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A BASAL OLIGOCENE LOCAL FAUNA FROM McCARTY'S MOUNTAIN, SOUTHWESTERN MONTANA

by

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TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

Page

LIST OF ILLUSTRATIONS

Figure Page

Table

LIST OF ILLUSTRATIONS (Continued)

Table Page

Plate

ABSTRACT

Vertebrate fossil localities on the south side of McCarty's Mountain, Montana were recollected and each fossil located stratigraphically. The material provides new additions to the descriptions of *Oreonetes anceps* and *Limnetes platyceps*. The pes of *O. anceps* is described for the first time. *Leptomeryx cf. blacki* and *Leptomeryx cf. minutus,* previously unknown from Montana, compare very closely with Duchesne River, Eocene, and Titus Canyon, basal Oligocene specimens. The cylindrodont rodents from McCarty's Mountain show a high degree of variability in cheek tooth pattern and position of the mental foramina. No evidence was found for a supposed Orellan age at McCarty's Mountain. The fauna collected indicates that all the fossil beds on the south side of McCarty's Mountain and north of the Big Hole River are basal Oligocene in age and were deposited at approximately the same time as those at Pipestone Springs and Thompson Creek, Montana.

The sediments, sedimentary tuffs and stream gravels, were deposited on a floodplain at the margin of a basin. Although earlier authors called these beds "lake beds", no evidence for lacustrine deposition was found. A measured section indicates that at least 1200 feet of sediment was deposited at the main locality. No observable change of lithology occurs in the sequence of sedimentary tuffs. Stream channels, probably representing tributary streams, are confined to the lower and upper parts of the geologic section. The presence

of boulders in the stream channels indicates that the surrounding area had relief, but the amount is undeterminable from this study.

The fossil beds dip from 30 - 50° and lie unconformably on folded and faulted Cretaceous sedimentary and igneous rocks. The Lower Oligocene rocks are unconformably overlain by undisturbed Pliocene? pediment gravels indicating that faulting occurred before the development of the pediment.

The abundance of tapiroid, Paleolagus temnodon, and Oreonetes anceps specimens may indicate that these animals inhabited the floodplain or the margin of the basin. The scarcity of Limnetes platyceps material may indicate that this animal lived away from the basin in upland forests.

INTRODUCTION

HISTORICAL REVIEW

Mammalian fossils from the McCarty's Mountain area were first discovered in the summer of 1903 by a Carnegie Museum expedition led by Earl Douglass. In an account of the discovery, Douglass (1905, pp. 209-211) mentions two fossil localities. The first "situated north and a little east of Dillon, at a distance of about sixteen miles" and the second "about two miles west (of the first) and of a little different character of strata." According to the account, the first locality yielded a great many fossils, including many skulls and partial skeletons. Of the second locality, Douglass writes, "only two specimens were obtained, a *Colodon* and an apparently new rodent."

Unfortunately, the fauna collected from these localities was never described in its entirety. Douglass described four species ot *Ictops* and tentatively listed twelve mammalian genera from these beds. Burke (1936, 1938) described two new species of rodents from the material at Carnegie Museum, but apparently the rest of the material has never been specifically determined.

Although Douglass recognized a sequence of beds "more than seven hundred feet in thickness" and apparently located some of the fossils stratigraphically, his notes on these locations have never been found. The genera which he tentatively listed for McCarty's Mountain could indicate a sequence representing part or all of the Oligocene. Wood *et al.* (1941) write of this area, "McCarty's Mountain,

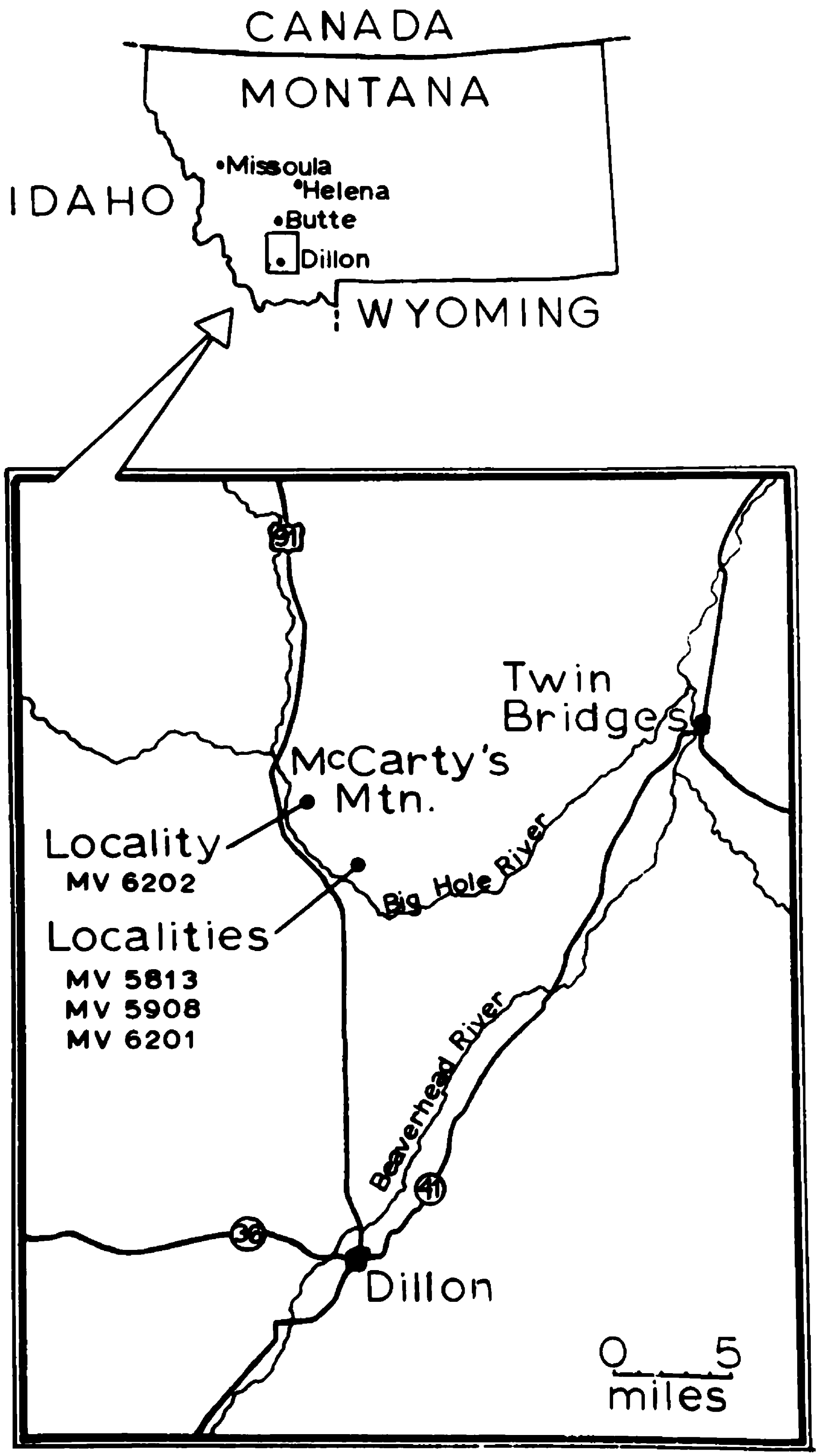

Figure 1. Index map of McCarty's Mountain vertebrate fossil localities.

Figure 2. Panorama of the south side of McCarty's Mountain, Montana.

so far as available knowledge goes, is merely a locality term for Oligocene exposures on its slopes or at its base . . . . much or all of the Oligocene may be represented."

Thus, the exact age and relationship of these exposures has remained unknown. The purpose of the present study is to attempt to correlate the fauna of McCarty's Mountain with other faunas of known age.

LOCATION

The first locality mentioned by Douglass is an area of badlands located in Madison County, Montana, north of the Big Hole River. It is 16.5 miles north of Dillon in Sec. 28, T. 4 S., R. 8 W. (figures 1 and 2). The area is easily accessible from a secondary dirt road on the north side of the Big Hole River which connects with State Highway 41 on the east and U. S. Highway 91 on the west. This locality is approximately 1/4 mile long and slightly less than 1/4 mile in width. The area is divided into three Montana State University vertebrate localities, M.V. 5813, M.V. 5908, and M.V. 6201 (plate 2, in folder). Throughout this paper these three locality numbers will be grouped and referred to as the main locality.

The second locality which Douglass mentions is 2.7 miles northwest of the main locality in Secs. 23 and 24, T. 4 S., R. 9 W. This locality consists of several closely spaced outcrops, none of which is more than 150 feet in diameter. Because the material from these outcrops is very fragmentary, they have been grouped together as Montana State University vertebrate locality M.V. 6202 (plate 1, in folder).

