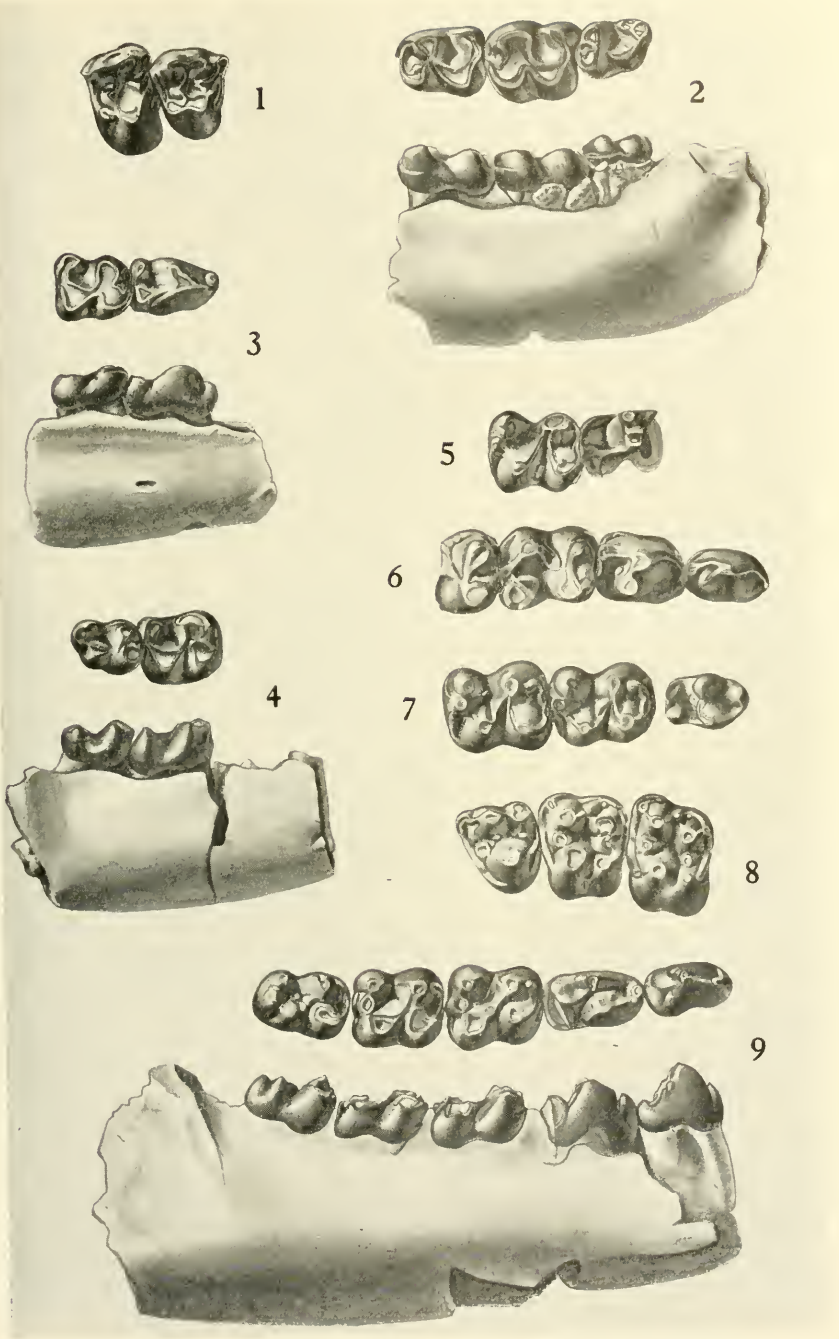
CARNIVORES AND ARTIODACTYL FROM THE LOWER EOCENE OF WYOMING

(SEE EXPLANATION OF PLATES AT END OF TEXT.)



CARNIVORES FROM THE LOWER EOCENE OF WYOMING

(SEE EXPLANATION OF PLATES AT END OF TEXT.)

