

# BULLETIN OF THE PEABODY MUSEUM OF NATURAL HISTORY, YALE UNIVERSITY

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PEABODY MUSEUM OF NATURAL HISTORY  
YALE UNIVERSITY

BULLETIN 14

## Revision of the Uintatheres

BY

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NEW HAVEN, CONNECTICUT

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## ABSTRACT

The valid genera and species of the large Eocene uintatheres from the western United States have been sorted out from the many proposed by Marsh, Cope, and others and their types cited. Three large genera are recognized from the middle and upper Eocene: *Uintatherium* Leidy, 1872, a middle Eocene form of large size with a mesocephalic skull; *Tetheopsis* Cope, 1885, a very large form from the uppermost middle Eocene and lowermost upper Eocene, which has a dolichocephalic skull; and *Eobasileus* Cope, 1872, from the upper Eocene, the largest and most dolichocephalic uintathere known. One variable species of *Uintatherium* can be demonstrated, *Uintatherium anceps* (Marsh), 1871. Two species of *Tetheopsis* are indicated: one, *Tetheopsis ingens* (Marsh), 1885, has a much shorter snout than the type species, *Tetheopsis speirianus* (Osborn), 1881. There is probably but one species of *Eobasileus*, *E. cornutus* (Cope), 1872. The disposition of all the invalid genera and species is given. The three smaller American genera and the three Asiatic genera are also summarized.

Some of the stratigraphic problems of the uintathere-bearing Bridger, Washakie, and Uinta formations and their subdivisions are discussed. Each of these formation names should be used for all post-Green River Bridgerian and Uintan strata in the basin for which it is named.

A new species, *Bathyopsis middleswarti*, is intermediate in size between *Bathyopsis fissidens* (lower Eocene) and *Uintatherium anceps* (upper part of the middle Eocene). It is the first known uintathere from the lower part of the middle Eocene.

Uintatheriidae Flower, 1876, should be retained as the family name for all uintatheres. A division of the Uintatheriidae into three subfamilies, Bathyopsinae, Uintatheriinae, and Gobiatheriinae, is proposed.

*Uintatherium*, *Tetheopsis*, and *Eobasileus* all show strong sexual dimorphism. The skulls of the females differ in having lighter bones and smaller protuberances or "horns". The lower jaws of the females of *Tetheopsis* and *Eobasileus* possessed only a rudimentary inframandibular process for the protection of the sabre-tooth canine. The female of *Uintatherium*, however, differed from those of other uintatheres in possessing a well developed inframandibular process.

Minor trends in the evolution of uintathere lower molars are indicated. Marsh's interpretations concerning the shape and size of the lower cropping teeth are shown to be correct. The large sabre-tooth canines are regarded as defensive weapons for both males and females. Comparison of the uintathere tooth patterns with those of *Carodnia* and the pantodonts suggests that the order Amblypoda may be valid.



## INTRODUCTION

### ORIENTATION AND STATEMENT OF THE PROBLEM

The uinatheres are a group of mammals known only as fossils. They constitute the Order Dinocerata. Their first known occurrence is near the base of the upper Paleocene and they became extinct sometime in the late Eocene.

The best known and most typical forms are the large North American genera. These advanced uinatheres are notable for their large size, for the three pairs of protuberances on the top of the skull, and for the huge sabre-tooth canine.

Most forms possessed a process or flange on the lower jaw which extended downward and slightly laterally from the area of the mental foramina and which served as a protective shield or brace for the sabre-toothed canines. This flange will be referred to hereinafter as the "inframandibular process."

The upper Paleocene and lower Eocene uinatheres were plantigrade types of moderate size. The middle and upper Eocene forms were very heavy animals and had five-toed graviportal feet, much as elephants do today. Their primitive brains were the smallest in proportion to body size of any known mammals. The most consistent characters of the group are the V-shaped loph of the upper cheek teeth and the extra cusp (metastylid) and loph (posterior talonid loph) on the lower cheek teeth.

The nearest relatives of the uinatheres are the coryphodontids and barylambdids, which make up the Order Pantodonta. Some workers, notably Cope and Osborn, regarded the Pantodonta and Dinocerata as suborders of the Order Amblypoda. The ancestry of the Dinocerata is unknown. There are no forms linking them with any of the possible condylarth ancestors. They left no descendants. They ranged from forms about the size of a pig, like *Probathyopsis*, in the upper Paleocene and lower Eocene to a form the size of a large rhinoceros, *Eobasileus*, in the upper Eocene. *Uinatherium*, from the upper half of the middle Eocene is by far the commonest and best known uinathere. *Tetheopsis* overlaps *Uinatherium* and *Eobasileus* in time and is intermediate in physical appearance. These three genera included the largest land mammals of their time.

The genera of Dinocerata and their ranges are:

<i>Probathyopsis</i>	Upper Paleocene and lower Eocene of North America
<i>Prodinoceras</i>	Upper Paleocene of Asia
<i>Bathyopsoides</i>	Upper Paleocene of North America
<i>Mongolotherium</i>	Lower Eocene of Asia
<i>Bathyopsis</i>	Lower and middle Eocene of North America
<i>Uinatherium</i>	Middle Eocene (and upper Eocene?) of North America
<i>Tetheopsis</i>	Middle and upper Eocene of North America
<i>Eobasileus</i>	Upper Eocene of North America
<i>Gobiatherium</i>	Upper Eocene of Asia

The main problem in this study has been to find out which of the many genera and species proposed by the early workers are valid and to identify properly the invalid ones. In order to understand the age relationships of the uinatheres the stratigraphy of the formations bearing them had to be studied. Other problems

studied were the phylogeny of the uinatheres, the origin of uinathere molars, the relationship of uinatheres to the Pantodonta, and the ancestry of the order.

The ecologic niche occupied by the uinatheres was taken over by the titanotheres, which were at the peak of their diversity at the time the uinatheres became extinct in the upper Eocene. These, in turn, were replaced by rhinoceroses in the later Cenozoic.

#### ACKNOWLEDGMENTS

The revision of an entire group of fossil animals is almost certain to require the study of material which is kept in many museums. This has been the case with the uinatheres. Without the generous cooperation of the staffs at several museums of paleontology this study would not have been possible.

George Gaylord Simpson permitted me to inspect and describe the extensive collection of uinatheres in the American Museum of Natural History, including all Asiatic specimens then known,<sup>1</sup> and probably half of the known American material. He also authorized the services of the photographic department of the American Museum for taking several excellent photographs used in this report.

C. L. Gazin and David Dunkle allowed me to study the uinathere collection at the United States National Museum, where the photographic department provided three excellent uinathere photographs for this report by authority of Dr. Gazin. Glenn L. Jepsen of Princeton University, Bryan Patterson, then of the Chicago Museum of Natural History, and Horace G. Richards of the Academy of Natural Science of Philadelphia gave me permission to study the uinatheres at their institutions.

C. Bertrand Schultz of the University of Nebraska State Museum lent to the Peabody Museum an important skull which I have made the holotype of a new species. The skull was donated to the University of Nebraska Museum by the collectors, Mr. and Mrs. T. C. Middleswart of Bridgeport, Nebraska.

Dr. Carlos de Paula Couto of the Museo do Rio Grande do Sul, Brazil, was extremely helpful in showing me a then undescribed specimen of *Carodnia*, which is pertinent to this study.

John A. Dorr of the University of Michigan showed me the *Probatyopsis* material from the Hoback Basin of Wyoming.<sup>2</sup>

Peter Robinson gave loyal assistance during two field seasons. J. Leroy Kay of Carnegie Museum and G. E. Untermann and Arnold Lewis of the Utah Field House of Natural History helped in finding localities in the field. William A. Morris, then a graduate student at Princeton University, gave much helpful advice in the field concerning the stratigraphy of the Washakie Basin. John McDowell drafted the maps which are on Plates 1 and 2. Mrs. Delores McCole contributed many excellent editorial suggestions.

The cost of field work in the summer of 1950 was paid from the John T. Doneghy, Jr. Research Fund, as were the travel expenses of visiting several museums. Some of the expenses incidental to getting the text and plates ready for the printer were paid by the University of North Carolina Alumni Research Fund.

This report was submitted to the faculty of the Department of Geology at Yale University in partial fulfillment of the requirements for the degree of Doctor

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<sup>1</sup> Flerov (1957) has recently described additional Mongolian uinatheres collected by the Paleontological Institute of the USSR.

<sup>2</sup> Described as *Prouintatherium hobackensis* Dorr, 1958.

of Philosophy. Prof. Joseph T. Gregory of the Department of Geology of Yale University supervised the thesis work. I am indebted to him for the guidance and encouragement he has given me throughout the course of this study.

#### ABBREVIATIONS

The following abbreviations are used throughout the text to refer to museum collections:

AMNH	American Museum of Natural History, New York, N. Y.
ANSP	Academy of Natural Sciences, Philadelphia, Pennsylvania
CMNH	Colorado Museum of Natural History (now Denver Museum of Natural History), Denver, Colorado
CNHM	Chicago Natural History Museum, Chicago, Illinois
PIN	Paleontological Institute, Academy of Sciences, U.S.S.R., Moscow, Russia
PUM	Princeton University Museum, Princeton, New Jersey
UMMP	University of Michigan Museum of Paleontology, Ann Arbor, Michigan
USNM	United States National Museum, Washington, D. C.
YPM	Peabody Museum of Natural History, Yale University, New Haven, Connecticut

Uintathere specimens are also in the collections of the Amherst College Museum and the University of Nebraska State Museum.

#### HISTORY OF RESEARCH ON THE DINOCERATA

O. C. Marsh found some uintathere scraps in the Bridger Basin of Wyoming in 1871 which he described under the name of *Titanotherium ? anceps* (Marsh 1871, pp. 35-36). This was the first mention of a uintathere. The following summer Leidy and Marsh collected in the Bridger Basin and Cope collected in the adjacent Washakie Basin. Leidy was first to publish. On August 1, 1872, he distributed advance copies of an article to appear in the Proceedings of the Academy of Natural Sciences of Philadelphia (Leidy 1872a) in which he described *Uintatherium robustum*.

So far as I can tell, Cope and Marsh both published new names for uintatheres on August 19, 1872. Fortunately, both names are synonyms and we are spared from having to deal with a problem in priority. Nevertheless, Cope regarded his name *Loxolophodon* as valid and he regarded Marsh's name *Tinoceras* as its synonym. Marsh felt that the reverse was true. Both Cope and Marsh nearly ignored Leidy's genus, *Uintatherium*.

Cope hastily and privately published his new discoveries of the summer in his *Palaeontological Bulletins*. In one instance Cope was in such haste to get into print that he telegraphed his description of a new genus of uintathere to Philadelphia and the famous garbled telegram which resulted entered the scientific literature. Marsh justifiably criticized this practice, but according to the rules of

nomenclature these names were validly published because they were sent to people who were informed in zoology and geology.

Marsh found an excellent skull during his 1872 explorations which he described in September of 1872 under the name of *Dinoceras mirabilis* (Marsh 1872d, pp. 343-344).

Cope's good specimen was an *Eobasileus* and Marsh's was a *Uintatherium*, but each thought he had the same beast, so when they compared descriptions they found differences which each interpreted as errors on the other man's part.

It was largely competition over the uintatheres that precipitated the Cope-Marsh warfare. This notorious scientific vendetta began in the summer of 1872 when Cope began his scientific explorations in southern Wyoming. Marsh always resented competition and he particularly resented what he regarded as Cope's intrusion into his fossil domains (Osborn 1931, p. 177).

Marsh was far ahead of Cope in his interpretation of the Dinocerata. Cope made some initial errors which Marsh immediately caught; he called the tusks incisors, he confused an isolated parietal horn for a nasal bone, and he insisted for a long time that the Dinocerata were Proboscidea. Marsh on the contrary made the correct interpretation on each of the points. He, of course, had a right to publish corrections of Cope's interpretations, but the vindictive and triumphant spirit in which he did this was uncalled for.

Marsh's vituperation over Cope's handling of the Dinocerata grew so intense that the editors of the *American Naturalist* refused to print one of Marsh's diatribes under the heading of a scientific article, but added it to the June 1873 number as an appendix, with Marsh paying for its publication. To quote from this gem of hate (Marsh 1873f, p. ix):

He [Cope] had endeavored to secure priority by sharp practice, and failed. For this kind of sharp practice in science, Prof. Cope is almost as well known as he is for number and magnitude of his blunders. . . .

. . . Prof. Cope's errors will continue to invite correction, but these, like his blunders, are hydra-headed, and life is really too short to spend valuable time in such an ungracious task, especially as in the present case Prof. Cope has not even returned thanks for the correction of nearly half a hundred errors.

Cope, accusing Marsh of "blundering criticism," said: ". . . he repeats his statements, as though the *Uintatherium* were a Rosinante, and the ninth commandment a windmill" (Cope 1873d, p. 2). Marsh accused Cope of predated his papers; Cope denied this vigorously. While Cope certainly "endeavored to secure priority by sharp practice," I have found no evidence to suggest that he actually predated his separates.

It should be remembered that all this argument was over the uintatheres. In such an atmosphere of raging hate and uncontrolled vituperation, objectivity and scientific detachment were sacrificed in an all-out battle in defense of priority and ego. The result was nomenclatorial chaos. From August 1872 through June 1873 Cope and Marsh each published 16 really different articles on Dinocerata. Leidy, Cope, and Marsh each proposed two genera. Leidy proposed two species, Cope three, and Marsh four. After June they apparently tired of the matter and the great flow of articles on uintatheres was much reduced.

In 1876 Marsh summarized his knowledge of the Dinocerata and published plates of a brain case. In 1885 he published his monograph on the Dinocerata (Marsh 1885b), which Cope characterized as ". . . the handsomest work on the subject yet published" (Cope 1885d, p. 705).

In 1881 Cope described *Bathyopsis*, a lower Eocene uintathere from the Wind River basin. He summarized his opinions on the Dinocerata in "Cope's Bible" (Cope 1885a, pp. 559-600 and plates 29a, 30-44, and 58a) and in a series of articles under the common title of *The Amblypoda* (Cope 1884). In the latter he advocated what later came to be known as the "ectoloph rotation hypothesis" of uintathere tooth cusp nomenclature (p. 1117) and proposed a new genus, *Octotomus*, based on one of Marsh's species (1885b, p. 53). After the publication of Marsh's monograph, Cope proposed two more genera based on Marsh's species (Cope 1885c).

In 1888 Cope presented the only ideas on uintathere occlusion which have been brought forth until now.

H. F. Osborn, W. B. Scott, and Francis Speir entered the fossil vertebrate field on behalf of Princeton University in 1877 with explorations in the Bridger Basin and collected uintathere specimens. They obtained some in the Washakie Basin in 1878 and again from the Bridger Basin in 1885 (Osborn, Scott, and Speir 1878; Osborn and Speir 1879; Osborn 1881; Scott 1886). The story of these expeditions and the circumstances behind many of the fossil discoveries are related in Scott's autobiography (Scott 1939, pp. 69, 78-79, 165-169).

American Museum expeditions to the Washakie Basin (in 1893 and 1895 under J. L. Wortman and in 1906 under Walter Granger) and to the Bridger Basin (in 1904 and 1905 under Granger) brought back a large amount of uintathere material, much of it excellent. The expedition of 1893 was by far the most productive. Eight skulls and the only immature uintathere teeth known from North America were among the many uintathere specimens collected that summer. None of the material from these five expeditions has previously been reported.

Osborn advanced and expanded Cope's views on the origin and relationships of the Dinocerata in 1898. In 1910 he published on a small uintathere skull from the Wind River Basin which is presumably *Bathyopsis*.

In 1923 Horace Elmer Wood II outlined a different theory of cusp nomenclature for the uintatheres, one which has since been universally accepted.

Harold Cook published in 1926 on a large uintathere from northwest Colorado which he called *Uintacolotherium*.

In 1929 the first discoveries of Paleocene uintatheres were announced: *Prodinoceras* from Mongolia (Matthew, Granger, and Simpson 1929) and *Probathyopsis* from Wyoming (Simpson 1929). In the latter paper Simpson elaborated upon Wood's views on uintathere relationships and dentition.

Osborn and Granger (1932) described a fine series of uintathere skulls and parts from the upper Eocene of Mongolia, which they called *Gobiatherium*.

Jepsen (1930) reported on a species of *Probathyopsis* from the lower Eocene of the Bighorn Basin.

Patterson (1939) reported on two new Dinocerata, the oldest yet found (Tiffanian) from the DeBeque formation or "Plateau Valley beds" of Mesa County, Colorado. *Bathyopsoides*, a rather advanced genus, and a species of *Probathyopsis* were described.

Recent discoveries have been reported by Dorr (1952, 1958), who found lower Eocene specimens of *Probathyopsis* in the Hoback Basin of Wyoming (see footnote 2 on p. 3). Gazin added a *Bathyopsis* from the lower Eocene beds of the west-central Bridger Basin (1952) and a questionable *Probathyopsis* from the upper Paleocene Almy formation in Lincoln County, Wyoming (1956). Kelley and Wood

(1954) described a *Probathyopsis* from the Lysite faunal zone of the Wind River Basin. K. K. Flerov (1952) described a new genus from Mongolia, *Mongolotherium*, and proposed a subdivision of the Uintatheres into three families. An abstract of some of the principle taxonomic conclusions presented in this Bulletin has been published (Wheeler 1955).

## GEOGRAPHIC AND STRATIGRAPHIC DISTRIBUTION

Uintatheres are known from only three states in North America—Wyoming, Colorado, and Utah—and from several localities in Mongolia. The general localities from which uintatheres have been collected in North America are shown in plate 1. Most of the known specimens of uintatheres, but only three of the nine known genera, come from the upper Bridgerian beds of the Bridger and Washakie Basins in southwestern Wyoming.

### STRATIGRAPHIC DISTRIBUTION OF THE KNOWN UINTATHERES

#### TIFFANIAN:

- DeBeque formation, Mesa County, Colorado
  - Bathyopsoides harrisorum* Patterson
  - Probathyopsis newbilli* Patterson
- Polecat Bench formation, Park County, Wyoming
  - Undescribed "*Bathyopsoides*" in Princeton Museum

#### CLARKFORKIAN:

- Polecat Bench (or Willwood?) formation, Park County, Wyoming
  - Probathyopsis praecursor* Simpson
  - Probathyopsis* sp. Jepsen
- Almy formation, Lincoln County, Wyoming
  - Probathyopsis?*, sp. Gazin

#### UPPER PALEOCENE, stage not certain:

- Gashato formation, Mongolia
  - Prodinoceras martyr* Matthew, Granger and Simpson

#### LOWER EOCENE, Wasatchian equivalent:

- No formation name given, Tsagan Ula region, Mongolia
  - Mongolotherium plantigradum* Flerov
  - Mongolotherium efremovi* Flerov

#### WASATCHIAN:

- Hoback formation, Sublette County, Wyoming
  - Probathyopsis successor* Jepsen<sup>3</sup>
- Willwood formation, Park County, Wyoming
  - Probathyopsis successor* Jepsen
- Wind River formation, Fremont County, Wyoming
  - Probathyopsis lysitensis* Kelley and Wood
  - Bathyopsis fissidens* Cope
- New Fork tongue, Knight formation, Lincoln County, Wyoming
  - Bathyopsis fissidens* Cope

#### LOWER BRIDGERIAN:

- Bridger formation, Sweetwater County, Wyoming
  - Bathyopsis middleswarti*, new species
- Huerfano formation, Huerfano County, Colorado
  - Bathyopsis* sp.

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<sup>3</sup> Now *Prouintatherium hobackensis* Dorr, 1958.

## UPPER BRIDGERIAN:

Bridger formation, Uinta and Sweetwater Counties, Wyoming

*Uintatherium anceps* (Marsh)

Washakie formation, Sweetwater County, Wyoming

*Uintatherium anceps* (Marsh)

*Tetheopsis speirianus* (Osborn)

## UINTAN:

Washakie formation, Sweetwater County, Wyoming

*Tetheopsis speirianus* (Osborn)

*Tetheopsis ingens* (Marsh)

*Eobasileus cornutus* (Cope)

Washakie formation, Moffat County, Colorado

*Eobasileus cornutus* (Cope)

Uinta formation, Uintah County, Utah

*Eobasileus cornutus* (Cope)

? *Uintatherium anceps* (Marsh)

## UPPER EOCENE, stage not certain:

Irdin Manha formation, Mongolia

*Gobiatherium mirificum* Osborn and Granger

Details of the stratigraphic occurrence of several of the uintatheres are given in the sections describing particular fossils. The stratigraphy of three of the uintathere-bearing formations (Bridger, Washakie, and Uinta) is more involved and is here discussed in some detail. A correlation chart (Chart 1) may be found on page 11.

## THE BRIDGER FORMATION

The Bridger formation was named by Hayden, who designated Church Buttes (a Bridger B badlands) as typical (Hayden 1869, p. 191). Previous to the present report no uintatheres were known from the lower Bridger formation; nevertheless, Marsh (1885b, p. 6) referred to the entire formation as the "*Dinoceras* beds." The first detailed stratigraphic study of the Bridger formation was done by Matthew and Granger and published in a sketch map in a memoir by Matthew (1909, plate 42).

These authors split the Bridger formation into five divisions which were designated by letters from bottom to top as A, B, C, D, and E (1909, p. 296). "For the more exact recording of the collections made by the American Museum parties, the horizons were further divided into five numbered levels corresponding to the basal, lower, middle, upper, and top levels of each horizon" (1909, p. 297).

The lettered members are delimited mainly by five thin resistant beds of fresh water chert or siliceous limestone called "white layers."

Upper White Layer—About 75 feet from the top of D

Lone Tree White Layer—Top of C

Burnt Fork White Layer—"about the middle of" C

Sage Creek White Layer—Top of B

Cottonwood White Layer—At the top of B3

Osborn (1909, p. 51) either miscopied or misunderstood the intentions of Matthew and Granger as to the nomenclature of these "white layers." He omitted



the Cottonwood White Layer entirely and called the Sage Creek White Layer by the name "Cottonwood White Layer." He later repeated this error (Osborn 1929, pp. 80 and 83). As Cottonwood Creek does not flow near the C member and Sage Creek Spring is right at the "white layer" which lies at the base of C, there was no lapsus on Matthew's part to justify Osborn's change.

These "white layers" are not always single nor are they always white. They range from completely calcareous to completely siliceous. They may be white, tan, or (if siliceous) bluish-grey. The silica may be nearly pure, distributed rather evenly through a calcareous mass, or may occur in blebs. The "white layer" may be a thin single bed as the Cottonwood White Layer on top of Church Buttes, double as the Upper White Layer on the southwest corner of Cedar Mountain (plate 5, fig. 3), or multiple as the Cottonwood White Layer along Little Dry Creek or the Sage Creek White Layer at Sage Creek Spring (Sinclair 1906, plate 38).

These "white layers" extend for a remarkable distance considering their thinness. The Cottonwood White Layer extends from Cedar Mountain almost to Church Buttes, over 30 miles. The other four named "white layers" are present around Sage Creek Mountain (Big Bone Buttes), Cedar Mountain (Henry's Fork Table), and Hickey Mountain (Henry's Fork Divide). Their identification on Twin Buttes is questionable. On Twin Buttes, a unit composed of whitish calcareous tuffs occurs at the level of the saddle between the two peaks (plate 3, fig. 3). However, it is not resistant and is certainly not like the true "white layers" of the western Bridger Basin. One of the "white layers" (Lone Tree?) shows these characteristics on the southwest side of Sage Creek Mountain (Sinclair 1906, plate 35 and this paper, plate 3, fig. 1).

The fact that such thin layers are so widespread shows that the Bridger formation must have been deposited on a broad and very flat flood plain which could support a broad but ephemeral lake from time to time.

The structure of the Bridger formation is simple. The beds are nearly flat-lying and there are no faults. Nevertheless, a study of exact stratigraphic horizons is hampered by the lack of topographic maps of the area. Determining position in stratigraphic section is materially aided by the resistance of the "white layers" which often cap escarpments (plate 4, fig. 1). These escarpments are easily traced and are shown on the map by Matthew and Granger (Matthew 1909, plate 42).<sup>4</sup>

Matthew (1909, p. 296) gives the thicknesses of the various divisions as A—200 ft., B—450 ft., C—300 ft., D—350 ft., and E—500 ft., a total of 1800 feet. Osborn (1909, p. 51) modifies this to 350 ft. of C and 375 ft. of D, giving 1875 feet. Matthew does not state where Granger took his measurements. It could not have been along the line of the cross-section because only the very top of unit A appears along it and he reports a complete thickness for that unit.

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<sup>4</sup> This map is marred by a rather strange cartographic error. The nine townships in the lower left hand corner of the map have been displaced one range to the west. This has brought the apparent position of Lonetree into the same range as Lyman (R. 114W.) whereas it actually lies in R. 113W. Because of this the streams from Black's Fork to Sage Creek appear to be much closer together on Matthew and Granger's map than they really are. The Lyman-Lonetree road is shown with a much bigger swing eastward north of Sage Creek Mountain than it actually has. The geographic features of Range 112 W. have been stretched out to fill the blank space that would have been left in R. 113W. The result is that Henry's Fork Table (Cedar Mountain) is shown as six miles longer than it really is. The scale of this map is 6 miles to the inch, but is incorrectly given as "2 miles equals 1 inch."

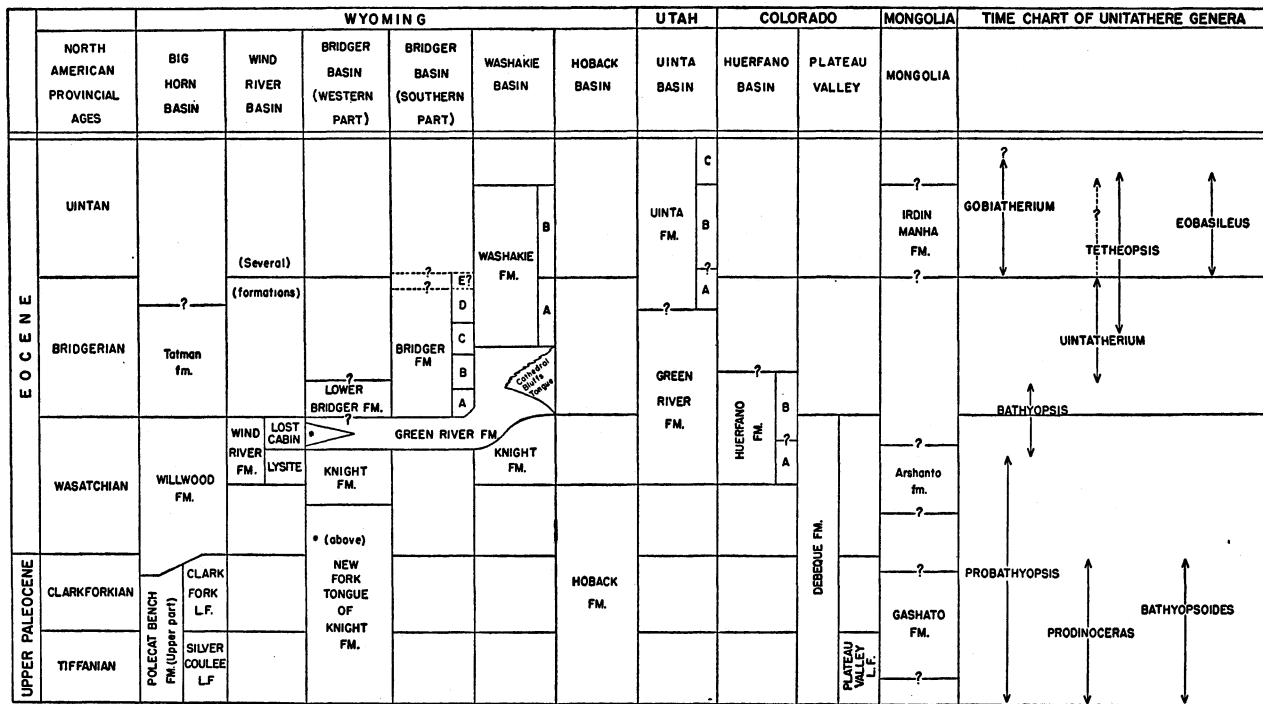


Chart 1. Correlation chart of uintathere bearing formations. Generic ranges shown to the right.

My own measurements of the Bridger formation indicate:

- E—500 ft. (West end of Cedar Mountain)
- D—300 ft. (West end of Cedar Mountain)
- C—300 ft. (estimated)
- B—700 ft. + (mostly Little Dry Creek)
- A—200 ft. + (Carter and Church Buttes rail station)

This is a total of 2000 feet. The difference obtained in total thickness is not significant, but they were surely low in their thickness for Division B.

On the south end of Twin Buttes I measured only 790 feet of Bridger between the top of the Green River formation which here underlies Division C and the base of the Bishop conglomerate overlying Division E. According to Matthew's section all of Bridger C-D-E is supposed to be present here, resting with slight disconformity on Green River formation. But this thickness contrasts with the 1100 feet for Divisions C, D, and E farther southwest. (See plate 3.)

The reason for the difference in thickness at Cedar Mountain and at Twin Buttes will not be known without detailed mapping, for the named key bed "white layers" could not be located with any certainty on Twin Buttes.

M. M. Fidler (1950) reports 1340 feet of Bridger formation in a deep well at the Church Buttes Gas Field northeast of Lyman, Wyoming. The surface member here is Bridger B. This shows a considerable thickening of the lower Bridger formation toward the northeast.

Bridger A has a large percentage of very thinly laminated "paper" shales which alternate with tuffs. Fresh water invertebrates are prolific whereas vertebrates are rare. The only identified mammalian fossil from this division is *Palaeosyops fontinalis* (Cope). This species is also known from the upper faunal zone of the Huerfano formation of Colorado (Osborn 1919, p. 559). Both Bridger A and Huerfano B are regarded as Bridgerian because of the presence of *Palaeosyops*.<sup>5</sup>

Divisions B, C, and D of the Bridger formation are lithologically very similar to one another. They are composed of fine-grained tan, grayish, or greenish tuffs which resemble clays or sandy clays, the "white layers" (fresh-water limestones and cherts), and green or tan channel sands (see Granger 1906). Division B has less of a greenish cast to the sands. With one exception, all the uintathere specimens from the Bridger formation have come from Divisions C and D (plate 4, fig. 3).

Division E is a gypsiferous red-banded unit carrying an extremely sparse vertebrate fauna (plate 4, fig. 2). According to Matthew (1909, p. 296), "The uppermost beds are very barren of fossils but a few fragmentary mammal remains sufficiently prove that they belong to the Bridger age." This assertion was essentially repeated by Osborn (1929, p. 85). But Osborn also said: "Bridger E is theoretically correlated with Washakie B and Uinta B. . . ." If it can be "proved" to be Bridgerian in age it cannot be correlated even theoretically with Uinta B. The Bridgerian or Uintan age of Bridger E is unproved and unknown.

Divisions A and E are thus separable by their distinctive lithology. Divisions B, C, and D are separable as lithologic units because of the "white layers," even

<sup>5</sup> The following genera are listed from Huerfano B (Osborn 1919, p. 558). The ages of other deposits in which they occur show:

Wasatchian: *Eotitanops*, *Eohippus*, *Bathyopsis* (small), *Didymictis*

Bridgerian: *Palaeosyops*, *Mesonyx*, *Trogosus*

Wasatchian or Bridgerian: *Eometarhinus*, *Hyrachyus*

The Huerfano B faunal zone would seem to be as much Wasatchian as Bridgerian, if not more so. The supposed Bridgerian age of Bridger A is not proved.

though they are not inherently different from each other. It is convenient that an important faunal break occurs approximately at the Sage Creek White Layer, separating Divisions B and C (see Osborn 1929, p. 84). This has led H. E. Wood II to designate Bridger A-B of Matthew as the Black's Fork member, and Bridger C-D as the Twin Buttes member. The two members have similar lithology, but the Sage Creek White Layer, which forms a conspicuous bench, serves as a mappable boundary between the two members. The beds of Division E have not been given a formal name.

*Uintatherium anceps* remains are abundant in Bridger C and D. One specimen of a new species of *Bathyopsis* has been found in the lower Bridger (see pp. 24-25 of this report).

#### THE WASHAKIE FORMATION

The Washakie formation was named by F. V. Hayden in 1869 (p. 190). He referred to it as the "Washakee group," but later changed this to "Washakie group" (Hayden 1871, p. 71). The Washakie formation is the youngest formation of the Washakie Basin, a structural basin noted for its many encircling cuestas. "Washakie Basin" is a geologist's term and is unknown to the residents of the area.

The pioneer report on details of the Washakie formation was by John B. McMaster, who led the Princeton Expedition of 1878. McMaster's measured section of Washakie totals 638 feet, if his Bed 28 is regarded as 20 feet thick. The thickness of this bed was omitted from his report because of a typographical error (McMaster 1881, pp. 52-54 and plate 6).

Granger published the most extensive description of the Washakie formation available to date (1909). He shows a measured section and cross-section through Haystack Mountain.<sup>6</sup> Granger divided the formation into two "horizons": a lower, Washakie A, and an upper, Washakie B, drawing the boundary between his units 11 and 12 (1909, pl. 7, fig. 1). He then adds: "It is possible that strata Nos. 12 and 13 (55 feet) should be included in the lower horizon" (Granger 1909, p. 21). He had stated (*ibid.*, p. 20): "Stratum No. 11, a nearly white sandy shale, was selected, for the purpose of field labelling, as dividing the lower from the upper beds. . . . Fossils found immediately below stratum No. 11 . . . pertain to that phase of the fauna which more nearly resembles the fauna of the Bridger, while the . . . fossils . . . about 60 feet above the datum plane, pertain to the Uinta phase." From these citations we can see that Granger was attempting to settle on some logical place to draw a line between the strata containing two faunas.

On the eastern end of Haystack Mountain, the very local key bed he selected is resistant, bench forming, and accentuated by the whiteness of the lowermost beds of Washakie B above it. Presumably, it is also near the middle-upper Eocene faunal change. But this marker bed lacks sufficient lateral extent to serve as a mappable horizon between two lithological members.

Granger's measured section of the Washakie formation is 642 feet thick, which is essentially the same as McMaster's total. This is sheer coincidence, as the two

<sup>6</sup> Morris (1954) writes, "The upper part of the Washakie formation has been eroded into a long ridge, named Mammouth Buttes, which is convex toward the north. Haystack Mountain, marking the eastern end of this east-west ridge. . . ." This is the terminology used by Cope (1873e) in his interesting but rather grandiose popular description of his explorations on Haystack Mountain. It is my belief that Haystack Mountain is preferable to Mammouth Buttes as the name of the highest eminence of the Washakie Basin. It is the name used by Bradley in his map of the Washakie Basin (1945) and is the name used by the local residents.

figures were arrived at differently. Granger states: "The thickness of the sediments described [by McMaster] is given as about 700 feet, but there is an error in the joining of two of his sections taken at different localities; one section partly duplicating the other instead of their forming one continuous section as he states." The 700 feet is a figure given by McMaster (1881, p. 51), but it is not the sum of the thicknesses of his smaller units, a figure which McMaster does not mention. Granger has assumed that this larger figure of McMaster's is due to the conjoining of sections which really partially overlap, but it is actually due to an arithmetic error in the figure stated by McMaster.

The location of McMaster's section 2 is only vaguely given but apparently he regarded the lower beds of the Washakie formation as "probably transition[al] from the Green River to the Bridger . . ." (McMaster 1881, p. 48). This may have compensated for the lengthening of the section cited by Granger.

Granger's statement that "the dip averages 6°" does not correspond with his rather low measurement of 267 feet of Washakie A. Applying a dip of 6° to the strata between beds 1 and 12 on Granger's cross-section gives (trigonometrically) a thickness of 1280 feet. Calculated the same way, my measurement of 2° would give 430 feet.

There is a wide vale between the outer cuesta of lower Washakie A and the base of Haystack Mountain. This vale is generally two to three miles wide, but, according to Granger, the outer cuesta "approaches to within a mile of the base of the mountain . . ." (Granger 1909, p. 18). One mile of flat ground will present 185 feet of beds which dip at 2°. There is no such covered interval given in Granger's section.

These two features of Granger's section lead one to suspect that while he recognized that the beds had a dip he did not adjust for it in the actual measurement of the section. If this is so, the Washakie formation, as measured from the old Overland Trail to the top of Haystack Mountain, is thicker than Granger represents. My own measurements, which were also taken near the eastern end of Haystack Mountain, confirm this (plate 5, fig. 1, and plate 6, fig. 1).

Washakie B		Feet	
Washakie A			540
	Base of Haystack Mountain	200 ft.	
	Covered—estimated	200 ft.	
	Beds in and near outer cuesta	220 ft.	620
			<hr/>
	Total thickness about		1160

I concur with William Morris (oral communication) that Washakie A and Washakie B horizons are not sufficiently distinctive to warrant the status of members, nor is there any persistent mappable bed dividing the faunal zones. The lettered horizons of the Washakie formation are faunal zones (whereas the lettered horizons of the Bridger formation are lithologic members).

The geology of the outer parts of the basin has been described by Bradley (1945). He noted that the Washakie formation overlies the Green River formation conformably. The Green River-Washakie contact is transitional and the base of the Washakie formation is arbitrary. The two formations are nevertheless distinct, and no one would confuse their main masses.

A question still remains as to whether the post-Green River Eocene deposits of the Washakie Basin should be called Washakie formation or Bridger formation.