PRESENT STUDY

Field work for this study was conducted during the summer of 1962. Preparation and preliminary identification of the fossil material was accomplished during the following months and the report completed during the summer of 1963.

Because the exact location of much of the material previously collected was unknown and thus of no stratigraphic value, it was necessary to recollect the entire stratigraphic sequence. At the outset it was understood that this would be a difficult task because the main locality has been frequented by many collectors since its discovery. In order to establish stratigraphic control on all material discovered, a grid system was used to locate each fossil which might be identifiable. This method guaranteed complete coverage of all surface exposures and was rewarded by the discovery of a substantial fauna including several nearly complete skulls.

The only available maps of the area were incomplete U. S. G. S. topographic maps of the Willis 1-N. E. and Willis 1-N. W. quadrangles. In order to locate each fossil exactly, the area of the main locality on the Willis 1-N. E. quadrangle was enlarged to a scale of 1 inch equals 234 feet. The location of each fossil was then plotted on this larger scale map (plate 2, in folder).

A reconnaissance was made of the area surrounding the fossil localities and a general geologic map of the area was drafted (plate 1, in folder). The exposed geologic section at the main locality was measured and sampled. Thin sections were cut and analyzed from six of the rock samples in the section.

The following abbreviations have been used in this paper:

A. M. N. H.	- American Museum of Natural History
C. I. T.	- California Institute of Technology Museum
C. M.	- Carnegie Museum of Pittsburg
M. S. U.	- Montana State University Museum of Vertebrate Paleontology
M. V.	- Montana Vertebrate Locality.
P. V.	- Princeton University Museum
S. D.	- South Dakota School of Mines Museum
U. S. N. M.	- United States National Museum
mm	- Millimeters All measurements unless otherwise specified are given in millimeters. Tooth measurements are taken at alveoli.

ACKNOWLEDGEMENTS

It is a pleasure to acknowledge the advice and encouragement of Dr. R. W. Fields, who suggested the problem and aided in the support of summer field work through N. S. F. grant G9375. I thank Doctors J. Hower and F. Wright for their comments and criticisms of the manuscript. I am also grateful to the other members of the faculty for their interest in the project and to Mr. W. D. Kuenzi for valuable discussion and argument.

I also wish to thank the staff of the South Dakota School of Mines Museum for their hospitality and permission to examine specimens.

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GEOLOGY

GENERAL FEATURES

McCarty's Mountain is located in the Northern Rocky Mountain Physiographic Province (Alden, 1953). This province is characterized by deeply dissected mountain uplands separated by intermontane basins. T. 4 S. and T. 5 S., R. 8 W., including the main fossil locality, were mapped by H. S. Gale in 1913. The report of this mapping was published by J. T. Pardee (1925).

In the present study, no attempt was made to do detailed areal geology. The geology published by Pardee was checked and a geologic reconnaissance conducted over the unmapped area separating the fossil localities. The contacts mapped by Gale, in the vicinity of the main locality, were not accurate and have been relocated on the geologic map of this area included at the end of this report (plate 1).

Closely folded and faulted Paleozoic and Mesozoic sedimentary rocks outcrop to the east and northeast of the main fossil locality. They range in age from Mississippian (Madison limestone) to Cretaceous (Colorado? formation). The exposures are excellent and the major structures are well defined on aerial photographs. A detailed section of these rocks was measured and described by Gale (Pardee, 1925). Immediately east of the main locality is the west limb of a north plunging anticline. The rocks, sandstones and varicolored shales of the Cretaceous Kootenai formation, dip at 50° toward the west and beneath the Lower Oligocene sediments of the main locality.

Another area of steeply dipping Kootenai sandstones and shales occurs at the westernmost fossil locality, M.V. 6202. Here, the strata strike N 15° W and dip 55° southwest.

Directly north of the main locality and trending north-south is a porphyritic andesite sill. The fresh rock is dark gray to brownish-black and contains phenocrysts of plagioclase feldspar. Upon weathering, the rock becomes a deep red to reddish-brown (figure 6). A "baked" zone in the Cretaceous rocks extends outward about ten feet from the sill. The emplacement of the sill occurred after folding of the Cretaceous sediments since it is not involved in the folding to the east. Its relationship to the other igneous rocks in the area is not clear. Gale, however, mapped a cross-cutting relationship with quartz monzonite five miles north, in which the andesite is cut by the quartz-monzonite discussed below. The outcrop of the sill ends abruptly at the northern edge of the Tertiary outcrop, but presumably continues beneath.

The main mass of McCarty's Mountain, northwest and north of the area of this study, is an isolated quartz-monzonite stock related to the Boulder batholith, part of which forms the core of the Highland Mountains to the north. According to recent potassium-argon age determinations (Knopf, 1957), the emplacement of the Boulder batholith and related stocks occurred late in the Cretaceous. This date is somewhat questionable since the batholith is known to be a composite structure.

Surrounding the stock is a zone in which contact metamorphism has altered the sedimentary rocks. On the map accompanying this report, these rocks have been classified as undifferentiated metamorphics. They appear to be largely quartzites and argillites in the area mapped, which is about a mile from the intrusion.

The Lower Oligocene rocks of the fossil localities lie unconformably on the late Cretaceous? intrusives and older sedimentary rocks and are in turn overlain unconformably by Pliocene? gravels. As shown on plate 1, these fossiliferous beds outcrop as widely scattered patches on a broad area of benchland. The beds at these outcrops dip from 30 - 50°. It is almost certain that similar beds underlie the intervening area, but the slopes of the arroyos are debris and grass covered and there are no outcrops other than those of the overlying gravels.

The gravels which overlie the Lower Oligocene beds are well consolidated (figure 3). The unit varies in thickness from 10 - 15 feet. Pebbles, cobbles, and boulders in the gravel are well rounded and primarily composed of igneous and

Figure 3. Pliocene? pediment gravels unconformably overlying sedimentary tuff.

metamorphic rock. The finer matrix consists of sand and clay which is probably reworked from earlier Tertiary sediment. The gravel unit dips about 5° toward the south.

The gravel appears to represent an alluvial veneer associated with a pediment surface. This ancient pediment surface, now dissected, is still apparent from figure 2. The truncated and dipping beds of the Kootenai formation and Lower Oligocene protrude through the gravel. Similar deposits occur in nearly all the basins of Southwestern Montana, but their relative age is still questionable. Only a few fragments of bone were found in the gravel at McCarty's Mountain. Fields and Kuenzi (personal communication), working in the Jefferson River Valley to the north, have found teeth of Pliohippus in similar gravels. Freeman, Ruppel, and Klepper (1958, p. 512) have questionably referred similar gravels in the Townsend Valley to Late Pliocene. The gravels at McCarty's Mountain are questionably placed as Pliocene on the map accompanying this report.

Recent fan gravels extend out from McCarty's Mountain and partially bury the pediment surface.

LOWER OLIGOCENE FOSSIL BEDS

Structure

The Lower Oligocene rocks of the main locality are folded and faulted. At the most southwesterly outcrops, the beds strike N 10° W and dip 30° SW. At the northern limit of the outcrops, the beds strike N 75° W and dip 43° SW. Several intermediate strikes and dips were recorded in the intervening strata. Much of the area, however, is debris and grass covered and the bedding is poorly developed. Therefore, it was not possible to determine the extent of faulting involved with the folding. Numerous minor faults containing calcite occur in the rocks at the northernmost exposures, but it is unlikely that any major fault movement has occurred within the Oligocene strata of this locality.

The rocks of the largest exposure at locality M.V. 6202 strike N 55° W and dip 50° NE. The smaller outcrops have a similar attitude.

There can be little doubt, from the above strikes and dips, that local faulting has been active in post-Lower Oligocene time. Gale mapped many thrust faults in the Paleozoic rocks to the east. Undoubtedly similar faults are present in the Cretaceous rocks beneath the Lower Oligocene beds. The faulting in this area occurred before the Pliocene? gravels were laid down since they have not been involved in the faulting.

Stratigraphy

The Lower Oligocene rocks of McCarty's Mountain can grossly be called sedimentary tuff following the terminology for pyroclastic rocks proposed by Wentworth and Williams (1939).

> Sedimentary Tuff - A tuff containing a subordinate amount of sediment introduced either during or after deposition.

The sedimentary tuff occurs as porrly defined beds and lenses 10 inches to 10 ± feet thick. A section measured at the main locality shows that at least 1200 feet of sediment and ash was deposited before the beds were tilted. This sequence was measured assuming that no significant faulting occurs in the covered areas.