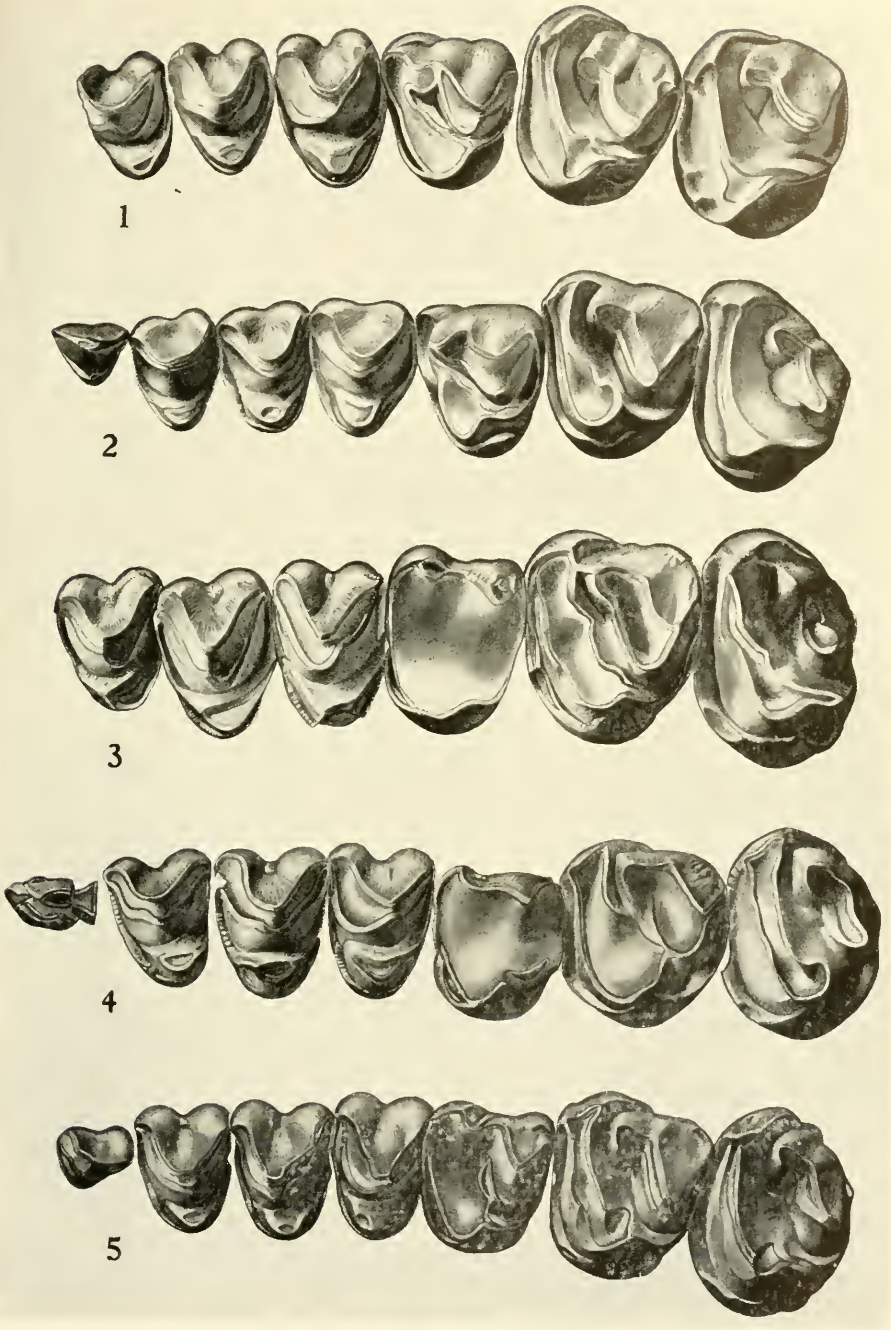


CONDYLARTHS FROM THE LOWER EOCENE OF WYOMING

(SEE EXPLANATION OF PLATES AT END OF TEXT.)