The rock term, Bridger formation, is firmly associated with the middle Eocene (Bridgerian) age. The rock term, Uinta formation, is firmly associated with the earlier of the two ages of the upper Eocene (Uintan). The sediments of the Washakie Basin are intermediate between the typical Bridger and Uinta formations in both geographic position and time (plate 1 and chart 1). The Washakie formation is one bead in a chain of large outcrop areas which are separated by relatively short distances and are obviously part of an original continuum of sedimentary strata inclined to time surfaces. The Washakie problem is part of a larger one involving all of the post-Green River Eocene deposits. The lacustrine Green River formation and the overlying fluvial materials transgress upward across time surfaces as one goes clockwise around the flanks of the Uinta Mountains through the Bridger, Washakie, Sand Wash, Piceance Creek, and Uinta Basins (see plate 1).

If one name suffices for the lower dominantly lacustrine deposits (Green River fm.), then it might be logical to consider all the overlying dominantly fluvial deposits as one formation (Bridger?). This has been essentially the practice in the United States Geological Survey publications as typified by Bradley (1931, 1945).

Picard (1957) has presented several cogent reasons for not extending the term Bridger formation to include any of the sediments south of the Uinta Mountains. Here Bradley had used Bridger formation for the present Uinta A plus B and Uinta formation for the present Uinta C. Picard's arguments pertain mainly to the use of one formation name rather than two. Nevertheless, he chose to use Uinta formation as the name for the entire post-Green River Eocene sequence in the Uinta and Piceance Creek Basins. Other workers have chosen the same point of view (Dane 1954, Cashion and Brown 1956).

With the strata in the Bridger Basin referred to the Bridger formation and the strata in the Uinta and Piceance Creek basins referred to the Uinta formation, the problem of the name for the beds in the Washakie Basin (and the related small Sand Wash Basin) remains.

These beds have never been referred to the Uinta formation, and there is not sufficient lithologic similarity to justify such a move. Their referral to the Bridger formation deserves consideration, however.

According to current opinion, Washakie A was deposited during upper Bridgerian time (Bridger C + D) and Washakie B was deposited during lower Uintan time (Uinta A + B). Washakie A does not lithologically resemble any of the Bridger formation. Washakie B has some resemblance to the upper Bridger, but very little to the Uinta B with which it is correlated.

Because the post-Green River Eocene strata are geographically and lithologically distinct from both the Bridger and Uinta formations, and because Bridger and Uinta are chronostratigraphic as well as lithostratigraphic names, and because there are both Bridgerian and Uintan elements in the faunas, it is best to refer these beds to a separate formation, the Washakie. This is the usage of Morris (1954) in an article dealing chiefly with the lower Eocene Knight formation.

*Uintatherium* is an abundant fossil in certain areas of the Washakie A faunal zone (plate 6). *Eobasileus*, a rare fossil, is known from Washakie B. The few known specimens of the genus *Tetheopsis* are all from the Washakie formation, occurring in both faunal zones.

## THE UINTA FORMATION

The Uinta formation of northeastern Utah was named by Comstock in 1875 and clarified by King and Emmons in the same year. The rather complex earliest history of this name is explained by H. E. Wood (1934, p. 242-244).

King probably had only the higher level (present Uinta C or Myton member) in mind when he defined the term, Uinta formation. Peterson considered the entire sequence as divisible into three "horizons," designated alphabetically from bottom to top as A, B, and C (in Osborn 1895, p. 72-74). Peterson gave brief lithologic definitions: A—hard brown sandstones and shales . . . 800 ft., B—soft, coarse sandstones and clays . . . 300 ft., C—ferruginous, brown and red sandstones and clays . . . 600 ft. Osborn (1895) gave faunal lists for each "horizon."

As Peterson begins his description of the C "horizon" he says, "We now reach the *true Uinta* [*italics Peterson's*]. . .". He then cites the reference to King (1878). Neither Peterson nor Osborn actually commit themselves as to whether or not the A and B "horizons" are part of the Uinta formation.

The Uinta A sequence as understood today is only the lower part of the original Uinta A as defined by Peterson. Osborn (1929, p. 91-93) restricted the term "Uinta A" to the lower part of the original "Uinta A"; that is, to the "Lower *Metarhinus* zone" of Riggs (1912). Osborn also placed the upper part of the original Uinta A (Upper *Metarhinus* zone of Riggs) in Uinta B as Uinta B<sub>1</sub>. The original Uinta B was amended to be Uinta B<sub>2</sub>.

Bradley (1931) and Hunt (1956) of the U. S. Geological Survey restrict the term Uinta formation to the upper or Uinta C sequence. They refer the underlying post-Green River pre-Uinta C sequence to the Bridger formation.

In 1932 Peterson (at W. B. Scott's suggestion) proposed the name Duchesne formation for the redbeds previously regarded as the upper part of Uinta C (Peterson 1932, p. 61). The name was preoccupied and J. Leroy Kay proposed (also at W. B. Scott's suggestion) the name Duchesne River formation to replace it (Kay 1934, p. 294).

Dane (1954) not only confirms the inclusion of all of the original A "horizon" as Uinta formation, but notes that "the saline facies of the western sections, hitherto regarded as a phase of the Green River formation, is stratigraphically, and in time, approximately equivalent to the lower part of the Uinta formation in the eastern sections." These beds of the "saline facies" were "formerly considered a saline facies of the [underlying] Green River formation."

The three divisions of the Uinta formation, even as amended, are lithologically different, though the contacts are transitional. Division A consists of hard, tan, massive brown sandstones with minor amounts of shale and conglomerate. Its meager fauna associates it with Uinta B. Division B is formed mostly of alternating beds of tan sandstone and greenish-gray shales and sandy mudstone. Its fauna is correlated with that of the Washakie B faunal zone. Division C includes conspicuous amounts of lenticular sandstone masses. (See Osborn 1929, p. 92). H. E. Wood named Uinta A + B the Wagonhound member and Uinta C the Myton member (Wood 1934, p. 242). He says that these members are "rather distinct from each other geographically as well as faunistically." Though the Uinta subdivisions were originally proposed with one eye on the mammalian faunas, they also have objective lithostratigraphic validity.

One fragment of a *Uintatherium?* humerus and a skull of *Eobasileus* have been found in Uinta B<sub>1</sub>. Several *Uintatherium?* bones have been collected from Uinta B<sub>2</sub>. Another *Eobasileus* skull came from Uinta B, numerical subdivision unknown (see p. 45-46 and p. 53-54 of this report).

## TAXONOMY

### SUPERGENERIC TERMS

The following supergeneric names have been applied to uintatheres

Tinoceridae	Marsh 1872c, p. 323
Dinocerea	Marsh 1872d, p. 344
Eobasiliidae	Cope 1873a, p. 563
Dinocerata	Marsh 1873a, p. 117
Tinoceratidae	Marsh 1873b, p. 295
Eobasileidae	Cope 1873d, p. 3 or 293
Uintatheriidae	Flower 1876, p. 387
Sphaleroцерatinae	Brandt 1878, p. 18
Dinoceratidae	Zittel 1893, p. 439
Bathyopsidae	Osborn 1898, p. 182
Uintatheroidea	Tilney 1931, p. 435
Prodinoceratidae	Flerov 1952, p. 1029
Gobiatheriidae	Flerov 1952, p. 1032

All of the above terms except the last two and Bathyopsidae were meant to refer to all uintatheres.

The first family name proposed for uintatheres was Marsh's "Tinoceridae." As family names are based on plural stems, Marsh amended this to "Tinoceratidae." The genus *Tinoceras* is a synonym of *Uintatherium* and this family name is therefore inappropriate.

Marsh was quick to regard the uintatheres not only as a new family, but as a new order. For this order he proposed the name "Dinocerea." As with family names, ordinal names should be based on plural stems, so he soon improved the name to Dinocerata. As Simpson stated (1945, p. 242), "The correction has been universally allowed, and there is no impelling reason for returning to the first spelling. The name has always included the forms now placed here and no others, so that its applicability is not open to question." This lack of an excuse for changing the name is unfortunate. It is based on an invalid genus and furthermore, any person except one of the cognoscenti will confuse the word with "Dinosauria." An ordinal name based on the genus *Uintatherium* would be far better.

Cope, of course, proposed a family name of his own, Eobasiliidae, which he soon corrected to Eobasileidae. (Cope thought for a long time that the uintatheres were Proboscidea, and did not propose an ordinal name to oppose Marsh's Dinocerata.) *Eobasileus* is a valid genus and the name Eobasileidae stands as the first valid family name proposed for the uintatheres. Hay so recognized this fact in his second bibliography (1930, p. 617).

Nevertheless the family name which has been used by most subsequent workers is Uintatheriidae, named by Flower after the valid genus *Uintatherium*. The choice is between Cope's prior but seldom used Eobasileidae and Flower's subsequent but commonly used Uintatheriidae.

The rules of priority are not compulsory when applied to names of ranks higher than genera. Here it would be confusing rather than clarifying to use the prior name. For these reasons Uintatheriidae is the best family name for the group.



Sphaleroceratinae was proposed by Brandt, who regarded the uintatheres as a subfamily of rhinoceroses. The name has no standing in nomenclature because it was not based on any generic name.

Osborn proposed Bathyopsidae to include the genus *Bathyopsis*. Hay placed the Bathyopsidae in the Pantodonta (1902, p. 700), but this was undoubtedly either an error in printing or a lapsus of some sort.

Zittel's "Dinoceratidae" is based on an invalid genus. Tilney used the etymologically incorrect "Uintatheroidea" in a paper which dealt with fossil brains. His reason for attempting a superfamily designation is unknown.

A division of the uintatheres into three suprageneric groups is convenient and necessary. Flerov's (1952) proposal to place the uintatheres in three families (Prodinoceratidae, Uintatheriidae, and Gobiatheriidae) was most timely. That such a division was not proposed sooner is surely due to the extraordinary conservatism of the uintathere molars. This conservatism can be expressed taxonomically by placing these three groups at a lower rank.

My preference is to divide the uintatheres into three subfamilies: Bathyopsinae, new rank (=Bathyopsidae Osborn, 1898) to include all the earlier small to medium-sized American and Asian Dinocerata; Uintatheriinae, new rank (=Uintatheriidae in the restricted sense of Flerov 1952) to include the large, deep-skulled American forms of the middle and upper Eocene; Gobiatheriinae, new rank (=Gobiatheriidae Flerov, 1952) to include *Gobiatherium*.

The separation of the more primitive uintatheres into a subfamily seems reasonable and useful. I prefer Osborn's Bathyopsidae to Flerov's Prodinoceratidae. Bathyopsidae has 54 years of priority. In his Prodinoceratidae, Flerov included *Prodinoceras*, *Probathyopsis*, *Mongolotherium*, and *Bathyopsoides*, but excluded *Bathyopsis* (which he placed in the Uintatheriidae). *Probathyopsis* cannot be reasonably placed in a different family from *Bathyopsis*. The earlier Asian and American uintatheres are simply not sufficiently different to warrant suprageneric separation, at least not on the basis of present knowledge.

The possibility exists that the Pantodonta, Dinocerata, and Xenungulata are suborders of a natural order for which the rather battle-scarred name Amblypoda is available. (See Patterson 1939, p. 352 for a statement on the original usage of the term.) Further discussion is given on p. 75-76 of this report.

## SYSTEMATIC DESCRIPTIONS

### ORDER DINOCERATA MARSH

Large,<sup>7</sup> primitive, archaic mammals with short five-toed feet. Carpus and tarsus alternating. Astragalus flattened with cuboid facet broad and facing distally, neck and head of astragalus absent or poorly defined. V-shaped crest on upper P<sup>3</sup>-M<sup>3</sup> with protocone at apex of V. Lower cheek teeth with a prominent metastylid, an antero-internally extending hypoconid loph, and a posterior talonid crest; lacking a hypolophid; paraconid vestigial. No upper incisors. Femur lacking third trochanter; fibula not articulating with calcaneum; infraspinous fossa of scapula very large.

<sup>7</sup> Even the smallest uintathere genera were large mammals for their time.

## FAMILY UINTATHERIIDAE FLOWER

Characters same as for order.

## SUBFAMILY BATHYOPSINAE

New rank (=Bathyopsidae, Osborn 1898)

Small to medium-sized American and Asian Dinocerata of the upper Paleocene, lower Eocene, and lower part of the middle Eocene. Skulls not notably deep, with or without sagittal crests. Hornlike protuberances absent or small. Tiny paraconid crest present primitively; lacking in higher forms. Talonids primitively with an entoconid distinct from remainder of posterior talonid loph and with crests on the entoconid and hypoconulid; otherwise with entoconid as integral part of posterior talonid loph and without said crests. Lower canine caniniform. Tail long. Three sacral vertebrae. Upper incisors present. (The last three characters are based on Flerov's *Mongolotherium*.)

*Probathyopsis* Simpson

Simpson, 1929

TYPE SPECIES: *Probathyopsis praecursor* Simpson

DIAGNOSIS: Small uintathere, P<sup>2</sup> with metacone indistinct and ectoloph nearly parallel to the cheek-tooth row. Protocones project farther medially than hypocones. Lower molars elongate with strong paraconid crest and less developed talonid crest. Hypoconulid crest present, entoconid distinct. Upper canine flattened, blade-like.

DISTRIBUTION: Upper Paleocene and lower Eocene of the Big Horn Basin of Wyoming, Upper Paleocene of Plateau Valley of Colorado, lower Eocene of the Hoback Basin, Wyoming, and of the Wind River Basin, Wyoming.

*Probathyopsis praecursor* Simpson

Simpson 1929, pp. 1-2

HOLOTYPE: AMNH 16786

DISTRIBUTION: Upper Paleocene of Big Horn Basin of Wyoming.

DIAGNOSIS: Entoconid of M<sub>3</sub> large, possessing a small antero-medially directed crest, and forming a part of the posterior talonid crest. Hypoconulid crest weak and directed anteriorly. First molar proportionately large. Parastyles small. Cingulum encircling protocone. Talonid narrow. No prominent ridge on posterior flanks of molar lochs.

DISCUSSION: The holotype was found "at the head of Big Sand Coulee," Big Horn Basin, Wyoming, in the Clark Fork faunal zone. It includes a pair of lower jaws with the left canine, right P<sub>4</sub>, talonids of both second molars, both third molars; the right P<sup>2</sup>, left P<sup>3</sup>, both upper second molars, and the posterior half of the right M<sup>3</sup>. Of the upper teeth only the right M<sup>2</sup> is in bone. The lower jaw is notable for its small size, rounded symphysis, rudimentary inframandibular process, and the large round mental foramen beneath the canine. The lower jaw has been damaged in the region of the diastema. If P<sub>1</sub> was present it was not large. The specimen is figured by Simpson (1929, pp. 1-2) and on plate 13, fig. 1 of this report.

Another specimen, AMNH 16984, from the Clark Fork faunal zone of the Big Horn Basin, consists of left P<sup>4</sup>, M<sup>1</sup>, and M<sup>3</sup> (figured by Simpson).

*Probathyopsis successor* Jepsen

Jepsen 1939, pp. 128-130, plate 4, figs. 8-11

HOLOTYPE: PUM 13234

DISTRIBUTION: Lower Eocene, Gray Bull faunal zone, Big Horn Basin, Wyoming and lower Eocene part of the Hoback formation, Hoback Basin, Wyoming.

**DIAGNOSIS:** The entoconid of  $M_3$  is large, lacks a crest, and forms part of the posterior talonid crest. The hypoconulid crest is weak and is directed antero-medially. The wide talonid is rounded posteriorly. There are no parastyles. The cingulum encircles the protocone. The first molar is not proportionately large or small. Upper molars have a prominent ridge on the posterior flank of the posterior loph. The cingulum is complete on all upper cheek teeth except where this ridge intersects it.

**DISCUSSION:** The holotype was found in lower Gray Bull beds, T55N, R101W, Sec. 2, Park County, Wyoming. The right  $P^{2-3}$ , left  $P^4-M^3$ , an upper canine, three lower incisors and a lower canine, and an incomplete right  $M_3$  are present. The lower canine is smaller than in *P. praecursor*. Except for these isolated teeth, there is no lower jaw in this specimen.

The prominent ridge on the posterior flank of the posterior loph of the molars is probably an individual variant.

Two uintathere lower jaws were collected from the lower Eocene part of the Hoback Basin, Wyoming, by J. A. Dorr in the summer of 1950. Dorr (1952, p. 89) refers these specimens to *P. successor* because of the identity of the upper cheek teeth. The better specimen (UMMP 27249) is a nearly complete left lower jaw with isolated cheek teeth and canines. This lower jaw is especially significant because the inframandibular process is well developed, unlike the condition in the holotype. The second specimen (UMMP 27250) is an incomplete left lower jaw with an  $M_2$ , right lower jaw with an  $M_3$ , and a fragment with right  $P^2-M^3$ , and isolated teeth.<sup>8</sup>

#### *Probathyopsis lysitensis* Kelley and Wood

Kelley and Wood 1954, pp. 356-357

**HOLOTYPE:** Amherst 11167

**DISTRIBUTION:** Lower Eocene, Lysite faunal zone, Wind River Basin, Wyoming.

**DIAGNOSIS:** According to Kelley and Wood "this species is referable to *Probathyopsis*, [but] it is more advanced than any other described species, especially in the reduction of the protolophid and the character of the heel of  $M_3$  in which it is approaching *Bathyopsis*" (1954, p. 357).

**DISCUSSION:** The specimen consists of isolated left  $P_4$ ,  $M_1$ ,  $M_3$ , and talonids of  $M_2$ s and external fragment of the right  $M_1$ . It was found at the type locality of the Lysite member of the Wind River formation. This member is younger than the Gray Bull zone of the Big Horn Basin which contains *Probathyopsis successor* and is older than the Lost Cabin member in the Wind River Basin, which contains *Bathyopsis fissidens*.

Kelley and Wood present a convincing case for the intermediate position of *P. lysitensis* between these two species. They note that the  $M_3$  "resembles *Bathyopsis* in the less rounded outline of the posterior portion of the heel, and the more externally placed hypoconulid" (1954, p. 357). The molars of *Probathyopsis* are distinctly more elongate than those of *Bathyopsis*. In this connection they (1954, p. 356) have stated that the  $M_1$  is "much smaller than in *Bathyopsis* and proportionately narrower."

#### *Probathyopsis* sp. Jepsen

Jepsen 1930, p. 129

**DISTRIBUTION:** This problematical specimen (PUM 13378) was found east of Little Sand Coulee near its mouth in the Clark Fork faunal zone, Polecat Bench Formation, Park County, Wyoming.

<sup>8</sup> Dorr (1958) has proposed a new genus and species, *Prouintatherium hobackensis*, for these specimens from the Hoback Basin. His paper appeared after the completion of this manuscript.

DIAGNOSIS: Entoconid of  $M_3$  large, possessing a small anteromedially directed crest, and completely separate from the posterior talonid loph. Hypoconulid crest very strong and directed anteriorly.

DISCUSSION: Jepsen's mention of this Clark Fork fragment reads (1930, p. 129): "An undescribed species in the Princeton Collection from the Clark Fork is much like *P. praecursor*, and less similar to the species herein described, the lower teeth of the three specimens making, as far as can be ascertained, a superb example of an evolutionary sequence, (1) *P. sp.* (Clark Fork), (2) *P. praecursor* (Clark Fork), (3) *P. successor* (Gray Bull)." I agree entirely with this proposed evolutionary sequence.

The specimen consists of a left premolar (either  $P^3$  or  $P^4$ ) and the talonid of a right third molar. The third molar has a large entoconid which is widely separated from the posterior talonid loph. With the possible exception of the holotype of *Prodinoceras martyr*, this is the only uintathere specimen where this is the case. As in *Probathyopsis praecursor*, the entoconid has a crest.

The premolar shows the hypoconulid crest and prominent paraconid crest, typical of *Probathyopsis*. It is unfortunate that more is not known of this primitive form.

#### *Probathyopsis sp.* Gazin

Gazin 1956, p. 16

DISTRIBUTION: These specimens (USNM 21283 and 21284) were collected from beds of Clark Fork age in the Almy formation about seven miles west of LaBarge, Lincoln County, Wyoming.

DISCUSSION: These two upper premolars ( $P^3$  or  $P^4$ ) are of uncertain affinities. As Gazin states, they are comparable to molars of *Bathyopsoides* though occurring in somewhat younger beds. It would be equally logical to extend the range of *Bathyopsoides* and place them in that genus.

#### *Probathyopsis newbilli* Patterson

Patterson 1939, pp. 378-381

HOLOTYPE: CNHM P15549

DISTRIBUTION: Upper Paleocene of the "Plateau Valley beds," DeBeque fm., Mesa County, Colorado.

DIAGNOSIS:  $M_3$  not known. First molars proportionately small. Parastyles prominent. Cingulum not encircling protocone. Teeth relatively wide. Hypoconid crest extending onto the flank of the metastylid.  $P_1$  present. Diastema very small.

DISCUSSION: The holotype is the only known specimen showing even a moderately complete dentition. It is from an immature animal, as the third molar had not yet erupted. The permanent premolars are present, however. An  $M^1$  of a paratype is the only known upper tooth from this species. The  $M_2$  has no entoconid. Since it usually shows the minor features of the  $M_3$  in a subdued manner, the latter probably lacked a strong entoconid. This species is quite distinct from both *P. praecursor* and *P. successor* and is not closer to one than to the other.

#### *Prodinoceras* Matthew, Granger, and Simpson

Matthew, Granger, and Simpson 1929

TYPE SPECIES: *Prodinoceras martyr* Matthew, Granger and Simpson.

DISTRIBUTION: Upper Paleocene, Gashato formation of the Gurban Saikhan Basin, Mongolia.

DIAGNOSIS: Small uintathere.  $P^3$  with metacone relatively distinct and ectoloph turned inward anteriorly at  $45^\circ$  to the tooth row.  $P^3$ - $P^4$  with distinct ectoloph. Cingula interrupted at protocone. Hypocones internal to protocones. Upper canine stout and nearly straight with sharp anterior and posterior edges. Entoconid of  $M_3$  probably separate from posterior talonid loph. Lower jaw otherwise unknown except for isolated cropping teeth.

*Prodinoceras martyr* Matthew, Granger and Simpson

Matthew, Granger, and Simpson 1929, pp. 9-11

HOLOTYPE: AMNH 21714

DISTRIBUTION AND DIAGNOSIS: Same as for genus.

DISCUSSION: The species is known chiefly from the holotype which consists of a palate, upper cheek teeth and canines, anterior part of the right zygoma, two associated cropping teeth, and the poorly preserved heels of the lower third molars. Flerov (1952) reports parts of teeth and bones of postcranial skeleton from the same deposit. The right  $P^2$  is basined whereas the left  $P^2$  is not (Jepsen 1930, p. 129). The zygoma is weaker and less bowed than that of *Bathyopsis*. Its anterior end is cylindrical and attaches to the muzzle without the brace that extends forward from the point of attachment in all other known uintathere skulls.

The heels of the lower third molars have both been damaged. But from the two of them one can reconstruct the probable structure of the trigonid. On the left  $M_3$  there is a strong hypoconid crest. On the right  $M_3$  there seems to be an entoconid, which is separate from the posterior talonid crest but connects with it indirectly by meeting the hypoconulid crest posterior to the hypoconid crest.

None of the characters observed in *Prodinoceras* gives any clue as to whether it would be a better ancestor for *Gobiatherium* than any of the American Paleocene forms.

*Bathyopsoides* Patterson

Patterson 1939

TYPE SPECIES: *Bathyopsoides harrisorum* Patterson

DISTRIBUTION: Upper Paleocene of the "Plateau Valley beds" (DeBeque fm.), Mesa County, Colorado. Upper Paleocene (Tiffanian), Polecat Bench formation, Big Horn Basin, Wyoming.

DIAGNOSIS: Medium-sized uintathere.  $P^2$  with relatively distinct metacone. First molars relatively small. Entoconid of  $M_3$  small, but possessing a small antero-medially directed crest.  $M_3$  with strong hypoconulid crest present, directed anteriorly. Lower incisors with small posterior heels; lower canine considerably larger than incisors. Prominent sagittal crest, no parietal horns. Diastema longer than in *Probathyopsis* or *Prodinoceras*, about as in *Bathyopsis*. Jaw with deep inframandibular process sloping evenly backward and upward to the angle.

*Bathyopsoides harrisorum* Patterson

Patterson 1939, pp. 373-378

HOLOTYPE: CNHM P15546.

DISTRIBUTION AND DIAGNOSIS: Same as for genus.

DISCUSSION: This genus and species is unusually large for so early a form. It is striking also for its well-developed canines, the long and deep inframandibular flange, and the sagittal crest. This last feature is unique among known uintathere skulls, but it should be remembered that the skulls of *Probathyopsis* and *Prodinoceras* are unknown. A few skeletal remains are known of this form (Patterson 1939, p. 377): two incomplete vertebrae, the proximal end of an ulna, and an unciform. Patterson characterizes the unciform as approaching that of contemporary Pantodonta.

An undescribed lower jaw of this genus was found in 1950 by a Princeton University expedition in the upper Paleocene of the Big Horn Basin.

*Mongolotherium* Flerov

Flerov 1952, pp. 1029-1032

TYPE SPECIES: *Mongolotherium plantigradum* Flerov.

DISTRIBUTION: Lower Eocene horizons in the Tsagan Ula region, Southern Gobi, Mongolia.

DIAGNOSIS: Medium-sized uinatheres with very prominent sagittal and occipital crests. Upper part of occipital region overhangs posteriorly and extends well to the rear of the foramen magnum. Upper incisors present. Prominent diastema between canines and molars. Entoconid distinct and large. No horns or arched nasal bones.

*Mongolotherium plantigradum* Flerov

Flerov 1952; 1957, pp. 138-139.

HOLOTYPE: Coll. PIN No. 533-117.

DISTRIBUTION: Lower Eocene, upper horizon (=Wind River) at Naran Bulak in the Tsagan Ula region, Southern Gobi, Mongolia.

DISCUSSION: *Mongolotherium* is the most recently described uinathere genus. K. K. Flerov of the Institute of Paleontology of the Academy of Sciences of the U. S. S. R. described the genus and species from 10 skulls, 17 lower jaws, separate bones of the postcranial skeleton and numerous fragments.

In three respects it greatly resembles *Bathyopsoides*, from the upper Paleocene of Colorado and Wyoming. Both have a prominent sagittal crest, their lower jaws are shaped much the same, and both have a rather primitive type uinathere lower molar with a separate entoconid, despite the fact that both genera are large for their time. I do not agree with Flerov's statement (1952, p. 1031) that the lower jaw resembles that of *Uinatherium*.

*Mongolotherium* has upper incisors, a condition not known for any uinathere reported previously. However, this delicate anterior portion of the skull has been missing in all other small *Bathyopsinae* found so far. The larger species, *Bathyopsis middleswarti*, had no upper incisors. Presence of upper incisors may well be the usual condition in the earlier *Bathyopsinae*. Also *Mongolotherium* has a long tail (one-third of the whole length of the spine according to Flerov). This is probably true of the other *Bathyopsinae* as well, and contrasts with the condition in *Uinatherium*, which has a relatively short tail.

*Mongolotherium efremovi* Flerov

Flerov 1957, pp. 37-38, figs. 1, 2, 5, 10, 12-15, 27

HOLOTYPE: Coll. PIN No. 534-47

DISTRIBUTION: Lower Eocene, lower horizon (=Gray Bull) at Ulan Bulak in the Tsagan Ula region, Southern Gobi, Mongolia.

DISCUSSION: Flerov's important paper on *Mongolotherium* did not come into the hands of the author until this bulletin was in the late stages of editorial revision. As a consequence, no comparisons with *M. efremovi* have been attempted. Specimens ascribed to this species, including the holotype skull, are well illustrated by Flerov's (1957) paper. The plantigrade condition of the feet of the primitive uinatheres is shown in his fig. 20.

*Bathyopsis* Cope

Cope 1881a, p. 75

TYPE SPECIES: *Bathyopsis fissidens* Cope

DISTRIBUTION: Lower Eocene of the Wind River Basin and of western part of Bridger Basin, Wyoming. Middle Eocene (? lower Bridgerian) of the Bridger Basin of Wyoming. Possibly from the lower Eocene (or middle Eocene) of the Huerfano Basin, Colorado.

DIAGNOSIS: Small to medium-sized uinathere. Trigonids high, small  $P_1$  present. Metastylid strong and closely appressed to trigonid. Entoconid not notably distinct. No hypoconulid crest. Paraconid crest much reduced. Jaws very deep with strong inframandibular process sloping evenly backward and upward to the angle. Lower molars not as elongate as in *Probathyopsis*.

Cranial table only slightly basined, horns rudimentary. Skull not deep. Temporal fossa visible from above. No sagittal crest.

*Bathyopsis fissidens* Cope

Cope 1881a, p. 75

Cope 1881b, pp. 194-196

Cope 1885a, pp. 596-600, plates 29A, figs. 1-3 and 58a, fig. 1

Osborn 1913

Gazin 1952, pp. 64-65

HOLOTYPE: AMNH 4820

DISTRIBUTION: Lower Eocene (Lost Cabin faunal zone) of the Wind River Basin, Wyoming, and of the New Fork tongue of the Knight formation, Bridger Basin, Wyoming.

DIAGNOSIS: The skull referred to *Bathyopsis fissidens* is distinguished from that of *B. middeswarti* by the much smaller size, relatively narrower occiput, and the elongate maxillary horns.

DISCUSSION: The holotype consists of a lower jaw lacking the anterior part of the symphyseal region and the cropping teeth, the angles and ascending rami, the  $P_1$ s and the heel of the left  $M_3$ . The cheek teeth are very well preserved. This specimen, the holotype of *Probathyopsis newbilli*, and an anomalous specimen of *Uintatherium anceps* (YPM 11194) are the only known uintatheres which possessed a  $P_1$ . It is not preserved in *B. fissidens*, but the alveoli show that it was tiny, one-rooted, and located in front of the diastema. The alveoli show that the canine was larger than any of the incisors. The inframandibular flange is massive.

The uintathere skull referred by Osborn (1913) to *Bathyopsis fissidens* (AMNH 14802) is important because it is the smallest complete one known. The teeth are poorly preserved but the skull is in good condition. It is half the length and about an eighth of the volume of the skull of an average *Uintatherium*. It is well illustrated by Osborn (1913). The small horns, shallow skull, flat cranial roof, and small size make it strikingly different from the larger uintatheres. The teeth, however, are of the stereotyped uintathere pattern.

"A pair of lower jaws (USNM 19990) including the greater part of the left ramus with  $P_3$  to  $M_3$  and a smaller part of the right ramus with portions  $P_2$  to  $M_3$ , of a uintathere was found in the New Fork tongue of [the] Knight [formation] on Alkali Creek about 10 miles above its junction with the Green River" [in the Bridger Basin of Wyoming] (Gazin 1952, pp. 64-65). He regards them as cf. *Bathyopsis fissidens*.

The teeth are slightly larger than in holotype except for  $P_4$ . This specimen differs from the holotype in the absence of the inframandibular flange. Gazin notes the possibility of sexual dimorphism.

*Bathyopsis middeswarti* new species

Plate 7, figs. 1-3

HOLOTYPE: University of Nebraska State Museum IQ 1037. Collected by Mr. and Mrs. T. C. Middleswart of Bridgeport, Nebraska.

DISTRIBUTION: From lower Bridgerian beds in Sweetwater County, Wyoming, about 25 miles north-northwest of the town of Green River in Township 22 N., Range 108 W.

DIAGNOSIS: Distinguished from *B. fissidens* by the much larger size, the relatively wider occiput, and the round maxillary horns.

DESCRIPTION: The specimen consists of a skull lacking the occipital condyles and part of the occiput, the canines, and the second and third premolars. It has undergone a slight dorso-ventral compression (plate 7).

The skull is from an old individual. The premaxillaries extend slightly anterior to the nasals. The nasal bones terminate at pointed tips and barely extend

in front of the prominent nasal horns which diverge posteriorly. The nasals are separated by a conspicuous suture for their entire length. The maxillary horns are prominent and lie close together, their tips being only imperceptibly farther apart than those of the nasal horns. They are rounded and slope off gently to the front and steeply to the back. Distinct ridged frontal protuberances lie above the anterior end of the orbit as in *B. fissidens*. The top of the skull is widest at the parietal horns, which are situated above the posterior end of the zygoma. The parietal horns are low swellings, elongate, mainly transversely, but also directed slightly anteriorly. The median continuations of these horns curve backward and meet at the midline. The suture between the two frontals and the two parietals is very prominent from the region of the frontal protuberances to the region of the parietal horns. The canines were large and the root went backward and upward toward the maxillary horn. The palate is deeply excavated in the region of the canines. No P<sup>1</sup> was present. The cranial table is nearly flat and the occiput is wide and low. The temporal fossa is long and shallow, and its lower and outer part is visible from above. The teeth are worn and damaged and reveal little detail. The hypocone of M<sup>3</sup> was apparently very large, though its condition makes this uncertain. The tooth shown in the photograph restored in the position of a P<sup>2</sup> is probably the external part of a P<sup>3</sup> which has suffered abnormal and very strong wear medially. The basicranium shows no details.

*?Bathyopsis* sp.

This small uinthere premolar (AMNH 17438) was collected by George Olsen in 1918, two miles northwest of Gardner, Huerfano County, Colorado. It definitely establishes the presence of uintheres in the Huerfano Basin. It is a P<sub>3</sub> or P<sub>4</sub> measuring 14.5 mm by 8.0 mm. In size and dimensions this is somewhat more like *Probathyopsis* than *Bathyopsis*. However, the position in the geologic time scale is later than any certain specimens of *Probathyopsis*.

Osborn (1897, p. 258) reported the proximal portion of a small tibia from the Huerfano which he referred tentatively to *Uintherium*, though it was smaller than any known tibia of that genus. Later he referred it to *Bathyopsis* (1919, p. 558). Unfortunately this dubious specimen could not be located for checking.

SUBFAMILY UINTATHERIINAE, NEW RANK

This subfamily corresponds to the Uintheriidae as restricted by Flerov (1952) except for his inclusion of *Bathyopsis*. Reasons for regarding it as a subfamily have been given on p. 18.

Large American Dinocerata of the upper part of the middle Eocene and the lower part of the upper Eocene. Skull deep, with three pairs of "horns" or protuberances. Deep basin between the temporal crests and anterior to the occipital crest. No upper incisors. Lower canine incisiform. Lower molars somewhat less elongate. No paraconid crest. Entoconid very rarely separate from rest of posterior talonid loph. No entoconid or hypoconulid crests. Sacrum with four vertebrae. Tail relatively short.

*Uintherium* Leidy

*Uintherium* Leidy, 1872, pp. 168-169

*Uinтамastix* Leidy, 1872, p. 169

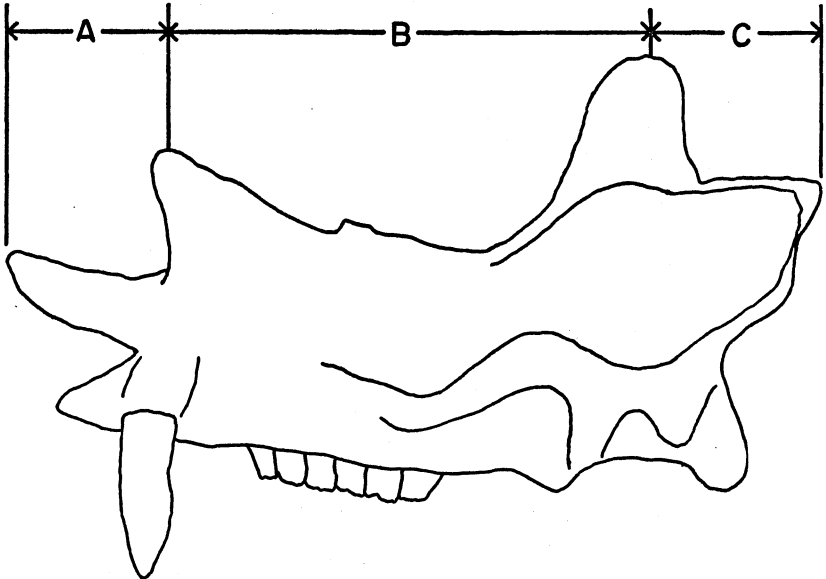
*Loxolophodon* (in part) Cope, 1872b

*Tinoceras* (in part) Marsh, 1872a, p. 504, 1872b, and many other references

*Dinoceras* Marsh, 1872d, p. 344 and many other references



- Dinoceras* (*Paroceras*) Marsh, 1885b, p. 200  
*Tinoceras* (*Platoceras*) Marsh, 1885b, p. 213, 214  
*Tinoceras* (*Laoceras*) Marsh, 1885b, p. 216  
*Octotomus* Cope, 1885b, pp. 44, 52-53  
*Ditetrodon* Cope, 1885c, p. 594  
*Elachoceras* Scott, 1886, pp. 304-307



	$\frac{B}{A}$	$\frac{B}{C}$
<b>Eobasileus</b>	0.8 to 0.9	2.1 to 3.1
<b>Tetheopsis</b>	1.2 to 1.8	2.1 to 3.5
<b>Uintatherium</b>	1.5 to 2.2	1.2 to 2.3

Fig. 1. Skull proportions in uintathere genera. The outline is from a specimen of *Uintatherium anceps*.

TYPE SPECIES: *Uintatherium robustum* Leidy, 1872 = *Titanotherium? anceps* Marsh, 1871.

DISTRIBUTION: Upper Bridgerian (middle Eocene) of the Bridger and Washakie Basins of Wyoming and questionably present in Uintan (Upper Eocene) of the Uinta Basin of Utah.