No obviously different units were observed which might aid correlations with other rocks within this or adjoining basins. The bedding for the most part is difficult to see because the lithology of the rock everywhere appears nearly uniform.

Nodules are common throughout the sequence. The longest axis of the nodules varies from 4 ± inches to two feet (figure 4). Many of the fossils were found within these nodules and must have acted as nuclei in their formation.

Several distinct stream channels occur in the sedimentary sequence. These show poorly developed graded bedding and crossbedding (figure 7). Boulders of red-weathering andesite over a foot in diameter were found within some of these channels (figure 8). The trend of the channels is approximately north-south indicating that the source of the andesite boulders was the sill outcropping only a few hundred feet away. Most of the other fragments are of crystalline igneous and metamorphic rock. These channels are most abundant near the base and at the top of the measured section.

The fine-grained sedimentary tuff, comprising the bulk of the sediment, was examined in thin sections made from samples taken at 180 feet, 390 feet, 780 feet, and 1140 feet above the base of the section. No noticeable differences were observed. The tuff is composed primarily of partially altered shards of volcanic glass with quartz grains, plagioclase, calcite and iron oxides in a clay matrix. The clay matrix, identified by Mr. T. Mowatt using x-ray diffraction, is montmorillonite. The color of the sedimentary tuff, which is due largely to the clays, varies from light buff to light gray.

Figure 4. Nodules in the sedimentary tuff.

Figure 5. Blocky weathering of sedimentary tuff.

Figure 6. Red-weathering andesite sill directly north of main locality.

Figure 7. Stream channel within sequence of sedimentary tuffs.

Figure 8. Red-weathering andesite boulders in stream channel.

Weathering produces a cracked surface to the sedimentary tuff (figure 5). This is due to the alternate swelling of montmorillonite when it is wet and subsequent shrinkage when dried. Many of the fossils are virtually exploded in this process. The calcite cement present in fresh samples becomes leached during the weathering process.

Visual inspection showed no significantly different continuous units. In an effort to find some correlative feature in these beds, two other approaches were attempted. The first of these was an attempt to determine the index of refraction of the volcanic glass. The glass shards are badly altered, however, and the oil immersion technique was unsatisfactory for any precise results.

The second approach was an analysis of the iron content of the rock using the x-ray spectrograph. The percent of iron present in six samples from the main locality and two from locality M.V. 6202 were determined by Dr. J. Hower and are presented in table 1. The generally high iron content of the tuffaceous sediments indicate that the original ash was andesitic. It is doubtful, however, that this method can be used for correlation purposes within the basin since the iron content would vary greatly with local environmental conditions. For example, the highest percentage of iron in the eight samples is found in a gray lenticular unit near the middle of the section. This high iron content very likely represents a high organic content in the original sediment. This content could be expected to vary widely over the basin and it would be significant only as an indication of the immediate environment of deposition.

Table 1

Iron content of sedimentary tuff in percent

Main Locality		M.V. 6202	
Location in feet above base of section	Percent Iron		Percent Iron
150	6.2	Sample from largest outcrop	9.0
330	7.6	Sample from small outcrop	7.6
600	6.6		
660	10.4		
840	5.5		
1110	5.3		

Environment of Deposition

A question of long standing concerning these and the many other Tertiary rocks in the region is whether the sediments were deposited in a lake or by streams meandering on a floodplain. The early surveys in the area mapped almost all of these beds as "lake beds." Douglass (1889) expanded this view and stated that "these fresh water lakes filled the valleys and at some time east of the main divide, left only the tops of the mountains standing as islets, long islands, and peninsulas in the waste of waters." Because Oligocene and Miocene sediments are found in the area at elevations high above the present-day basin floors, Douglass assumed that the lake was very deep and extensive. For example, as Cook (1960, p. 207) points out, Miocene exposures occur on the Continental Divide near Bannack Pass at an elevation above 7,500 feet. These Miocene deposits also crop out in the valleys on either side at much lower elevations. In the Gravelly Range, southeast of McCarty's Mountain, early Oligocene sediments occur at 10,200 feet (Mann, 1954). It is now generally recognized, however, that this is not the original site of deposition. Widespread, but erratic, uplift and faulting during the Late Tertiary have been used to account for the location of these beds (e.g. Cook, 1960).

There is still ample evidence for the occurrence of Oligocene lakes in at least two basins of Southwestern Montana. Fish fossils, fresh water gastropods, and paper shales containing plant impressions occur in the Douglass Creek Basin (Konizeski, 1961). These lakes, however, were shallow and local. The vast deep lake pictured by Douglass very likely never existed during the Tertiary period in Western Montana.

There is reason to believe that the sediments at the McCarty's Mountain localities are in part paludal and in part fluvial in origin.

The channels mentioned above are unquestionably fluvial deposits and, because of the rock type, size of the boulders, and trend of the channels, very likely represent minor streams entering the basin. No channels representing a major stream are found in these outcrops.

As in the White River sediments of South Dakota, fragments of bone are found which show gnawing by rodents. This could hardly have taken place in a lake. The bones are not water-worn which indicates that they were gnawed by rodents and then buried in place. This could occur on the marshy edge of a lake or on the floodplain of a river.

A species of Helix, not unlike those occurring today, was taken from one of the outcrops. This is a terrestrial gastropod which might favor the marshy edge of a lake or a floodplain, but would not be found within a lake unless it had been transported.

The occurrence, in close proximity, of a skull, lower jaw, part of a femur and most of a left tibia and pes of Oreonetes anceps is one of the best arguments for an environment at a lake edge or on a floodplain rather than beneath the waters of a lake.

The elements of the pes were found in their respective positions and were joined to the tibia indicating that the flesh was still present when the limb was buried. The lack of any of the bones between the skull and the left posterior limb indicates that the animal was dismembered, very likely by a carnivore or scavenger, immediately before burial. If the carcass had been transported into a lake, it would be very difficult to account for these extremities remaining together without the intermediate parts of the animal.

The fragmentary nature of the fossils at these localities also argues against deposition in a lake. It seems logical to assume that, if parts of animals were transported into a lake, the bones would show evidence of abrasion or, if they died in the waters at the lake margin, more complete specimens would be found.

The high iron content and color of the lenticular bed noted above as representing a high organic content of the original sediment is most easily explained as a small depression in which organic matter and ash were accumulating. However, if the organic matter were accumulating on a lake bottom, some evidence of this material such as the leaf impressions, twigs or fish fossils which occur in the lake sediments in the Upper Ruby and Douglass Creek Basins might be expected. No plant or lacustrine animal remains have been found in any of the beds at this locality.

If the deposition of these sediments occurred on a floodplain, one might expect that the floodplain contained trees, shrubs and other vegetation and that the bedding planes would be very irregular presuming that the sediments were deposited during times of flood. Many of the bedding planes are indistinct, but those which can be traced are relatively straight and show no disruption by roots.

The above information neither proves nor disproves the occurrence of a lake within the basin during Lower Oligocene times. It does, however, indicate that the environment in which the sedimentation took place was not continuously covered by water as in a lake. If a lake existed, the sediments recorded here formed on the marshy border. It is difficult to visualize a lake whose margin remained approximately in the same place while 1200 feet of sediment was deposited at the margin by alternate rise and fall of the lake level. Therefore, from the evidence presented above, the following condition seems most probable:

McCarty's Mountain Lower Oligocene sediments were deposited on a floodplain. The watertable must have been very near and in places above the surface providing conditions too moist for large trees, but suitable for shrubs and other low vegetation. Frequent and widespread flooding of the floodplain by sluggish streams took place. The flooding could be the result of rainfall or could be caused by faulting and/or plugging of the watercourses by lava and ash from the widespread volcanic activity in the area as postulated by Pardee (1950), Freeman, Ruppel, and Klepper (1958), and Mann (1954). The lower and upper beds in the measured section were deposited at the basin margin as indicated by the very large boulders of andesite brought into the sediment by swift-flowing small tributary streams. The lack of channels in the middle beds could indicate that the margin of the basin had shifted and the area of deposition was no longer at the edge of the basin. Renewed faulting might explain the reoccurrence of tributary channels in the upper beds. However, the lack of any unconformity within the sequence argues against this interpretation. If faulting occurred in the area during accumulation of the sedimentary tuffs, the site of deposition remained essentially horizontal. Other factors such as amount of rainfall and rapidity of deposition must have had an effect, but cannot here be taken into account. Thus, little can be said of the relief of the area surrounding the basin from this study.

FAUNAL CENSUS AND CORRELATION

The McCarty's Mountain fauna existed during the Chadronian provincial age. Wood *et al.* (1941, p. 11) define this provincial age as the time during which *Mesohippus* and titanotheres co-existed. Both are found at McCarty's Mountain.