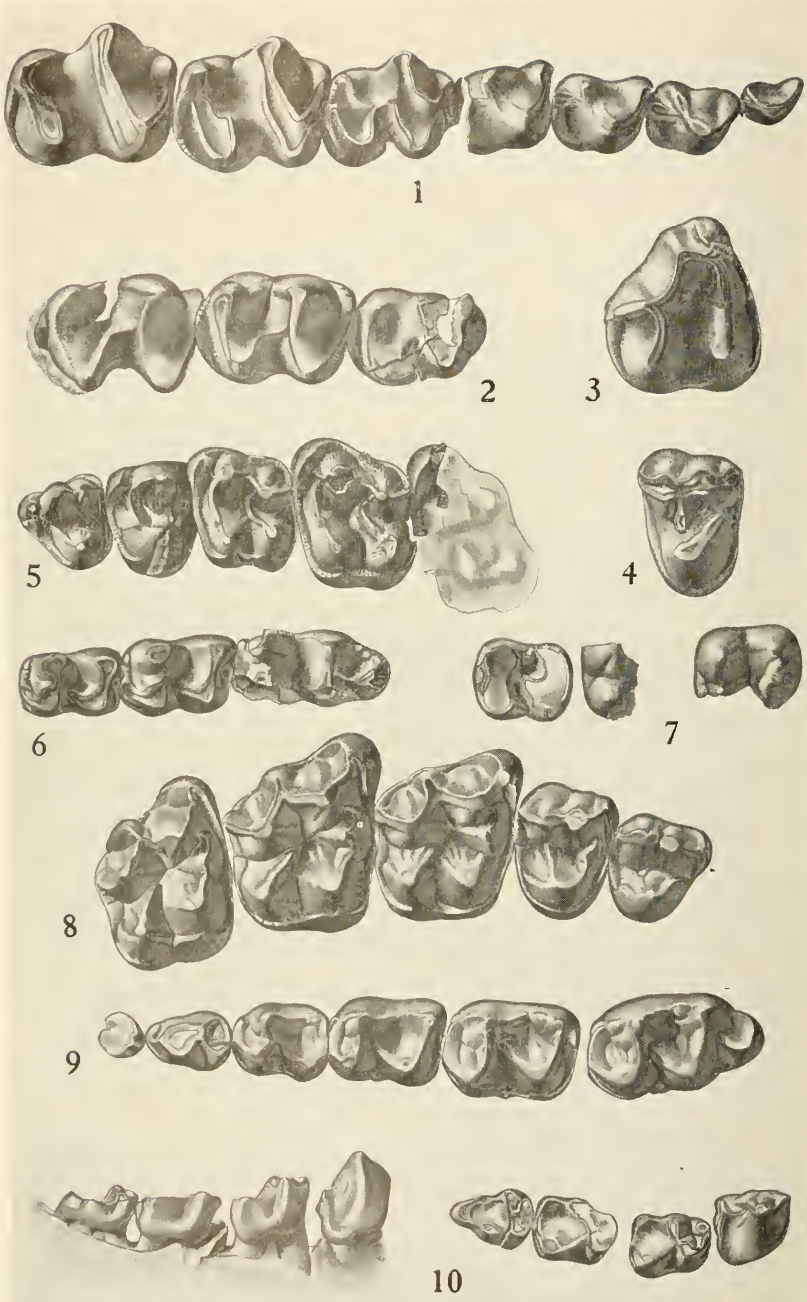
MENISCOTHERIUM FROM THE LOWER EOCENE OF WYOMING

(SEE EXPLANATION OF PLATES AT END OF TEXT.)