DIAGNOSIS: Large uintathere, distinguished from *Eobasileus* and *Tetheopsis* by skull proportions. Skull relatively broad with parietal horn well in advance of occiput. The relative proportions for the large genera are shown in figure 1. Posterodorsal part of temporal fossa very wide; maxillary horn above diastema. Skull in known specimens 69 to 85 cm. long; upper cheek tooth row 143 to 169 mm long.

DISCUSSION: It was Marsh's original intention that his monograph would be followed in publication by a synopsis in the Fifth Annual Report of the Director of the U. S. Geological Survey. It happened that the synopsis (Marsh 1885a) was

published first (see Marsh 1885b, p. 237). No formal descriptions of new species were given in the synopsis but several illustrations were included with the names of new species under them. By the rules of nomenclature this constitutes the first publication of these species. *Tinoceras hians* and *Tinoceras crassifrons* are shown in 1885a as sectioned skulls. These cross-sections are deductions rather than actual views and do not pass as illustrations of the specimens. Though the author's edition of Marsh's monograph bears the date 1884 on the title page, it was not published until February 1885 (Matthew 1937, p. 170). The regular Survey edition was published in 1886 (see Patterson 1939, p. 376).

*Uintatherium* was the first new generic name applied to a uintathere. Advance copies of Leidy's preliminary description of the genus were mailed on August 1, 1872. Fortunately, this preceded by 18 days the start of the flurry of contradictory and hasty papers by Cope and Marsh. The name *Uintatherium* has never had its priority questioned, but it has been ignored. Marsh referred most of his specimens of this genus to "*Dinoceras*" or "*Tinoceras*." The only good uintathere specimens that Cope had belonged to *Eobasileus* and *Bathyopsis*.

The problem of how to designate the type species of *Uintatherium* requires some comment. The first named species of uintathere is *Titanotherium? anceps* Marsh, 1871. The next named species was *Uintatherium robustum* Leidy, 1872. Subsequently Marsh applied the new generic name *Tinoceras* to *Titanotherium? anceps*.

The holotype of each species is poor. A glenoid process and part of a humerus were the only parts present which were common to both. Not until Marsh worked up the complete and excellent specimen which he called "*Dinoceras mirabile*" could it have been realized that the two specimens were similar.

Data presented below strongly suggest that the two specimens are conspecific; hence the name of the enlarged species is *Uintatherium anceps* (Marsh). It can be argued that the type species should be *Tinoceras anceps* (Marsh) = *Titanotherium? anceps* Marsh because that is also the name of the species. But in Opinion 164 of the International Commission on Zoological Nomenclature it is definitely stated that "(1) When two or more genera are united in a taxonomic group, such action in no way affects the types of the genera concerned [here *Uintatherium* and *Tinoceras*]; (2) the broader genus thus formed takes as its name the oldest available name based on any included species; (3) the genus bearing that name retains as its type the species previously so established." Therefore, *Uintatherium* retains as its type the species established as its type: i.e., *U. robustum*. Hence the designation of the type species as *Uintatherium robustum* Leidy = *Titanotherium? anceps* Marsh. (Opinion 164 was reworded and incorporated into the 1953 Copenhagen revision of the International Rules of Zoological Nomenclature as a paragraph of Article 30.)

Opinion 164 was issued as a solution to a similar problem, but one where the prior named species and the type species were not synonyms. The fact that *Tinoceras anceps* was originally *Titanotherium? anceps* does not negate the fact that *Uintatherium* and *Tinoceras* are the genera being united.

All specimens of *Uintatherium* apparently belong to a single variable species, *U. anceps*.

#### *Uintatherium anceps* (Marsh)

*Titanotherium? anceps* Marsh, 1871, p. 35

*Uintatherium robustum* Leidy, 1872a, pp. 168-169

*Uintamastix atrox* Leidy, 1872a, p. 169

- Loxolophodon furcatus* Cope, 1872b  
*Loxolophodon pressicornis* Cope, 1872b  
*Tinoceras grande* Marsh, 1872c, p. 323  
*Dinoceras mirabile* Marsh, 1872d, p. 344  
*Dinoceras lacustre* Marsh, 1872d, p. 344  
*Dinoceras lucare* Marsh, 1873e, p. 408  
*Dinoceras laticeps* Marsh, 1873g, p. 301  
*Eobasileus galeatus* Cope, 1873f, pp. 1-2  
*Uintatherium leidianum* Osborn, Scott and Speir, 1878, pp. 63-80 and Plate A  
*Uintatherium princeps* Osborn, Scott and Speir, 1878, pp. 81-82  
*Dinoceras distans* Marsh, 1885a, pp. 258-260. 1885b, p. 199  
*Tinoceras pugnax* Marsh, 1885a, pp. 258, 263-264, 267, 269, 282. 1885b, pp. 20, 33, 215-216  
*Uintatherium latifrons* Marsh, 1885a, p. 262. 1885b, pp. 220-221  
*Tinoceras vagans* Marsh, 1885a, p. 262. 1885b, p. 218  
*Uintatherium segne* Marsh, 1885a, p. 276. 1885b, pp. 40, 222  
*Dinoceras agreste* Marsh, 1885b, pp. 20, 197  
*Dinoceras cuneum* Marsh, 1885b, pp. 77-78, 197-198  
*Dinoceras reflexum* Marsh, 1885b, pp. 201-202  
*Tinoceras affine* Marsh, 1885b, pp. 204-205  
*Tinoceras crassifrons* Marsh, 1885b, pp. 208-209  
*Tinoceras hians* Marsh, 1885b, pp. 210-211  
*Tinoceras jugum* Marsh, 1885b, p. 212  
*Tinoceras (Platoceras) latum* Marsh, 1885b, pp. 213-214  
*Tinoceras (Laoceras) pugnax* Marsh, 1885b, pp. 216 (new sub-genus only)  
*Elachoceras parvum* Scott, 1886, pp. 304-307  
*Uintatherium alticeps* Scott, 1886, pp. 305-307  
 (The bibliographic references given above refer to the original citation for each synonym, except for five species of Marsh first described in 1885a, for which the reference from Marsh's monograph (1885b) is also given.)  
 HOLOTYPE: YPM 11030  
 DISTRIBUTION AND DIAGNOSIS: Same as for genus.

DESCRIPTION AND HISTORY OF THE HOLOTYPE: This fragmentary specimen was discovered by Lt. W. N. Wann "in September 1870, on the Divide near Sage Creek" (Marsh 1885b, p. 203). This would place the specimen low in Bridger D.

Marsh's original description reads: "The specimens discovered, which evidently pertained to three different individuals, mainly consist of several dorsal vertebrae, the distal end of a humerus, the greater portion of a tibia, and some of the smaller bones of the extremities . . ." (Marsh 1871, p. 35). But in his monograph (Marsh 1885b, p. 203) he states: "The type specimen . . . consist[s] of portions of the skull, cervical and dorsal vertebrae, and a tibia." The beast seems to have lost some foot bones and gained a skull. One might easily be suspicious that Marsh "improved" on his type specimen, but fortunately this was not the case. In the first place anyone setting about to "improve" a type specimen would select far better material than is referred to this specimen. It must be kept in mind that Marsh did not know what he had, except that it was a rather large animal. *Uintatherium* is certainly not an animal that would ever be deduced by anyone who had never seen one. Marsh simply did not know at first what some of the bones were.

The holotype consists of the left glenoid fossa and process with adjacent parts of the squamosal, the right parietal horn with adjacent parts of the parietal, a part of the parietal and occipital bones showing the postero-dorsal wall of the braincase, the left occipital condyle, four thoracic vertebrae, the proximal end of the left radius, and the left tibia with its middle section restored (plate 8, fig. 1). A comparison of the size of the parts with mature individuals of *Uintatherium* reveals that this specimen was a young individual. The parietal horn is notably

small. Specimen YPM 11032, the distal tip of a humerus, is listed in the catalog as a part of YPM 11030. The left parietal horn is shown on page 203 and an anterior thoracic vertebra on page 80 of Marsh's monograph.

**LEIDY'S SPECIMENS:** Leidy collected fossils in the Bridger Basin in the summer of 1872. Members of his party found several fragmentary specimens of uintatheres. He designated the best of these as the holotype of a new genus and species, *Uintatherium robustum* (Leidy 1872a, pp. 167-169). The specimen was well described and illustrated in a later work (Leidy 1873, pp. 93-109, 331-334 and plates 25-28). It is from Bridger C on or near the northeast base of Twin Buttes.

Various parts of the holotype of *U. robustum* are listed in the records of the Academy of Natural Sciences of Philadelphia under several different numbers. These are given below with the number of the figures from Leidy 1873 as follows:

ANSP 12607 (lower rear part of skull, pl. 26, fig. 1; pl. 28, figs. 1, 2). ANSP 12609 (right M<sup>3</sup>, pl. 25, figs. 6, 7, 8; pl. 27, fig. 30; pl. 28, fig. 1). ANSP 12610 (right M<sub>3</sub> with adjacent part of lower jaw, pl. 25, figs. 9, 10; pl. 27, fig. 31). ANSP 12611 (right M<sup>2</sup>, pl. 25, fig. 12). ANSP 12612 (left M<sup>3</sup>). ANSP 12613 (coronoid process and condyle of left lower jaw, pl. 27, fig. 33). ANSP 12619 (horizontal ramus and M<sub>3</sub> of left lower jaw, pl. 27, fig. 32). ANSP 12622 (plaster cast of endocranial cavity. See Marsh 1885b, p. 57 and Tilney 1931, pp. 445, 447). All these numbered parts refer to one specimen, the holotype of *U. robustum*.

Another specimen of *Uintatherium* found "near the camp in Dry Creek Canyon" (Bridger C) consists of a canine (ANSP 12608, Leidy 1873, pl. 25, figs. 1-5 and pl. 28, fig. 1) and a right P<sup>3</sup> or P<sup>4</sup> (ANSP 12606, Leidy 1873, pl. 25, figs. 13-14). This is the holotype of "*Uintatherium atrox*" Leidy, which he at first supposed was a sabre-toothed carnivore.

Leidy says of the holotype of *Uintatherium robustum* (1873, p. 241): "Of this animal Drs. Carter and Corson found together a number of parts of the same skeleton, consisting of the back portion of a cranium retaining parts of both temporal fossae, the occiput and the occipital condyles; parts of the upper and lower jaws containing the back molars; a mutilated humerus, a proximal and a distal extremity of a femur; and a calcaneum and an astragalus. They were found 10 miles from Dry Creek Canyon, about 50 miles from Fort Bridger."

One would naturally assume from this description that some skeletal parts were found with the skull parts. But unfortunately, the more detailed accounts in Leidy 1873 show that this is an oversimplification, as shown by these excerpts: Page 104—"The mutilated upper extremity of the femur, [ANSP 12615] represented in Fig. 4, Plate XXVI, was found . . . on the buttes west of Dry Creek Canyon, a dozen miles from the former specimens." Page 105—"The mutilated distal end of a femur [ANSP 12618], represented in Fig. 5, was found in the same locality [as the proximal end], but at a distance . . ." Page 105—"Several large tarsal bones, found together on the buttes to the west side of Dry Creek Canyon, may perhaps belong to *Uintatherium*. They consist of a calcaneum [ANSP 12604], astragalus [ANSP 12605], and cuboid [specimen now missing] of the left foot."

Besides these specimens, a right humerus (ANSP 12616) was found at the same locality as the holotype (Leidy 1873, pl. 26, fig. 3). A mutilated atlas (ANSP 12617: Leidy 1873, pl. 26, fig. 2 and pl. 27, fig. 34), the condyle of a right lower jaw (ANSP 12620) and a fragment of a canine (ANSP 12621) complete the résumé of specimens collected by Leidy's party.

A comparison of the few measurements available on the holotype of *Uintatherium "robustum"* with those of many specimens shows that this specimen is a *Uintatherium* of slightly smaller than average proportions. The dimensions com-

pare well with those of specimen YPM 11036 ("*Dinoceras mirabile*" of Marsh). The posterior part of the temporal area seems unusually well provided with vascular foramina. The third molars possess a tubercle at the entrance to the median valley.

**MARSH'S HOLOTYPE SPECIMENS:** The holotype of "*Dinoceras agreste*" Marsh (YPM 11221) was found "near Spanish John's Meadow" (probably Bridger C). Marsh was prone to build up his specimens, either with plaster or in print. This specimen was said to consist of a skull, scapula, and ribs (Marsh 1885b, p. 197). The implied "complete" skull is actually quite fragmentary, except for an excellent occipital and cranial region. Also present are a right nasal horn, that part of the right maxillary which extends between the anterior premolar and the canine, parts of the zygomatic arches, and lesser fragments. The cranial and otic regions have been broken and weathered out in such a manner as to show more anatomical detail than I have seen in any other uintathere skull. It is surprising that Marsh never took advantage of this specimen.

For the holotype of "*Dinoceras cuneum*" (YPM 11042) Marsh gives the locality as "near Haystack Mountain." The field label and catalog are more exact: "Haystack Mountain, 8 miles down." This is the area in the Washakie A zone south of Haystack Mountain where so many uintatheres have been found. Marsh exaggerates his specimen somewhat (1885b, p. 198). Present are the top part of a skull with the nasals damaged, about half of the pre-sacral vertebrae with only the sixth cervical, and second and third thoracic in good condition, a sacrum, and parts of the pelvis. The sixth cervical is illustrated as free (1885b, p. 77); it is actually still embedded in the matrix. The primary palate, olfactory chambers and the brain case are well exposed.

The locality for the holotype of "*Dinoceras distans*" Marsh is incorrectly stated to be (1885b, p. 199) "at Barrel Springs" (Washakie Basin). Both the field label and the museum catalog show that this specimen (YPM 11235) came from four miles down (east on) Henry's Fork from Lonetree in the Bridger Basin. It could be from either Bridger C or D. This specimen does not have "generally open sutures" as Marsh states. The anterior terminations of the nasal bones show that there were distinct prenasal bones which are now missing. This specimen varies notably from the normal in the unusually large size of the ridge between the maxillary horns and in the sharp angulation between the dorsal and lateral surfaces of the skull from an area just behind the maxillary horns to an area well up on the parietal horns. Marsh states (1885b, p. 199): "The cavity for the brain is exposed in this specimen, and shows a nasal septum just in front of the anterior constriction. The short olfactory lobes were bounded in front by thin cribriform plates." Unfortunately the skull has been rather thoroughly repaired (not restored) in this region and this point could not be checked without considerable disruption of the specimen. The left P<sup>3</sup>-M<sup>3</sup> and the right M<sup>3</sup> are present but in poor condition.

The holotype of "*Dinoceras laticeps*" Marsh (YPM 11039) comes from "near Spanish John's Meadow" in the Bridger Basin. The specimen is very likely from Bridger C. It is large and bulky for a *Uintatherium*. The parietal and maxillary horns are very massive. The crushing of the skull has bent the occipital crest backward, increasing the apparent length of the skull by 6 cm., thus making it seem even larger than it is.

The crushing has altered the apparent shape of the postero-dorsal part of the temporal fossa so that this part appears to be narrow as in *Tetheopsis* or *Eobasi-*

*leus*. This skull has been weathered just enough to expose many foramina and the brain cavity, but not enough to damage the skull seriously. As a result the otic and alisphenoid regions show a detail not visible on most specimens. The tips of the premaxillaries show slight excavations for vestigial incisors. In the middle of the diastema between the upper left canine and P<sup>2</sup> is a small alveolus for a rudimentary P<sup>1</sup>. The lower jaw lacks teeth, but otherwise needs no restoration.

The cheek teeth shown by Marsh (1885b, pls. 10 and 12) have actually been partly or entirely restored in wax.

The specimen, YPM 11038, is the holotype of "*Dinoceras lucare*" Marsh. It was found "two miles east of Big Bone Buttes" and was therefore in Bridger D. The anterior part of the skull is complete and much of the posterior part is also present, but unfortunately enough pieces are missing to prevent a good restoration. The left canine and all of the cheek teeth are present and in excellent condition. The right dentition is illustrated in natural size in Marsh's monograph (1885b, pl. 9). The M<sup>3</sup> is notable for the tiny accessory tubercle on the flank of the hypocone. The internal surface of the basisphenoid has been weathered so that much detail is revealed. An axis minus neural arch, three posterior thoracic vertebrae, most of a right ulna, and a fourth right metatarsal constitute the rest of the good skeletal material.

Of special interest is the excellent skull which serves as the holotype of "*Dinoceras mirabile*" Marsh (YPM 11036). The locality is "Big Bone Buttes" or Sage Creek Mountain in the Bridger Basin. The specimen is almost certainly from Bridger D. It consists of a nearly perfect skull, an axis, a third cervical, probably the distal thoracic vertebra, and three lumbar vertebrae. The skull is superbly illustrated on plates 1 through 7 of Marsh's monograph and described in great detail on pages 11-61. The axis is shown on plate 21, the distal thoracic and first lumbar on plate 25, and the last two lumbar on plate 26 (1885b). This skull is slightly smaller than average. The M<sup>3</sup> is notable for the prominent accessory tubercle on the flank of the hypocone (see also plate 9, fig. 1 of this report).

Marsh reported and illustrated four supposed lumbar vertebrae from this specimen. As but three lumbar are known on the remarkably complete skeleton found by Dr. C. L. Gazin (Gilmore 1943, p. 765) and as the most anterior of the "lumbar" vertebrae figured by Marsh appears to have a protuberance low on the neural arch for contact with a rib, it seems probable that this is actually the last thoracic. This supposed first lumbar (called "fourth lumbar vertebra from sacrum" by Marsh) is the poorest of the four vertebrae. The illustrations of the specimen (Marsh 1885b, pl. 25, figs. 1-5) have been improved by drawing some parts of the left side from a mirror image of those of the right side. Figure 1 is reversed from the right side to be consistent with all his other lateral views of vertebrae, which are drawn from the left.

A fragmentary specimen consisting of pieces of the skull, a left cuneiform, part of the right ulna, and the head of a femur was assigned by Marsh to a new species, *Dinoceras reflexum*. This holotype (YPM 11229) is from "Tule Springs" in the Bridger Basin and hence from either Bridger C or D.

The Washakie A faunal zone yielded YPM 11574, the holotype of "*Tinoceras affine*" Marsh. The specimen was found "eight miles south of Dug Springs" in the Washakie A faunal zone. The posterior end of the skull has been sawed in the median plane (Marsh 1885b, fig. 178, p. 204). The dorsal surface of the secondary palate can be seen on one of the pieces. As Marsh noted, part of the vomer can be observed wedged in between the two halves of the palatine branch of the maxil-

laries. Contrary to what Marsh implies about the posterior end of the malar, it ends in a recess of the zygomatic process of the squamosal as it does in all specimens of *Uintatherium*. From Marsh's locality of "Cattail Springs" in the Bridger Basin came the holotype of "*Tinoceras crassifrons*" Marsh (YPM 11236). The specimen could be from either Bridger C or D. The ridge between the maxillary horns is notably high as in YPM 11235. The surfaces at the anterior end of the nasals cited by Marsh as "sutural surfaces for the pre-nasals" are more likely fractures across the nasals. Marsh's statement (1885b, p. 208) that "the olfactory chambers were not divided by a transverse bony septum" seems rash. The preservation is not good enough to justify stating whether such a septum was present or not. The skull has been broken so that the entire primary palate and the top of the braincase are visible.

The holotype of "*Tinoceras grande*" Marsh (YPM 11040) was found near Barrel Springs, Washakie Basin. It is undoubtedly from the Washakie A faunal zone. It includes the anterior part of a skull, an atlas, an axis, the third and fourth cervicals, and two thoracic vertebrae. The skull portion bears the left canine and left P<sup>2</sup>-P<sup>4</sup>, all in excellent condition.

The holotype of "*Tinoceras hians*" Marsh is unique among the larger uintatheres in that the tips of the maxillaries show slight excavations for vestigial incisors. This skull (YPM 11499) was found at "Cattail Springs" in the Bridger Basin and could be from either Bridger C or D. The palatal region has been repaired and restored. For some strange reason, the space between the primary and secondary palate and above the cheek tooth area has been filled in with a plaster and sand mixture intended to look like matrix. Consequently Marsh's statement (1885b, p. 211) that "The olfactory chambers were divided transversely by a bony septum" cannot be checked without considerable disruption of the specimen.

The locality for the holotype of "*Tinoceras jugum*" Marsh is given cryptically as "Wyoming." The field label shows that the specimen (YPM 11500) was collected by L. LaMothe and John W. Chew in September 1874. A letter from Chew to Marsh shows that they were collecting in the Bridger Basin at that time. The specimen is composed of the anterior portion of the top of the skull and of the two parietal horns with much of the adjacent parietal bone. A high sharp ridge connects the two maxillary horns. Marsh regarded this as justifying a distinct species, despite the presence of such a ridge in several other specimens.

Marsh recorded the locality for the holotype of "*Tinoceras lacustre*" (Marsh) "near Bitter Creek" in the Washakie Basin. The town of Bitter Creek is situated on the Knight formation. Washakie A is the faunal zone of the Washakie nearest to Bitter Creek and hence the most probable zone from which this specimen came. The specimen (YPM 11037) consists of the left upper premolars, a fragment of the left M<sup>1</sup> and the right M<sup>3</sup>, both the left and right P<sub>2</sub>, part of the trigonid of the left M<sub>3</sub>, and a right radius. Marsh originally called this specimen "*Dinoceras lacustris*." It is a mystery why he chose to transfer the specimen from one of his genera to another. In the woodcut of the upper molars (1885b, p. 212) the fragment of the M<sub>1</sub> is depicted as an M<sup>2</sup> and the M<sup>3</sup> has been reversed from the right side without comment.

The holotype of "*Tinoceras latum*" Marsh was found "near Spanish John's Meadow" in the Bridger Basin, probably in Bridger C. The specimen (YPM 11242) consists of pieces of the skull and the right P<sub>2-4</sub> plus a trigon and metastylid (probably M<sub>3</sub> right) and a heel (probably M<sub>2</sub> right).

The Washakie Basin yielded the holotype of "*Tinoceras pugnax*" Marsh (YPM

11044). The locality is given all too briefly as "at Haystack Mountain." The skull has been slightly compressed dorso-ventrally in the posterior part. The result gives the temporal fossa a superficial resemblance to that of *Tetheopsis* or *Eobasileus*, much as in YPM 11039. All the upper premolars and the right M<sup>2-3</sup> and canine are present. This is one of the few uintathere skulls with an associated lower jaw. The lower jaw lacks canines and incisors and the coronoid processes have been restored. The restored portion is not indicated in Marsh's illustration (1885b, pl. 19).

The specimen (YPM 11241) is from "Red Dog Buttes" in the Washakie Basin, probably from the Washakie A faunal zone. It is the holotype of "*Tinoceras vagans*" Marsh. Marsh does not state that the anterior end of this dorsal half of a skull is badly crushed.

About "two miles from Big Bone Buttes" in the Bridger Basin (probably in Bridger D) the holotype of *Uintatherium "latifrons"* Marsh was found. The skull, of which only the dorsal part is present, is notable for the open suture dividing the anterior ends of the nasal bones. A good second thoracic vertebra, the centra of three of the more posterior thoracic vertebra and of two lumbar, and the head of a femur are also preserved (all YPM 11231).

The holotype of *Uintatherium "segne"* Marsh was found, according to field labels, at "Tule Springs" in the southern part of the Bridger Basin. The specimen (YPM 11194) could be from either Bridger C or D. The lower jaw is notable for being the only one of *Uintatherium* in which there is a P<sub>1</sub>. The P<sub>1</sub>, which is two-rooted but very small, is next to the canine in front of the diastema. The left P<sub>1</sub> is represented only by the alveolus, and the right P<sub>1</sub> is broken flush with the jaw. The right coronoid process and condyle have been restored. The specimen also includes the right maxillary horn and the bone from the area between the maxillary horns, both parietal horns, the third thoracic vertebra, a thoracic from about midway in the series, both ends of a femur, and both ends of a humerus. Both the maxillary and parietal horns are notably robust. The parietal horns have a ridge in front which Marsh explains (1885b, p. 222) as "evidently formed by the frontal bone rising nearly to the top of the protuberances." More probably it is the posterior end of a sharp angulation between the dorsal and lateral surfaces of the skull extending well up on the parietal horns as in YPM 11235.

CATALOG OF MARSH'S REFERRED SPECIMENS: Marsh's reasons for erecting new species for many of his specimens will probably always be unknown. So far as we can tell, he took almost no account of individual variation within a species nor did he utilize teeth in his definitions. Even with this in mind, it is difficult to understand Marsh's justification for many of his species. His reasons for referring species to various genera are elusive to say the least. But his reasons for referring certain specimens to certain species are the most mysterious of all. In a broad way, he referred larger bones to various species of "*Tinoceras*" and smaller ones to "*Dinoceras*," but he was not consistent in this. "*Dinoceras mirabile*" was a dumping ground for a majority of his odds and ends.

The Dinocerata monograph leaves a general impression that most of the skeletal material shown in the plates is from the holotype of "*Dinoceras mirabile*" (YPM 11036). Actually this "skeleton" is a composite drawn from many different animals. Though Marsh refers to numbered specimens in the text illustrations, he gives no numbers for those illustrated in the plates. In the following synopsis of referred material, references are made to illustrations both from the text and from the plates.



Marsh referred the following specimens to "*Dinoceras mirabile*" (1885b, pp. 195-196). The plate and figure numbers are from Marsh's monograph.

YPM 11195. Probably Bridger C. Right magnum, unciform, scaphoid, and lunar.

YPM 11199. Bridger D (field label says "600' above Henry's Fork"). Right ectocuneiform (pl. 50, figs. 13-18), metatarsal II (pl. 51, figs. 7-12), metatarsal III (pl. 51, figs. 13-15 and pl. 52, figs. 1-3), and metatarsal IV (pl. 52, figs. 4-9). These bones are all from the right pes, but have been reversed in the drawings. Damaged right radius, scaphoid, lunar, and cuneiform are also present.

YPM 11200. Bridger D. Right scaphoid (fig. 11, p. 103), right cuneiform, and poor right metacarpal V.

YPM 11206. Bridger D. Left ulna (pl. 30), left radius (pl. 29), right femur (reversed on pl. 44, cross-section fig. 137, p. 141), and the proximal phalanx of a median carpal digit (pl. 38, fig. 1).

YPM 11208. Probably Bridger C. All leg and foot bones from left side. Distal end of humerus (cross-section fig. 107, p. 91), radius (length given by Marsh on p. 95 incorrect, read .417 for .254), scaphoid (pl. 31, figs. 1-6), cuneiform (pl. 32, figs. 1-6), trapezium and trapezoid (pl. 33), magnum and unciform (pl. 34), metacarpals I and II (pl. 35), metacarpals III (pl. 36, figs. 1-6), a sesamoid (pl. 38, fig. 7), distal end of femur, tibia (pl. 45), patella (pl. 46, figs. 5-8), cuboid (pl. 49, figs. 1-6), metatarsal I (pl. 50, figs. 1-6), metatarsal V (pl. 51, figs. 10-15), a proximal phalanx (pl. 53, fig. 3), a median phalanx (pl. 53, fig. 4), sesamoids (pl. 53, figs. 8-10), two cervical and one thoracic vertebrae.

YPM 11210. Bridger C or D. Left femur (cross-section, fig. 138, p. 141), left fibula (pl. 46, figs. 1-4), left astragalus (pl. 47), calcaneum (fig. 143, p. 152 and pl. 48), mesocuneiform (pl. 50, figs. 7-12), and a right patella. (Left astragalus on pl. 9, fig. 3, this report.)

YPM 11211. Bridger D (field label says "above upper white layer"). All bones from right side. Pisiform (reversed in pl. 32, figs. 7-12), magnum (fig. 121, p. 115), unciform (fig. 123, p. 119), metacarpal I, and metacarpal IV (reversed in pl. 35, figs. 7-9 and pl. 36, figs. 1-3).

YPM 11212. Bridger C or D. Right ramus and symphyseal region of lower jaw with right P<sup>4</sup>-M<sup>3</sup> (pl. 8), first thoracic vertebra (figs. 95-96, p. 80), second thoracic vertebra (figs. 99-100, p. 82), left humerus and distal end of right humerus, an anterior rib (figs. 129-132, reversed), three other ribs, left parietal horn and the centrum of an axis.

YPM 11215. Bridger C or D. Left scapula (pl. 27), proximal end of very large right humerus (cross-section, fig. 106, p. 91), distal thoracic vertebra (pl. 24, figs. 5-9), and a right patella.

YPM. 11218. Probably Bridger C. Left scaphoid, lunar, cuneiform, trapezoid, magnum, unciform, navicular, both femora, distal half of both humeri, right ulna and radius, and a smaller left ulna (parts of two specimens were given one number).

YPM 11225. Bridger C or D. Some vertebral centra and a right calcaneum.

YPM 11226. Probably Bridger D. Fragments and a good right metatarsal IV.

YPM 11230. Bridger D. Right lunar (fig. 114, p. 105), left cuneiform (fig. 118, p. 108), left trapezoid (fig. 119, p. 112), right magnum (fig. 122, p. 115), left astragalus, and the proximal end of a right radius.

YPM 11232. Bridger C or D. Right ulna lacking distal end, left ectocuneiform, and most of an innominate bone.

YPM 11234. Bridger C or D. Part of a radius (cross-section fig. 109, p. 94), some caudal vertebrae.

YPM 11245. Probably Bridger D. Left humerus (pl. 28) and distal end of right humerus.

YPM 11247. Bridger C or D. Right unciform and left navicular.

YPM 11248. Bridger C or D. Right femur, right astragalus, atlas, and left glenoid area.

YPM 11251. Washakie A. Symphyseal region of lower jaw (figs. 39-40, p. 38), atlas (pl. 20), first left rib (pl. 39, figs. 1-3), left scaphoid, left femur, right cuneiform and five good thoracic vertebrae.

YPM 11252. Bridger C or D. Both ends of large left tibia, part of left fibula, and notably wide left parietal horn.

YPM 11255. Probably Bridger D. Axis, third and fourth cervical, fifth cervical (figs. 89-90, p. 76), sixth cervical (figs. 91-92, p. 77), seventh cervical (pl. 22, figs. 6-10), first thoracic, and second thoracic (pl. 23).

YPM 11490. Probably Bridger C or D. Incisiform lower tooth, either the third incisor or the canine (fig. 45, p. 42).

YPM 11491. Probably Bridger C or D. Incisiform lower tooth, either the third incisor or the canine (fig. 43, p. 42).

YPM 11492. Probably Bridger C or D. Incisiform lower tooth, either the third incisor or the canine (fig. 44, p. 42).

YPM 11514. Washakie A. Parts of battered lower jaw including symphyseal region, three well-worn incisiform teeth, and a well-worn right  $M_3$ .

YPM 11520. Bridger C or D. Right pisiform, scaphoid, and crushed calcaneum.

YPM 11528. Bridger C or D. Right cuboid and astragalus.

YPM 11529. Wyoming, locality unknown. A proximal phalanx (pl. 53, fig. 1), other phalanges, most of the left and part of the right metacarpal III, right metatarsal IV, axis, and an incomplete vertebra.

YPM 11548. Bridger C or D. Right radius, proximal half of right ulna (cross-section fig. 111, p. 98), proximal end of left tibia, parietal horn, and the proximal ends of two left radii. (More than one specimen involved.)

Marsh referred the following specimens to "*Tinoceras ingens*." He did not give locality data for them.

YPM 11503. Wyoming, locality unknown. Left lunar.

YPM 11504. Wyoming, locality unknown. Right lunar (reversed in fig. 115, p. 105).

YPM 11577. Wyoming, locality unknown. Left cuneiform (fig. 117, p. 108).

YPM 11209. Bridger Basin, locality unknown. (Catalog gives Church Buttes, which is Bridger B. The collector, B. D. Smith, not to be confused with the more able Sam Smith, was not experienced and it is probable that this locality is incorrect.) Left astragalus (figs. 141-142, p. 149).

YPM 11219. Henry's Fork. Bridger C or D. Right lunar (reversed in fig. 116, p. 105), right trapezium, trapezoid, magnum, metacarpal IV, proximal end of radius and distal end of humerus.

YPM 11246. Field label says "Twin Buttes, H. Fork." Bridger C or D. Collected by John Chew, July 1873. A poor radius. Lunar mentioned by Marsh on p. 106 not located.

Marsh referred the following specimens to "*Dinoceras laticeps*" (1885b, p. 200).

YPM 11197. Bridger C or D. Left astragalus (figs. 139-140, p. 149).

YPM 11202. Henry's Fork. Bridger C or D. Top skull, much of glenoid and basicranial regions, canine (root and tip reversed in Marsh's plate), both  $M^2$ s, and right  $P^3$  (pl. 14), left ectocuneiform.

YPM 11222. "Tule Springs." Bridger C or D. Distorted and repaired skull with left dentition. Cheek teeth very poor. Canine good (fig. 50, p. 44). Part of a pelvis.

YPM 11239. "Red Dog Buttes." Probably Washakie A. Left scaphoid (fig. 112, p. 103) and left lunar.

Marsh referred YPM 11207 to "*Dinoceras cuneum*," USNM 4212 to "*Dinoceras distans*," and YPM 11266 to "*Tinoceras anceps*."

YPM 11207. "Big Bone Buttes," probably Bridger D. Both parietal horns, the skull top from the maxillary horns to the anterior end, the distal ends of both femora, and 19 vertebral centra.

USNM 4212 (YPM 1601 in Marsh's monograph). Washakie A. Top portion of an immature skull (fig. 33, p. 30; fig. 47, p. 43; fig. 58, p. 54).

YPM 11266. Wyoming, locality unknown. Portions of the skull top of an immature specimen including anterior part of nasals and the maxillary and parietal horns.

COPE'S TYPES: The specimen AMNH 5045a is the holotype of "*Eobasileus pressicornis*." The locality is Haystack Mountain in the Washakie Basin. The specimen could be from either faunal zone of the Washakie. Judging from Cope's rather ornate but general description (1873e), it probably came from some level low on Haystack Mountain and therefore high in Washakie A.

#### Partial bibliography of "*Eobasileus pressicornis*" (Cope)

- Cope 1872b. *Lefalaphodon exressicornis*
- Cope 1872c. *Eobasileus cornutus* (in part)
- Cope 1872d. *Loxolophodon pressicornis*
- Cope 1872e. *Eobasileus pressicornis*
- Cope 1873a. *Eobasileus pressicornis*
- Cope 1873c. *Uintatherium pressicornis*
- Cope 1885a. *Eobasileus pressicornis*

The "species" was first described in the famous garbled telegram (Cope 1872b) as "*Lefalaphodon exressicornis*." The entire original description of the species reads "horns compressed sub-acuminate." Cope says that the telegram was dated August 17 and that the bulletin was published on August 19.

The very next day Cope described (1872c) *Eobasileus cornutus*, which he claimed was "established on remains of five individuals." The holotype of "*Eobasileus pressicornis*" was one of these five individuals. On August 22 (1872d) he again referred to the corrected "*Loxolophodon pressicornis*" (and referred *Eobasileus cornutus* to "*Loxolophodon cornutus*." His slightly improved description reads: "Established on numerous remains. . . . Its marked peculiarity, as first noticed, consists in the compression of the horn cores throughout the proximal half of their length, with more acuminate form, than in *L. cornutus*. They measure also about seven inches in length" (i.e., the maxillary horn was neither as rounded nor as bulky).

At one point in Cope's evolution of thought on the taxonomy of uintatheres, he decided for a very brief period that *Loxolophodon* was perhaps best reserved for some coryphodonts after all, and again assigned all three of the species he had described to *Eobasileus* (1872e, p. 542).

Early the following year he listed the type material (1873a, pp. 575-579). "Represented by numerous portions of the cranium, with fragments of limbs of one individual; of almost all portions of the skeleton, except the cranium, of a second. A humerus, with astragalus of a third, is of uncertain reference, while a single humerus of another specimen may belong here. Fragments of several other individuals of appropriate size may pertain to it."

In this same article, Cope assigned the holotype of *Eobasileus*, *E. cornutus*, to the resurrected "*Loxolophodon*" and left *E. pressicornis* and *E. furcatus* in *Eobasileus* with the former designated as the type species, an impossible taxonomic procedure.

At one time Cope regarded this species as belonging to *Uintatherium*. He says: ". . . it has been ascertained that the *E. pressicornis* and *E. furcatus* belong to the genus *Uintatherium*, having rudimental knobs instead of flat shovels on the nasal bones" (1873c, p. 159). This decision has turned out to be correct. Unfortunately, he did not adhere to it.

In his "bible" (1885a, p. 562) Cope states that "the typical specimen embraces cervical, dorsal, and lumbar vertebrae, ulna, both femora and tibiae, astragalus, navicular, etc., and large parts of the scapulae and pelvis." No skull parts are mentioned, however in the original description (1872a) he definitely cited the character of a maxillary horn and nothing else. The specimen to which this horn belongs must be the type specimen because it is the only one cited in the original description. W. D. Matthew noticed this. On card 5042 of the catalog of vertebrate fossils in the American Museum of Natural History he wrote: "This cannot be the original type, although Cope [1885a] states that it is." Which specimen then is the type?

In his description of "*Eobasileus furcatus*" Cope relates: "This species was originally described from a posterior horn which was obtained near the locality which furnished the typical specimen of *E. pressicornis*. It was found in an old camp separate from the other specimens. The trail from this camp passed the front of the bad-land bluffs, and where it reached the foot of the latter I found projecting from the rock parts of a skull and skeleton, which I suspect to be the animal to which the horn belonged. It is very probable that the horn was picked

up at this point, although, of course, there is no direct evidence to that effect" (1885a, p. 565).