While placed by Wood's definition in the Chadronian provincial age, certain features of the fauna allow a more precise correlation to be made. Table 2 is a census of the fauna identified in the present study at McCarty's Mountain. Included in this table are the numbers of the identified specimens of each genus and species. The stratigraphic location of each specimen number is given in plate 2 (in folder).

A review of this assemblage indicates relationships to Late Eocene and Early Oligocene faunas. For example, *Colodon kayi?* bears close resemblance to the species described from the Upper Eocene Sage Creek beds. *Leptomeryx cf. minutus* is very likely the same as the specimen of this species described by Peterson from the Duchesne River Eocene fauna. *Leptomeryx cf. blacki* is almost certainly the same species as the mandible described from the Titus Canyon fauna which Stock (1949) has assigned to basal Oligocene. *Ardynomys* is known only from the Early Oligocene of Mongolia.

Table 2

Faunal Census with Specimen Numbers

Peratherium titanelix?	0788
Ictops acutidens	0873 - 0888 - 0921 - 0780 - 0798 - 0787
Ischyromys pliacus	0936 - 0932 - 0933 - 0866
Ardynomys occidentalis	0740 - 0746 - 0741 - 0923
?Ardynomys occidentalis	0799 - 0929
Cylindrodon fontis	0935 - 0783
Cylindrodon aff. fontis	0764 - 0882 - 0800 - 0872 - 0766 - 0920 0552 - 0865
Pseudocylindrodon aff. medius	0927 - 0360 - 0361 - 0758 - 0747
Protoptychus? sp.	0556

Table 2 (Continued)

Faunal Census with Specimen Numbers

Parajidaumo minor	0551 - 0791
Paleolagus temnodon	0790 - 0862 - 0553 - 0362 - 0785 - 0918 0767 - 0769 - 0792 - 0786
Parictis cf. dakotensis	0886
Caenopus sp.	0772
Subhyracodon?	0774 - 0889 - 0328 - 0864 - 0883 - 0355 0878 - 0357
Brontotheriidae	0887 - 0930
Mesohippus sp.	0761 - 0919 - 0924 - 0875 - 0781 - 0356
Colodon? cingulatus	0877 - 0876 - 0879 - 0914 - 0871 - 0868
Colodon cf. kayi	0939
Oreonetes anceps	0784 - 0912 - 0762 - 0797 - 0759 - 0777 0917 - 0775 - 0863 - 0928 - 0364 - 0771 0789 - 0776 - 0867 - 0329 - 0782 - 0354 0763 - 0555 - 0869 - 0744 - 0890 - 0743 0779 - 0918 - 0931 - 0752 - 0796 - 0916 0870
Limnetes platyceps	0937 - 0938 - 0768 - 0915 - 0793
Leptomeryx cf. blacki	0880 - 0881 - 0934 - 0363 - 0756
Leptomeryx cf. minutus	0742

The stratigraphic position of two of these fossils precludes the possibility that these beds extend into Orellan time. A titanothere femur was discovered in outcrop at approximately 900 feet above the base of the section and a mandible of *Cylindrodon* was found at 1100 feet above the base. The range of these two forms is, as far as known, restricted to the Chadronian provincial age.

Chadronian faunas have been collected from other basins in Western Montana. Two local faunas with significant faunal lists are Thompson Creek and Pipestone Springs. A comparison of parts of these faunas with specimens collected from McCarty's Mountain is given in table 3. In the table, an X indicates that the same species is present. If the species is not the same, the name of the different, but closely related species, is given.

There can be little doubt that these faunas are closely related in time. The presence of some species at one locality but not at another might be due to environmental differences or to the accidents of collecting or describing.

Only two species were identified from locality M.V. 6202, *Colodon cf. kayi*, M.S.U. 0939, and *Ardynomys occidentalis*, M.S.U. 0740. *C. cf. kayi* has not been found at the main locality. *A. occidentalis*, however, occurs at both localities and indicates a close time relationship between the two. Lithologically, the beds of M.V. 6202 resemble the beds from the main locality and are here considered as essentially the same.

The fauna of McCarty's Mountain is equal, or very nearly equal, to Pipestone Springs and Thompson Creek faunas and is referred to the basal Oligocene. No faunal evidence indicating Orellan age was found in the McCarty's Mountain sediments.

Table 3

Comparative Lists of Early Oligocene Faunas from Southwestern Montana

McCarty's Mountain	Pipestone Springs*	Thompson Creek*
Peratherium titanelix?	X	
Ictops acutidens	X	
Ischyromys pliacus	X	
Cylindrodon fontis	X	X
Pseudocylindrodon	X	
Parajidaumo minor	X	
Paleolagus temnodon	X	X
Parictis cf. dakotensis	*P. dakotensis*	
Caenopus sp.		
Colodon? cingulatus	*Colodon sp.*	*Colodon sp.*
Oreonetes anceps		X
Limnetes platyceps	*Limnetes sp.*	X

*Taken from "Guidebook of Eighth Field Conference, Society of Vertebrate Paleontology, Western Montana," 1958, Edited by R. Fields, Mont. State Univ. Press

PALEOECOLOGY

The assemblage of fossil mammals collected for this study is not of sufficient size or completeness to warrant definite statements as to the habitats of these animals during their existence. Nevertheless, several suggestions seem worthy of mention.

Konizeski (1961), using both plant and animal fossils as evidence, described the Early Oligocene biota of Douglass Creek Basin approximately 90 miles north of McCarty's Mountain. According to Konizeski, a moist, temperate climate with seasonal variations prevailed. Two major botanical assemblages are indicated, a lowland-lake border association and an upland coniferous forest.

Becker (1961), in his discussion of the Upper Ruby Basin, approximately 40 miles southeast of McCarty's Mountain, recognized five major contemporaneous Middle Oligocene floral habitats. His studies were based mainly on the many fossil plants found in the basin. The five floral habitats are lake, shore, floodplain, upland, and mountain slope. In general, the high mountain slopes supported a coniferous or mixed forest, the lower slopes a deciduous forest, the riparion environment a deciduous forest with many climbing plants and the marshy lake shore a flora of ferns and grasses.

A xeric element was also recognized in the flora. Becker attributes this to a xeric woodland association with a strong admixing of desert scrub. From his study, he suggests that, during the Middle Oligocene, precipitation was greater than at present and temperatures were somewhat warmer and lacked present day extremes.

He also suggests that the elevation of the basin was lower, but relief of the area greater than in the Ruby Basin today.

Both Becker and Konizeski indicate that the topography during the Oligocene was not greatly different from that now present in Southwestern Montana. If this is true, it may be possible at a later date to determine which animals inhabited these botanical environments by using the approach presented by Shotwell (1955). The basic assumption used in Shotwell's faunal interpretations is that the number of individuals present in a fossil quarry varies in direct proportion to the distance of their habitat from the site of deposition. Unfortunately, the M. S. U. sample of the Early Oligocene fauna at McCarty's Mountain is not sufficient to apply the quantitative approach. It is hoped that, at a later date, this collection can be combined with the Carnegie Museum collection and that the quantitative approach can be used to interpret the relationships of the animals present in these floral environments. Such an analysis is beyond the scope of the present problem. A few generalities can be made, however, using knowledge of present day animal populations and using the basic assumption of Shotwell's statistical approach to paleoecology.

Only four species of tapirs now exist. Three species of these solitary animals occur in Central or South America and the fourth in Southeast Asia. They are found generally where conditions are warm and water is plentiful. It is not unlikely that the tapiroids of the Early Oligocene had much the same habit and environment. They are uncommon fossils and the number found at McCarty's Mountain is unusually large in relation to the size of the collection. This would seem to indicate that these animals inhabited the area immediately surrounding the site of deposition. Since these sediments were deposited at the basin margin, two environments are possible as habitats; the floodplain or the land immediately above the floodplain. The present day tapirs favor the river bottomlands. Very likely the Oligocene tapiroids were also bottomland dwellers.

Little is known of the habits or environment of *Oreonetes anceps*, but because of the quantity of specimens collected, this animal also very likely inhabited the bottomlands. *Limnetes platyceps*, on the other hand, is very poorly represented. This could mean that the animal occurred in very limited numbers, but it is more likely that *L. platyceps* lived in the deciduous forests of the lower mountain slopes and frequented the area of deposition only occasionally.

The presence of only one carnivore in the collection is surely due to the accidents of preservation or collection. Undoubtedly numerous carnivores preyed on the many herbivores living in the region and contributed to the fragmentary nature of the herbivores in the assemblage.