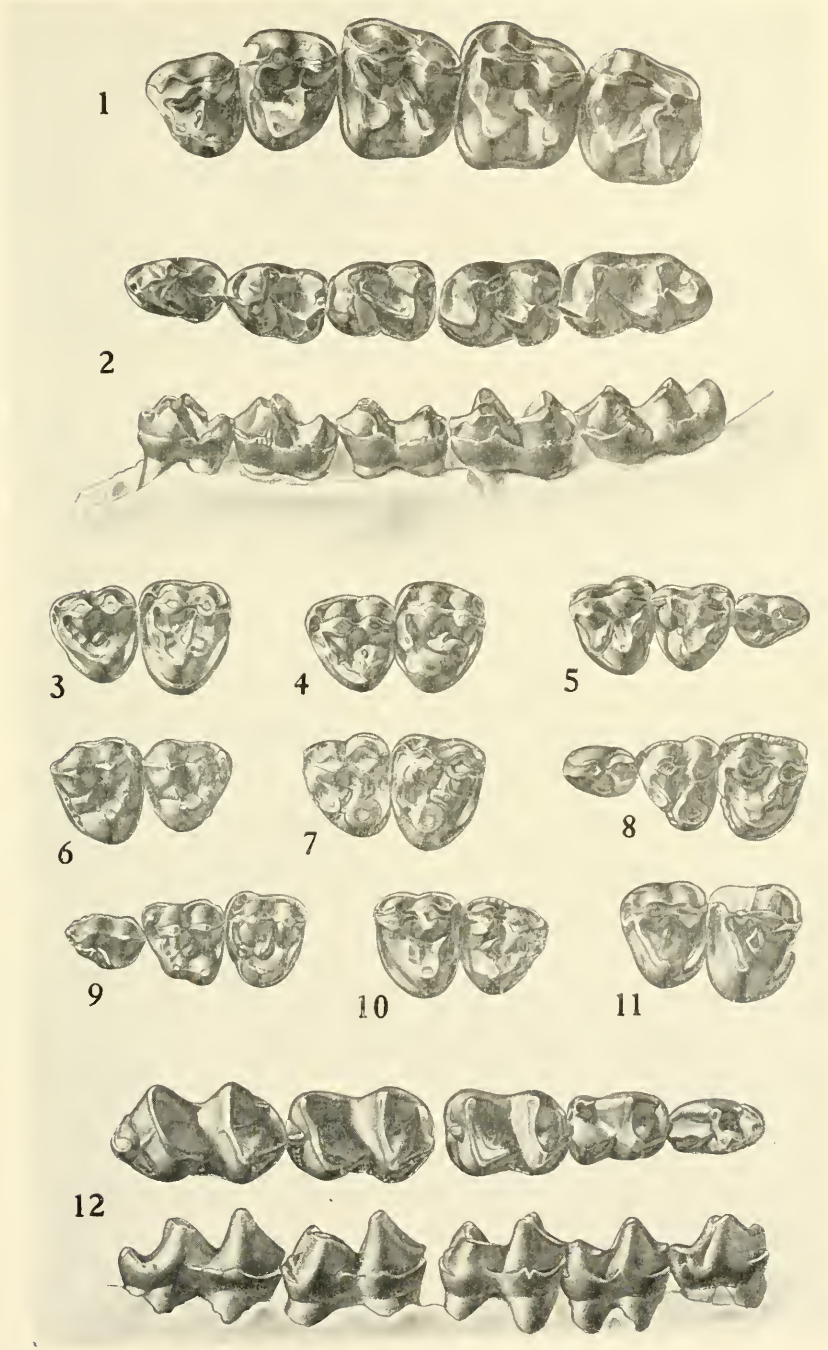
CORYPHODON FROM THE LOWER EOCENE OF WYOMING

(SEE EXPLANATION OF PLATES AT END OF TEXT.)