On the next page Cope alludes to "the supposed remainder of the specimen [which] includes various parts of the cranium, without teeth; portions of the atlas, femur, and fore and hind feet." The only specimen illustrated by Cope which contains the skull part demanded by the original description of *Eobasileus pressicornis* and by the description in Cope 1873a is this specimen, i.e., the posterior horn, which he has added to the holotype of "*E. furcatus*."

The holotype of "*E. pressicornis*" is illustrated on plate 32 and on plate 33, figs. 1-4 and 6 of Cope 1885a under the title of "*Eobasileus furcatus*." The dimensions of the parts and the inferred shape of the temporal fossa of this fragmentary specimen indicate a *Uintatherium anceps* of slightly larger than average size.

Cope's almost daily nomenclatorial changes seem inexplicable unless we keep in mind that one of the descriptions was a telegram. Perhaps the sequence of events was like this: Cope found parts of five uintatheres which he referred to a new genus and species, *Eobasileus cornutus*. He mailed a letter containing this description (*Palaeontological Bulletin* No. 6) several days prior to August 17. It was to be published immediately, and appeared on August 20. Then he changed his mind and decided to publish two of the specimens as new species (*Loxolophodon pressicornis* and *L. furcatus*) and to change the name of *Eobasileus cornutus* to *Loxolophodon cornutus*. He mailed a letter to this effect to the American Philosophical Society which was published as *Bulletin* 7 on August 22. When he mailed the letter, or shortly thereafter, he decided to send a telegram also because he knew that both Marsh and Leidy had found the same or similar beasts that summer, and he hoped to insure priority in that manner.<sup>9</sup> But the telegram arrived in Philadelphia prior to either letter and was published on August 19. (Five days was sufficient time for a letter to go from Black Buttes station to Philadelphia. A letter from Sam Smith to Marsh went from Green River to New Haven in that time.)

The holotype of "*Eobasileus furcatus*" (AMNH 5045) was found near the type of "*E. pressicornis*" and is probably from a level high in Washakie A of Haystack Mountain. As indicated above, the taxonomy and bibliography of this species usually parallels and sometimes anastomoses with that of "*E. pressicornis*." The "species" was first described in Cope's garbled telegram (1872b) as *Lefalaphodon bifurcatus*.

The original description was "nasals with long spatulate lobes" (1872b). The specimen was one of five individuals referred to *Eobasileus cornutus* in Cope 1872c. The specimen was soon more amply described under the name *Loxolopho-*

<sup>9</sup> Cope probably knew from B. D. Smith that both Leidy and Marsh had uintathere material. Smith collected for Marsh in the summers of 1871 and 1872. In a letter dated July 5, 1872, Smith reported to Marsh: "I have . . . sacks of one skeleton the top part of the head is nearly hole both horns one tusk was all gon it was in hard rock and hard to get out I have done the best I could." [This specimen was probably YPM 11038.] In a letter of August 28, 1872, he says: ". . . my motive in going with Cope was to ceep him off some places that I think is good bone contry close hear I did not intend to quit you long" . . . But Cope felt that B. D. Smith was a big help for he says in a letter to his brother: ". . . our guide has been on 'bone expeditions' before, and is first rate" (Osborn 1931, p. 186). Leidy was not the least bit secretive about his discovery of the uintathere canine. Smith reported to Marsh (August 28, 1872): "whe got one tusk and part of the jaw nearly one foot long [probably YPM 11040] I think the same kind that Prof Lidy got part of the tusk of hear that he is blowing about." B. D. Smith's letters indicate a rather garrulous person and there is no reason to believe that he wouldn't tell Cope anything he knew.

*don furcatus*: "This species is indicated by portions of the nasal bones. These have differed in form materially from those of *L. cornutus*. The convex protuberances seen in *L. cornutus* were here represented by processes of singular form. They were compressed, narrowed at the base, and expanded distally into a flat spatulate body. The whole process measures seven to eight inches in length, and three and a half in width distally. The animal could not have been materially smaller than *L. cornutus*" (1872d).

Marsh correctly observed that: "*Eobasileus furcatus* is based on what he [Cope] regards as portions of the nasal bones. The description, however, indicates that these specimens are merely the posterior horn cores. . . ." (Marsh 1873a, p. 119).

Cope then admitted that this might be so: "This species was originally described from a large horn-core whose extremital part resembles strongly the nasal shovel of *Eobasileus*<sup>10</sup> *cornutus*. . . . Marsh has described somewhat similar horn cores from the lateral crests of the skull behind in *U. mirabile*, whence it may be that of my specimen is referable to that position, although it differs much from those of that species . . .

"As compared with the posterior horn-core of *Loxolophodon cornutus*, there is every difference. That is continuous with one margin of the crest, this erect above it; that has a round base, this is a lenticular one. It is more like that of *U. mirabile* . . . but abundantly distinct" (Cope 1873a, p. 580).

As related on p. 36 of this report, Cope attempted to add the type of "*E. pressicornis*" to this specimen (1885a, pp. 565-566). The holotype is a right parietal horn and is illustrated in Cope 1885a as figs. 5, 5a, 5b, and 5c of plate 33. This plate is labeled "*Uintatherium furcatum*," though it is called "*Eobasileus furcatus*" everywhere else in his tome. Contrary to Cope's explanation to the plate, fig. 5 is the posterior view and fig. 5a is the anterior view.

This horn is almost certainly from a male skull of *Uintatherium anceps*. The horn is larger than average for this genus, but it is smaller and of different shape than the parietal horn of any known male *Tetheopsis* or *Eobasileus*.

CATALOG OF COPE'S REFERRED SPECIMENS: AMNH 5042. Referred by Cope to "*Eobasileus pressicornis*." This is specimen "Number 3" of the five individuals referred to *Eobasileus cornutus* (1872c). The specimen is outlined in Cope 1873a (p. 575) as "almost all portions of the skeleton, except the cranium." He also relates that: "Two or three hundred yards from the typical specimen, I obtained remains of almost all parts of the skeleton of what is probably the present species. The femur is identical in character. The specimen embraces cervical, dorsal, and lumbar vertebrae, ulna, both femora and tibiae, astragalus, navicular, &c., and large parts of the scapulae and pelvis . . . .

"The femur is nearly as long as that of *Loxolophodon cornutus*, but is more slender, and has a relatively smaller head" (1873a, p. 577).

Cope attempted to make this specimen the type of *Eobasileus pressicornis* after he had assigned its true holotype to *Eobasileus furcatus* (1885a, pp. 565-566).

There is a worn cervical vertebra from this specimen which has lost both epiphyses and has been eroded on the posterior face of the centrum, causing the centrum to appear to be unusually short. From this, Cope regarded short cervical vertebrae as diagnostic of "*Eobasileus*" (1885a, p. 561).

In his "bible" Cope gives the length of the femur as 750 mm. (1885a, p. 578). This would be as large as the femur from the holotype of *Eobasileus cornutus*. The figure is in error, however, and the true length is 670 mm., which is about the average length for a *Uintatherium anceps* femur.

AMNH 5043. Distal half of a right humerus referred by Cope to "*Eobasileus pressicornis*" (1873a, p. 578). Collected about 100 yards from the type of "*E. pressicornis*" on Haystack Moun-

<sup>10</sup> A lapsus on Cope's part. In this article he refers *E. cornutus* to *Loxolophodon*.

tain, Washakie Basin. This humerus is certainly from a *Uintatherium*, one of smaller than average size. The specimen is illustrated (Cope 1885a, pl. 30, fig. 6).

AMNH 5046. Referred by Cope to *Uintatherium "robustum."* The specimen is from the upper Bridger of the Bridger Basin and is illustrated (1885a, pl. 36, figs. 1-2). It consists of some badly weathered fragments of a lower jaw and is undoubtedly one of the worst specimens ever figured in a scientific report. Only the ventral part of the mandibular symphysis is still left. The left  $M_{2-3}$  illustrated are partly wax.

AMNH 5048. Cope refers to this specimen as "*Uintatherium?*". It is from somewhere on Haystack Mountain, faunal zone unknown. He describes (1873a, pp. 581-583 and 1885a, pp. 593-596) and illustrates it (1885a, pls. 34 and 35) thoroughly. No skull parts were present, but the skeletal parts present are not large enough to be referred to anything but *Uintatherium anceps*.

PRINCETON UNIVERSITY MUSEUM TYPES: The specimen PUM 10076 is the holotype of *Uintatherium "leidianum"* Osborn, Scott, and Speir 1878 (pp. 63-80 and pl. A, figs. 6-8). (See also Osborn 1881, pp. 23-24, pl. 2 and pl. 3, fig. 5.) PUM 10076 is from Bridger D-3 (Osborn 1929, p. 86). The occipital and basicranial regions of the skull are missing, as are the right zygoma and glenoid region, both canines and  $P^2$ s, and the right  $P^3$ . The parietal and maxillary horns are unusually large for a *Uintatherium*, but the nasal horns are of average shape and size. The length of the cheek-tooth row is 144 mm. This is one of the shortest known from *Uintatherium*, an unusual feature in a skull which is so massive, even for that genus. The orbito-sphenoid mentioned by Osborn (1881, p. 24) is an artifact of crushing. The species was apparently based on differences in the size and shape of the horns. The temporal fossa is broken behind, but the part remaining shows that it had the proper shape for a *Uintatherium*. Also the portion of the skull anterior to the maxillary horns is too short to be anything but that genus.

The holotype of *Uintatherium princeps* was described by Osborn, Scott, and Speir (1878, pp. 81-82), but not illustrated. Osborn later regarded it as synonymous with *U. robustum* Leidy (1881, p. 18). The name is not recorded in the Princeton Museum catalog and the specimen could not be located.

No uinthere specimen has been as misinterpreted as the holotype of "*Elachoceras parvum*" Scott, 1886. This skull (PUM 10298) was found near the road where it crosses Henry's Fork Divide north of Lonetree. Scott relates the details of its discovery (1939, pp. 167-168) and Osborn gives the level as Bridger D-1 (1929, p. 86).

This unusual skull is ideally either ancestral to or the young of a *Uintatherium*. Scott considered both possibilities and decided that it was a holdover from an ancestral type of uinthere, more advanced than *Bathyopsis*.

Scott judiciously weighed three possibilities before deciding that it was a new genus: (1) that it was a skull of *Bathyopsis* (then known only from a pair of lower jaws), (2) that it was a female of *Uintatherium*, or (3) that it was a young specimen of *Uintatherium*. He decided that it was not *Bathyopsis* because of the high trigonids in the lower molars of that genus, which he felt should be reflected in the upper molars in some fashion not shown on this skull; that it was not a female of *Uintatherium* because the tusks were larger than he supposed would exist in a female; that it was not a young specimen because of the closed sutures and the worn dentition.

After the discovery of a skull of *Bathyopsis* (Osborn 1910), it was confirmed that the Princeton specimen was indeed not referable to that genus.

The skull is that of a mature animal for the reasons cited by Scott. The right cheek teeth are very worn. The right  $M^3$  is as worn as that tooth in any known uinthere. However, the left cheek teeth show a strikingly different situation.

M<sup>2</sup> and M<sup>3</sup> are not worn at all, and the other left teeth are only slightly worn. Osborn discusses this skull extensively in comparing it with the skull of *Bathyopsis*, and his sketch of the teeth shows this inconsistent wear very clearly (1910, p. 420). Yet, he did not mention it, nor, for that matter, did Scott.

Mr. Robert Witter of the Princeton University Museum carefully examined and partially dismantled the specimen. The cheek teeth of both sides were found to belong to the skull, showing that it was not a composite specimen.

Judging from other specimens studied, it seems probable that the canines of the female *Uintatherium* were not much reduced, but that the horns were. The small size of the maxillary and parietal horns on this specimen and the resulting decrease in bulk of their supporting structures strongly indicate a female specimen. It is the next to the smallest mature specimen among the larger uintatheres.

For these reasons it seems certain that "*Elachoceras parvum*" is merely a pathologic female of *Uintatherium anceps*.

The holotype of *Uintatherium "alticeps"* Scott, 1886 (PUM 10297) was found at the same locality as "*Elachoceras parvum*" in Bridger D-1 (Osborn, 1910), though at a slightly higher level (Scott 1886, p. 307). All teeth of the right side of this skull are present, as are a portion of the left canine, and the left P<sup>3</sup> to M<sup>1</sup> and inner half of M<sup>2</sup>. The hypocone of the M<sup>3</sup> has on its flank an accessory cusp which is unusual in being a little antero-posterior ridge instead of round. Scott reports that "there is a pair of small tubercles at the entrance of valley of the last molar" (1886), but this portion of the only M<sup>3</sup> present has been restored. Apparently that part of the tooth was damaged or lost, and the point cannot be checked. The skull is of average length for *Uintatherium*, but the length of the cheek-tooth row is near the upper end of the range for that genus. The occiput is notably high in proportion to its width. Scott regarded this as a specific character. The shape of the occiput is highly variable in *Uintatherium anceps*, however, and this character is not of specific importance. The other proportions of the skull are average for *Uintatherium*, as can be seen in Scott's outline drawing (1886, p. 305, fig. 4).

CATALOG OF PEABODY MUSEUM SPECIMENS NOT PREVIOUSLY IDENTIFIED: A few of the Peabody Museum specimens recorded below were mentioned by Marsh, but not referred to any species. The rest have not been previously described.

YPM 11196. Collected by J. W. Chew in 1873 from Sage Creek, Bridger Basin. Part of left lower jaw with P<sub>4</sub>, five thoracic centra, the proximal and distal ends of both humeri, and parts of a tibia, radius, and ulna.

YPM 11201. Collected near Henry's Fork (Bridger C or D) by the Yale College Scientific Expedition of 1873. The specimen is a good left humerus, 578 mm. long.

YPM 11205. This specimen was collected four miles east of Henry's Fork Divide by the Yale Expedition of 1873. It is probably from Bridger D. Included in it are pieces of the posterior portion of the skull, a broken glenoid process, part of the roof of the nasal chamber showing the top of a median septum, a badly weathered canine and other upper teeth, the seventh cervical and another cervical, a thoracic, and parts of the left radius and both tibiae.

YPM 11219. From Henry's Fork, Bridger Basin, Wyoming. Collected by L. Lamothe in October, 1873. Good right lunar, magnum, trapezium, trapezoid, and metacarpal IV with a shattered humerus and ulna.

YPM 11220. Collected near Henry's Fork (Bridger C or D) by O. C. Marsh in 1873. This specimen includes the top part of the skull except for the part between the maxillary and parietal horns and the basisphenoid.

YPM 11223. Collected by G. G. Lobdell on September 11, 1871. A left femur lacking the great trochanter. (Lobdell was a member of Marsh's 1871 student expedition.)

YPM 11224. This distal end of the right humerus was collected by O. C. Marsh somewhere in the Bridger Basin in 1873. Marsh cites this specimen as having a coronoid fossa which is deeper than the olecranon fossa (1885b, p. 90), which is not unusual.

YPM 11233. This lower jaw lacks teeth, but is otherwise nearly complete and in good condition. It was found by Sam Smith at "Lone Tree, Henry's Fork" (probably Bridger C) and is of the proper size for *Uintatherium*.

YPM 11238. A small humerus, 501 mm. long, collected by L. Lamothe and John Chew at Big Bone Buttes (Bridger D) in July 1874. It is the smallest known humerus from a *Uintatherium*. The epiphyses have fused, so the animal was mature.

YPM 11243. Part of the lower jaw without teeth collected at "Lone Tree, Henry's Fork" (probably Bridger C) by Sam Smith in June 1874. Present are the right horizontal ramus, posterior part of symphyseal area, and the area around the left flange, and a tibia. The inframandibular processes are larger than usual in a *Uintatherium*, though the jaw is not otherwise large.

YPM 11254. Femur from "Dug Springs, 8 miles south," a Washakie A locality. Collected May, 1876 by Jake Heisey.

YPM 11266. Radius and nasal bones. Collected August 1879 by Lamothe and Chew. There is no locality data with the specimen, but the shipment number is otherwise associated with Bridger Basin specimens.

YPM 11267. Right astragalus of average size collected "near Henry's Fork east of divide" (Bridger C or D) by O. C. Marsh, in 1873.

YPM 11494. This lower left  $P_3$  or  $P_4$  is unique in having a small cusp at the internal opening of the valley between the hypocondyl loph and posterior loph. It was collected somewhere in the Twin Buttes member in June 1874.

YPM 11495. A very worn incisor collected by Sam Smith in November, 1875 at "Lone Tree, Henry's Fork" (probably Bridger C).

YPM 11498. Parts of a lower jaw collected by Jake Heisey in November, 1875 at "Lone Tree, Henry's Fork—4 miles down" (Bridger C or D).

YPM 11504. Right lunar. Sent in from Wyoming by H. Lamb. Locality otherwise unknown.

YPM 11505. Left trapezoid: Wyoming, locality unknown.

YPM 11508. Wyoming, locality unknown. Left astragalus.

YPM 11510. Largest known *uintathere* tibia. Collected at Haystack Mountain by Sam Pearson in May 1875 (Washakie fm.—level not known). Though large, this bone is not so much larger than other *Uintatherium* tibia that it need be placed in one of the larger genera.

YPM 11512. Collected by Mat Forshey in May, 1876 at "Dug Springs, 8 miles south" (Washakie A). The proximal ends of a left radius and ulna are here stuck together in natural position by matrix.

YPM 11513. Weathered left astragalus of average size. The locality data is the same as that for YPM 11512.

YPM 11516. Locality uncertain, probably Twin Buttes member of the Bridger formation. Collected by L. Lamothe and John Chew, July 1874. This right magnum was mentioned by Marsh (1885b, p. 114) as one in which the lunar articular surface is confluent with that for the third metacarpal.

YPM 11525. From Henry's Fork, Wyoming (Bridger C or D). The specimen consists of a braincase and otic region broken so as to show some of the internal structures, the distal end of the right humerus, and a right unciform mentioned by Marsh (1885b, p. 117).

YPM 11523. Marsh referred this fourth right metacarpal to "*Dinoceras*" and gave detailed measurements (1885b, p. 126). Collected by John Chew somewhere in the Twin Buttes member of the Bridger formation in 1873. The good parts of the specimen are a left astragalus (1885b, p. 148), and a left ectocuneiform and lunar.

YPM 11532. Collected by L. Lamothe in 1873. Wyoming, locality unknown. Very worn incisor.

YPM 11537. Collected from "Dug Springs, 8 miles south" or Washakie A by Sam Smith on May 20, 1876. A crushed right humerus, distal end of a left humerus, right astragalus, lunar, scaphoid, cuneiform, and some very weathered skull fragments.

YPM 11539. A worn incisor collected by Sam Smith in June 1874 at Tule Springs (Bridger C or D).

YPM 11541. Worn right lower  $P_2$ - $M_3$ . The  $M_3$  and to a lesser extent the  $M_2$  are the most elongate in any specimen of *Uintatherium*. It is interesting to find this primitive *uintathere* character as a variant of *Uintatherium* and it is unfortunate that the locality data was not properly recorded. L. Lamothe and John Chew collected it in September 1874 and gave the locality only as Wyoming. However, from a letter written by Chew to O. C. Marsh, it is known that Chew spent that month collecting from the higher beds of the Bridger Basin.

YPM 11557. This poor specimen includes the proximal end of a metatarsal, a mesocuneiform, and a part of the distal end of a femur. It was collected by O. C. Marsh somewhere in the Bridger



Basin on September 11, 1870. The specimen is important because Marsh had it in his possession at the time he described "*Tinoceras anceps*. It is possible that Marsh had this specimen in mind when he mentioned "some of the smaller bones of the extremities" (1871, p. 71).

YPM 11558. Collected by Mat Forshey at "Dug Springs 8 miles south" (Washakie A). A whole right tibia of average size plus the distal ends of the left radius and the left tibia.

YPM 11571. Radius from Washakie A at "Red Dog Buttes". Collected by Sam Pearson in June, 1875.

YPM 11573. Tibia from "Red Dog Buttes," a Washakie A locality. Collected by Sam Pearson in July, 1875.

YPM 11576. Tibia from Henry's Fork Divide, probably Bridger D. Collected by J. J. DuBois of the Yale Scientific Expedition of 1871.

YPM 14324. Collected June 10, 1876 by Mat Forshey from "Red Dog Buttes, formation green sand" (probably Washakie A of east end of Haystack Mountain). A right ulna.

YPM 14325. (Date same as 14324). A right astragalus.

YPM 14326. Collected August 10, 1882 by John Chew on "Bear Mountain, 6 miles West of Sage Creek Mountain" (probably from Bridger D of Hickey Mountain). Tibia.

YPM 14327. A left femur from "green sand, Red Dog Buttes" or the eastern end of Haystack Mountain. Probably from Washakie A.

YPM 14328. A right acetabulum and ischium from Tule Springs (probably Bridger C). Collected by Sam Smith on June 17, 1874.

YPM 14329. Same locality as 14328. An extremely wide parietal horn.

YPM 14330. From Dug Springs, lower green sand (Washakie A). Distal half of left humerus and distal two-thirds of right humerus.

YPM 14332. Right astragalus and parts of limb bones. Collected about 6 miles south of the east end of Haystack Mountain in Washakie A by Peabody Museum party, June 1950.

CATALOG OF AMERICAN MUSEUM SPECIMENS NOT PREVIOUSLY MENTIONED: The following specimens were collected by the American Museum expedition of 1893 to the Bridger and Washakie Basins under the direction of J. L. Wortman. They have not previously been cited in any literature. A large percentage of the known uintathere material was collected by this expedition. It is unfortunate that this collecting was before the zoning of either the Bridger or the Washakie formations. Locality data does not give the level or the place.

However from the correspondence of Wortman to Osborn, it can be said that any uintathere collected by this expedition in the Washakie Basin is almost certainly from Washakie A. A statement by Wortman in a letter dated June 11, 1893, is particularly helpful: "We have finished the sandstone between LaCledé and Barrel Springs and our next country will be the continuation of the same layer to the southwest." The expedition later moved on to the Bridger Basin.

AMNH 1658. Washakie Basin. Left humerus.

AMNH 1659. Washakie Basin. Humerus.

AMNH 1660. Washakie Basin. Tibia.

AMNH 1661. Washakie Basin. Left magnum, scaphoid, unciform, metacarpal III and metacarpal IV, and the right patella and metatarsal III.

AMNH 1662. Washakie Basin. Right magnum, lunar, astragalus, and navicular.

AMNH 1664. Washakie Basin. This skull and lower jaw are slightly smaller than the average for *Uintatherium*. The horns are of average size. The teeth show moderate wear. The upper dentition lacks only the right P<sup>4</sup> and M<sup>1</sup> and the left canine and P<sup>2</sup>. The cingulum does not extend around the protocone. The lower jaw possesses only the right P<sub>3</sub>-M<sub>3</sub>. The inframandibular process is large; the anterior part of the jaw is missing. The metastylid on the unworn M<sub>3</sub> is smaller than usual.

AMNH 1665. Bridger Basin. This specimen includes a skull of average size, but with very large parietal horns, a sacrum and pelvis, and three posterior thoracic vertebrae. The skull has undergone a slight lateral compression. The pelvis is complete except for the dorso-lateral part of the right ilium. The three thoracic vertebrae are probably the three most posterior ones. Two of these vertebrae have a round capitular facet partly on the centrum and partly on the lower part of the neural arch. A very small tubercular facet is located higher and more posteriorly on the neural arch, just anterior to the posterior zygapophysis. The other vertebra possesses a single

round facet on the side of the neural arch. These three vertebrae show how the ribs are attached in the posterior part of the thoracic column. Marsh's specimens do not show this clearly. In addition, the two like vertebrae also show very clearly the zygapophysis, which has an extension arising at the external side hooking around the top of the posterior zygapophysis of the next anterior vertebra as in many artiodactyls.

AMNH 1666. Bridger Basin. The left tibia of this specimen was slightly smaller than average. The left fibula has been placed in the American Museum mounted skeleton.

AMNH 1667. Bridger Basin. A radius and a tibia here are the shortest known. However, the epiphyses have fused.

AMNH 1668. Bridger Basin. Included here are the left radius, calcaneum, the ulna minus the distal end and a right astragalus.

AMNH 1669. Bridger Basin. Right ulna and a part of the radius.

AMNH 1671. Washakie Basin. Skull and lower jaw (pl. 8, fig. 3). The skull, which is smaller than average, is badly crushed from side to side, but measurements in the antero-posterior line are valid. The squamosal area has the proper shape for a *Uintatherium* and the maxillary horns are well in advance of the anterior cheek teeth. The horns are very small. The right P<sup>2</sup> and M<sup>1</sup> are missing, but the upper dentition is otherwise complete. The canine teeth are unique among known uintatheres in that they have been broken and then worn smooth. The upper cheek-tooth row is the shortest (143 mm.) of any known specimen of *Uintatherium*. The teeth are very worn.

The lower jaw lacks the posterior part of the right ramus, the incisors, and the right P<sub>4</sub> and M<sub>1</sub>. The inframandibular process is fully developed. The length of the premolar series in proportion to the length of the molar series is greater than in any other uintathere.

The small horns of this old individual lead one to suspect that the specimen was a female. But the canines, though smaller at the base than the average, are stouter than the slightly built type seen in specimen YPM 11043, in which the tooth is associated with a very small pendant process. In this AMNH specimen the inframandibular process is large. All known *Uintatherium* lower jaws possess an inframandibular process.

AMNH 1674. Washakie Basin. Right astragalus.

AMNH 1675. Bridger Basin. The right front and hind feet of a specimen of average size were collected in an articulated condition. A right tibia was also obtained. These feet are complete except for the three phalanges of the pes and the cuneiform, trapezium, and trapezoid of the manus. Since most of the bones are cemented by matrix only a few measurements could be made.

AMNH 1678. Bridger Basin. These left and right rami of a lower jaw constitute the only known tooth-bearing specimen of an immature uintathere from North America. The anterior and posterior thirds are missing. The left DP<sub>2</sub>-M<sub>1</sub> and the right DP<sub>2</sub>-M<sub>2</sub> are present. The jaw has been prepared to show both the sides and crown of the unerupted P<sub>4</sub>. This gives a unique opportunity to compare in a uintathere the measurements of a deciduous tooth and the premolar which succeeds it. The premolar is 20 per cent wider and longer than its predecessor. The tooth pattern is not significantly different. The deciduous molar is very worn (pl. 13, fig. 4).

AMNH 1683. Bridger Basin. This is the second largest skull assigned to *Uintatherium*. The parietal horns are missing and the right maxillary horn has been restored. The maxillary horn is larger than average. The nasal horns are wide and flat and give a square-nosed appearance more typical of *Tetheopsis* or *Eobasileus*. The proportions of the skull are definitely those of *Uintatherium*, however.<sup>11</sup> The otic region is well preserved. The teeth present are the left canine, P<sup>2-3</sup>, and M<sup>2-3</sup> and the right P<sup>4</sup> and M<sup>1-2</sup>. The third molars show an interesting variation in the cusps which are present at the external entrance to the median valley of some specimens. The left M<sup>3</sup> has a single cusp here, but the right M<sup>3</sup> has a double cusp.

AMNH 1685. Bridger Basin. Tibia.

AMNH 1686. Washakie Basin. A right humerus and a right scapula and many ribs and vertebrae. The humerus is in the American Museum mounted skeleton.

AMNH 1689. Washakie Basin. This skull has the typical proportions of *Uintatherium*, though it is larger than average. The horns are notably massive. The left maxillary and right parietal horns are broken. The skull has a slight distortion, but this is more a skewness than a flattening and the measurements are probably all valid. All the teeth are present except the right canine. The cingulum extends around the protocone on all the cheek teeth except the P<sup>2</sup>.

AMNH 1691. Bridger Basin. The skull is that of a small, but mature individual. The right side of the skull especially toward the posterior end is badly eroded. The left cheek teeth are com-

<sup>11</sup> Marsh, who thought the shape of the nasal horns was an important criterion, would probably have referred this specimen to "*Tinoceras*."

plete except that the distal part of the canine has been broken off. The  $M^3$  is unworn. The cingulum extends around the protocone only on  $P^{3-4}$ .

AMNH 1692. Bridger Basin. The skull and lower jaws of this average-sized specimen are a part of the mounted specimen of *Uintatherium* in the American Museum. There has been considerable restoration of the lower jaw, but the skull is excellent. Some injury caused the left parietal horn to bifurcate in the remarkable fashion shown in Osborn's illustration (1910, p. 155).

AMNH 1693. Washakie Basin. This is one of the smallest skulls of *Uintatherium*. Its horns are small; the naso-frontal sutural ridges are prominent. The skull is in a stage of early maturity; all the teeth are worn except the  $M^3$ , which is, nevertheless, fully erupted. The hypocone of the third molar is unusually large. There is a small double cusp at the entrance to the median valley of  $M^3$ . The cingulum does not extend around the protocone on any of the cheek teeth. The canines were lost before petrification, but they appear to have been relatively small. The specimen was probably a female.

AMNH 1694. Washakie Basin. This excellent skull is from a large individual. The parietal horns are large and are unusually wide toward the top. The naso-frontal sutural ridges are prominent. There is a strong median ridge on the occiput. The otic region is well preserved. All the teeth are present except the left canine. The hypocone is small. The cingulum extends around the protocone only on  $P^{3-4}$ .

The following specimens were collected in the Washakie Basin by the American Museum expedition of 1895 under J. L. Wortman. Letters from him to Osborn relate that a camp was established early in June at Kinney's Spring (west-central part of Washakie Basin) and that they worked the exposures to the southwest of Haystack Mountain, but had little success. Late in June the expedition moved to the "southern out-crops of the formation" and camped in "the heart of these badlands." There is no way of deducing from the locality data from which faunal zone a given specimen came. Wortman specified that some specimens came from the "Lower Washakie."

AMNH 2316. "Lower Washakie." (Washakie A). Right tibia.

AMNH 2338. Collected by Wortman in July 1895 in the "Middle beds S. of Haystack Mountain." (Probably upper part of Washakie A.) A right astragalus.

AMNH 2339. A left navicular.

AMNH 2366. This is, without doubt, the finest skull of a uintathere ever collected (pl. 8, fig. 2; pl. 10, fig. 3). The dentition is complete and in good condition, including both the canines. The otic region shows much detail. The skull is of average size and proportions, except that the cheek-tooth row is proportionally longer than usual.

The hypocone of the  $M^3$  is large and is as high as the protocone. There are two low cusps at the entrance to the median valley of the right  $M^3$  and one cusp at that point on the left  $M^3$ . Only the  $M^1$  is any more than slightly worn.

AMNH 2367. A dorso-ventrally flattened skull roof. The nasal horns are wide and flat; no teeth are present. This skull is as long as any assigned to genus *Uintatherium*. The estimated probable length of the skull (81 cm.) takes into account the slight elongation due to flattening. The proportions are those of a *Uintatherium*.

The following specimens were collected by members of the American Museum Expedition of 1904 to the Bridger Basin under Walter Granger. Granger subdivided the Bridger into very small faunal units and usually recorded the exact level from which a specimen came.

AMNH 12167. "Spanish John's Meadow, Upper Level." Bridger C or D. Right tibia.

AMNH 12169. Bridger D-4 of Henry's Fork Hill (Cedar Mountain), 30 feet below upper white stratum. The right radius, patella, caudals 1-4, and all four feet are in the American Museum's composite mounted skeleton. Matthew records in the American Museum catalog that "the limbs and feet were found articulated and extending downward, the specimen evidently having been mired." Also present were the right femur and tibia, the pelvis, and some lumbar vertebrae. The posterior part of the top of a skull of a large *Uintatherium* is "questionably associated."

AMNH 12170. Bridger C-4, Henry's Fork Hill (Cedar Mountain), 30 feet below the Lone Tree White Stratum. Complete large lower jaws. This is the only lower jaw of a uintathere which

contains incisors in place. The cheek teeth are complete except for the left  $P_2$ . The left  $I_{1-2}$  and the right  $I_1$  and canine are present. Only the  $I_1$  of the incisors has undergone any wear and this is slight. The cheek teeth are moderately worn.

AMNH 12171. Bridger C-5, Henry's Fork Hill. Well preserved right femur, tibia and fibula, all much smaller than average. The femur, which has the epiphyses solidly fused, is by far the shortest one known of a Uintathere. The tibia shows with great distinctness the downward facing facet for articulation with the proximal end of the fibula.

AMNH 12173. Summers' Dry Creek, Bridger D-4. A right scapula is in the AMNH mounted skeleton. The left innominate bone is also preserved.

AMNH 12174. Lane Meadow, Bridger C-3, Burnt Fork White Stratum. The specimen includes the left humerus, radius, and ulna, both femora and tibiae, cervicals 1, 4, 5, 7, and thoracics 2, 4, 5, 8-9, 11, 13-16 (numbers according to AMNH catalog), and presumably the five lumbar vertebrae shown. These are all included in the AMNH mounted skeleton.

AMNH 12176. Henry's Fork (Lone Tree). (Probably Bridger C.) Right ulna in the AMNH mounted skeleton.

AMNH 12177. Bridger C-4, Henry's Fork, Lone Tree, 50 feet below Lone Tree White Stratum. Right radius and ulna. The association is questionable as the radius seems unduly short for the long ulna.

AMNH 12178. Bridger C-3. Henry's Fork Hill 200 feet below Lone Tree White Stratum. Small left ulna.

The following specimens were collected by the 1906 expedition of the American Museum in the Washakie Basin.

AMNH 13152. Washakie A at base of Haystack Mountain. A young skull roof showing maxillary horns only 40 mm. high and 150 mm. from tip to tip. There is a suture just in front of the right parietal horns and extending across the skull as in USNM 4212 described by Marsh. The base of the maxillary horn shows the space for the proximal end of the canine; posterior to this is the anterior end of a small sinus.

AMNH 13157. Washakie A of Haystack Mountain. A left astragalus.

AMERICAN MUSEUM MATERIAL FROM THE UINTA BASIN: The Uintathere material collected in the Uinta Basin by the American Museum of Natural History Expeditions of 1894 and 1895 is rather tantalizing.

The specimens collected in 1894 were cited by Osborn (1895, pp. 75-76, 82) who referred them to *Uintatherium*. However, at that time he regarded the holotype of *Eobasileus cornutus* as another *Uintatherium* for he says (1895, p. 76), "Judging from the limbs, it was a very large animal, and will not improbably be found to belong to the *Uintatherium cornutum*." Later Osborn (1909, pp. 55-57) called Division "A" (now  $B_1$ ) the *Uintatherium* zone on the basis of specimen AMNH 1881, which is the head of a humerus. He assigned the name *Eobasileus* zone to Division "B" (now  $B_2$ ) on the basis of all other specimens (see pp. 16 of this report).

The following catalog lists specimens collected in 1894. (Note that the museum numbers are confusingly similar to the date when they were collected.)

AMNH 1881. Head of a humerus.

AMNH 1884. Rear part of a skull, in poor condition and full of matrix.

AMNH 1885. Distal end of left humerus. Transverse diameter about 220 mm., which is larger than average.

AMNH 1886. Left femur of slightly larger than average size. (Incorrectly cited as specimen 1880 in Osborn 1895, p. 82.)

AMNH 1887. Left femur of slightly larger than average size.

AMNH 1888. Left femur of slightly larger than average size.

AMNH 1889. Smaller than average right maxillary horn.

AMNH 1889a. Smaller than average right maxillary horn.

AMNH 1890. A right astragalus, distal end of a right femur, left lunar, very worn left scaphoid, and a right patella. These foot bones are of average size.

Specimens collected in 1895 (all Uinta B<sub>2</sub> from "near the White River"):

AMNH 2061. Proximal end of a smaller than average left femur.

AMNH 2062. Left scaphoid.

AMNH 2063. Left tibia, with two short sections of the shaft missing; smaller than average.

AMNH 2093. Distal half of a femur, smaller than average.

AMNH 2094. Broken and weathered left astragalus, and right cuneiform.

The two significant skulls found in the Uinta Basin by the Chicago Museum of Natural History are *Eobasileus*. The skeletal parts of *Eobasileus* (and *Tetheopsis*) are notably larger than in *Uintatherium*. Also, there have been no specimens of *Uintatherium* found in the upper part of the Washakie formation (which is correlated with Uinta B). Therefore one would not expect to find uintathere bones of the size proper for *Uintatherium* in the Uinta Basin.

And yet, despite Osborn's impression, these bones collected from the Uinta formation by the American Museum of Natural History expeditions of 1894 and 1895 are not notably large. Even the relatively largest of them (AMNH 1885) is not significantly larger than the average for *Uintatherium*.

If they are *Uintatherium* as their size indicates, why is *Uintatherium* not found in the equivalent upper Washakie formation? The exact generic disposition of these bones is not yet solved. In the meantime, it would be best to add an "upper Eocene (?)" to the otherwise middle Eocene range for genus *Uintatherium*.

CATALOG OF U. S. NATIONAL MUSEUM SPECIMENS: O. C. Marsh received a considerable sum of money for acquiring vertebrate fossils for the U. S. Geological Survey (Schuchert and LeVene 1940, pp. 272-273). These fossils now form a part of the U. S. National Museum collections. Included among them are the skull top of a young uintathere and some other uintathere material of small consequence.

USNM 4212. Top of an immature skull showing the fronto-parietal suture just in front of the parietal horns.

USNM 4740. "10 miles N. E. of Red Dog" (Washakie A). Left tibia of average size.

USNM 4741. "10 miles N. E. of Red Dog" (Washakie A). Another left tibia of average size.

USNM 4742. "10 miles N. E. of Red Dog" (Washakie A). A right femur of smaller than average size.