The semi-hypsodont cheek teeth of the cylindrodont rodents could indicate that they inhabited the more arid open woodlands where Becker suggests the xeric and coarser vegetation was found. The benchlands bordering the river bottoms are the most arid parts of the region today.

Paleolagus temnodon is the only leporid species present in the M. S. U. collection. This animal is well represented and very likely lived in the bottomlands environment as do the marsh rabbits of today.

Mesohippus, *Leptomeryx*, and the brontotheres are poorly represented in the

M. S. U. collection. These animals are apparently well represented in the Carnegie Museum collections, however, and no environmental significance is assumed from the number of M. S. U. specimens.

Living rhinoceroses are found in a variety of environments ranging from grassland to swamps. Little can be said of the environment of the extinct forms present at McCarty's Mountain.

DESCRIPTION OF FAUNA

Class MAMMALIA

Order MARSUPIALIA

Family DIDELPHIDAE

Peratherium titanelix? Matthew

M. S. U. 0788, part of a left mandible with M_4, is the only representative of the marsupials in the Montana State University collection. In size this specimen agrees with *Peratherium titanelix* which Matthew (1903, p. 202) described from Pipestone Springs, Montana. The diagnostic premolars are not present, however, so the specimen is questionably referred to this species.

Order INSECTIVORA

Family LEPTICTIDAE

Ictops acutidens Douglass

M. S. U. 0921, a partial skull with mandibles attached; M. S. U. 0888 a slightly crushed skull with right P^3 - M^3; M. S. U. 0780, part of a skull from the post-orbital constriction to the occiput; M. S. U. 0798, the badly weathered anterior part of a skull; M. S. U. 0873, a fragmentary mandible with one molar; and M. S. U. 0787, part of a right mandible with $M_{\bar{4}}$ are referred to Douglass' first described species of *Ictops.* Douglass (1901, p. 245) based this species on material collected from Pipestone Springs. Matthew (1903, p. 207) named a second species, *I. thomsoni,* from the same locality and Douglass (1905, pp. 212-223), in a later publication, named *I. intermedius, I. montanus, I. tenuis,* and *I. major* from McCarty's Mountain.

After reviewing the descriptions of these species and comparing their measurements with the present material, it seems likely that the variations on which these species are based are within the limits of one species or at most two. A revision of this genus will likely place the five later named species as synonyms of *Ictops acutidens.*

It would be unwise to relegate the five species to synonomy without actually comparing the specimens in question. Therefore, no synonomy is listed in this paper. The specimens collected for this study, although overlapping several of the species named above in size, are referred to *Ictops acutidens.* The species is adequately discussed in the publications noted above.

Table 4

Comparative Measurements - *Ictops acutidens*

	M. S. U. 0921	M. S. U. 0888	M. S. U. 0780	*Holotype C. M. 36
Posterior length of skull from $M^{\underline{1}}$	28.0	30.0		
Width of skull at post orbital constriction	11.4	12.0	12.2	
Length, $M^{\underline{1}}$ - $M^{\underline{3}}$	6.6	6.8		
Length, $P^{\underline{3}}$		2.9		3.5
Width, $P^{\underline{3}}$		2.1		
Length, $P^{\underline{4}}$		2.6		3.3
Width, $P^{\underline{4}}$		2.8		3.3
Length, $M^{\underline{1}}$		2.3		3.0
Width, $M^{\underline{1}}$		3.1		3.8
Length, $M^{\underline{2}}$	2.3	2.2		2.2
Width, $M^{\underline{2}}$		3.7		4.2
Length, $M^{\underline{3}}$	1.8	1.8		1.5
Width, $M^{\underline{3}}$		3.0		3.0
Depth of mandible under $M_{\overline{3}}$	4.0			4.5
Length of lower molar series	8.1			8.5
Length, $M_{\overline{1}}$	2.8			2.5
Width, $M_{\overline{1}}$	2.0			

*Douglass, E., 1901, Trans. Amer. Philos. Soc., new ser., vol. 20, p. 245.

Table 4 (Continued)

Comparative Measurements - *Ictops acutidens*

	M. S. U. 0921	M. S. U. 0888	M. S. U. 0780	*Holotype C. M. 36
Length, $M_{\overline{2}}$	2.8			
Width, $M_{\overline{2}}$	2.0			
Length, $M_{\overline{3}}$	2.5			2.5
Width, $M_{\overline{3}}$	1.9			

*Douglass, E., 1901, Trans. Amer. Philos. Soc., new ser., vol. 20, p. 245.

Order RODENTIA

Family ISCHYROMYIDAE

Ischyromys pliacus Troxell

(Plate 3, figure 1)

M. S. U. 0866, a right mandible with $P_{\overline{4}}$ - $M_{\overline{3}}$; M. S. U. 0936, a left mandible with $P_{\overline{4}}$ - $M_{\overline{3}}$; M. S. U. 0933, a left mandible with $P_{\overline{3}}$ - $M_{\overline{1}}$; and M. S. U. 0932, a right mandible with $M_{\overline{1}}$ - $M_{\overline{2}}$ are large ischyromyid rodents which are comparable to *I. pliacus* in size. A peculiar feature of the molars on M. S. U. 0866, is a large cuspule located in the median valley and connected to the protoconid by a short spur. It is not present on the worn $M_{\overline{1}}$ of M. S. U. 0933 and probably is not of diagnostic value.

Family CYLINDRODONTIDAE

The cylindrodont rodents pose one of the most vexing problems of this study. This group constitutes the greatest part of the rodent fauna but assumes a bewildering array of variation in lophs, cuspules, degree of hypsodonty and position of mental foramina. At first, since a considerable thickness of sediment is present at McCarty's Mountain, I felt that these variations perhaps represented an evolutionary sequence. However, when the stratigraphic position of each specimen was checked, no such sequence was apparent. To the contrary, most of the cylindrodonts were found in a 50 foot stratigraphic interval near the middle of the section.

Before beginning a discussion of the variation within this group, a brief resumé of the nomenclature used in tooth description seems necessary. There is no consistency in the terminology employed in describing this group, which makes use of the literature exceedingly difficult. Figure 9 shows the terminology used in this paper. It is based on that given by Wood and Wilson (1936). No cusp homologies are intended.

Douglass (1901, p. 251) described *Cylindrodon fontis*, from specimens collected at Pipestone Springs, Montana, approximately 50 miles northeast of McCarty's Mountain. To this author's knowledge, this is still the only described species of *Cylindrodon*. Burke in 1935 (pp. 1-4) named a new genus and species, *Pseudocylindrodon neglectus*, from specimens previously included in *C. fontis*. Two more species of *Pseudocylindrodon* were later named, *P. medius* by Burke (1938, pp. 255-270) from specimens collected at McCarty's Mountain and

P. sylvaticus by Russell (1954, pp. 99-100) from a specimen in the Kishenehn fauna.

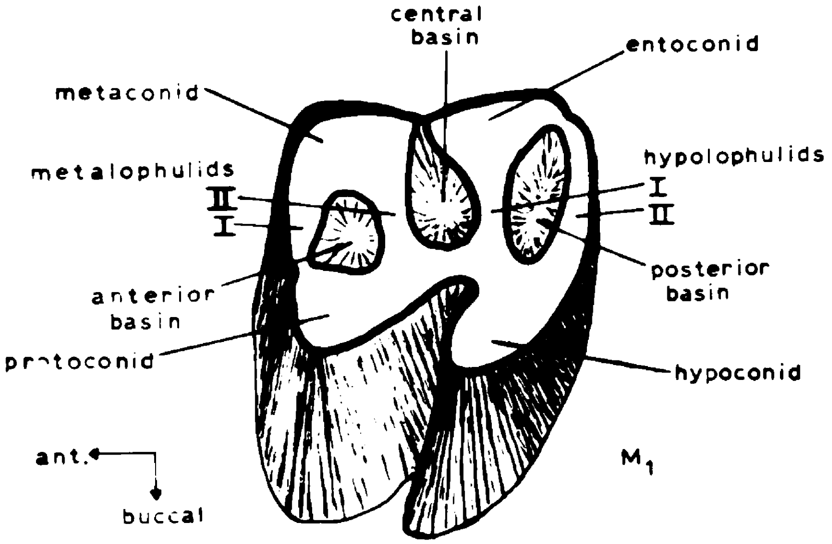

Figure 9. Tooth nomenclature used in description of cylindrodont rodents.