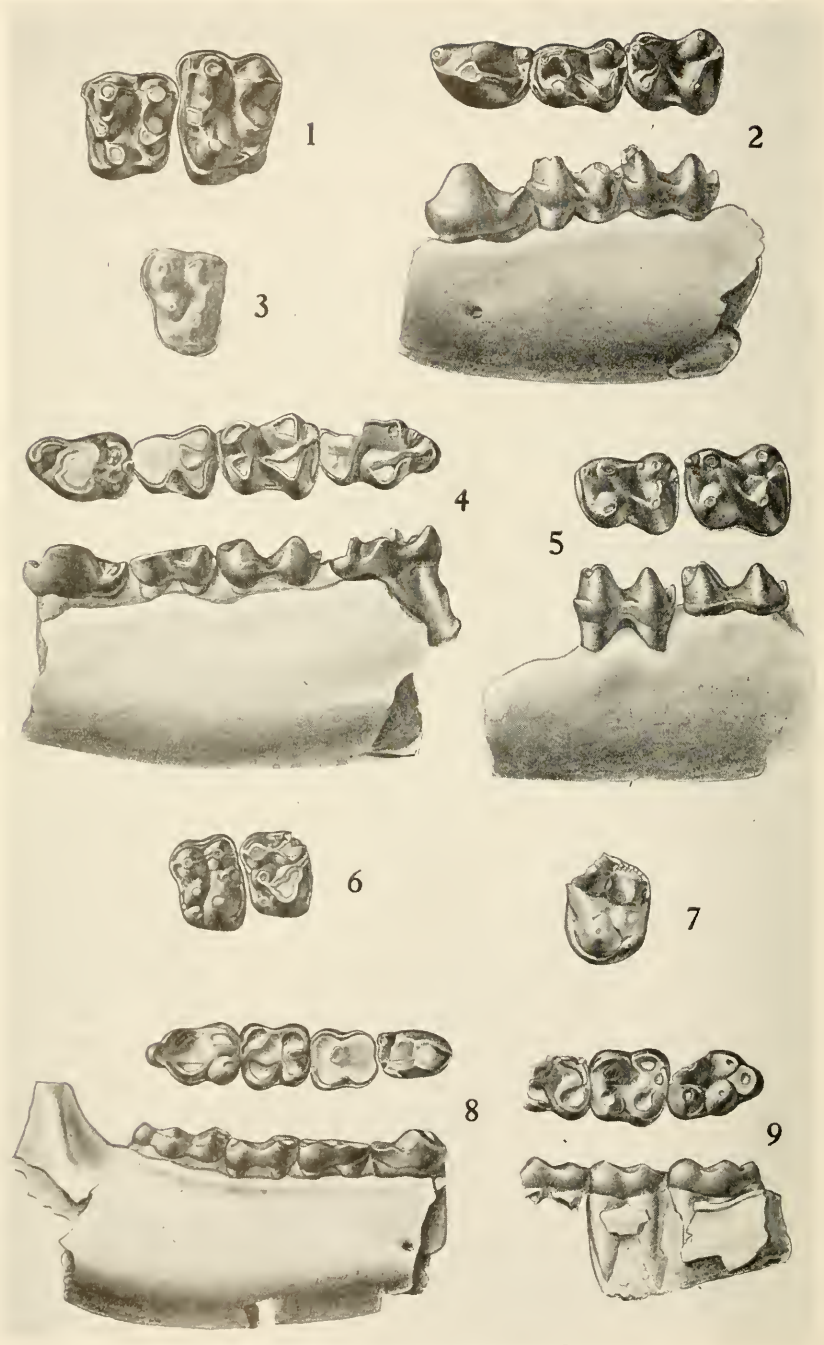
CORYPHODON, PERISSODACTYLS, TAENIODONT, AND PRIMATE FROM THE LOWER EOCENE OF WYOMING

(SEE EXPLANATION OF PLATES AT END OF TEXT.)



HYRACOTHERIUM AND HEPTODON FROM THE LOWER EOCENE OF WYOMING

(SEE EXPLANATION OF PLATES AT END OF TEXT.)



HEXACODUS AND BUNOPHORUS FROM THE LOWER EOCENE OF WYOMING

(SEE EXPLANATION OF PLATES AT END OF TEXT.)