USNM 5919. Collected by the American Museum party in the Washakie Basin in 1893. The skull and lower jaws are both present. The parietal horns are extremely wide toward the top (150 mm.). The left upper teeth are fairly well preserved, those on the right lack much of the external portion. The length of the upper tooth rows of the two sides are different and one row has been displaced with respect to the other. The true length is probably 170 mm. The length of the lower cheek-tooth row is 172 mm. This specimen has the longest upper and lower cheek-tooth rows of any specimen of *Uintatherium*. The teeth are well worn.

The lower jaw has a large inframandibular process which ascends in front more abruptly than is usual. There is a relatively large paraconid on M<sub>2-3</sub>. The metastylids are small. The canine has only a slight curvature. Its surface is eroded. Both the skull and lower jaws have been considerably cracked and have undergone some surficial erosion. The skull is 80 cm. long. The maximum length for this genus is 81 cm.

USNM 16662. Bridger D. Collected by C. L. Gazin and party in 1941 on the divide between Henry's Fork and Sage Creek northwest of Lonetree. This is the most nearly complete skeleton of *Uintatherium* ever found. It was described and illustrated by Gilmore in 1943. The skull has been considerably flattened in the posterior portion and the occipital crest has been turned back by this crushing to a horizontal position. The 33 ribs found show that there were at least 17 thoracic vertebrae (only 11 were actually recovered). This individual had three lumbar vertebrae.

USNM 16663. Collected by C. L. Gazin and party in 1941 in Bridger C of Sage Creek Basin. An excellent skull of average size. All the cheek teeth are present. The left canine and the distal part of the right canine are missing. The skull is of average size, but the teeth are very small for the size of the skull (pl. 10, fig. 2). The specimen contains the rudiments of a left incisor. This cylindrical bit of tooth material lies in an elongate pit. The corresponding pit on the right

premaxillary is empty. Anterior to each of these is a distinct circular pit, probably for another even smaller rudiment, not preserved here. Other specimens may show these small pits, i.e., YPM 11039, but this is the only one with a bit of tooth material in place.

The palate has a strong median keel from the center of the diastema to a point opposite the  $M^3$ . The "palato-maxillary foramen" of Marsh is larger than usual. The pterygoids are strong. The hypocone is large and possesses a prominent accessory cone on its postero-external flank on  $M^{2-3}$ . The  $M^1$ , as usual, is too worn to determine this point. The internal cingulum extends around the protocone on all the cheek teeth. The external cingulum is very weak. The teeth are only moderately worn.

USNM 18599. Probably Bridger D. Found in 1946 by C. L. Gazin and party north and east of Sage Creek Mountain and northwest of Cedar Mountain. A weathered skull and part of the left lower jaw with  $P_3-M_3$ . The external cingulum of the right  $M^3$  extends across the median valley and there is a cusp at the entrance to this valley. The paraconid is distinct, even on  $P^3$  and  $P^4$ . The cingulum extends around the protocone. The dimensions of the  $M^3$  are: antero-posterior, 37 mm.; transverse, 36 mm.; anterior loph, 37 mm.; posterior loph, 34 mm.

USNM 18600. From high on the northeast flank of Twin Buttes, probably Bridger D. Collected by C. L. Gazin and party in 1946. Some lateral crushing has occurred and the rostrum has been restored. The otic region is well preserved. A crack through the skull separates the right  $P^3$  and  $P^4$  and the left  $M^1$  and  $M^2$ . The right canine is much restored, but the dentition is otherwise complete. The cheek teeth are very worn, except for the  $M^3$ .

The right  $M^3$  has two cusps at the entrance to the median valley and the left  $M^3$  has one. These two cusps of the right  $M^3$  are clearly a part of the external ridge which descends posteriorly from the paracone into the median valley. The external cingulum is lower on the tooth and crosses the median valley, thus showing that these cusps are not related to the cingulum.

The internal cingulum does not extend around the protocone of any of the teeth. This specimen is unique in having a hypocone on the  $P^4$  (pl. 10, fig. 1). No other uinthere specimen has a hypocone on any premolar.

USNM 18601. High in Bridger C or low in D northwest of Cedar Mountain. Collected by C. L. Gazin and party in 1946. This part of the anterior portion of a skull has the left canine and  $P^2-M^2$  and a broken  $M^3$ . The left canine is moderately curved and does not have a lower median ridge. The "palato-maxillary" foramen is large and lies opposite  $P^{2-3}$ . The maxillary horns are short, but unusually robust: 80 mm. high, 100 mm. antero-posteriorly, and 85 mm. transversely. The infraorbital foramen is very large. The lacrimal foramen is distinct and lies on the facial portion of the lacrimal bone. A very worn lower canine occurred with the specimen; the cheek teeth are but moderately worn.

USNM 18603. Collected high in Bridger C or low in Bridger D from a patch of badlands northwest of Cedar Mountain by C. L. Gazin and F. L. Pearce in August 1946. A larger than average isolated right  $M_3$  (pl. 13, fig. 3). The entoconid and the paraconid are preserved very distinctly on this specimen. The external cingulum, which extends forward up to the trigonid, is continuous with the posterior loph, and not with the posterior cingulum. There is also a distinct anterior cingulum. No internal cingulum is present. These features of the cingulum are the usual for *Uintatherium*, but are more clearly shown on this specimen than on most.

USNM Vertebrate Paleontology Field Number 71-46. Collected by C. L. Gazin and party in 1946 from a green lens in the Lone Tree White Layer (Bridger C-D boundary). The lower jaw is notable for the abrupt anterior edge of the pendant process, which is nearly vertical; and for the presence of three anteriorly facing mental foramina. All these foramina are located above the pendant process in the region below the diastema. The teeth are very worn and broken. The specimen also includes a radius and ulna of nearly average length and a good cervical vertebra.

### *Tetheopsis* Cope

*Loxolophodon* (in part) Osborn, 1881

*Tinoceras* (in part) Marsh 1885b, pp. 205-206, 211, 217-218

*Tetheopsis* Cope 1885c

TYPE SPECIES: *Tinoceras stenops* Marsh = *Loxolophodon speirianum* Osborn.

DISTRIBUTION: Middle and upper Eocene of the Washakie formation of the Washakie Basin, Wyoming.

DIAGNOSIS: Large uinthere, distinguished from *Uintatherium* and *Eobasileus* by skull proportions. Skull long and narrow with parietal horn situated relatively near occiput; postero-dorsal part of temporal fossa not widened; maxillary horn situated mainly above the diastema; portion of skull in front of maxillary horns moderately elongate. Skull in known specimens 75-95 cm. long; upper cheek-tooth row 161-179 mm. long.

DISCUSSION: Marsh based his ideas of the characters of his genus "*Tinoceras*" on a specimen (YPM 11041) which he called "*Tinoceras*" *ingens*. But the holotype, "*Tinoceras*" *anceps*, is referable to the previously named genus, *Uintatherium*. Marsh presents excellent illustrations of "*Tinoceras*" *ingens* in his monograph, and subsequent workers have associated the name "*Tinoceras*" with a concept based on this specimen.

Since "*Tinoceras*" cannot be the name of this genus another one must be applied. A search through the literature shows that the only valid generic name ever applied to a specimen in this genus is *Tetheopsis* Cope, based on the species *Tinoceras stenops* Marsh.

The name *Tetheopsis* is a product of Cope-Marsh warfare. Cope observed the figure of "*Tinoceras*" *stenops* Marsh (1885b, p. 217) and rushed into print with this new genus. The name is from the Greek "tethe" (grandmother) and "opsis" (appearance). This may be "in allusion to the absence of lower canines and incisors" (Palmer 1904, p. 669). It is not, as Osborn said (1931, p. 179), the "beast of the deep-set eyes." The woodcut in Marsh's monograph shows a restored portion at the anterior end of the lower jaw. It happens that the cropping teeth have not been restored either on the specimen or the drawing. The bare elements of caution should have suggested to Cope that the cropping teeth had merely been broken away with the rest of the tip of the lower jaw. It should also have occurred to him that, if the cropping teeth had been genetically absent, Marsh would have commented on it.

Cope's original description (1885c) reads: "No inferior canines or incisors; three inferior premolars. . . . *Tetheopsis* Cope. . . . *Tetheopsis* is established on *Tinoceras stenops* Marsh." Later Cope found out to his satisfaction that the anterior end of the lower jaw had been restored. He hastily repudiated the genus on the basis that the specimen was an artifact (1886). It should be pointed out, in justice to Marsh, that his drawing shows quite clearly which parts are restored.

By a strange taxonomic accident, a name based on an assumed and non-existent character, and repudiated by its author, turns out to be the only valid one for this genus. As in the case of *Uintatherium*, the type species is a synonym.

The data on specimens of *Tetheopsis* are usually insufficient to make exact statements about its stratigraphic range. However, no specimen has ever been collected from anywhere but the Washakie Basin and all specimens except AMNH 1687 come from on or near Haystack Mountain.

#### *Tetheopsis speirianus* (Osborn)

*Loxolophodon speirianum* Osborn 1881, pp. 18-23, 26, 28, plates 1 and 4

*Tinoceras annectens* Marsh 1885a, pp. 43, 56, 73, 74

Marsh 1885b, pp. 205, 206

*Tinoceras longiceps* Marsh 1885a, pp. 275, 279

Marsh 1885b, pp. 214-215

*Tinoceras stenops* Marsh 1885a, p. 283

Marsh 1885b, pp. 217-218

HOLOTYPE: PUM 11079.

DISTRIBUTION: Middle and upper Eocene of Washakie formation of the Washakie Basin, Wyoming.

DIAGNOSIS: Distinguished from *T. ingens* by the relatively longer portion of the skull anterior to the maxillary horns.

DISCUSSION: The holotype of "*Loxolophodon*" *speirianum* Osborn was collected from Bed 9 of Washakie A (Granger's section) at the west end of Haystack Mountain, Washakie Basin, Wyoming (Osborn 1929, p. 90). This is the only

specimen of *Tetheopsis* for which the stratigraphic level is exactly known. The skull is second in length only to the Colorado Museum specimen of *Eobasileus cornutus*. Nevertheless, it does not present a massive appearance and is probably a female. The horns are moderately long, but are slender, and the canines, as indicated by their alveoli, were only of moderate size. The resemblances of the horns to those of YPM 11256, which is certainly a female, further support this idea. Osborn (1881) described the skull and included a large illustration which is reproduced as plate 11, fig. 1 of this report. The lower jaw and the skeletal elements which he illustrated with it are not from the same specimen.

Osborn regarded this skull as congeneric with the holotype of *Eobasileus cornutus*, which he referred to the invalid genus, *Loxolophodon*. The two skulls do resemble each other in their great length and in the shape of the temporal fossa. But Osborn did not cite these resemblances and I am unable to tell from his descriptions just why he regarded them as congeneric.

Specimen YPM 11043 is the holotype of "*Tinoceras annectens*" Marsh, which includes a skull and lower jaws. It is from Haystack Mountain, Washakie formation, Washakie Basin, Wyoming. Unfortunately, the collector, Jake Heisey, did not give Marsh precise locality data. The specimen includes the much restored skull, a badly damaged left cheek-tooth row separate from it, the lower jaws with the left P<sub>3</sub>-M<sub>3</sub> and the right premolars, the seventh cervical and six thoracic vertebrae. The basicranial and palatal regions are missing and the right parietal horn and most of the occiput are restored. The skull is very long (about 91 cm.) and the horns are long and robust. The damaged M<sup>3</sup> is as large as any known. The canine illustrated by Marsh (1885b, p. 21) is now missing from the collections.

The lower jaw is very elongate and except for one specimen of *Eobasileus cornutus* (CMNH 496) has the longest lower cheek-tooth row of any untathere (pl. 14, fig. 2). The lower jaw was also illustrated by Marsh (1885b, p. 36).

Presumably, Marsh placed this specimen in "*Tinoceras*" because of the large size and the general resemblance to the holotype of *Tetheopsis ingens*.

Another one of Marsh's specimens, YPM 11256, became the holotype of "*Tinoceras longiceps*" Marsh. It was collected at "Red Dog Buttes" or the eastern end of Haystack Mountain, Washakie formation, Washakie Basin, Wyoming. The horizon is uncertain, but is probably Washakie A. The specimen includes the left maxillary with worn left cheek teeth and part of the zygoma, an isolated left canine, the left maxillary and parietal horns, a left lower jaw with a well worn canine, P<sub>3-4</sub>, and M<sub>2-3</sub> present, and a part of the broken right lower jaw without teeth. The upper cheek-tooth row is the longest of any untathere except for one specimen of *Eobasileus cornutus* (CMNH 495). The lower dentition lacks P<sub>2</sub> and most of M<sub>1</sub> and there has been some readjustment of the teeth and jaw anterior to M<sub>2</sub> in preparation. Consequently, the true length of the row cannot be obtained. The broken right jaw shows the hollow interior.

Both the maxillary and parietal horns show small sinuses at their bases. These horns resemble those of the holotype. This specimen is referred to *T. speirianus* because of this similarity as well as the great size of the tooth row and the lack of resemblance of the horns to those of the female of *Eobasileus* from the Uinta Basin (CNHM P12164).

Marsh probably referred YPM 11256 to "*Tinoceras*" because of the large size of the tooth row and the great length of the lower jaw. He assigned all of his large specimens to "*Tinoceras*" even though size was not part of his definition.

Another specimen of *Tetheopsis speirianus* serves as the holotype of "*Tinoceras*



*stenops*," another one of Marsh's innumerable species. It is from the "green sand" (upper or lower?) of the Washakie formation at Haystack Mountain, Washakie Basin, Wyoming. Unfortunately, the collector, Sam Smith, did not state from which green sand the specimen (YPM 11567) came. A pair of lower jaws is articulated to the skull with a small gape. The cheek teeth are highly worn but are all present (Marsh 1885b, figs. 53-54, p. 47). The skull is badly crushed from side to side and the right side was badly eroded in weathering. The parietal and right maxillary horns are missing and only a part of the left maxillary horn is present. The symphysis of the lower jaw and the cropping teeth are missing.

Marsh probably assigned the specimen to "*Tinoceras*" because of its large size. Because of the lack of a parietal horn the exact skull proportions cannot be determined. But from the part of the temporal fossa that is present, it can be seen that this area is not expanding postero-dorsally. Marsh's line-drawing restorations (1885b, p. 217) are substantially correct. The proportions are those of a *Tetheopsis* (pl. 11, fig. 2).

A previously undescribed specimen, AMNH 1687, was collected somewhere north of Haystack Mountain, Washakie Basin, Wyoming, by the American Museum expedition of 1893. It is very probably from Washakie A.

As explained on p. 42, and uintathere found on this expedition is almost certain to be from Washakie A. Further information, which surely refers to this specimen, was given to Osborn in a letter from Wortman dated June 3, 1893: "There is a very curious thing in regard to the skulls of this group [uintatheres] quite the reverse of what I expected to find. In this brown sandstone layer (what I think is the very bottom of the Washakie beds) the nose is short while in the overlying green sand we find a form with elongated nasals. We have however only one skull from this latter layer."

The only skull with an unusually long portion anterior to the maxillary horns collected by this expedition is this specimen. We thus find an advanced type of uintathere rather low in Washakie A.

This skull, which has not been previously described, is the smallest which is referred to *Tetheopsis*. It is a female as indicated by the small size of the horns and the canine root. The skull has been distorted and much of its height is probably due to a side to side compression. Some torsion has thrown the tooth rows out of alignment. Only broken ends of roots of cheek teeth and canines remain. The left parietal and right maxillary horns have been restored. The ratio of the parts of the skull and the shape of the squamosal area show that the specimen is a *Tetheopsis*.

Osborn referred PUM 10385 to "*Loxolophodon*" (1881, pp. 29-30, pl. 1, lower jaw only; pl. 3, figs. 1-2). The locality for this jaw is given in the Princeton Museum specimen catalog as "Laclede Meadows." Laclede stage station, the walls of which are still standing, is located northwest of Haystack Mountain, near the place where Bitter Creek has cut through Laney Rim. It seems probable that the "Laclede Meadows" would apply to the relatively flat terrain lying between Laclede stage station and Haystack Mountain, and hence that the specimen is from Washakie A faunal zone.

Osborn's illustration of the specimen includes some restoration. It does not show that the cheek teeth are in poor condition or that the right jaw is still embedded in matrix. The posterior loph of  $M_3$  is composed of a row of partially discrete, tiny cusps which are more distinct in this specimen than in any other uintathere. The most external of these cusps is set apart from the adjacent cusp,

a unique feature. The jaw is notable for the very small size of the inframandibular process, a feature best interpreted as indicating the jaw of a female. The length of the cheek-tooth row (155 mm.) seems too small for *Tetheopsis* but the specimen is referred to that genus on the resemblance of the lower jaw to that of YPM 11256 and because of the absence of jaws of this type in *Uintatherium* (pl. 11, fig. 1, this report).

Another Princeton specimen (PUM 11611) came from "15 miles south of Laclede." One was described and illustrated by Osborn and Speir under the title "The Lower Jaw of *Loxolophodon*" (1879). The left incisors and a canine were associated with the ramus in the matrix but were not actually emplaced in bone. These incisors, which were again illustrated by Osborn in 1881 (pl. 2, figs. 3-4), could not be found (pl. 13, fig. 2, this report).

The unworn M<sup>3</sup> is very large, and appears especially so when compared with the M<sup>2</sup> of more nearly average size. The mental process is exceedingly small. The specimen is regarded as a female and is referred to *Tetheopsis speirianus* for the same reasons as pertain to PUM 10385.

### *Tetheopsis ingens* (Marsh)

*Tinoceras ingens* Marsh 1885a, pp. 261, 263, 267, 269, 281, 286

Marsh 1885b, pp. 20, 30, 31, 33, 211, and pls. 15-18

HOLOTYPE: YPM 11041.

DISTRIBUTION: Middle or upper Eocene, Washakie formation of the Washakie Basin, Wyoming.

DIAGNOSIS: Distinguished from *T. speirianus* by the short portion of the skull anterior to the maxillary horns, the skull resembling *Uintatherium* in this respect. Only one specimen is known.

The holotype of "*Tinoceras*" *ingens* Marsh comes from Haystack Mountain, Wyoming, Washakie formation, probably from Washakie B or high in Washakie A. It was upon this excellent skull that Marsh based most of his ideas of the genus "*Tinoceras*." Since the parietal horns are near the occiput and the muzzle is relatively short, the proportion of the skull between the parietal and maxillary horns is larger than in any other uintathere, as is very evident from visual inspection. The dentition, which has had greater than average wear, is complete (Marsh 1885b, pl. 18). The internal cingulum completely encircles the protocone on M<sup>3</sup> only; the external cingulum, as is usual when it is present, is around the paracone only (pl. 12, fig. 1, this report).

### *Tetheopsis* or *Eobasileus*

The following specimens are referred to either of these two genera on the basis of size and stratigraphic position. Without certain areas of the skull definite generic determinations cannot be made.

AMNH 5041. Holotype of "*Eobasileus galeatus*" Cope.

#### Partial bibliography of "*E. galeatus*"

Cope 1873f	<i>Eobasileus galeatus</i>
Cope 1874	<i>Loxolophodon galeatus</i>
Osborn 1881	<i>Loxolophodon galeatus</i>
Cope 1885a, pp. 585-587, and pls. 43-44.	<i>Eobasileus galeatus</i>
Marsh 1885b, p. 209.	<i>Tinoceras galeatum</i>

This very fragmentary skull is given by Cope as "from the bad lands of Mammoth Buttes" (i.e., Haystack Mountain, Washakie formation). This skull is as big as the holotype of *E. cornutus*, according to Cope. The parietal horns equal

those of the type of that species, but the maxillary horns are shorter (17.5 cm.). The nasal horns are wide; the posterior molar is very large. The posterior part of the temporal fossa has the shape for either *Tetheopsis* or *Eobasileus*. It is certainly one of these two genera, but the fragmentary nature of the specimen makes exact identification uncertain.

A right unciform found by Sam Smith in the "green sand" (lower or upper?) of Haystack Mountain, Washakie Basin, Wyoming on May 24, 1882 is the biggest uintathere unciform known (YPM 11431).

Nearly as large is the right unciform (YPM 14331) collected May 28, 1882 by Jake Heisey from a Haystack Mountain "green sand" (level uncertain, but in the Washakie formation).

A specimen collected from the Washakie B on the northwest face of Haystack Mountain by the American Museum Expedition of 1906 (AMNH 13149) is still mostly encased in plaster jackets. It can be seen that the femur, canine, and innominate bone are notably bigger than those of any *Uintatherium*. The catalog records that there is a lower jaw.

The largest known uintathere radius (AMNH 2333) was collected from Washakie A beds south of Haystack Mountain by the American Museum of Natural History expedition of 1895. It is placed in *Tetheopsis* because of the combination of large size and only a middle Eocene age.

AMNH 13153. Left humerus collected on September 21, 1906 by Walter Granger from the Washakie B zone. This is the second largest uintathere humerus. Even so, it is not notably larger than humeri of *Uintatherium*. Its stratigraphic level and its slightly larger size suggest one of the larger genera.

### *Eobasileus* Cope

*Loxolophodon* (in part) Cope, 1872b (August 19)

*Eobasileus* (in part) Cope, 1872c (August 20)

*Tinoceras* (in part) Marsh, 1885b, pp. 119-120 and 214

*Uintacolootherium* Cook, 1926

TYPE SPECIES: *Loxolophodon cornutus* Cope, 1872b

DISTRIBUTION: Upper Eocene of the Washakie Basin of Wyoming, the Uinta Basin of Utah, and Moffat County, Colorado.

DIAGNOSIS: Large uintathere, distinguished from *Uintatherium* and *Tetheopsis* by skull proportions. Skull long and narrow with parietal horn situated relatively near occiput; postero-dorsal part of temporal fossa not widened; maxillary horn longer than 18 cm. and situated above premolars; portion of skull in front of maxillary horns very elongate. Skull in known specimens 85-95 cm. long; upper cheek-tooth row 168-188 mm. long.

DISCUSSION: In the garbled telegram (1872b) Cope proposed three new species of uintatheres which he referred to *Lefalaphodon* (meaning *Loxolophodon*). One day later he referred all these new species to a new genus and species, *Eobasileus cornutus* (1872c). Two days later (1872d) he confirmed the separation of *Loxolophodon* from *Bathmodon* and gave brief descriptions of four species: *L. semicinctus* and the three species proposed in the telegram, *L. cornutus*, *L. pressicornis*, and *L. furcatus*. (The placing of a *Coryphodon* and an *Eobasileus* in the same genus was surely a *lapsus* by Cope. *L. cornutus* is now referred to *Eobasileus cornutus* and *L. pressicornis* and *L. furcatus* are referred to *Uintatherium anceps*.)

Unfortunately, Cope wanted to record his every change of mind in print, and, in this phase of his study of uintatheres he changed it very frequently. He then decided that the three species proposed in the telegram were best placed in *Eobasileus* (1872e and 1872g). He also published a corrected version of the garbled telegram (1872f).

Early in the next year he returned the species *Eobasileus cornutus* to *Loxolophodon cornutus*, but claimed that that species was the type of the latter genus, by personal fiat apparently.

He further implied that *Eobasileus pressicornis* was to be the type of that genus, despite the fact that the type is *Eobasileus cornutus* by monotypy.

Cope's skull of an *Eobasileus* from near the top of Haystack Mountain was the

first good uintathere skull to be reported. It is surprising that only two other skulls of this genus (and possibly a third) have turned up since.

I have not been able to prove the presence of more than one species.

*Eobasileus cornutus* (Cope)

*Lefalaphodon discornatus* Cope 1872b

*Eobasileus cornutus* Cope 1872c

*Loxolophodon cornutus* Cope 1872d

*Tinoceras latum* (in part) Marsh 1885b, p. 214

*Uintacolotherium blaynei* Cook 1926

*Eobasileus uintensis* Osborn 1929, p. 93 (*nomen nudum*)

HOLOTYPE: AMNH 5040

DISTRIBUTION AND DIAGNOSIS: Same as for genus.

DISCUSSION: The holotype (AMNH 5040) was collected by E. D. Cope and Sam Smith in August 1872 high on Haystack Mountain in unit 22 of Granger's section of Washakie B. The specimen consists "of a nearly perfect [skull], the right scapula . . . several vertebrae, including the sacral, the first or second rib, the pelvis complete, and the entire right femur. . ." (Cope 1873a, p. 568).

This dolichocephalic skull is the largest known of any uintathere (95 cm.). The maxillary horns are very long and the nasal horns are extremely flat and wide. Much of the occiput and the parietal horns are missing and have been restored. Judging from the Chicago Natural History Museum skull of *E. cornutus*, this restoration was well done and the measurements dealing with this area of the partially restored holotype seem sufficiently close to the original to be useful.

The skull and parts of the skeleton of this specimen have been described in detail by Cope (1885a, pp. 569-585 and pls. 37-42). The cheek teeth are all present, but are deeply worn. There is no external cingulum and the internal cingulum extends around the protocone on M<sup>3</sup> only. The sabre-toothed canine is the longest known and is greatly curved.

In 1874, Marsh sent Sam Smith (who had helped Cope collect this holotype in 1872) and Jake Heisey to find any part of the specimen that might have been missed. A dorsal vertebra, a lunar, a maxillary horn tip, and an occipital condyle were found. As the maxillary horn is not from the holotype, the other bones may not be either, even though Marsh says that they are (Marsh 1885b, p. 208). (The holotype has both maxillary horns present.) These bones were recorded as YPM 11217, but were subsequently donated to the American Museum.

Some leg bones were collected from "upper green sand, Dug Springs" or Washakie B by Jake Heisey on May 15, 1876. This specimen (YPM 11509) consisting of a right unciform, right astragalus, and the ends of the right tibia, was referred by Marsh (1885b, pp. 119-120) to "*Tinoceras ingens*" and the unciform was illustrated. The specimen is referred to *E. cornutus* because of its large size and its position high in Washakie B, where *Eobasileus* is the only uintathere which is certainly known.

Some skull parts (YPM 11533) collected from the "green sand" of Haystack Mountain, Washakie Basin were referred to "*Tinoceras latum*" by Marsh (1885b, pp. 213-214) even though it is not like the holotype of that species. The extremely wide and flat pair of nasal horns and the long (19 cm.) and stout right maxillary horn are diagnostic of *Eobasileus*.

A large uintathere skull from the Uinta formation, high in unit B<sub>1</sub> was collected by J. B. Abbott in 1910 on the "White River Divide" two miles east of Bonanza Mine, Uinta County, Utah. This excellent skull (CNHM P12170) has

not been previously described, though it has been cited in the literature. Riggs (1912, p. 17) stated that "*Eobasileus* is first reported from skulls capable of identification." Osborn referred to this skull as "*Eobasileus uintensis*" and fixes its exact stratigraphic position (Osborn 1929, p. 93.) This name is a *nomen nudum* as there was no description or illustration. The skull lacks only the tips of the nasals and premaxillaries, the left parietal and maxillary horns, and the left canine and P<sup>2</sup>, which have all been restored (pl. 12, fig. 2 of this report).

The skull is dolichocephalic and large, though not as large as the holotype. The occiput is widest about midway from top to bottom, rather than at or very near the top as in *Uintatherium*, and possesses a strong median vertical ridge. (This part of the occiput was restored in Cope's type.) The canine is not notably long, but is strongly curved. An internal cingulum extends around the protocone of the molars, but not the premolars; there is no external cingulum. The M<sup>1</sup> is highly worn, but the other cheek teeth are only moderately so. On the M<sup>2-3</sup> the crest which descends posteriorly from the paracone is strong and runs all the way to the bottom of the median valley, but does not give rise to any small cusps there.

The size and proportions of the skull are those of an *Eobasileus*. Differences between this skull and that of the holotype might be regarded by some as specific in character. Judging from the variation shown in the species *Uintatherium anceps*, it is not sufficiently different to represent a new species.

A rather poor skull (CNHM P12164) was collected from unit B of the Uinta formation in Coyote Basin, Uintah County, Utah, by the Field Museum Expedition of 1910. This skull has been extremely flattened from side to side and the portion in front of the maxillary horns and the P<sup>3</sup> is missing. The left P<sup>3</sup>-M<sup>3</sup> and an isolated right M<sup>3</sup> are present and are highly worn. The length of the molar series is exceeded only by that of the Colorado Museum's *Eobasileus* (CMNH 495) and by a Peabody Museum *Tetheopsis* (YPM 11043). The position of the maxillary horn above the cheek-tooth row, and the proportions of the part of the skull posterior to the parietal horns are characters of both *Tetheopsis* and *Eobasileus*. The skull is referred to the latter genus because of the differences from known female specimens of *Tetheopsis* such as YPM 11256. The surprising feature of the skull is the parietal and maxillary horns, which are merely tiny bumps. The skull is almost certainly from a female of the genus *Eobasileus* (pl. 12, fig. 3).

The Colorado Museum of Natural History exhibits the holotype of *Uintacolotherium blayneyi* Cook (CMNH 495). They also have the referred specimens CMNH 496 (probably but not certainly associated pair of lower jaws), CMNH 529 (a right canine and possibly associated cheek teeth), and CMNH 483 (a lower left P<sub>3</sub> or P<sub>4</sub>), all found in Sand Wash Basin, between Little Snake River and Vermillion Creek, Moffat County, Colorado.

These specimens have been described and figured by Harold J. Cook (1926a), who assigned them to a new genus and species, *Uintacolotherium blayneyi*. Cook compared the skull with Marsh's specimens of *Uintatherium* and with the holotypes of *Tetheopsis speirianus* and *T. ingens*, but, as Simpson (1945, p. 242) indicated, he did not compare it with the type of *Eobasileus cornutus*.

The skull is remarkably large; the elongate maxillary horn lies mainly above the anterior part of the cheek tooth row; the portion of the skull lying anterior to the maxillary horns is slightly longer than that portion between the maxillary and parietal horns, and the parietal horns are close to the occiput. These features show that the skull belongs to *Eobasileus*.

The anterior parts of the nasals and premaxillaries have been restored, as most

of the symphyseal portion of the probably associated paratype lower jaw has been. However, the restored parts of both the jaws seem to be in harmony with each other and with the rest of the specimen, and the measurements involving the restored parts of the specimen are taken as being good estimates. The maxillary and parietal horns have also been restored, although one maxillary horn was preserved and is kept separately from the skull. This horn shows that the elongate maxillary horns are correct. But the restored parietal horns, with the strong convex curvature toward the front, have too much resemblance to maxillary horns.

The skull is smaller than the holotype of *E. cornutus* but it does have the longest upper cheek-tooth row of any uintathere. The lower cheek-tooth row is likewise the longest known from a uintathere. Cook gives the length of the lower premolar series as 116 mm. (1926a, p. 11), but the figure is far too large. A check on the photograph of the lower jaw shows that the premolar series is about 77 mm. long and that the entire lower cheek-tooth row is about 196 mm. long. Except for YPM 11043 (a *Tetheopsis speirianus*) the lower cheek-tooth row is far larger than that from any other uintathere specimen.

The lower premolar illustrated and tentatively referred to "*Uintacoloitherium blayneyi*" by Cook (CMNH 483) is interesting because of the pustulose posterior loph. In this it resembles the third molar of PUM 10385, a *Uintatherium anceps*, but this is the only specimen of a premolar with such distinct cusps on the posterior loph.

The Eocene beds of Sand Wash Basin have been tacitly assumed to be of Bridgerian age, probably for geologic reasons. These beds are separated from the main mass of the Washakie formation by a distance of 15 to 20 miles. Both lithologic masses overlie the main body of the Green River formation. Since the Washakie A faunal zone (Bridgerian) directly overlies the Green River formation in the Washakie Basin, it is logical to suppose that the same faunal zone overlies the Green River formation in the nearby Sand Wash Basin.

But the presence of *Eobasileus cornutus* indicates the occurrence of Uintan deposits in the Sand Wash Basin. These are logically regarded as an outlier of the Washakie B faunal zone. Cook records a new genus of titanotheres, *Tanyorhinus*, from the Sand Wash Basin, which stands midway between *Mesatirhinus* (middle and upper Eocene) and *Dolichorhinus* (upper Eocene) (1926b, p. 14). Other genera of the fauna (*Hyopsodus*, *Telmatherium*, and *Manteoceras*) do not help to determine faunal zones. The non-uintathere part of the fauna does not contradict the evidence of *Eobasileus*, and the presence of an advanced dolichorhinine titanotheres tends to confirm that at least part of the Washakie formation in the Sand Wash Basin is of Uintan age.

#### CATALOG OF PEABODY MUSEUM SPECIMENS REFERRED TO *Eobasileus*:

YPM 11259. Collected by Mat Forshey on May 12, 1876 from "Dug Springs, upper green sand" or Washakie B. The proximal and distal ends of a large left tibia and the worn distal end of a left radius and proximal end of a left ulna are referred provisionally to this species because of their size and stratigraphic level.

YPM 11260. Collected by Sam Smith on May 13, 1876 from "Dug Springs, upper green sand" or Washakie B. This specimen has a light tan color which is unusual in a fossil from the Washakie formation. Present are the anterior two-thirds of the sacrum, the left ischium and pubis, two lumbar, one broken and one nearly complete, and the distal end of a left femur. The specimen is referred to *E. cornutus* because of the large size and the high stratigraphic level.

YPM 11511. From "Dug Springs, upper green sand" or Washakie B of the Washakie Basin; collected by J. Heisey, May 12, 1876. This large parietal horn, which shows the posterior end of a sinus at its broken proximal end, is referred to *E. cornutus* because of size and stratigraphic position.

YPM 11534. A very long right maxillary horn collected by Sam Smith on May 7, 1875 from the Washakie formation at Haystack Mountain, Wyoming. This horn was cited by Edinger (1950, p. 451), for the maxillary sinus observed at its base. Only the genus *Eobasileus* is known to have maxillary horns this long (22 cm.).

YPM 11545. Collected by J. Heisey on May 13, 1876 from "Dug Springs, upper green sand," Washakie B of Haystack Mountain, Washakie Basin, Wyoming. Distal end of a large left tibia, referred to *E. cornutus* because of size and stratigraphic position.

YPM 11562. Collected by Sam Smith and Mat Forshey at "Dug Springs, upper green sand," Washakie B of Haystack Mountain. This left humerus is far larger than any other uintathere humerus known. This fact, plus its stratigraphic position high in Washakie B, show that it is almost certain to be from an *Eobasileus*.

YPM 14322. From the "upper green sand, Dug Springs," Washakie B of Haystack Mountain. Collected by Mat Forshey on May 12, 1876 at "the same altitude of Cope's big head [holotype of *E. cornutus*] and about one mile north [west-northwest?] of it." The left maxillary contains an  $M^2$  only slightly worn and an  $M^3$  on which only very faint wear has occurred. These two teeth are as large as any uintathere  $M^{2-3}$  known. Because of its large size and its stratigraphic position high in the Washakie formation, the specimen is very probably an *Eobasileus*. All other known teeth of *Eobasileus* are much worn, so this specimen provides the only opportunity to compare the  $M^3$  of this genus with that of *Uintatherium*. Aside from gross size, every character of this tooth is repeated in some or most specimens of *Uintatherium*. The protoconule is distinct from the protocone. The protocone inclines forward and slightly overhangs its anterior margin. The anterior cingulum is unusually tall and prominent, and terminates externally in a robust style. The internal cingulum goes completely around the protocone (which it does not in  $M^2$ ). The posterior cingulum is strong, but less so than the anterior one, and terminates externally in a tiny style. A very faint external cingulum is present. There are no accessory cusps on the hypocone or at the entrance to the median valley (pl. 9, fig. 2).

YPM 14323. A large right femur collected by Sam Smith, May 15, 1876, from the Washakie B horizon of Haystack Mountain, "Dug Springs, upper green sand." This femur is the same size as that from the holotype of *E. cornutus*.

Of the various Yale specimens which I have referred to *Eobasileus*, only two were mentioned by Marsh. These he referred to two species of "*Tinoceras*." None of the others were mentioned by him, and two important specimens had not even been catalogued. All but two were collected by Sam Smith, Jake Heisey, or Mat Forshey between May 12 and 15 of 1876. It is amazing that Marsh paid so little attention to these important specimens, which are striking because of their great size.

#### SUBFAMILY GOBIATHERIINAE

##### New rank (=GOBIATHERIIDAE Flerov, 1952)

DIAGNOSIS: No upper canines, bowed zygoma, bony septum between anterior ends of nasals and premaxillaries. Skull unusually flat.

Simpson (1945, p. 242) notes that: ". . . *Gobiatherium* is obviously on a different line of descent from the later American forms and might be placed in a distinct subfamily. . . ." He did not actually make this move, as he regarded it as an unnecessary complication at that time. However, *Gobiatherium* is very different from all other uintatheres, primitive or advanced. This dichotomy is so pronounced that it deserves expression in the formal classification.

##### *Gobiatherium* Osborn and Granger

Osborn and Granger 1932, pp. 4, 10-16.

TYPE SPECIES: *Gobiatherium mirificum*

DIAGNOSIS: Large uintathere. Skull extremely flat, zygoma bowed, nasal bones arched, and supporting tiny bony protuberances. Bony septum connecting anterior ends of nasals and premaxillaries. No maxillary or parietal horns. Upper and lower molars similar to *Uintatherium*. Lower jaw lacking inframandibular process. Incisors bilobed.

DISTRIBUTION: From the upper Eocene Irđin Manha formation. Known only from one locality 25 miles southwest from Iren Dabasu in Inner Mongolia.

##### *Gobiatherium mirificum* Osborn and Granger

Osborn and Granger 1932, pp. 4, 10-16.

HOLOTYPE: AMNH 26624

DISTRIBUTION AND DIAGNOSIS: Same as for genus.