Of the material collected in the present study, one lower jaw is definitely identified as C. fontis and another questionably. Nothing attributable to P. sylvaticus, P. neglectus, or P. medius was found. Several of the mandibles have some features which agree with the descriptions of these species, but each mandible differs considerably in other features. One of the differences is the position of the mental foramen or foramina, a feature which has been considered diagnostic in the Cylindrodonts. In none of the specimens is the location found to be the same. Douglass described the mental foramen of *C. fontis* as small and situated above the middle of the jaw anterior to $P_{\overline{4}}$. (In his original figure, however, there are two mental foramina (Douglass, 1901, Plate IX, figure 9)). In *P. neglectus* there are two horizontally placed mental foramina beneath $P_{\overline{4}}$ (see Burke, 1935) and, in *P. medius*, two vertically placed mental foramina are anterior to $P_{\overline{4}}$ (see Burke, 1938). Their position in *P. sylvaticus* is not known. This information would seem to indicate that the more hypsodont *Cylindrodon* has one mental foramen and the more brachyodont *Pseudocylindrodon* has two. This is not true of the present specimens. Some of those which appear more hypsodont (presumably *Cylindrodon*) have one and others two mental foramina. The same condition occurs in the more brachyodont specimens (presumably *Pseudocylindrodon*). This situation is further complicated by the depth of the anterior, central and posterior basins on the occlusal surfaces of the cheek teeth. The basins are supposed to be deeper and closed in *Cylindrodon* and wider and partially or wholly open in *Pseudocylindrodon*. No such distinctions can be made of the present specimens.

If the criteria used to name the species of *Cylindrodon* and *Pseudocylindrodon* are used here, at least seven new species must be named. This is completely unrealistic in view of our present concepts of animal ecology wherein it is unlikely that a number of closely related species can exist at approximately the same time at the same place. It seems more probable that many of the features used in specific or even generic diagnosis by previous authors are based upon high individual variation.

For the purposes of this paper, the M. S. U. specimens are divided into two groups solely on the basis of crown height. Those which appear most hypsodont are included in *Cylindrodon* and those which appear more brachyodont are included in *Pseudocylindrodon*. Admittedly, this division is very questionable, but the types and referred specimens are not available for comparison at this time and the purpose of this paper would not be forwarded by any attempt at a revision of this group.

Cylindrodon fontis Douglass

(Plate 3, figure 2)

M. S. U. 0935, a left mandible with $P_{\overline{4}}$ - $M_{\overline{3}}$ and M. S. U. 0783, a left mandible with $M_{\overline{1}}$ - $M_{\overline{3}}$ are referred to *Cylindrodon fontis* on the basis of size, a cylindrodont crown pattern with an external-anteriorly protruding hypoconid, deep, rounded isolated basins and hypsodont appearing teeth. The mental foramen of M. S. U. 0935 is located below and slightly anterior to $P_{\overline{4}}$. Scott and Jepsen give a more complete description of the species (1940, part 11, pp. 199-204).

Cylindrodon *aff.* *fontis* Douglass

M. S. U. 0882, a right mandible containing only $M_{\overline{3}}$, compares to *C. fontis* in size. The depth of the central basin of $M_{\overline{3}}$ also agrees with that of *C. fontis.* $M_{\overline{3}}$, however, does not have oblique implantation to the extent seen in *C. fontis* and the posterior and central basins are not isolated by hypolophulid I as in *C. fontis.* In its place a small spur from the hypoconid connects with a cuspule located in the coalesced central and posterior basins.

Two partial right mandibles, M. S. U. 0865 with $P_{\overline{4}}$ - $M_{\overline{3}}$ and M. S. U. 0872 with $M_{\overline{1}}$ - $M_{\overline{2}}$, are nearly the same and are here described together. The central and posterior basins of the molars are only partially closed internally. Metalophulids I and II are complete, closing the exit of the anterior basin. Hypolophulid I is complete, but hypolophulid II does not extend completely around the posterior edge of the crown to the entoconid, thus leaving the posterior basin open with the exit somewhat higher than the basin floor. $P_{\overline{4}}$ of M. S. U. 0865 is worn, but agrees generally with the description of the molars. The protoconid and metaconid are much closer than in the molars, however, and the anterior basin is open anteriorly. One mental foramen is present on M. S. U. 0872 and placed anterior to and below $P_{\overline{4}}$.

A right mandible, M. S. U. 0766, with $P_{\overline{4}}$ - $M_{\overline{3}}$ is slightly smaller than *C. fontis* and about the size of *Pseudocylindrodon neglectus.* The crown pattern of $P_{\overline{4}}$ compares with *Pseudocylindrodon* more than with *Cylindrodon*. The hypoconid is not drawn out posteriorly, a characteristic of *P. medius,* and leaves the external basin broadly open. A cuspule, such as that found in the holotype of *P. neglectus,* is present in the outlet of the external basin. $P_{\overline{4}}$ thus resembles *C. fontis* in hypsodonty, *P. medius* in the lack of a drawn out hypoconid and *P. neglectus* in the presence of a cuspule at the outlet of the external basin. The central and posterior basins of this tooth are partially coalesced, but the entoconid is drawn out transversely so that two distinct basins can be recognized.

Metalophulid I is present on the molars, but metalophulid II is represented only as a spur from the protoconid. The small anterior basin thus formed opens into the central basin, but disappears with slight wear. The central basin is open internally, but the exit is slightly higher than the basin. The posterior basin is closed. There are two mental foramina placed horizontally beneath $P_{\overline{4}}$.

Table 5

Comparative Measurements - *Cylindrodon fontis* and *C. aff. fontis*

	Montana State University									* Holotype
	0935	0783	0882	0865	0872	0766	0764	0920	0552	C.M. 38
Diastema							2.9			
Depth of ramus under $M_{\overline{1}}$	5.9	6.0	5.7±	5.5±	5.3±	4.8±	6.0±			
$P_{\overline{4}} - M_{\overline{3}}$	7.6			8.0		6.8	7.9±		7.5	7.6
$M_{\overline{1}} - M_{\overline{3}}$	5.7	5.8		5.8			5.7		5.6	
Length, $P_{\overline{4}}$				2.0		1.6			1.9	2.0
Width, $P_{\overline{4}}$				2.1		1.6			1.9	2.1
Length, $M_{\overline{1}}$		1.9		1.9	1.9	1.8	1.9		1.9	2.1
Width, $M_{\overline{1}}$		2.0		2.0	2.0	1.8	2.1		2.0	2.2
Length, $M_{\overline{2}}$		2.0		2.0	1.9	1.9	2.0	1.9	1.9	2.1
Width, $M_{\overline{2}}$		2.0		2.0	2.0	1.9	2.2	2.0	2.1	2.2
Length, $M_{\overline{3}}$		1.9	2.0	1.9		1.7	1.8	1.8	1.8	1.4
Width, $M_{\overline{3}}$		1.7	1.8	2.0		1.8	1.7	1.7	1.6	1.5

*Douglass, E., 1901, Trans. Amer. Philos. Soc., new ser., vol. 20, p. 251.

M. S. U. 0764, a right mandible containing $M_{\overline{1}}$ - $M_{\overline{3}}$ and M. S. U. 0920, a mandibular fragment containing $M_{\overline{2}}$ - $M_{\overline{3}}$ differ from *C. fontis* in having wider and shallower central basins on the molars. The anterior basin of $M_{\overline{3}}$ is very shallow and opens into the central basin. The masseteric fossa is deeper and the ridges bordering it are more prominent than on the mandible of *C. fontis*, M. S. U. 0935. There are two mental foramina placed horizontally beneath and anterior to $P_{\overline{4}}$.

M. S. U. 0552, a right mandible containing $P_{\overline{4}}$ - $M_{\overline{3}}$ differs in a number of respects from *C. fontis* and the other semi-hypsodont specimens thus far described. The floor of the posterior basin of $M_{\overline{1}}$ is divided into three circular basins by anterior-posterior ridges between hypolophulids I and II. On $M_{\overline{2}}$ this same condition exists with the addition of a prominent cuspule on each ridge where it joins hypolophulid II. The central basin of $M_{\overline{2}}$ also has an anterior-posterior ridge creating two basins. The posterior basin of $M_{\overline{3}}$ has only one anterior-posterior ridge and it is not as well developed as in the other two molars. In addition, metalophulid II of $M_{\overline{3}}$ has a prominent cuspule located on the internal side of the protoconid. There are two mental foramina placed obliquely beneath $P_{\overline{4}}$.

Pseudocylindrodon aff. medius Burke

(Plate 3, figure 2)

The five mandibles described below are more brachyodont than the specimens described under *Cylindrodon*. They also appear to be older, however, which could account for the fact that the tooth enamel does not extend below the alveoli.