DISCUSSION: All known specimens of this genus and its single species were collected from one locality in Inner Mongolia by the American Museum expedition of 1930. This is the only uintathere species so far reported from the upper Eocene of Asia. The lack of depth to the skull, absence of upper canines, bowed zygoma, and bulbous nasals with naso-premaxillary septum show long divergence from the advanced American forms. The two good skulls are about 68 cm. long, which is large, but not so large as the average of 75 cm. for the skulls of *Uintatherium*.

The holotype shows the skull shape and bulbous nasals well, but the teeth are badly worn (Osborn and Granger, 1932, p. 11). Another excellent skull (AMNH 26625) has a much better dentition in which only the  $M^1$  is deeply worn.

Osborn and Granger state (1932, p. 10): "In the two specimens with arched nasals, presumed to be males, there is a curved median bony septum connecting the nasals with the tips of the premaxillae." They also state that: "in one of these . . . the nasals are surmounted by a pair of bony excrescences."

However, the absence of either the bony septum or the nasal "excrescences" from any *Gobiatherium* skull seems to be due to weathering. The shape of the remaining surfaces suggests that bulbous nasals with small horns on them and a bony septum would be present in any undamaged specimen.

One specimen (AMNH 26618), which consists of the right upper dentition and some of the adjacent parts of the skull, is from an individual in which the  $M^3$  had not erupted at the time of death, but the permanent premolars were in place. This is the only upper dentition of an uintathere known from just this stage of growth. Its teeth are virtually unworn and show more detail than usual (pl. 14, fig. 1).

The upper molars of *Gobiatherium* are strikingly like those of *Uintatherium* despite the profound differences in the rest of the skull. However, *Gobiatherium* does differ in having a small metaconule in the posterior loph, a prominent cingular cusp on the antero-external portion of the  $P^2$ , the great width of the internal cingulum except at the most internal part of the protocone, and the small size of the hypocone.

The lower molars differ from *Uintatherium* only in that the metastylid is set apart from the metaconid more distinctly, so that there is a small bridge between them (pl. 14, fig. 3).

As would be expected in the absence of an upper canine, the lower jaw is not deep and there is no inframandibular process. The jaw can be likened to a cylinder with the teeth set in a ridge which is placed on the internal side of it. The condyle is not directed backwards as in *Uintatherium*, which means that the jaw is not so specialized for a wide gape. This correlates with the absence of canine tusks. The proportion of the height of the ascending ramus to the height of the skull is much greater than in *Gobiatherium*.

Unfortunately no lower incisors or canines are preserved with a jaw. But alveoli show that there were three incisors and a canine in a continuous uninterrupted series. From the lower rami of specimens AMNH 26630 and AMNH 26616, it is seen that the teeth of the incisor-canine series become slightly larger posteriorly, the reverse of the case in *Uintatherium*. Two isolated cropping teeth were found in a deposit which yielded several specimens of *Gobiatherium*. Their association is probable, but not certain. They are bilobed as in *Uintatherium*, but are thinner and more blade-like (Osborn and Granger 1932, p. 13).

Specimen AMNH 26622 is one of two known uintathere specimens showing



milk dentition. This jaw contains badly worn left DP<sub>3-4</sub>, which, as in the immature *Uintatherium*, show no detail (1932, p. 13).

#### DISPOSITION OF INVALID GENERA AND SUBGENERA

The names and disposition of invalid uintathere genera and subgenera are summarized.

#### *Loxolophodon* Cope

Cope 1872a, p. 420

TYPE SPECIES: *Loxolophodon semicinctus* Cope

A synonym of *Coryphodon*.

Cope described a new species of coryphodont which he called *Bathmodon semicinctus* (*Bathmodon* is also a synonym of *Coryphodon*). But even as he proposed this new species he hedged as follows:

"The differences in dentition which it presents are so marked as compared with the last species [*Bathmodon radians*], as to induce me to believe that it will be found on fuller acquaintance to belong to another genus. This may be called *Loxolophodon*."

After many changes of mind, he finally arrived at a taxonomy which he did not change further (1873a). He explains (1873a, p. 567) that *Bathmodon semicinctus* belongs in *Bathmodon* after all, and incorrectly assumes that the name *Loxolophodon* was thereby made available again. (See p. 36 of this report for an elaboration of this part of Cope's mobile taxonomy.)

#### *Uintamastix* Leidy

Leidy 1872a, p. 169

TYPE SPECIES: *Uintamastix atrox* Leidy

A synonym of *Uintatherium*.

A uintathere canine (which was associated with a premolar) impressed Leidy as belonging to a very formidable carnivore. When Marsh published on "*Dinoceras mirabile*" Leidy immediately realized that his *Uintamastix* was merely the canine of a *Uintatherium* (Leidy 1872b). (See p. 29 of this report.)

#### *Lefalaphodon* Cope

Cope 1872b

A lapsus for *Loxolophodon*.

This is the famous telegrapher's error which was placed in the literature. Cope was so anxious to beat out Marsh that he telegraphed a brief description of three new species of "*Loxolophodon*" to the American Philosophical Society, which printed it immediately as a *Palaeontological Bulletin*. The telegrapher made some errors in the interpretation or the transmission of the telegram. This error went into the literature.

However it should be pointed out that an editor made an attempt to bring some sense out of the garbled telegram and may have made some changes in the spelling. Not all of the difference between the telegram as it is printed in *Palaeontological Bulletin No. 5* and Cope's later version of it is necessarily the telegrapher's error.

*Palaeontological Bulletin No. 5* (Cope 1872b) reads as follows:

The Secretary announced that he had received, August 17th, 1872, a telegram from Professor Cope, dated Black Buttes, Wyoming, Aug. 17, 1872, reading (with conjectural corrections of specific names) as follows:—

Black Buttes, Wyoming, August 17, 1872

I have discovered in Southern Wyoming, the following species: *Lefalaphodon*, Cope. Incisor one; tusk canine none; premolars four, with one crescent and inner tubercle; molars two; size gigantic. —*Discornatus*; horns tripedral, cylindrical; nasals with short convex lobes. —*Bifurcatus*, nasals with long spatulate lobes. —*Excessicornis*, horns compressed sub-acuminate.

Edward D. Cope  
U. S. Geological Survey

Published Aug. 19, 1872

The three species of *Loxolophodon* proposed by Cope, *L. cornutus*, *L. pressicornis*, and *L. furcatus*, date from this publication, as the misspellings in the telegram were *lapsi* and not deliberate. Even though *Loxolophodon* was new as applied to uintatheres, it was a synonym, and the fact that it was here misspelled is immaterial.

#### *Tinoceras* Marsh

Marsh 1872a, pp. 123 and 504.

TYPE SPECIES: *Titanotherium? anceps* Marsh

A synonym of *Uintatherium*.

In this article Marsh proposed to change the name of *Titanotherium? anceps* to *Mastodon anceps*. At the last moment he changed his mind again and proposed that it be changed to *Tinoceras anceps*. This change was appended to the separate of the article which was published the same day as Cope's garbled telegram, August 19, 1872. In the regular issues of the *American Journal of Science* the "correction" proposing *Tinoceras* was printed on the last page of the December issue.

*Tinoceras* was the first uintathere genus proposed by Marsh. The holotype of its type species belongs to *Uintatherium anceps* (see p. 27 of this report).

#### *Dinoceras* Marsh

Marsh 1872d, p. 344

TYPE SPECIES: *Dinoceras mirabile* Marsh

A synonym of *Uintatherium*

The holotype of the type species is very clearly a specimen of *Uintatherium anceps*. The only character which Marsh could cite to distinguish this genus from *Uintatherium* was that it was supposed to have three lower premolars instead of four. This was based on the erroneous assumption that a lower jaw containing anomalous first molars adjacent to the canines (YPM 11194) pertained to *Uintatherium*, while certain other lower jaws pertained to *Dinoceras*. Marsh must have wanted very badly to retain his own genus.

#### Subgenus *Paroceras* Marsh

Marsh 1885b, p. 200

TYPE SPECIES: *Dinoceras laticeps* Marsh

Not a valid subgenus.

The holotype of *Dinoceras laticeps* (YPM 11039) is an individual of *Uintatherium anceps*.

Marsh regarded this species as showing characters intermediate between *Dinoceras* and *Tinoceras*. "The type of this species possesses the main characters of *Dinoceras*, but in the premaxillaries, palate, and brain-cavity shows an approach to *Tinoceras*, especially *Tinoceras pugnax*. It apparently represents a sub-genus of *Dinoceras*, which may be called *Paroceras*."

The holotype of *Tinoceras pugnax* is also referred to *Uintatherium anceps*. The supposed distinguishing features are variants of form and preservation and are not subgeneric or even specific characters.

#### Subgenus *Platoceras* Marsh

Marsh 1885b, p. 214

TYPE SPECIES: *Tinoceras latum* Marsh

Not a valid subgenus.

Marsh wrote: "This species, with *Tinoceras cornutum*, forms a distinct subgenus of *Tinoceras*, which may be called *Platoceras*."

The nasal horns on Cope's *Eobasileus cornutus* are extremely wide and flat, as in specimen YPM 11533, which was referred to *Tinoceras latum* by Marsh but is not its holotype (see p. 53 of this report). Since Marsh regarded *Eobasileus* as preoccupied by *Tinoceras*, there was a certain logic in a new name for the large uintathere with wide, flat nasal horns. But *Eobasileus* is valid while *Tinoceras* is not, and the holotype of *Tinoceras latum* is a *Uintatherium anceps*.

#### Subgenus *Laoceras* Marsh

Marsh 1885b, p. 216

TYPE SPECIES: *Tinoceras pugnax* Marsh

Not a valid subgenus.

The holotype of *Tinoceras pugnax* belongs in *Uintatherium anceps*. There is no justification for a subgeneric or even specific splitting.

#### *Octotomus* Cope

Cope 1885b, pp. 44, 52, and 53

TYPE SPECIES: *Dinoceras laticeps* Marsh

A synonym of *Uintatherium*

Cope proposed this new genus after studying Marsh's monograph. He does not say how it differs from *Uintatherium* or *Eobasileus*. Later he stated without explanation: "*Octotomus* is . . . a synonyme" (1885c). The holotype of its type species is a *Uintatherium anceps*. Even if this were not the case, it would still be preoccupied by Marsh's subgenus *Paroceras*.

#### *Ditetrodon* Cope

Cope 1885c

TYPE SPECIES: *Uintatherium segne* Marsh

A synonym of *Uintatherium*.

Marsh based a new species, *Uintatherium segne*, on a lower jaw (YPM 11194) which possessed a small first premolar adjacent to the canines and in front of the diastema. Marsh regarded this anomalous tooth as diagnostic of the genus *Uintatherium*. Cope regarded it as diagnostic of a new genus, *Ditetrodon*.

The alveoli which held these first premolars are very small. It is best to regard

their presence as a variation within *Uintatherium anceps* (see p. 33 of this report).

*Elachoceras* Scott

Scott 1886

TYPE SPECIES: *Elachoceras parvum* Scott

A synonym of *Uintatherium*.

The specimen concerned is apparently a pathologic *Uintatherium* female (see p. 39 of this report). Matthew referred it to that genus in 1899, but most authors have regarded *Elachoceras* as valid.

*Uintacolootherium* Cook

Cook 1926a

TYPE SPECIES: *Uintacolootherium blayneyi* Cook

A synonym of *Eobasileus*.

Cook compared his material with specimens of *Uintatherium* and *Tetheopsis*, but not of *Eobasileus* (Simpson 1945, p. 242). It is with this last genus that it is surely congeneric (see p. 54 of this report).

## MORPHOLOGY AND PHYLOGENY

O. C. Marsh devoted the bulk of his monograph to the description of various specimens now referred to *Uintatherium anceps*. He drew largely on two specimens (YPM 11036 and YPM 11208) which he called "*Dinoceras mirabile*." His descriptions were detailed and his illustrations were large and lavish. E. D. Cope published detailed descriptions of *Eobasileus cornutus* (1873a and 1885a) including an account of the otic and basicranial regions. Osborn gave moderately detailed accounts of a *Tetheopsis* which he called "*Loxolophodon*" (1881) and later of *Bathyopsis fissidens* and "*Elachoceras parvum*" (1913). With Granger he described *Gobiotherium* in some detail (1932). Harold Cook described an *Eobasileus* in detail in 1926. Edinger (1929) and Tilney (1931) present discussions of several brain casts.

Except for Cook, modern workers have not dealt much with the larger uintatheres, but have described the newer discoveries of the smaller forms and have discussed their bearing on uintathere origins and relationships. The only essay to include a summary of the large advanced uintatheres since Marsh's monograph is in W. B. Scott's *A History of Land Mammals in the Western Hemisphere* (1937, pp. 468-477).

Little needs to be added in the field of descriptive morphology of the larger American uintatheres thanks particularly to Marsh's monograph. However, the comparative morphology of these large uintatheres, some details of the teeth, and the features of sexual dimorphism have not been adequately outlined.

### COMPARATIVE MORPHOLOGY

**THE UPPER CHEEK TEETH:** The uintathere cheek-tooth pattern is not repeated in any other group, though it is approximated on the third molars of the xenungulate, *Carodnia*. The third and fourth premolars and the molars of the upper jaw have an anterior and posterior loph which meet internally and diverge externally to form a V. On unworn teeth there is a definite saddle between the two lophs just anterior to the internal apex of the V, but on worn teeth the top lophs appear fully joined. The posterior loph is straight, the anterior loph is slightly convex anteriorly. The external end of the anterior loph turns to the rear at its outer end and descends as a tiny ridge into the median valley. Here it may give rise to one or two small cusps in the third molars of some individuals of *Uintatherium*. There may be one of these cusps on the  $M^3$  of one side and two on the other. (See fig. 2 of this report.)

The anterior and posterior cingula are strong. It is also strong internally except at the most internal portion where it goes around the protocone. Here it may be either present (though weak) or absent. In *Uintatherium* this is variable, but the three commonest arrangements are: to be present here on all teeth, to be absent on all teeth, or to be present on  $P^{3-4}$  only. In some individuals the anterior cingulum gives rise to a prominent style, adjacent to the paracone. The external cingulum is weak and usually extends around the paracone only. It may lie across the entrance to the median valley, but should not be confused with the small ridge descending from the paracone.

The portion of upper tooth behind the posterior loph is large on  $M^3$ , moderate on  $M^{1-2}$ , and not significant on the premolars. On the molars there is a large cusp posterior to the protocone in this area, which all workers have called the hypocone. Sometimes it has an accessory cusp on its flank and more rarely, two.

The  $P^2$  is slightly smaller than any other cheek tooth and much less developed. It is triangular with one apex facing anteriorly. Typically there is a loph along the antero-external side of the tooth and a cusp on the postero-internal corner, probably a protocone. The loph is probably an ectoloph, as shown in *Proathyopsis* and *Prodinoceras* where there is a low ectoloph on  $P^{3-4}$ .

The  $M^1$  is smaller than either the  $P^{3-4}$  or the  $M^2$ . The  $P^3$  and  $P^4$  have the same size and detail of pattern and are indistinguishable from each other when isolated. The  $P^2$  is the smallest cheek tooth, the  $M^2$  is the second largest, and the  $M^3$  is by far the largest.

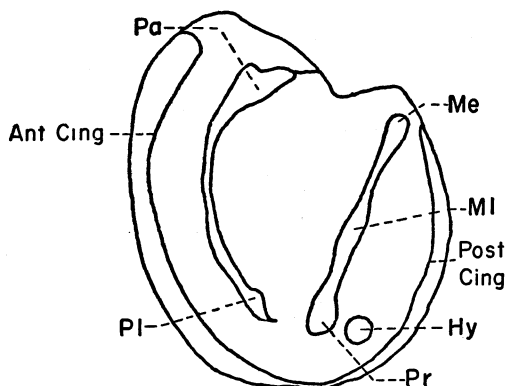


Fig. 2. Diagram showing cusp nomenclature of a typical left upper molar of a uintathere. Hy hypocone, Me metacone, Ml metaconulid, Pa paraconid, Pl protoconule, Ant Cing anterior cingulum, Post Cing posterior cingulum.

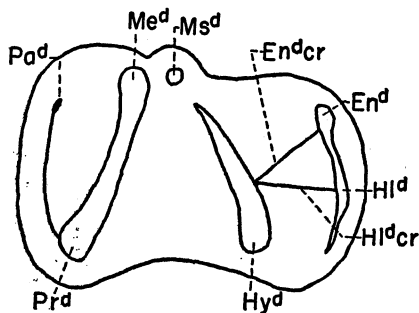


Fig. 3. Diagram showing cusp nomenclature of a left lower molar of a primitive uintathere.  $En^d$  entocoid,  $En^d$  cr entocoid crest,  $Hl^d$  hypoconulid,  $Hl^d$  cr hypoconulid crest,  $Hy^d$  hypoconid,  $Me^d$  metaconid,  $Ms^d$  metastylid,  $Pa^d$  paraconid,  $Pr^d$  protoconid.

**THE LOWER CHEEK TEETH:** The lower cheek teeth are as distinctive as the upper. They have high trigonids with prominent metalophids. The paraconid and paraconid crest are reduced, especially in the larger forms where they are but vestiges. A metastylid has formed adjacent to the metaconid as a sort of smaller "twin." This metastylid is very distinctive and is not present on the  $M_3$  of the xenungulate, *Carodnia*. The heel is low and does not have the typical ungulate hypolophid, as do the Pantodonta. The hypoconid has a crest which extends across the tooth toward the metastylid, but dies out low on its flank without reaching it. This hypoconid crest occludes against the anterior face of the posterior loph of the corresponding upper molar. In other words, it fits in the pocket of the V. At the postero-internal corner of the lower teeth is a posterior talonid loph across which the hypocone grinds.

The lower cheek teeth have prominent cingula anteriorly and posteriorly. The external cingula are weak or absent. The internal cingulum is strong along the heel but is weak along the trigonid (fig. 3).

In contrast to the upper teeth, there is no definitive morphologic distinction

between the lower molars and premolars. The heel becomes progressively less prominent on each tooth anterior to the third molars, mainly because of reduction of the posterior talonid loph. In the anterior lower cheek teeth this loph becomes very small and loses its independent function. It merely forms a functional part of the next posterior metalophid.

The first upper premolar is not known in any uintathere. However, some specimens of *Probathyopsis*, the holotype of *Bathyopsis fissidens*, and one individual of *Uintatherium anceps* (YPM 11194) do possess a very small functionless P<sub>1</sub> adjacent to the canine and in front of the diastema.

**THE CROPPING TEETH:** Flerov reports that *Mongolotherium* has large and well developed upper incisors (1952). It would seem that all the Bathyopsinae except *Bathyopsis* had upper incisors, though the poor preservation of this region prevents a positive assertion. The remaining uintatheres all lack upper incisors, though one specimen of *Uintatherium* (USNM 16663) does possess vestigial roots for some.

The lower canine is the smallest of the cropping teeth in the large American Eocene uintatheres and is completely incisiform. In the smaller genera and *Gobiatherium* it is the largest. In the smaller genera it is so caniniform that it would be better not to regard it as a cropping tooth at all.

The lower incisors of the uintathere were first described and illustrated by Osborn and Speir (1879) in a specimen now referred to *Tetheopsis*. As in *Uintatherium* the cropping teeth get progressively smaller posteriorly. The canine is completely incisiform.

There has been some disagreement about the shape of these incisors. Matthew says: "The lower incisors and canine of *Uintatherium* are of a very peculiar type. Each has a posterior heel which has grown up into a pointed cusp almost equaling the primary cusp in size, both cusps being pointed, convex-conical and moderately high. Marsh's restoration of the lower incisors and canine of various uintatheres in the plates of his monograph upon the 'Dinocerata' are far from being correct. They were apparently based upon two or three scattered teeth figured in the text of the memoir. There was little excuse for this, as Osborn's accurate drawings of the lower incisor-canine series in '*Loxolophodon*' had been published at least three years previously" (1937, p. 170).

Scott makes the observation that: "The [cropping teeth in *Uintatherium*] are of a peculiar shape, extended antero-posteriorly, with a conical cusp in front and a long heel behind, which sometimes bears a smaller cusp, and in *Eobasileus* they are bilobate" (1937, p. 472). (See fig. 4, below.)

The facts appear to be as follows: In both *Uintatherium* and *Tetheopsis* the cropping teeth are elongate antero-posteriorly and have a large conical cusp in front and a smaller conical heel behind. The incisors and canine were subject to great wear and in old individuals were worn flat. The incisors cited by Osborn but now lost (part of PUM 11611) were referred to "*Loxolophodon*" by Osborn and to *Eobasileus* by Scott, but are referred to *Tetheopsis* in this report.

Marsh's figures of "incisors" are not inaccurate as Matthew has stated. The drawings (Marsh 1885b, figs. 43-45, p. 42) are excellent representations of the actual specimens. Judging from the size of the cropping teeth in specimen AMNH 12170, all three are lower canines. Since all the cropping teeth are completely incisiform, the difference in the canine is one of size only.

The incisors of *Tetheopsis* are bilobed as Scott says, but the posterior lobe is the smaller. This is the case in *Uintatherium*, too. The cropping teeth of *Eobasi-*

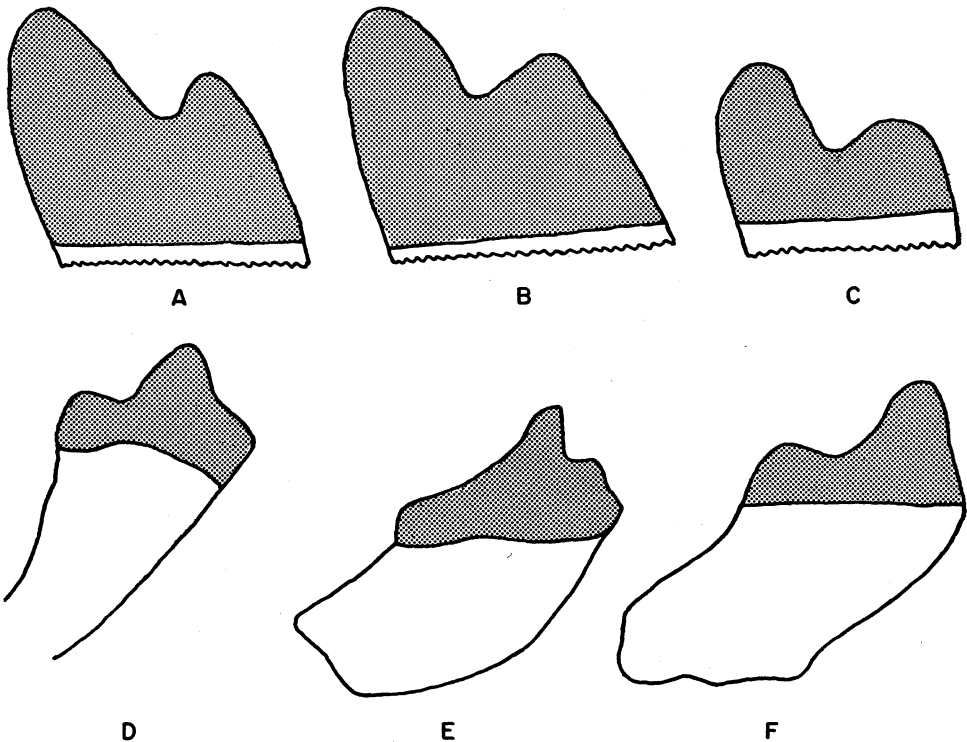


Fig. 4. Outlines of some lower canines of *Uintatherium anceps*, x 1. Stippled portion is enamel. A-C, medial views; D-F, lateral views. A and D are YPM 11491; B and E, YPM 11492; C and F, YPM 11490.

*leus* are unknown, but there is no reason to suppose that they are different in any way from those of *Tetheopsis*.

The incisors of *Gobiotherium* have only a tiny heel. In *Probathyopsis* they are flat and triangular (as seen in *P. successor*) whereas the canine is either caniniform with a tiny cusplet for a heel (*P. praecursor*) or flat and triangular (*P. successor*). The one known incisor from *Bathyopsis* (AMNH 4821) possesses a tiny heel (Cope 1885a, pl. 58a, fig. 1).

**THE UPPER CANINE:** The amazing upper canine teeth of the uintatheres seem out of place in vegetarians. But after comparisons with the sabre-toothed cats and with recent tusked herbivores some reasonable assumptions about their function can be made.

The uintathere upper canines most nearly resemble those of the sabre-toothed cats, because of the width of the blades. But we must look to the tusked artiodactyls for the best analogy with uintathere canines even though the blades are not as wide. That the uintatheres were herbivores is evident from the lophed nature of the cheek teeth and from the great wear evident on them in old individuals.

Among modern mammals the omnivorous peccary (*Tayassu*) has notably long canines, but they are stout and triangular in cross-section. A better analogy is found in the various tusked deer. Here we have a blade-like canine in a strictly herbivorous form, and, as in uintatheres, there are no upper incisors.



It is strange that this unusual armament had attracted almost no notice in the scientific literature until 1946 when Aitchison described the habits of the muntjacs and Chinese water deer. He notes four types of deer in which the males have canine tusks: the muntjac (*Muntiacus*), the Chinese tufted deer (*Elaphodus cephalophus*), the Chinese water deer (*Hydropotes inermis*), and the musk deer (*Moschus moschiferus*) (1946, p. 329).

Aitchison relates that the muntjac males prefer to use their very long horns both for defense and in sexual competition. When an opponent is beyond the guard of his antlers, the muntjac can and does use his tusks (1946, pp. 330-334). "If an attacker breaks through the antler guard, the male muntjac lowers his head and strikes upwards and backwards over his shoulder to slash his enemy with the sharp-edged posterior border of either tusk." "There are a number of known cases where human beings have been slashed by the tusks of cornered muntjacs." The muntjac has still another use for his tusks. When foliage is scarce he removes certain kinds of edible bark from trees with them. The teeth of both the muntjac and Chinese water deer are notable for their loose implantation in their sockets. Aitchison explains this as a compensation for the side-to-side masticatory movement of the lower jaw, which, as a ruminant, it must perform. "If the tusks were fixed they would almost completely restrict the movement of the mandible to approximation of the fixed 'open and close' movement of the carnivora; the hinged movement of the tusks is nature's compensation to this tusked ruminant."

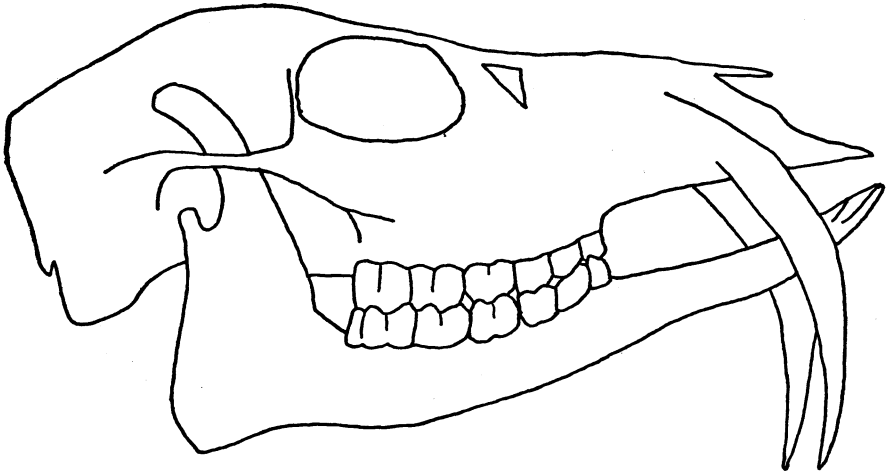


Fig. 5. Male musk deer, *Moschus moschiferus*, x 1.

Unlike the male muntjac the male Chinese water deer has no horns. The latter uses his canines, which are considerably longer than those of a muntjac, as his primary weapon. He "uses his long canines as sexual weapons; he raises the head and strikes downwards, viper-fashion, with these tusks, removing clumps of hair and skin from his opponent. . . ." (Aitchison, 1946, p. 331).

Some features of the jaws of the larger uintatheres can guide our speculation about the sabre-toothed canines. The condyle of the lower jaw faces backward rather than upward, and this condyle is elevated with respect to the tooth row. This mechanism is typical of many herbivores, including deer. The tusked deer can use their canines offensively, even though they seem to prefer their horns as

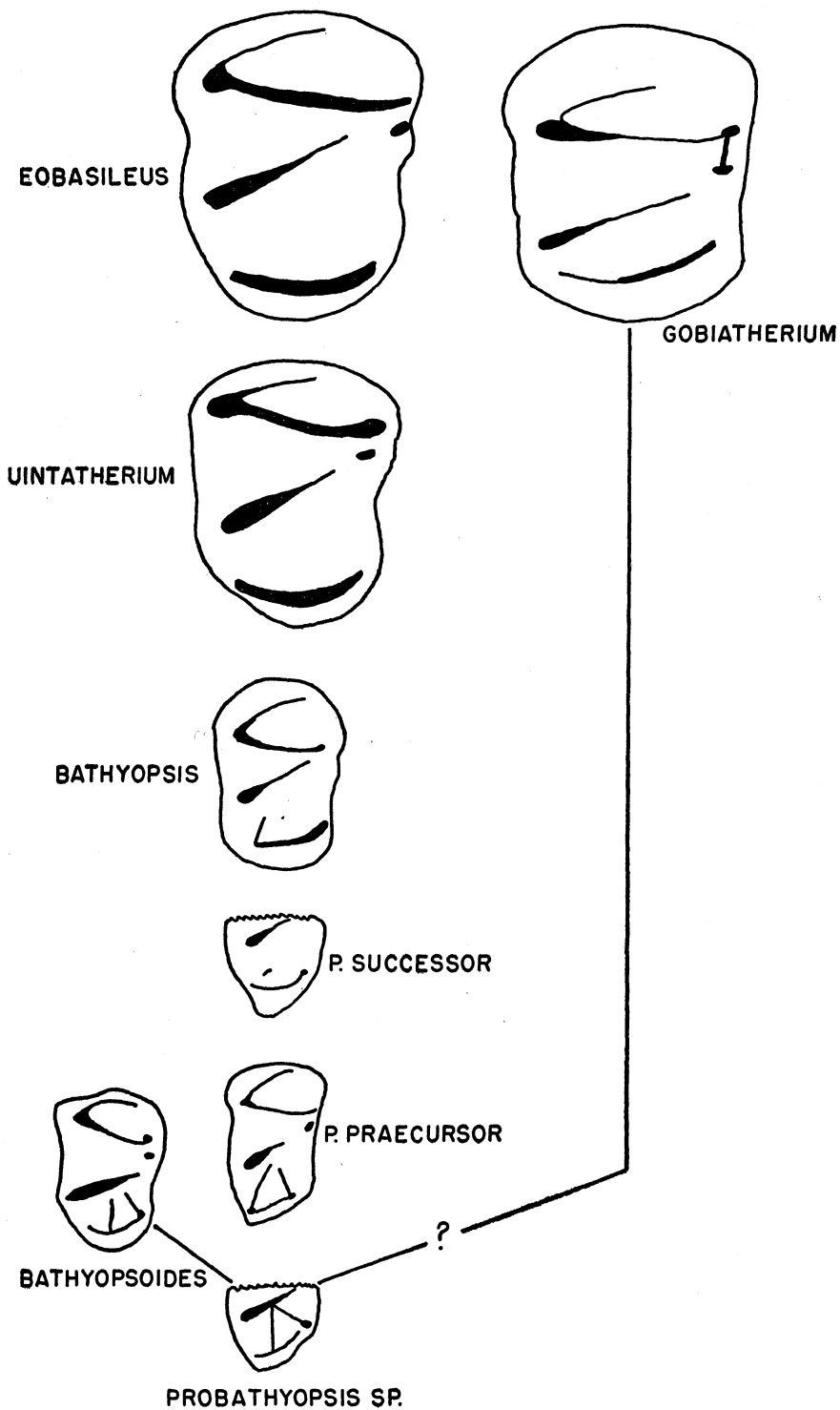


Fig. 6. Evolution of the lower molars of uintatheres. These outlines represent successive stages in evolution; only in a general way is this a phylogenetic chart. For uintathere phylogeny see Chart 2.

weapons. Perhaps the uintatheres, with their relatively small hornless protuberances, preferred the canines as their weapons. An interesting condition exists in specimen AMNH 1671, which had had both canines broken some time during its life. The broken ends have been worn smooth (pl. 8, fig. 3).

Thorpe says, "This genus [*Uintatherium*] possessed long superior canines and was therefore compelled to have a wide jaw gape . . ." (1922, p. 282). The uintathere mouth was extremely long and narrow, as the tongue must have been. In the larger forms there were no upper cropping teeth and the lower ones were unusual in their bilobed tandem blades. Presumably the animal cropped soft vegetation with this long tongue and bladed incisors, a method of feeding that did not require that the canines be cleared. It seems more probably that they were not "compelled" to have a wide gape for feeding, but used it as part of a defensive mechanism.

Simpson (1941, p. 10) says, "The canine curvature [of the uintatheres] is highly variable but tends to follow the principles already sketched [for the sabre-toothed cats] and the action seems to have been a downward hook or stab. Here, again, the purpose was surely offensive attack on living rivals."

This offensive attack may have been against carnivorous enemies or against sexual rivals. However, except for one specimen of *Tetheopsis* (YPM 11256) the canines are only slightly smaller in females than in males. It was, then, not an androgenic organ as it is in tusked deer. Nor was it used for rooting, as depicted in the restoration by C. R. Knight (Scott 1932, p. 335) because rooting upper canines are more peg-like. Whether the protuberances on the head or the canines were the preferred weapons must remain unknown, but in the females the small size of the protuberances suggests that they, at least, would favor the canines.

**MOLAR EVOLUTION:** Molar evolution within the uintatheres is quite straightforward and evident, probably because so little occurred. The known small changes are largely confined to the lower molars. The stages are diagrammed on fig. 6. The principal trend has been increase in size. The most primitive known stage is represented by *Probathyopsis*. In it the lower molars have relatively large paraconid crests, an entoconid which is distinct from the main body of the posterior talonid loph, and reduced hypoconulid and entoconid crests. In *Bathyopsis* the hypoconulid crest is reduced to a vestige and the entoconid crest has vanished. The paraconid crest was much reduced between *Bathyopsis* and *Uintatherium*. The  $M_3$  of *Probathyopsis* is notably more elongate than in succeeding forms. In *Bathyopsoides* the lower molars retain the hypoconulid and entoconid crest, but are precociously large. The only unusual feature of the upper cheek teeth of the most primitive Paleocene uintatheres (*Probathyopsis* and *Prodinoceras*) is the low notched ectoloph of the premolars.

Upper molars of *Gobiatherium* have a small hypocone and a large cingulum on the antero-internal corner (pl. 19). The lower molars show a metastylid which is situated further from the metaconid than in *Uintatherium* (fig. 6). Except for these small differences, the teeth of these genera have not diverged significantly.

Cope was the first to suggest that the anterior loph of the *Uintatherium* upper molar was homologous with the large anterior protocone-parastyle loph of *Coryphodon* ("ectoloph rotation hypothesis"). He called it the superior anterior cingulum. He says, "The difficulty is to ascertain the homology of the posterior transverse crest. It is difficult to see in it the two external V's of *Pantolambda* confluent into a simple ridge, yet such it seems to be" (1884, p. 1117). (This report, fig. 7.)

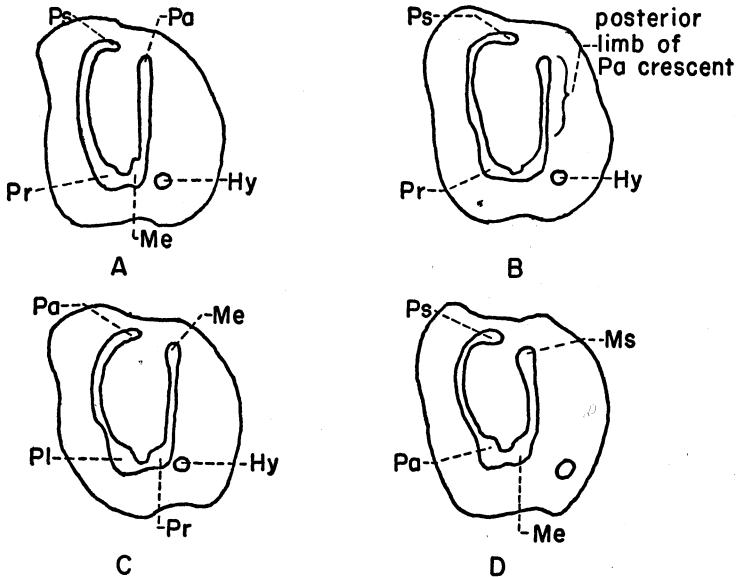


Fig. 7. Theories on the nomenclature of uintathere molars. A. Cope 1884, B. Cope 1888, C. Wood 1923 (present day viewpoint), D. Matthew 1928.

He later modified this and noted that the hypoconid crest of *Uintatherium* shears in front of the posterior loph of the upper molar. In *Pantolambda* it is the anterior limb of the talonid loph (corresponding to the hypoconid crest) which shears in front of the posterior limb of the anterior V of the upper molar. He concluded that the posterior loph of the *Uintatherium* upper molar homologizes with the posterior limb of the crescentic paracone of *Pantolambda* and that the anterior limb of the paracone and the crescentic metacone have entirely disappeared. This interesting afterthought was not supported by any other evidence, but his conclusion was noteworthy: "If this homology is correct, the Dinocerata were derived directly from the *Pantolambdidae*, and not through *Coryphodontidae*" (1888, p. 87). (*Pantolambda* is now regarded as an early member of the *Coryphodontidae*.)

Osborn (1898) did not comment on this somewhat better idea but referred solely to Cope's first proposal, namely that the slightly rotated ectoloph shown by *Coryphodon* had rotated further to become the posterior loph of *Uintatherium*. He illustrated three lower molars, those of *Pantolambda*, *Coryphodon*, and *Bathyopsis* and postulated that the *Bathyopsis* lower molar is readily derived from that of a *Coryphodon* "simply by the fission of the metaconid into the metastylid, and further reduction of the paraconid and entoconid. . . ." He said this despite the facts that the *Bathyopsis* molar is far smaller than that of *Coryphodon*, and that the two genera are contemporaries.

The view that *Coryphodon* was a near-ancestor to *Uintatherium* was not seriously challenged until Horace Elmer Wood II pointed out in 1923 that it was more straightforward to regard the points of the uintathere V-shaped loph as the elements of the normal trigon. He concluded that the two types of molars are composed of quite different cusp elements. This basic paper has been vigorously

supported by the work of Simpson (1929) and of Patterson (1939). The view that the Pantodonta and Dinocerata are not so closely related after all has been held by most workers ever since.

The "ectoloph rotation hypothesis" is a somewhat forced explanation. One might deduce that Cope and Osborn decided that *Uintatherium* and *Coryphodon* were related because of the similar foot structure and the superficial similarity of the teeth. Then they searched for some way in which one could have been derived from the other and produced this hypothesis.

There are two main objections to it. First, it multiplies entities unnecessarily (Wood's hypothesis has the advantage of being much simpler). Second, it considers the very similar molars and premolars of uintatheres as having different origins. Wood (1923, p. 603) comments: "I feel very strongly the essential unity in the ground-plan of the upper cheek teeth. From P<sup>2</sup> to M<sup>3</sup> there are three main cusps, which I believe to be the paracone, metacone, and protocone of the molars. . . . It seems probable therefore that in the Uintatheriidae the trigons and cusps in the molars are homologous with those of the premolars. . . ."

Simpson adds (1929, p. 4):

The premolars of *Pantolambda* and *Coryphodon* are closely similar and have homologous parts. Those of *Uintatherium*, according to Osborn's theory of 1898, must have arisen by the complete suppression of the internal heel, and hence have had a very different history from the molars, which they closely resemble.

. . . *Prodinoceras* and *Probathyopsis* seem to offer definite evidence regarding the origin of the uintathere molar and to establish Wood's view beyond much question. . . . The external ends of the two lophs are clearly the paracone and metacone, and the chief internal cusp is clearly the protocone. . . .

This view has the added recommendation that it considers the posterior premolars and anterior molars, almost identical in form, save for the presence of a hypocone in the latter, as composed of homologous parts instead of assigning to them widely different histories.

If the pantodonts and uintatheres have a common ancestor, then the premolars in the two groups have diverged more than the molars. The premolars in the Pantodonta have not undergone the near-molarization seen in all uintatheres, but have evolved their own peculiar pattern.

A third possibility, that the uintathere molar had a zalambdodont construction, was suggested by Matthew (1928, p. 970): "Examination of this construction in *Uintatherium* in comparison with the molars of zalambdodonts and other Insectivora and early tritubercular mammals might suggest that the high cusp in both premolars and molars is the paracone plus metacone, united in the premolars, more or less separated in the molars, and that the protocone is not present at all" (fig. 7). Until the missing links between *Probathyopsis* and its ancestor are found, this suggestion must be kept in mind as a possibility.

**THE FORM OF THE SKULL:** The form of the skull seems to reveal very little about evolutionary trends. Skull shape has usually been treated more than adequately in previous papers on uintatheres.

The chart (fig. 8) is presented to show the comparative skull outlines in one convenient place. The skulls are merely arranged according to stratigraphic horizon. No evolutionary sequence is implied in the figure.

The skulls of *Probathyopsis* and *Prodinoceras* are unknown. The skull of *Mongolotherium* is well illustrated by Flerov (1952) and resembles that of *Bathyopsoides*. *Bathyopsoides* and *Mongolotherium* have prominent sagittal crests. *Bathyopsis* and the larger American genera do not.

The larger American genera have very deep skulls with prominent occipital

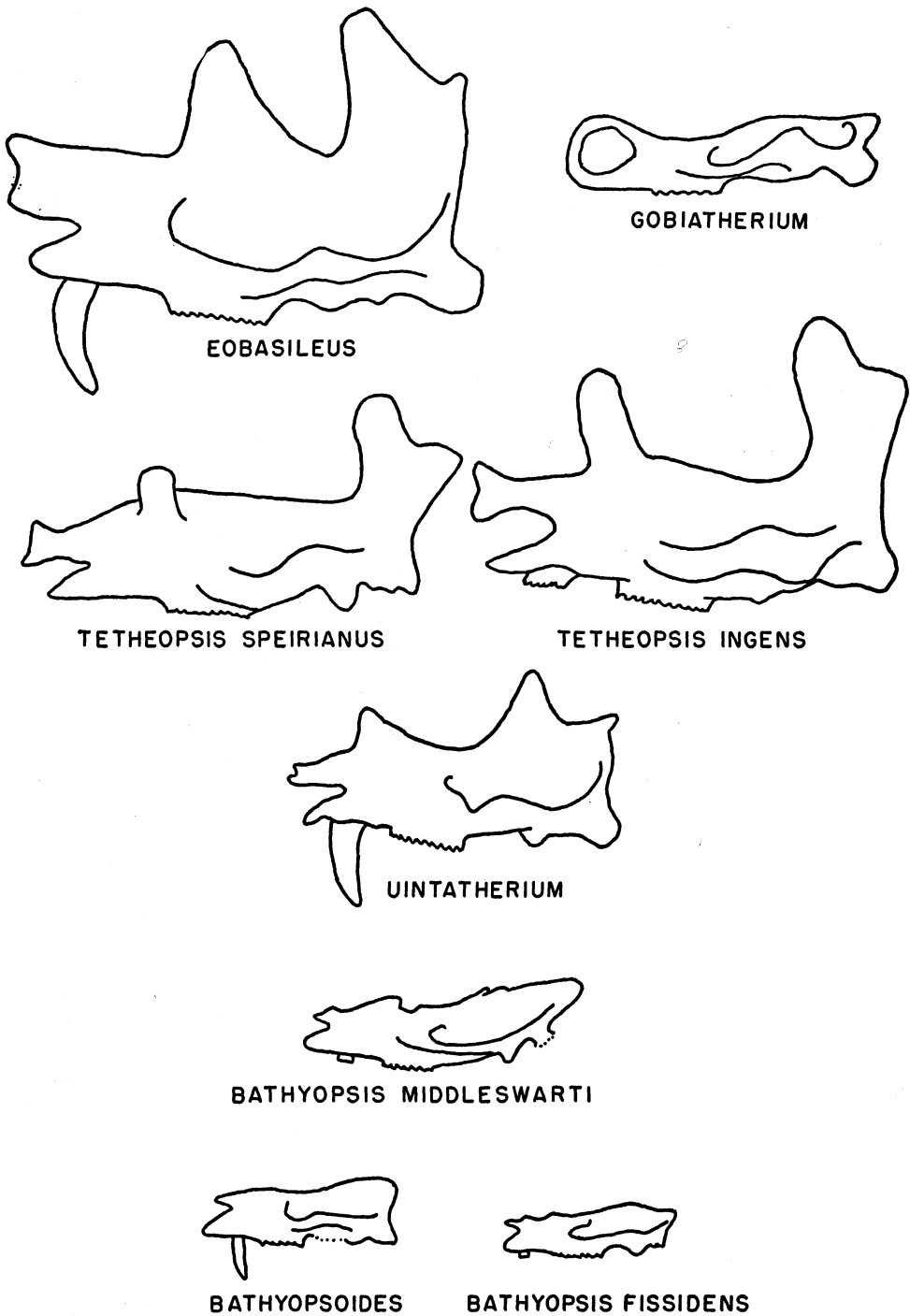


Fig. 8. Evolution of uintathere skulls, approximately  $\times 1/16$ . These outlines represent successive stages in evolution; only in a general way is it a phylogenetic chart. For uintathere phylogeny see Chart 2.

and temporal crests and medium-sized (female) to large (male) "horns" or protuberances. The temporal fossa is not visible from above.

*Bathyopsis* has a flat type of skull, without crests. The cranial table is slightly basined and there are rudimentary hornlike protuberances. The temporal fossa is not visible from above.

The *Gobiatherium* skull is grotesquely flat and characterized by the absence of crests, protuberances and upper canines. It does possess unusual arched nasal bones (fig. 8).

**SEXUAL DIMORPHISM:** Among the variants of the large uintatheres are forms with less bulky skulls, smaller average dimensions, small horns, slightly smaller canine tusks, lighter ridges around the cranial basin, and sometimes a vestigial inframandibular process. Marsh recognized that these were smaller, lighter forms and called them females. Osborn studied the lower jaws of two individuals with vestigial inframandibular processes from the Washakie Basin and regarded them as typical females.

In view of this dimorphism it is surprising that no large jaw with a diminutive inframandibular process has ever been found in the Bridger Basin. Only the slightly later sediments of the Washakie Basin bear them. Probably the female of *Uintatherium* was characterized by short and often tiny horns, slightly smaller average size, canine tusks only slightly smaller than in the male, and *no reduction of the inframandibular process*. Specimen AMNH 1671 has tiny horns and a light skull associated with a jaw bearing a full-sized inframandibular process. Other females are YPM 11202, called a female of "*Dinoceras laticeps*" by Marsh, the holotype of "*Elachoceras parvum*" Scott (PUM 10298), and probably the holotype of *Uintatherium anceps* (Marsh) (YPM 11030). (Pl. 8, fig. 1d.)

The female of *Tetheopsis* is represented by the holotype of *T. speirianus* (pl. 9, fig. 1). The bones are lighter than in the male, but the skull is nevertheless relatively long. The horns are of moderate size. The tusk is slightly smaller than in males. Specimen YPM 11256, called "*Tinoceras longiceps*" by Marsh, has a considerably smaller tusk which is associated with a vestigial inframandibular process. The tusk may or may not have been broken. It has the moderate median horns of the holotype. Two isolated jaws described by Osborn (PUM 10385 and 11611) possess this same reduced inframandibular process. (See pl. 14, fig. 2.) The male of *Tetheopsis speirianus* as shown in YPM 11043, called "*Tinoceras annectens*" by Marsh, has the typical enlarged inframandibular process (pl. 14, fig. 2).

The only female skull which is probably an *Eobasileus* is the crushed specimen lacking a snout from the Uinta Basin (CNHM P12164) (pl. 14, fig. 3). It has tiny horns and light bones. The lower jaw of the female *Eobasileus* is unknown.

These forms are called female by analogy to modern ungulates showing sexual dimorphism. In ungulates the males have the larger horns and sabre-tooth canines.

Sexual dimorphism seems a far better explanation than one involving a large-horned and thick-boned form and a small-horned and thin-boned form evolving at a rate such as to give exactly the same skull proportions at the same geologic levels. The greater gaiety of ornament and the bulkier appearance are probably androgenic phenomena, as indicated by van Bemmelen (1919).

One possible flaw in this explanation arises from the fact that only a small proportion of skulls which have been collected can be called female. Among modern ungulates in which one sex is more numerous in the herd, it is the female that is more common.

However, most of the "females" were discovered by the experienced scientists

of Princeton and American Museum expeditions. An explanation is that the earlier collectors of Cope and Marsh did not find the skulls of females as readily, because the horns and other bones are less robust. The large horns of the males must have been very obvious in the field judging from their frequency in the fragmental material sent in by Marsh's lay collectors. Later workers, especially J. L. Wortman, found a slightly higher proportion of females. Thus the infrequent discovery of female uintathere skulls is probably a function of preservation and collecting.

A *Probathyopsis successor*<sup>12</sup> found in the lower Eocene of the Hoback Basin in Wyoming has a prominent inframandibular process in contrast to the holotype of *P. praecursor*. Dorr (1952) believes the former to be a male and the latter a female. If this is so, then the direct descent of *Uintatherium* from *Probathyopsis* would be unlikely, because *Uintatherium* females have a large inframandibular process.

#### PHYLOGENY

Chart 2 on page 74 summarizes possible relationships and lines of descent within the Uintatheriidae. Dotted lines indicate uncertainty, solid lines merely show less uncertainty.

*Probathyopsis* and *Prodinoceras* are shown as closely related forms, on a somewhat different line from *Bathyopsoides* and *Mongolotherium*. *Bathyopsis* was derived from *Probathyopsis*.

*Uintatherium* is removed from the usual *Bathyopsis-Uintatherium-Eobasileus* sequence because of the peculiar presence of a large inframandibular flange in the female.

*Tetheopsis* is probably ancestral to *Eobasileus*. *Gobiatherium* remains a mystery, partly because the skull roof of *Prodinoceras* is unknown.

RELATIONSHIP BETWEEN DINOCERATA AND PANTODONTA: There need be no question that the uintathere molars and premolars have had similar history, that the points of the uintathere V are the normal trigon, and also that no known uintathere can be derived from any known pantodont.

From this it would seem to be the general belief today that uintatheres and pantodonts are not related except from a very remote common ancestor. I would like to suggest that a fairly near relationship is a possibility which should be kept in mind in future work with these groups.

W. D. Matthew has called the resemblance in foot structure between the Pantodonta and Dinocerata too close to be due to convergence (1928). The close correspondence of the bones in the alternating carpus and tarsus, and particularly the close resemblance of the astragali of uintatheres and pantodonts are strong evidence for Matthew's view (pl. 9). An astragalus from the Huerfano Basin (AMNH 17444) is the size of a *Coryphodon* astragalus but lacks the antero-internal extension. It is probably referable to *Bathyopsis*. (See Chart 2.)

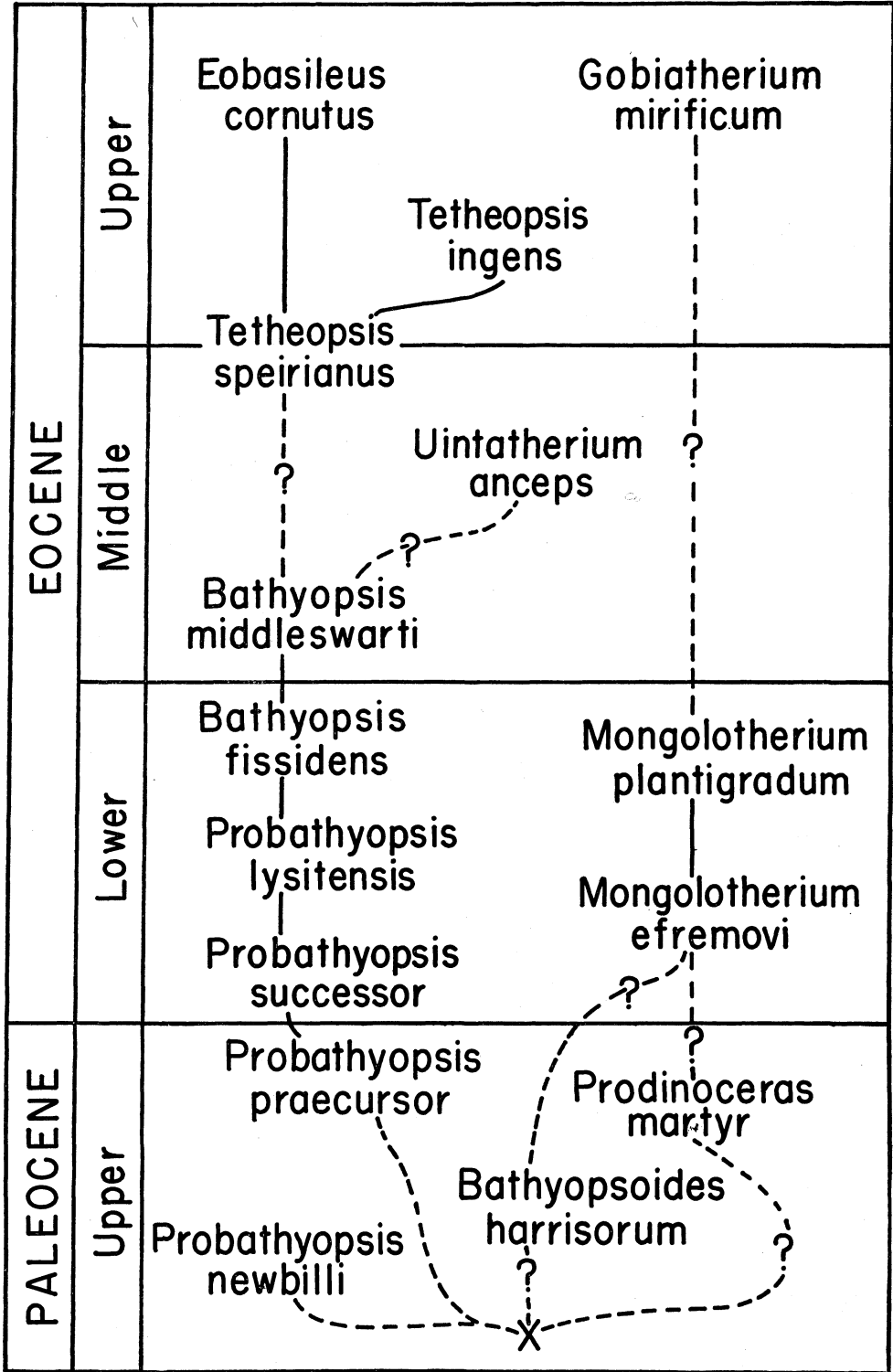
The resemblance of the astragali of a uintathere and a pantodont is even more striking when specimens of the two groups are of about the same size. When the *Bathyopsis* (?) astragalus, which is not significantly different from that of *Uintatherium*, is compared to *Coryphodon*, the resemblance is even closer than in the better known *Coryphodon-Uintatherium* comparison.

In a discussion of the general characters of the Order Insectivora, Simpson noted (1937, p. 105), "There are also some characters, like the peculiar specializa-

<sup>12</sup> See footnote 2 on page 3.



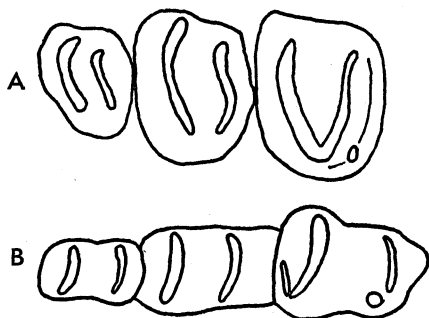
**Chart 2. Phylogenetic chart of the uinatheres. Solid lines indicate established relationships. Dotted lines represent uncertain or alternative relationships.**



tions of the incisors, that do not occur in all insectivores and are occasionally paralleled in other orders but that nevertheless appear so frequently among insectivores that they seem to reflect a certain genetic tendency and to help bind the group together." I would suggest that the great similarity of the astragalus may well be, as Matthew suggested, more than just convergence. Perhaps here, too, certain "peculiar specializations reflect a certain genetic tendency and help to bind the group together."

Consideration of yet a third animal type may serve to strengthen this possibility. *Carodnia*, from the Paleocene of Brazil, was first described by Simpson (1935) from a third molar which was very uintathere-like. Paula Couto (1952) has since described *Carodnia* from excellent material, and assigned it to a new order, Xenungulata. (Fig. 9.)

Fig. 9. Diagram of left molar teeth of *Carodnia*.  $M_{1-2}^{1-2}$  resemble the same teeth of *Hypercoryphodon*, an Oligocene pantodont from Mongolia. The third molars bear a close resemblance to the third molars of uintatheres. The lower third molar of *Carodnia* does lack a crest on the hypoconid and the metastylid adjacent to the metaconid. A, upper molars; B, lower molars. (After Paula Couto 1952).



The premolars of *Carodnia* are large, blunt, and rather entelodont-like. The first two molars above and below have two transverse lophs, somewhat like the Asian pantodont, *Hypercoryphodon*. But the third upper and lower molars are much like the uintathere counterparts and are the only teeth outside of the Dinocerata which have this pattern. The third upper molar has a long crest curving around like the anterior loph of a uintathere molar. The posterior loph does not meet it quite so closely as in the uintathere tooth, and the hypocone is large and affects the outline of the tooth which bulges out to accommodate it.

The third lower molar of *Carodnia* has a posterior talonid loph and a hypoconid loph as in uintatheres. It does lack the highly diagnostic metastylid, however. The cusps of these teeth are rounder and present a somewhat coarser appearance than in uintatheres. The hypoconid crest, for example, does not taper gradually toward the metastylid, but is more rounded and abrupt.

The presence of molars so closely resembling those of advanced Pantodonta and of the larger Dinocerata in one and the same individual of still another order (Xenungulata) seems suggestive of some "genetic tendencies" which may well have been inherited from an ancestor common to the three groups.

It may be possible that the Dinocerata, Pantodonta, and Xenungulata are members of a common group, and are, in fact, suborders of the Order Amblypoda.

ANCESTRY OF THE UINTATHERES UNKNOWN: The ultimate common ancestor of the Pantodonta as now defined and the Dinocerata may be found in a pantodont more primitive than any now known or in a more generalized ungulate group, probably the Condylarthra. On the basis of foot structure the alternating carpus and tarsus of the Hyopsodontidae offer the most tempting point of departure for the amblypod foot. (The primitive pantodont, *Pantolambda*, has a rather con-

dylarth-like foot [see Matthew 1937]). But the bunodont teeth of the Hyopodontidae offer no possible predecessors for those of the amblypods. The problematical *Carodnia* has an alternating carpus (Paula Couto 1952, pl. 37).

The presence of a metastylid in the doubly crescentic lower teeth of *Meniscotherium* offers some resemblance to the uintathere lower molar. However, the serial carpals and tarsals serve to make it less probable as an ancestor, though not to eliminate it.

The solution of the problem of uintathere ancestry will probably come from one of two directions. Perhaps a connecting link, probably, but not necessarily, a condylarth, will be found in the still very inadequately known Paleocene faunas of North America or Eurasia. Or the otic regions of known or yet undiscovered forms may some day yield important clues about uintathere relationships and ancestry. A great deal of work has been accomplished during this century in the comparative osteology of the otic region of mammals possessing auditory bullae. But the otic regions of Paleocene and Eocene mammals which lack bullae are poorly known, probably because paleontologists are reluctant to perform the necessary damage to good specimens.

The solution to this problem and many other problems in the relationships of early mammalian groups may well lie within such studies.

REVISION OF THE UINTATHERES

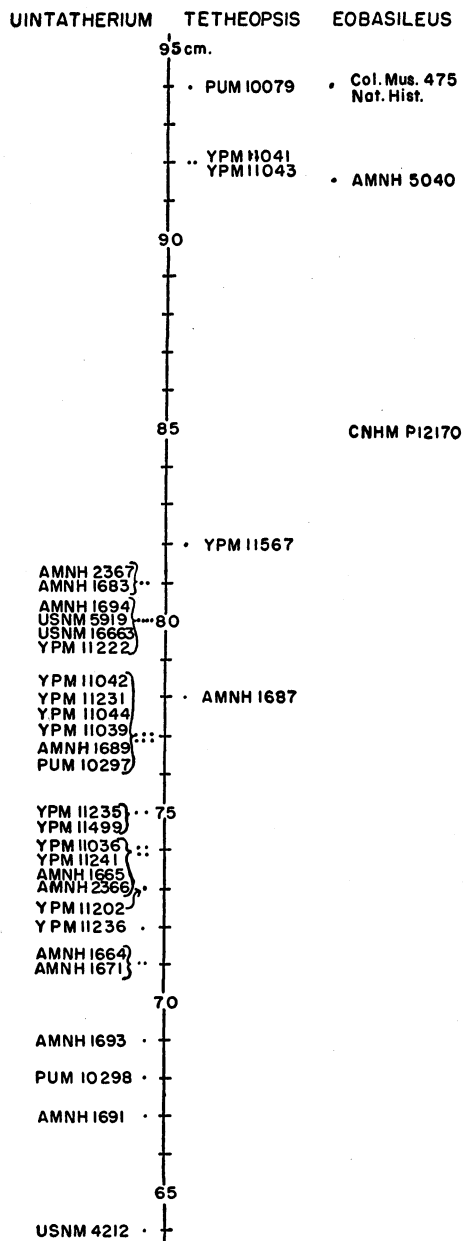


Chart 3. Lengths of uintathere skulls.

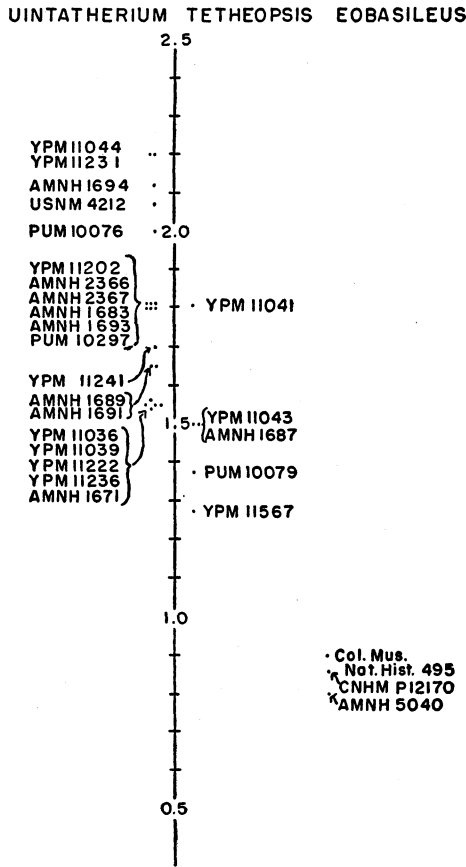


Chart 4. Uintathere skulls according to ratio B/A. See Fig. 1, p. 26. Note how *Tetheopsis ingens*, the "short-snouted" *Tetheopsis*, appears among *Uintatherium*.

REVISION OF THE UINTATHERES

UINTATHERIUM TETHEOPSIS EOBASEILEUS

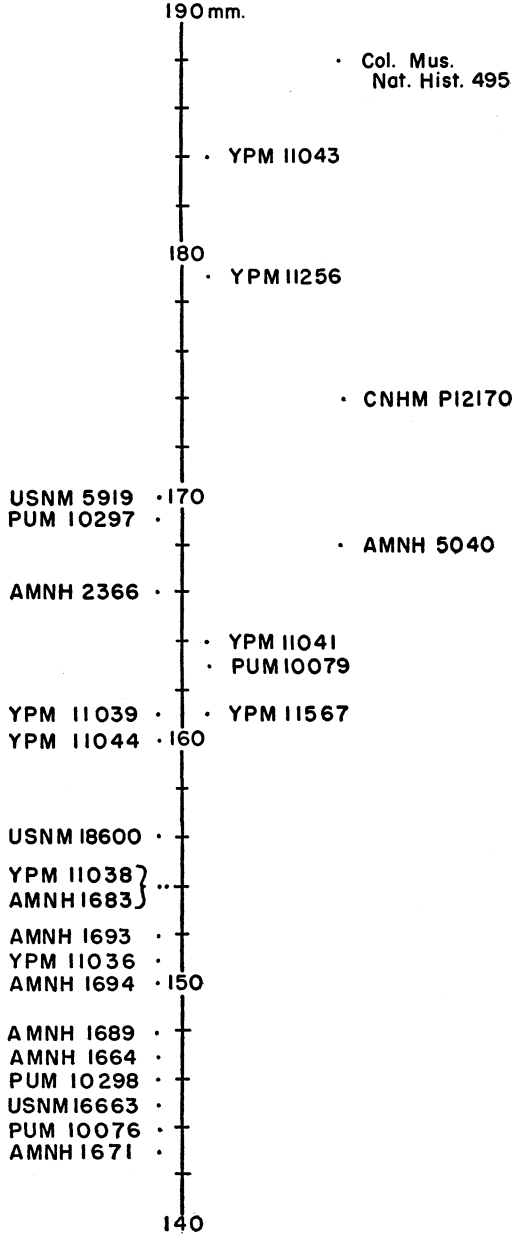


Chart 5. Lengths of upper cheek-tooth rows.

UINTATHERIUM TETHEOPSIS EOBASEILEUS

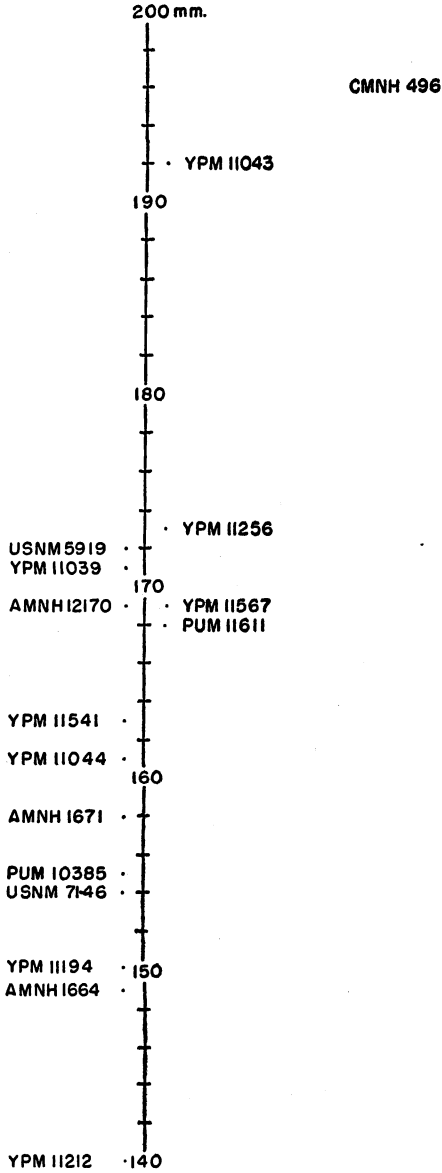


Chart 6. Lengths of lower cheek-tooth rows.



## REVISION OF THE UINTATHERES

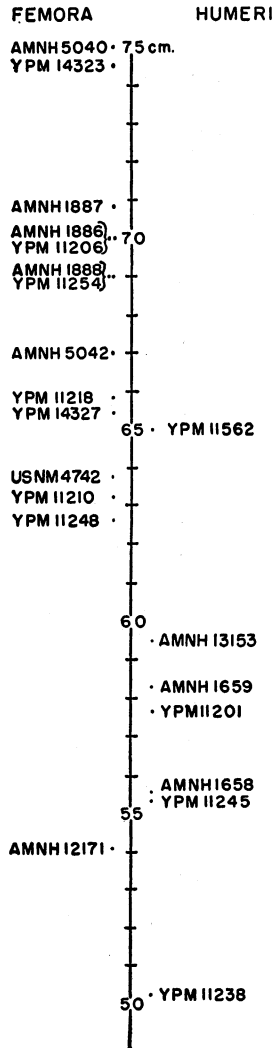


Chart 7. Lengths of uintathere femora and humeri. Note that femur YPM 14323 and humerus YPM 11562 are from Marsh's locality "Dug Springs, Upper Green Sand," which is surely high on Haystack Mountain, Washakie Basin. The specimens are very probably of *Eobasileus*, therefore. AMNH 5040 is from the holotype of *E. cornutus*. There is a notable gap between these specimens and the *Uintatherium* long bones.

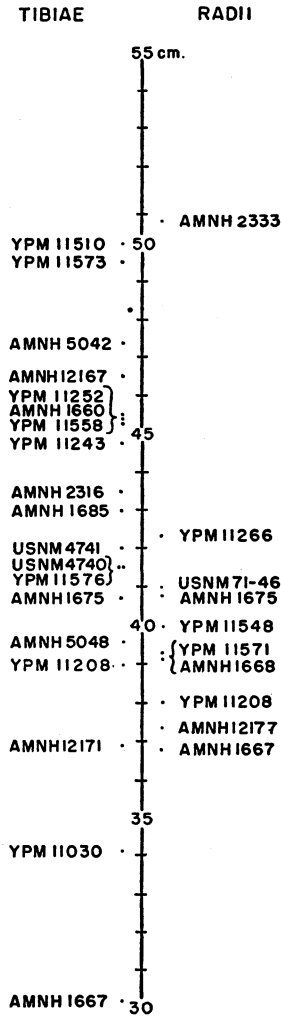


Chart 8. Lengths of uintathere tibiae and radii. This chart is hard to interpret because of the vague locality data of the longer bones. Tibia YPM 11510 is from "Haystack Mountain" and could be Washakie A or B, and could be *Tetheopsis*. Tibia YPM 11573 is from "Red Dog Buttes," a locality from which Marsh's collectors took much *Uintatherium* material from Washakie A. Probably isolated leg bones should be assigned to *Uintatherium*, unless they stand notably apart from the size range for that genus. Radius AMNH 2333 stands apart, and has been assigned to *Tetheopsis*, because it was collected from the "Lower Washakie, south of Haystack Mountain" and *Tetheopsis* ranges down into the Lower Washakie (Washakie A).

## REVISION OF THE UINTATHERES

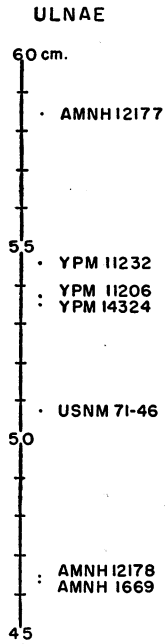


Chart 9. Lengths of ulnae. These are all *Uintatherium*, for the longest ulna is from Bridger C-4, and no *Tetheopsis* or *Eobasileus* has been collected from the Bridger Basin.

## Statistical Summary of Data from Charts 3 through 9.

In the following tables these symbols are used: O.R. = Observed Range, N = number of individuals, M = mean,  $\sigma$  = standard deviation, V = Variability. Standard deviation has not been computed for samples of less than 15 individuals.

Lengths of uintathere skulls (in centimeters). See Chart 3.

	O.R.	N	M	$\sigma$	V
<i>Bathyopsis fissidens</i>	33	1	33		
<i>Bathyopsis middleswarti</i>	51	1	51		
<i>Uintatherium anceps</i>	64-81	26	74.8	4.45	5.9
<i>Tetheopsis speirianus</i>	78-94	4	86.5		
<i>Tetheopsis ingens</i>	92	1	92		
<i>Eobasileus cornutus</i>	85-95	4	90.3		

The low value of V is surprising in the light of the supposedly great variability of *Uintatherium* skulls.

Comparing Bridger Basin and Washakie Basin specimens of *U. anceps*

	O.R.	N	M
<i>U. anceps</i> —Bridger Basin	67-81	13	75.0
<i>U. anceps</i> —Washakie Basin	64-81	13	74.6

These two samples are slightly too small for computing a significant coefficient of variability. It is obvious that the means of these two smaller samples are similar. They are, in fact, more similar than two samples from the same population would generally be, so their close approach is in part a coincidence.

Ratio B/A (Relative length of portion of skull in front of maxillary horn). See Chart 4.

	O.R.	N	M	$\sigma$	V
<i>Uintatherium anceps</i>	1.5-2.2	19	1.82	0.29	15.9
<i>Tetheopsis speirianus</i>	1.3-1.5	4	1.42		
<i>Tetheopsis ingens</i>	1.8	1	1.8		
<i>Eobasileus cornutus</i>	0.8-0.9	3	0.86		

## Lengths of upper cheek tooth rows (in millimeters). See Chart 5.

	O.R.	N	M	$\sigma$	V
<i>Uintatherium anceps</i>	143-170	17	153.9	8.38	5.4
<i>Tetheopsis speirianus</i>	161-184	4	171.8		
<i>Tetheopsis ingens</i>	164	1	164		
<i>Eobasileus cornutus</i>	168-188	3	176.7		

## Lengths of lower cheek tooth rows (in millimeters). See Chart 6.

	O.R.	N	M
<i>Uintatherium anceps</i>	140-172	11	158.4
<i>Tetheopsis speirianus</i>	168-192	4	175.5
<i>Eobasileus cornutus</i>	196	1	196

## Lengths of femora (in centimeters). See Chart 7.

	O.R.	N	M
<i>Uintatherium anceps</i>	50-71	12	65.9
<i>Eobasileus cornutus</i>	74-75	2	74.5

Lengths of humeri (in centimeters). See Chart 7.

	O.R.	N	M
<i>Uintatherium anceps</i>	50-60	6	56.2
<i>Eobasileus cornutus</i>	65	1	65

Lengths of tibiae (in centimeters). See Chart 8.

	O.R.	N	M	$\sigma$	V
<i>Uintatherium anceps</i>	30-50	19	42.5	5.23	12.3

Lengths of radii (in centimeters). See Chart 8.

	O.R.	N	M
<i>Uintatherium anceps</i>	37-42.5	9	39.4
<i>Tetheopsis speirianus</i>	51	1	51

Lengths of ulnae (in centimeters). See Chart 9.