M. S. U. 0360, a left mandible containing $P_{\overline{4}}$ - $M_{\overline{2}}$, is very badly weathered and cannot be adequately described. The most significant part of the jaw is the masseteric fossa which is very deep with unusually pronounced ridges bordering the fossa. The ridges meet below the posterior border of $M_{\overline{1}}$ creating a wedge-shaped protrusion. The two mental foramina are placed obliquely beneath and anterior to $P_{\overline{4}}$.

M. S. U. 0748, a left mandible, is also badly weathered and contains only tooth fragments. The masseteric fossa is characterized by the same prominent ridges forming a wedge-shape as in M. S. U. 0360.

M. S. U. 0747, a left mandible containing $P_{\overline{4}}$ - $M_{\overline{3}}$ is the most complete specimen of this group. $P_{\overline{4}}$ is not unlike some of the specimens described under _Cylindrodon_. The anterior basin of this tooth opens anteriorly, but is barely discernible due to wear. The central basin is open externally. $M_{\overline{3}}$ has coalesced central and posterior basins with a cuspule located on the external side of the larger basin. The ridges bordering the masseteric fossa are not as prominent as in M. S. U. 0360. The anterior dorsal ridge rises at a higher angle than in that specimen. The mental foramina are positioned vertically beneath and anterior to $P_{\overline{4}}$ and are very closely spaced.

M. S. U. 0758 is a right mandible containing worn $M_{\overline{1}}$ - $M_{\overline{2}}$. The anterior dorsal ridge rises at about the same angle as in M. S. U. 0747. The two mental foramina are located obliquely beneath $P_{\overline{4}}$ and are widely separated.

M. S. U. 0927, the anterior portion of a skull with the teeth intact is similar to the skull described as _P. medius_ by Burke (1938, pp. 255-270). M. S. U. 0927 is slightly larger and the length to width ratio of the cheek teeth is less.

Table 6

Measurements - *Pseudocylindrodon aff. medius*

Skull	M. S. U. 0927	*Referred Specimen C. M. 10001
Diastema	6.0	4.7
Width of palate at $P^{\underline{3}}$	4.1	4.1
Width of palate at $M^{\underline{3}}$	2.8	
Length of palate from incisors to post-palatal notch	13.0	
$P^{\underline{3}}$ - $M^{\underline{3}}$	8.6	7.1
$M^{\underline{1}}$ - $M^{\underline{3}}$	5.4	4.2
Length $M^{\underline{3}}$	1.8	1.6
Width $M^{\underline{3}}$	1.8	2.0

Mandible	M. S. U. 0360	M. S. U. 0361	M. S. U. 0747	M. S. U. 0758	*Holotype C. M. 9999
Diastema			5.2	4.0	2.3
Depth of ramus below $P_{\overline{4}}$	7.0		7.4	6.5	
A-P Length, incisor	2.5	2.3	3.0	2.5	1.8
$P_{\overline{4}}$ - $M_{\overline{3}}$		7.7	8.6	8.1	6.9
$M_{\overline{1}}$ - $M_{\overline{3}}$		5.7	6.5		5.0
Length, $P_{\overline{4}}$	1.9	2.0	2.2		1.9
Width, $P_{\overline{4}}$	2.0	2.1	2.3		1.8

*Burke, J. J., 1938, Ann. Carnegie Mus., vol. 27, p. 269.

Table 6 (Continued)

Measurements - *Pseudocylindrodon aff. medius*

Mandible	M. S. U. 0360	M. S. U. 0361	M. S. U. 0747	M. S. U. 0758	*Holotype C. M. 9999
Length, $M_{\overline{1}}$	2.0	1.9	2.1	1.9	1.8
Width, $M_{\overline{1}}$	2.0	2.2	2.3	2.1	1.9
Length, $M_{\overline{2}}$	2.1	1.9	2.1	1.9	1.7
Width, $M_{\overline{2}}$	2.2	2.3	2.5	2.2	2.0
Length, $M_{\overline{3}}$		1.8	2.2		2.0
Width, $M_{\overline{3}}$		2.0	1.9		1.8

*Burke, J. J., 1938, Ann. Carnegie Mus., vol. 27, p. 269.

Ardynomys occidentalis Burke

(Plate 3, figure 3)

The genus *Ardynomys* is unknown in North America except from the McCarty's Mountain locality. Burke (1936, pp. 135-149) first described the species *A. occidentalis* from specimens at the Carnegie Museum. Two larger species are known from the Ardyn Obo formation (Lower Oligocene) of Mongolia. In the M. S. U. collection, six specimens are referred to *A. occidentalis.*

M. S. U. 0740, the anterior part of a skull with the dentition intact, is one of the best rodent specimens obtained and is one of the few fossils obtained from Locality M. S. U. 6202 (see plate 1, in pocket). The description of the skull and depressions by an anterior-posterior ridge connecting hypolophulids I and II.

Table 7

Comparative Measurements - *Ardynomys occidentalis*

	M. S. U. 0741	M. S. U. 0923	*Holotype C.M. 1056
Diastema	5.9		5.0
$P_{\bar{4}}$ - $M_{\bar{3}}$	8.9		10.0
Length, incisor	3.1	3.0	3.2
Length, $P_{\bar{4}}$	2.4	2.1	2.3
Width, $P_{\bar{4}}$	2.7	2.3	2.2
Length, $M_{\bar{1}}$	2.0		2.2
Width, $M_{\bar{1}}$	2.9		2.8
Length, $M_{\bar{2}}$	2.0	2.2	2.6
Width, $M_{\bar{2}}$	3.0	2.5	2.7
Length, $M_{\bar{3}}$	2.1	2.1	
Width, $M_{\bar{3}}$	2.0	2.1	

*Burke, J. J., 1936, Ann. Carnegie Mus., vol. 25, p. 148.

Ardynomys? occidentalis Burke

A broken mandible with badly worn cheek teeth, M. S. U. 0799, agrees with *A. occidentalis* in size and bears a deep flange-like projection in the symphyseal region. It is questionably referred to this species because the inferior incisor does not have the flattened anterior surface characteristic of the species.

M. S. U. 0929, a weathered anterior portion of a skull containing only fragments of the cheek teeth is also questionably referred to this species. Although of no descriptive value, this specimen agrees closely with M. S. U. 0740.

Family PROTOPTYCHIDAE

Protoptychus? sp.

M. S. U. 0556, a right $M^{\underline{3}}$ (?) was questionably identified by Dr. A. Wood as *Protoptychus.* Comparative specimens are not at present available for definite specific allocation.

Family EOMYIDAE

Paradjidaumo minor Douglass

M. S. U. 0791, a right mandible with $P_{\overline{4}}$ - $M_{\overline{3}}$, and M. S. U. 0551, a left mandible with $P_{\overline{4}}$ - $M_{\overline{3}}$ agree with the material which Wood (1937, p. 244) records from Pipestone Springs and need no further description.

Order LAGOMORPHA

Family LEPORIDAE

Paleolagus temnodon Douglass

All of the leporid material collected in this study is referable to *Paleolagus temnodon* and is comparable to the specimens described from Pipestone Springs and Three Forks, Montana by Wood (1940, pp. 320-324). This material needs no further description and consists of the following: M. S. U. 0785, a left mandibular fragment with $P_{\overline{3}}$ - $P_{\overline{4}}$; M. S. U. 0792, a right mandibular fragment with $M_{\overline{1}}$ - $M_{\overline{2}}$; M. S. U. 0918, a left mandibular fragment with $P_{\overline{3}}$ - $M_{\overline{2}}$; M. S. U. 0786, a right mandibular fragment with $M_{\overline{1}}$ - $M_{\overline{3}}$; M. S. U. 0769, a fragmentary right maxilla with $P^{\underline{3}}$ - $M^{\underline{1}}$; M. S. U. 0362, a fragmentary left maxilla with $P^{\underline{4}}$ - $M^{\underline{1}}$; M. S. U. 0790, a fragmentary right maxilla with $P^{\underline{4}}$ - $M^{\underline{3}}$; M. S. U. 0767, a $P^{\underline{4}}$; and M. S. U. 0862, a lower molar.

Order CARNIVORA

Family CANIDAE

Parictis cf. dakotensis Clark

M. S. U. 0886, part of a right mandible containing $P_{\overline{4}}$ and a broken $M_{\overline{1}}$, is the only representative of the carnivores in this collection. In size, the specimen compares closely to *Parictis dakotensis* figured in Scott and Jepsen (1936, part 1, plate XIV). $P_{\overline{4}}$ and $M_{\overline{1}}$ are crowded together and overlapping as in that species. There are several differences, however, which may indicate that this specimen represents another species and perhaps even another genus. On $P_{\overline{4}}$ and $M_{\overline{1}}$ of *P. dakotensis,* a rather prominent external cingulum is present. On the present specimen, the external cingulum is incomplete on $P_{\overline{4}}$ and not present on $M_{\overline{1}}$. These teeth appear narrower and more trenchant in this specimen and the cusps are less blunt.