	O.R.	N	M
<i>Uintatherium anceps</i>	45.5-58.5	7	51.8

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**PLATES**

# UINTATHERE-BEARING FORMATIONS of the UNITED STATES

Adapted from the  
United States Geological Survey  
Geologic Map of the  
United States  
(1932)

Modified after  
Kay 1934  
Bradley 1945

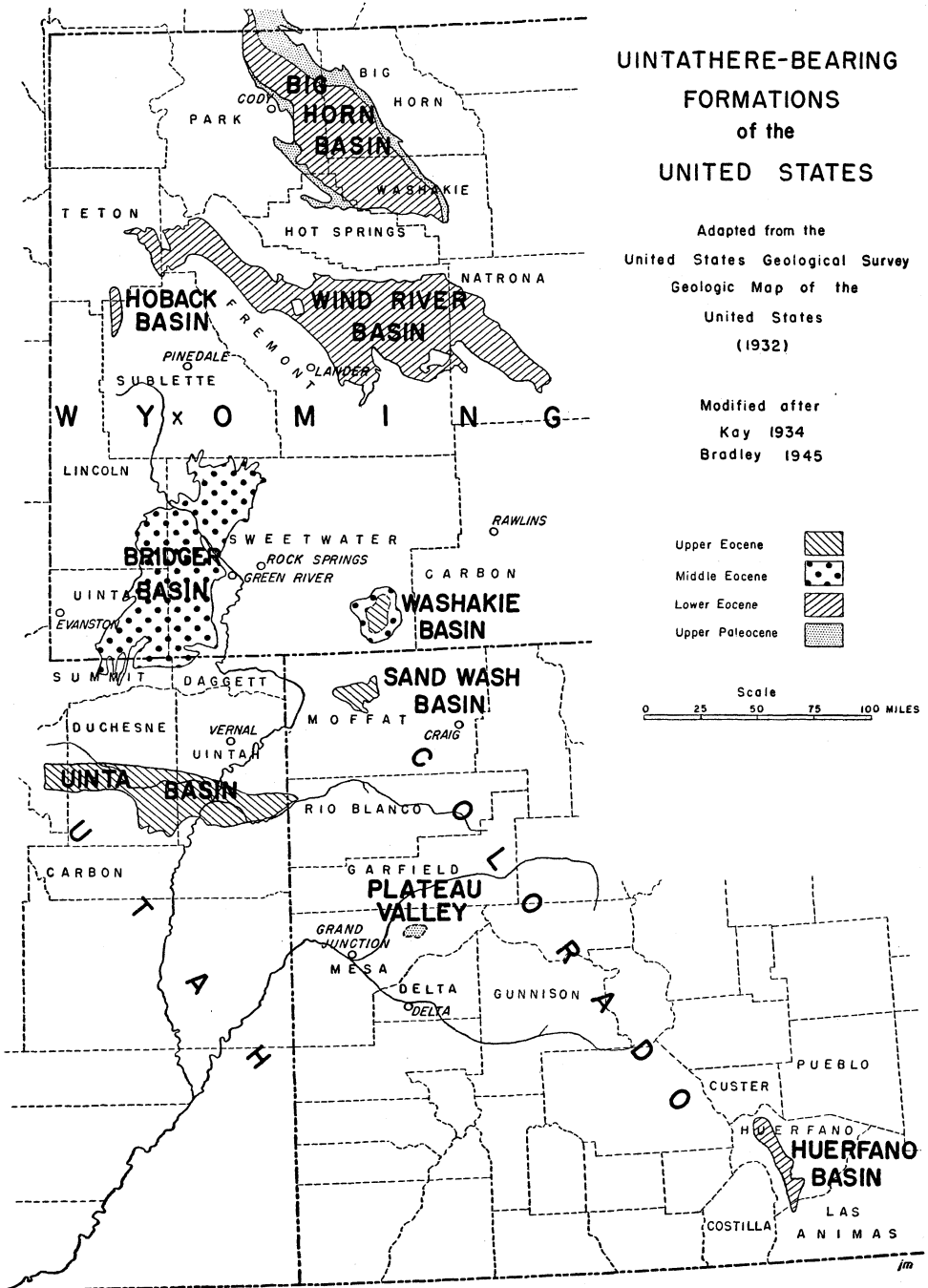


Plate 1. Map showing unitathere bearing formations of western United State. The "X" marks the area of the type locality of *Bathyopsis middleswarti*, new species. A very small amount of uintathere material has been collected from the Knight formation (Lower Eocene) and Almy formation (Upper Paleocene) in southwestern Wyoming in the area west of the outcrops of the Bridger formation.

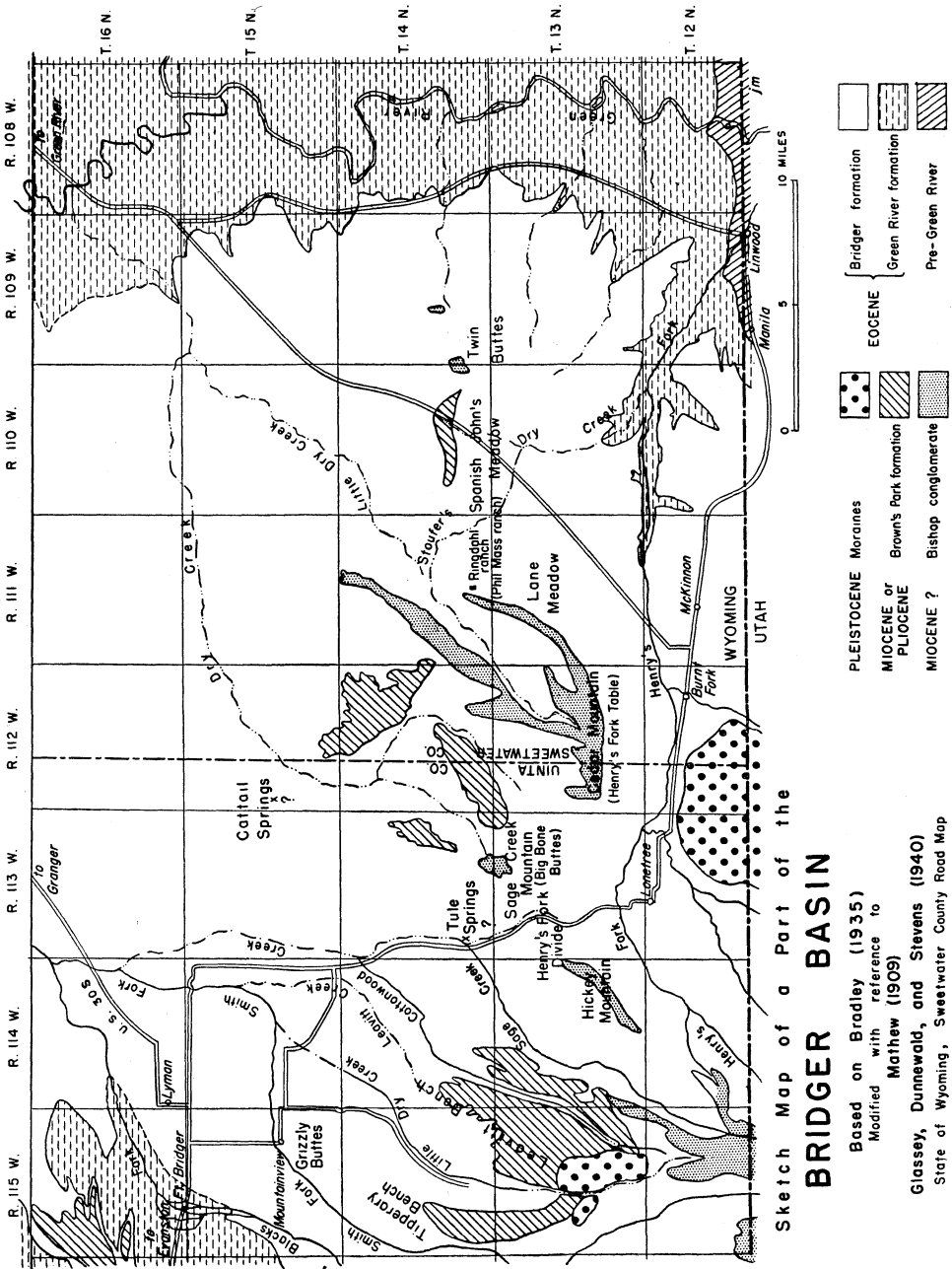


Plate 2. Map showing localities in the southern portion of the Bridger Basin in Wyoming.

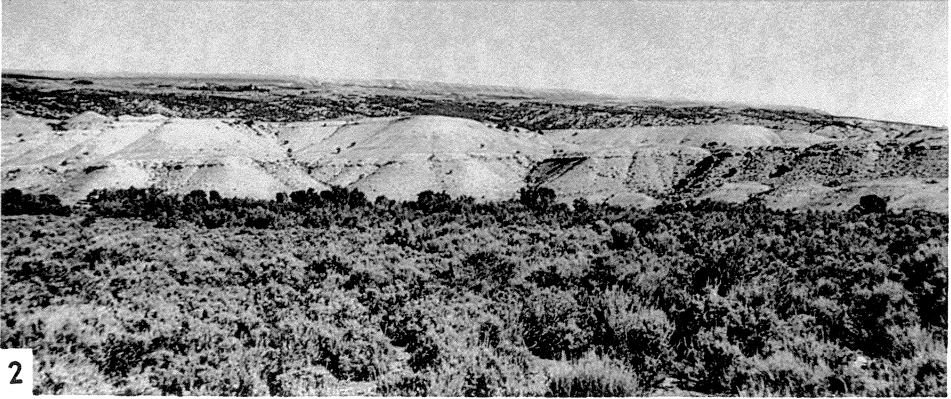
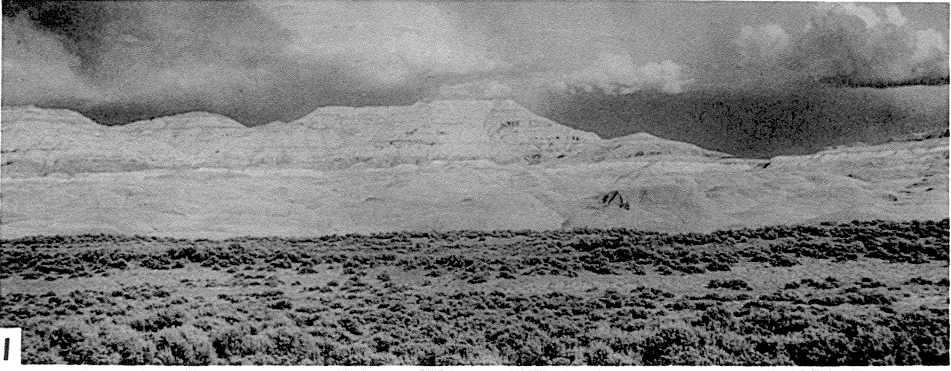


### PLATE 3

Fig. 1. Badlands along the lower slopes of southwestern corner of Sage Creek Mountain, Bridger Basin of Wyoming. Prominent white layer in foreground is probably the Lone Tree White layer which divides the Bridger C from the Bridger D.

Fig. 2. Outcrops at southeastern corner of Cedar Mountain in the Bridger Basin showing Bridger formation resting unconformably on Green River formation. The contact rises to the top of the outcrop at the right hand edge of the picture.

Fig. 3. Badlands high on Twin Buttes in Bridger Basin. The man is walking along a whitish layer in the Bridger formation. This layer is soft and, even though conspicuous from a distance, is not one of the true "White Layers" which are hard, siliceous beds.





#### PLATE 4

Fig. 1. View looking north along the west side of Sage Creek Mountain, Bridger Basin of Wyoming. The prominent escarpment is at the top of Bridger B and is capped by the Sage Creek "White Layer."

Fig. 2. Southwestern corner of Cedar Mountain, Bridger Basin of Wyoming. Bridger C in the foreground, Bridger D in the middle distance, and the prominently banded Bridger E toward the top of the hill. The Cap rock is the Miocene Bishop conglomerate.

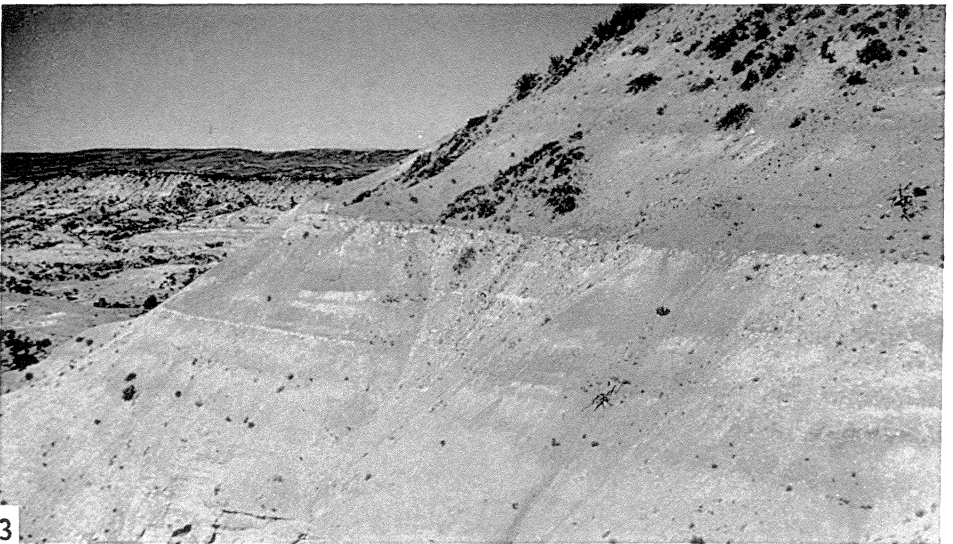
Fig. 3. Badlands of Bridger formation along southwestern portion of Sage Creek Mountain, Bridger Basin, Wyoming. The thin strip of badlands in the distance at the right hand side is the "Henry's Fork Divide" locality of Marsh, from which many specimens of *Uintatherium anceps* have been collected. Uinta Mountains in the distance.

## PLATE 5

Fig. 1. View of the prominent hill at the west end of Haystack Mountain, Washakie Basin, Wyoming. Washakie A (Middle Eocene) up to the prominent ledge in foreground with Washakie B (Upper Eocene) from there to top of hill.

Fig. 2. Badlands forming south slopes of Haystack Mountain as seen from the top. The type of *Eobasileus cornutus* was found by Cope in the higher beds in the distance.

Fig. 3. Double "White Layer" high on southwest corner of Cedar Mountain, Bridger Basin of Wyoming. This is probably the "Upper White Layer" of Matthew and Granger. It lies about 75 feet below the base of Bridger E.





## PLATE 6

Fig. 1. Eastern end of Haystack Mountain, Washakie Basin of Wyoming. The beds from the foreground to Haystack Mountain are Washakie A. The main mass of Haystack Mountain is Washakie B.

Fig. 2. Escarpment marking base of Washakie A, about 8 miles south of eastern end of Haystack Mountain, Washakie Basin, Wyoming. This is surely at or near the "Dug Springs, 8 miles south" locality of Marsh.

Fig. 3. *Uintatherium* quarry in Washakie A beds located a few hundred feet west of point where picture of Fig. 2 was taken.



PLATE 7

BATHYOPSIS MIDDLESWARTI

*Bathyopsis middleswarti*, new species, lower Bridger formation, middle Eocene of Sweetwater County, Wyoming. UNSM IQ 1037.

Fig. 1. Dorsal view.

Fig. 2. Ventral view.

Fig. 3. Lateral view, all x 1/5.



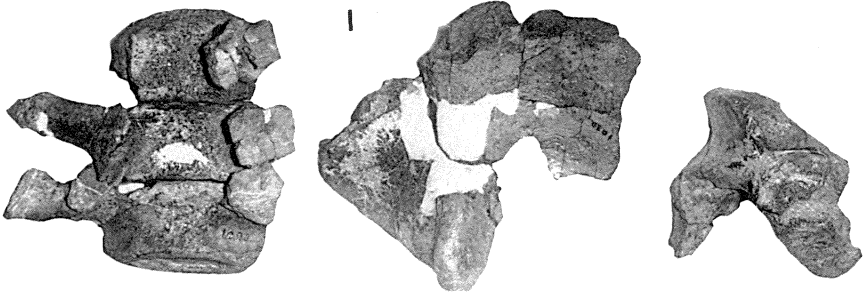
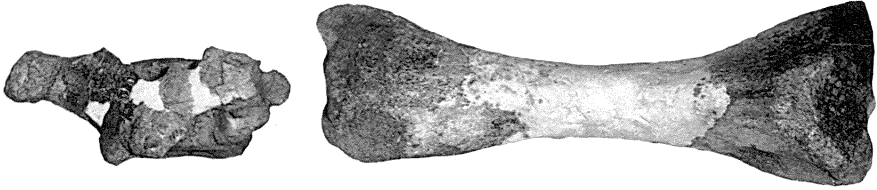
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## PLATE 8

### UINTATHERIUM ANCEPS

Fig. 1. *Uintatherium anceps* (Marsh), x 1/5. Holotype, YPM 11030. Bridger formation (D horizon), Uinta County, Wyoming. This specimen is fragmentary, but still identifiable as a female of *U. anceps*. Thoracic vertebrae on the left. The long bone is a left tibia. In the lower center is a portion of the skull around the right parietal horn. A portion of the skull around the left glenoid area with a portion of the zygoma is on the lower right.

Fig. 2. *Uintatherium anceps* (Marsh), lateral view of skull, x 1/7. AMNH 2366. From Washakie (A) formation, Washakie Basin, Sweetwater County, Wyoming. This specimen is, without doubt, the finest uintathere skull ever collected. Photograph by American Museum of Natural History.

Fig. 3. *Uintatherium anceps* (Marsh), lateral view of skull, x 1/7. AMNH 1671. Washakie formation, Washakie Basin, Sweetwater County, Wyoming. This crushed skull of a mature female is of interest for its small size and for the canines which were broken and then worn smooth. Photograph by American Museum of Natural History.

## PLATE 9

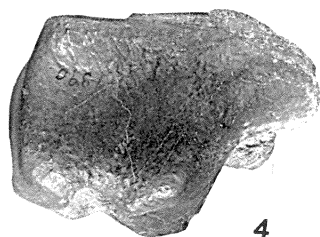
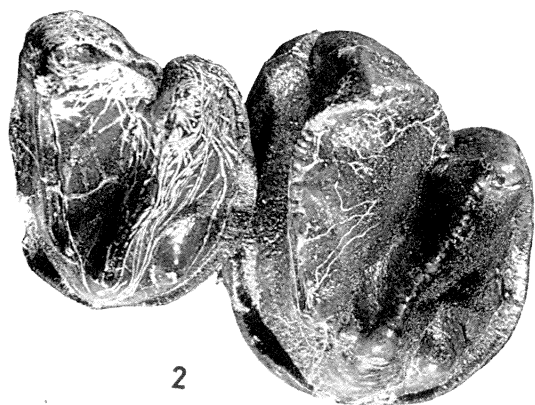
### UINTATHERIUM, EOBASILEUS, CORYPHODON

Fig. 1. *Uintatherium anceps* (Marsh), Lateral view of skull, x 1/7. YPM 11036. Bridger (D?) formation, Sage Creek Mountain, Bridger Basin, Uinta County, Wyoming. This fine skull is the holotype of "*Dinoceras mirabile*" Marsh, a synonym of *U. anceps*.

Fig. 2. *Eobasileus cornutus* Cope, occlusal view of left M<sup>2</sup> and M<sup>3</sup>, x 1. YPM 14322. Washakie (B) formation, Haystack Mountain, Washakie Basin, Sweetwater County, Wyoming. Detail of unworn upper molars.

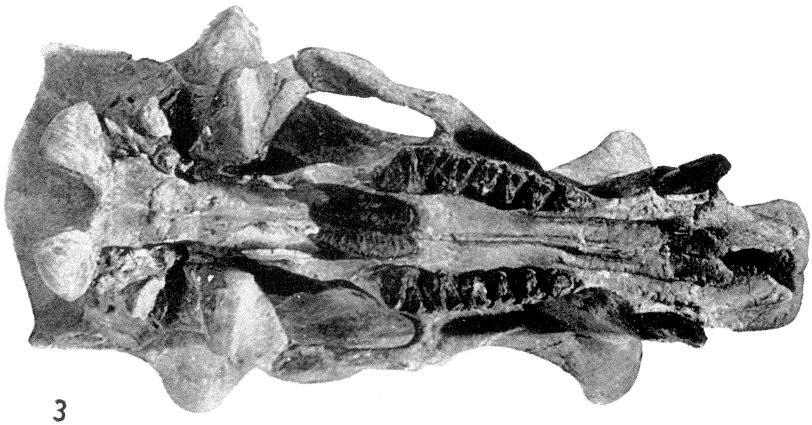
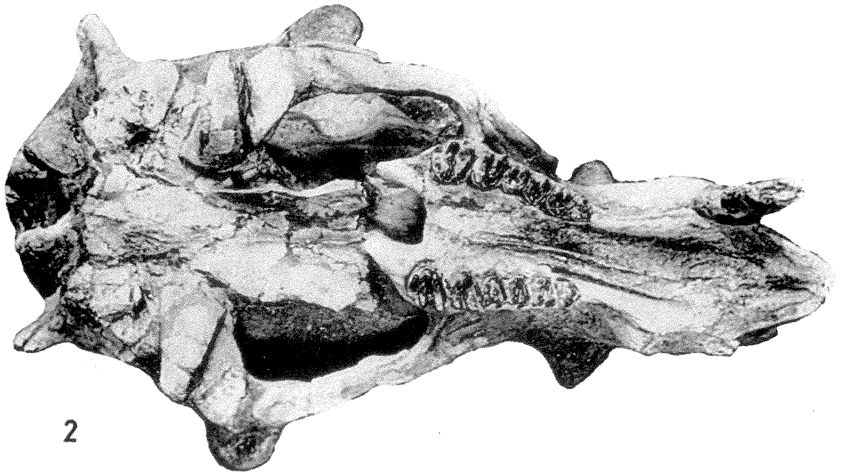
Fig. 3. *Uintatherium anceps* (Marsh), left astragalus, approx. x 1/2. YPM 11210. Bridger (C or D) formation, Bridger Basin, Wyoming. The dorsal view is on the left and the ventral view is on the right.

Fig. 4. *Coryphodon*. Left astragalus, approx. x 1/2. YPM 11390. The dorsal view is shown above the ventral view.



3





## PLATE 10

### UINTATHERIUM ANCEPS

Fig. 1. *Uintatherium anceps* (Marsh), ventral view of skull, x 1/7. USNM 18600. Bridger "D" formation, Twin Buttes, Bridger Basin, Sweetwater County, Wyoming. This specimen is unique among uintatheres in having a hypcone on the P<sup>4</sup>. Photograph by United States National Museum.

Fig. 2. *Uintatherium anceps* (Marsh), ventral view of skull, x 1/7. USNM 16663. Bridger (C) formation, Sage Creek area, Bridger Basin, Uinta County, Wyoming. Anomalous vestige of left incisor present on premaxillary. Photograph by United States National Museum.

Fig. 3. *Uintatherium anceps* (Marsh), ventral view of skull, x 1/7. AMNH 2366. Same skull as in Plate 8, fig. 2. Photograph by American Museum of Natural History.

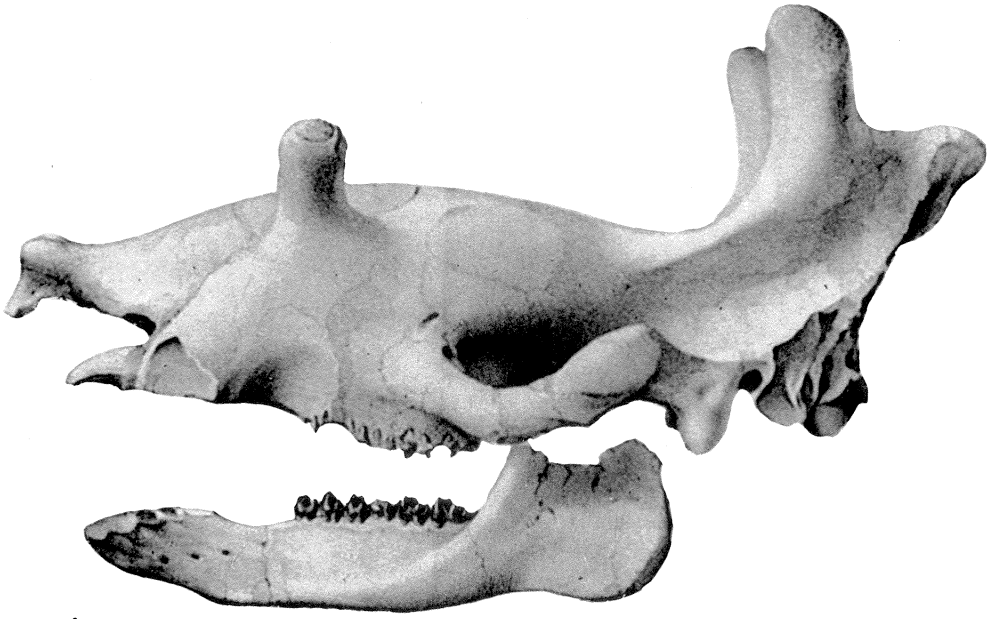


## PLATE 11

### TETHEOPSIS SPEIRIANUS

Fig. 1. *Tetheopsis speirianus* (Osborn), lateral view of skull and lower jaw, x 1/7. Skull, PUM 10079; lower jaw, PUM 10385. The skull is from Washakie (A) formation, east end of Haystack Mountain, Washakie Basin, Sweetwater County, Wyoming. The lower jaw is from the Washakie A formation somewhere in the area around Haystack Mountain. Both skull and lower jaw are from females. The skull is the holotype of "*Loxolophodon speirianum*" Osborn. The picture is a photograph of Plate 1 of Osborn's 1881 Memoir.

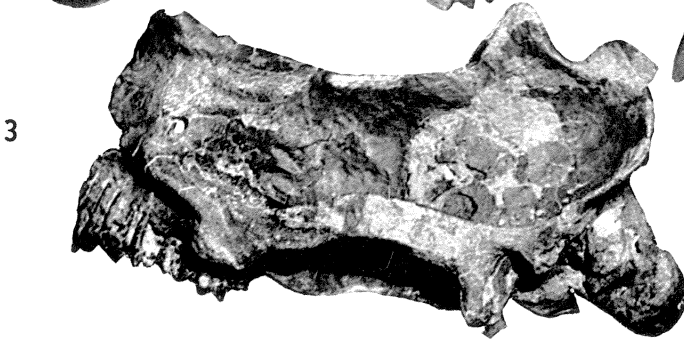
Fig. 2. *Tetheopsis speirianus* (Osborn), lateral view of skull and lower jaws, approx. x 1/6. YPM 11567. Washakie formation, Washakie Basin, Sweetwater County, Wyoming. Holotype of "*Tinoceras stenops*" Marsh. Cope mistook the restored anterior end of the lower jaw for bone, and took the supposed absence of lower incisors to be a generic characteristic. It was for this specimen that he erected his genus, *Tetheopsis*.



1



2



## PLATE 12

### TETHEOPSIS AND EOBSILEUS

Fig. 1. *Tetheopsis ingens* (Marsh), lateral view of skull, x 1/7. YPM 11041. Washakie (B?) formation, Haystack Mountain, Washakie Basin, Sweetwater County, Wyoming. Holotype specimen.

Fig. 2. *Eobasileus cornutus* Cope, lateral view of skull, x 1/7. CNHM P12170. Uinta (B) formation, from two miles east of Bonanza mine, Uintah County, Utah. This is the specimen referred by Osborn (1929) to the nomen nudum, *Eobasileus uintensis*. It is the only good uintathere skull from the Uinta basin.

Fig. 3. *Eobasileus cornutus* Cope, lateral view of skull, x 1/7. CNHM P12164. Uinta (B) formation, "Coyote Basin" in Uinta Basin, Uintah County, Utah. This rather poor skull, badly flattened and with the anterior portion missing, is the only known female of the genus *Eobasileus*.

## PLATE 13

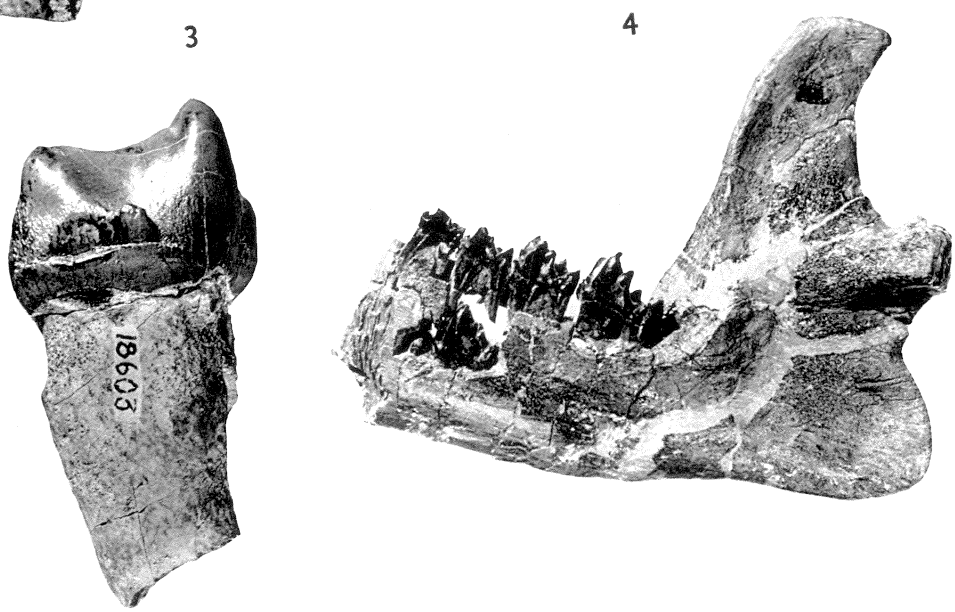
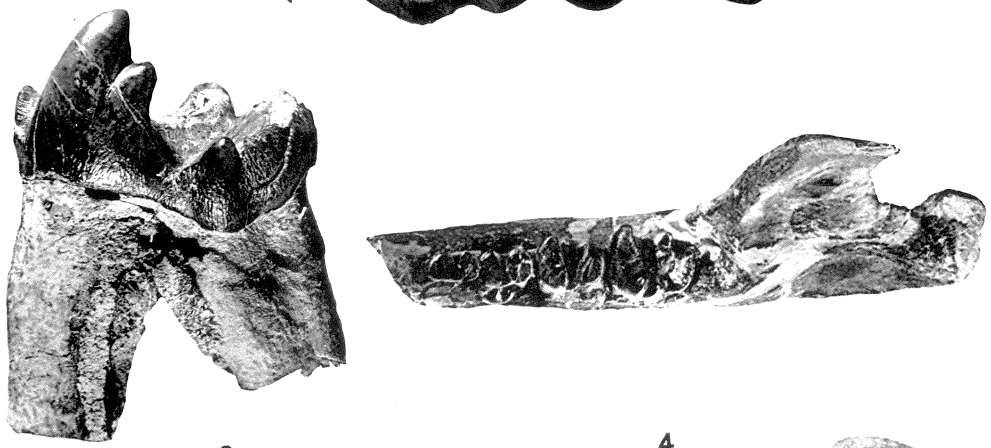
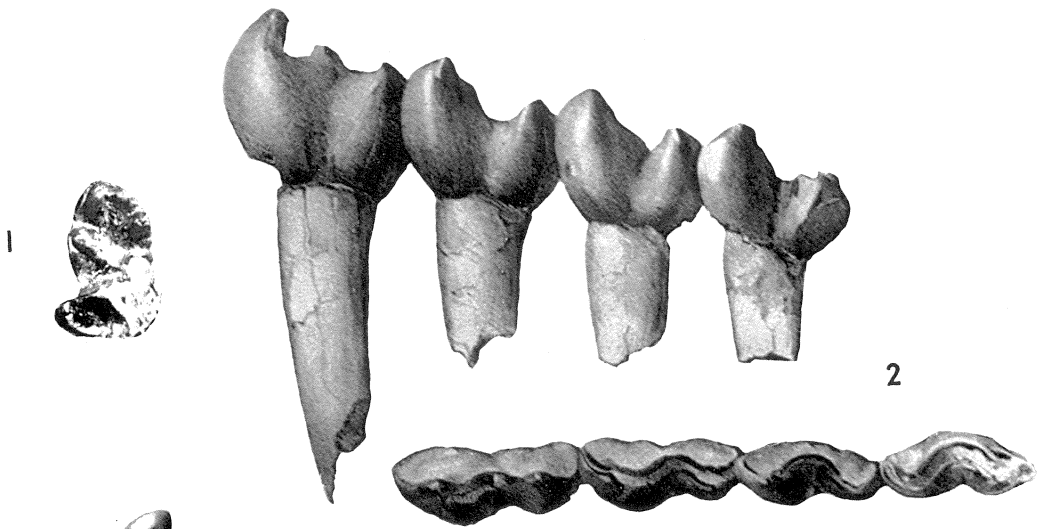
### PROBATHYOPSIS, TETHEOPSIS, AND UINTATHERIUM

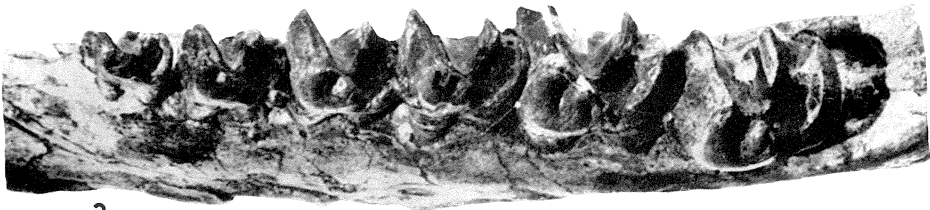
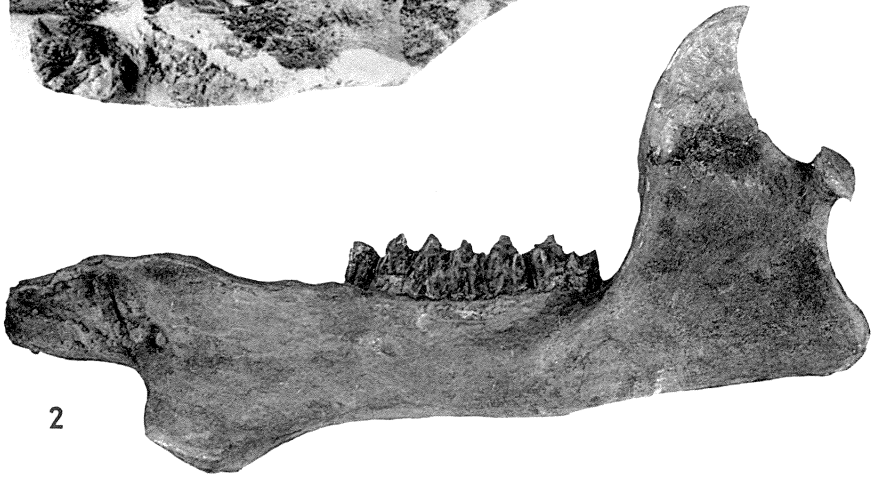
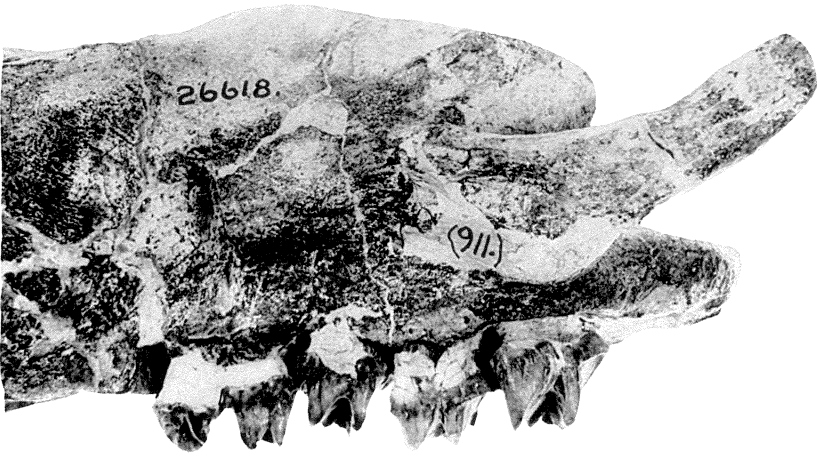
Fig. 1. *Probathyopsis praecursor* Simpson, occlusal view of right  $M_3$ , x 1. AMNH 16786. Polecat Bench formation, Clark Fork faunal zone, Park County, Wyoming. Part of holotype specimen. Photograph by American Museum of Natural History.

Fig. 2. *Tetheopsis speirianus* (Osborn), lateral view of left incisor-canine row, x 3/4. PUM 11611. Near Haystack Mountain, Washakie formation, Washakie Basin, Sweetwater County, Wyoming. This is a photograph of Plate 2, fig. 3 of Osborn's Memoir of 1881.

Fig. 3. *Uintatherium anceps* (Marsh), lower right  $M_3$ , x 1. USNM 18603. Collected from Bridger (C or D) formation, northwest of Cedar Mountain, Bridger Basin, Uinta County, Wyoming. Above, medial view showing the paraconid, metaconid, metastylid, and entoconid from left to right along the medial side, the hypoconid and its crest on the far (lateral) side, and the posterior talonid loph at the extreme right. Below, anterior view showing cingulum and tiny paraconid.

Fig. 4. *Uintatherium anceps* (Marsh), part of right lower jaw of an immature individual, occlusal and medial views, x 1/2. AMNH 1678. Bridger formation, Bridger Basin, Wyoming. This is the only known tooth-bearing specimen of an immature uintathere from North America. The jaw had been prepared to show both the sides and crown of the unerupted P<sub>4</sub>. Photograph by American Museum of Natural History.





## PLATE 14

### GOBIATHERIUM AND TETHEOPSIS

Fig. 1. *Gobiatherium mirificum* Osborn and Granger, left maxillary of immature individual with third molar not erupted and but slight wear on M<sup>1</sup>, lateral view and occlusal views, x 1/2. AMNH 26618. Irдин Manha formation, 25 miles southwest of Iren Dabasu, Inner Mongolia. Photographs by American Museum of Natural History.

Fig. 2. *Tetheopsis speirianus* (Osborn), lateral view of lower jaw, x 1/6. YPM 11043. Washakie formation, Haystack Mountain area, Washakie Basin, Sweetwater County, Wyoming.

Fig. 3. *Gobiatherium mirificum* Osborn and Granger, cheek teeth of right lower jaw, x 2/3. AMNH 26630. Irдин Manha formation, Inner Mongolia. Photograph by American Museum of Natural History.