Order PERISSODACTYLA

Family EQUIDAE

Mesohippus sp.

Six specimens consisting of parts of mandibles and maxillaries with fragmentary teeth are referable to *Mesohippus*, but none of these are sufficiently complete for specific determination. The specimens are small and the molar crowns are short. The specimen numbers are M. S. U. 0356, M. S. U. 0761, M. S. U. 0781, M. S. U. 0919, M. S. U. 0924 and M. S. U. 0875.

Few skeletal fragments were found which could be referred to *Mesohippus*. A right tibia, M. S. U. 0772, and a left astragalus, M. S. U. 0754, are referred to the genus.

Family HELALETIDAE

Colodon? cingulatus Douglass

(Plate 4, figure 1)

This species, which Radinsky (1963, pp. 66-67) questionably refers to *Colodon*, is known from only three localities, McCarty's Mountain, Thompson Creek, and Toston, Montana.

M. S. U. 0879, part of a right mandible containing $M_{\overline{3}}$; M. S. U. 0884, part of a right mandible containing $M_{\overline{3}}$; M. S. U. 0914, a badly shattered right mandible containing fragments of $P_{\overline{3}}$ - $M_{\overline{3}}$; M. S. U. 0876, a fragment of a right mandible with $M_{\overline{1}}$ - $M_{\overline{3}}$; and M. S. U. 0877, the symphyseal region of a mandible containing a right $P_{\overline{1}}$ and the root of the canine are referred to *Colodon? cingulatus.* In the three specimens in which $M_{\overline{3}}$ is preserved all have a very pronounced hypoconulid. According to Radinsky, however, the $M_{\overline{3}}$ hypoconulid varies greatly within *Colodon* and its use as a specific criterion is questionable. The lower canine of M. S. U. 0877 is retained and thus agrees with Late Eocene and Oligocene Mongolian species of *Colodon* rather than with the Chadron species of the plains, *C. occidentalis,* where the lower canines are vestigial or absent. Measurements of $M_{\overline{3}}$ are given in table 8.

Two weathered mandibles, M. S. U. 0871, containing fragmentary teeth are tentatively referred to this species on the basis of size and the very prominent $M_{\overline{3}}$ hypoconulid.

Colodon cf. kayi Hough

(Plate 4, figure 2)

M. S. U. 0939, part of a mandible containing $M_{\overline{2}}$ - $M_{\overline{3}}$, is referred to *Colodon kayi* mainly on size. The molars are quite unlike those described previously under *C.? cingulatus.* $M_{\overline{3}}$ has a very small hypoconulid, hardly more than a posterior cingulum, and is considerably smaller. The molars closely resemble those of *C. occidentalis,* but they are well outside the observed size range for that species given by Radinsky (1963). In size, the teeth of M. S. U. 0939 most nearly correspond to the Late Uintan species *C. kayi* found at Sage Creek, Montana. Measurements of this specimen are included in table 8.

Table 8

Comparative Measurements - Colodon

	C. ? cingulatus				C. cf. kayi	
	M. S. U. 0884	M. S. U. 0879	M. S. U. 0914	*Mean of C. M. Hypodigms	M. S. U. 0939	**Hypodigm C. M. 12088
Length, $M_{\overline{2}}$				18.10	12.0±	14.3
Width, $M_{\overline{2}}$					10.0	10.6
Length, $M_{\overline{3}}$	24.8	25.5	26.0	24.42	15.9	17.3
Width, $M_{\overline{3}}$	15.0	15.4	16.0±	15.28	10.8	11.6

*Radinsky, L., 1963, Yale Peabody Mus. Nat. Hist., bull. 17, p. 67.
**Radinsky, L., ibid., p. 61.

Helaletidae?

M. S. U. 0868, a worn left mandible containing tooth fragments, and M. S. U. 0913, the posterior portion of a right mandible are questionably referred to this family. In both cases the material is too fragmentary for generic identification.

Family RHINOCEROTIDAE

Caenopus sp.

(Plate 4, figure 3)

M. S. U. 0772, part of palate with right and left $P^{\underline{4}}$ - $M^{\underline{3}}$ and broken left $P^{\underline{3}}$, probably belongs to an undescribed species of *Caenopus*. The specimen is that of an old individual and the teeth are badly worn.

Table 9

Comparative Measurements - *Caenopus sp.* - *Caenopus mitis*

	M.S.U. 0772	*Holotype A.M.N.H. 6325
Width of palate at $M^{\underline{3}}$	40.0	
Width of palate at $P^{\underline{3}}$	30.0	
Alveolar length, $P^{\underline{4}}$ - $M^{\underline{3}}$	71.0	
Alveolar length, $M^{\underline{1}}$ - $M^{\underline{3}}$	57.0	
Length, $P^{\underline{4}}$	15.0	24.0
Width, $P^{\underline{4}}$	27.0	33.0
Length, $M^{\underline{1}}$	18.0	29.0
Width, $M^{\underline{1}}$	25.0	32.0
Length, $M^{\underline{2}}$	24.0	36.0
Width, $M^{\underline{2}}$	27.0	37.0
Length, $M^{\underline{3}}$	26.0	
Width, $M^{\underline{3}}$	23.0	

*Scott, W., Jepsen, G., and Wood, A., 1936-41, Trans. Amer. Philos. Soc., new ser., vol. 28, pt. 5, p. 796.

In size, the specimen agrees more closely with a specimen of *C. yoderensis*, S.D. 5331, examined at the South Dakota School of Mines Museum than with the type of *C. mitis* (A.M.N.H. 6325) as given by Scott (1941, pp. 794-796). The length from $P^{\underline{4}}$ to $M^{\underline{3}}$ in this specimen is 71.0 mm compared to $87.0^{\pm}$ mm for S.D. 5331 and $154.0^{\pm}$ mm for A.M.N.H. 6325. Several differences, other than size, were observed between this specimen and *C. yoderensis* which make it probable that this specimen is not referable to that species. $M^{\underline{2}}$ and $M^{\underline{3}}$ of the M.S.U. specimen are much more crowded than in S.D. 5331 and a broad anterior cingulum which is present on *C. yoderensis* is not present on this specimen.

The extremely worn condition of the teeth and the lack of adequate comparative material prevent the adequate description of a new species. The specimen is assigned to *Caenopus sp.* pending the discovery of more complete material.

Subhyracodon? sp.

M.S.U. 0878, part of a right mandible containing fragments of $M_{\overline{1}}$ - $M_{\overline{3}}$ is questionably referred to this genus. The size of the mandible is close to *S. occidentalis* (P.V. 11111), but somewhat smaller than specimens at the South Dakota School of Mines with which it was compared. The fusion of the posterior crest with the external wall on $M_{\overline{3}}$ appears to be less complete than *Subhyracodon*, but somewhat more complete than in *Hyracodon.*

Also questionably referred to this genus are several tooth and jaw fragments, M.S.U. 0861, M.S.U. 0357, M.S.U. 0883, and M.S.U. 0355; an unerupted molar, M.S.U. 0864; and several limb bones, M.S.U. 0774 and M.S.U. 0889.

Rhinocerotoidea *gen.* and *sp.* *indet.*

Two badly weathered mandible fragments, M. S. U. 0328 and M. S. U. 0795 are too small to be placed with *Subhyracodon?* and may belong to *Caenopus*. They are too badly weathered for even generic identification.

Many tooth and bone fragments belonging to this superfamily were found. Although not generically identifiable, they serve to indicate the abundance of this group.

Family BRONTOTHERIIDAE

M. S. U. 0887, part of a lower molar, and M. S. U. 0930, the proximal part of a left femur, are the only two specimens found at McCarty's Mountain which are definitely referable to the Brontotheriidae. The diameter ot the head of the femur is 95.0$^+$ mm. Both of the specimens were taken from outcrop at the main locality. Neither is adequate for even generic reference, but they are very significant stratigraphically.

Order ARTIODACTYLA

Family MERYCOIDODONTIDAE

The most complete and best preserved of the fossils collected at McCarty's Mountain belong to the family Merycoidodontidae. As represented by this fauna, the group is not diversified and almost all this material belongs to the subfamily Oreonetinae (Schultz and Falkenbach, 1956).

Oreonetes anceps Douglass

(Plates 5, 6, figures 1-2, 1-3)

Oreonetes anceps is represented by two nearly complete skulls and a third which is complete from the postorbital constriction forward to the premolars. This genus and species is known from only a few specimens all of which are from Montana. The material in the M. S. U. collection is the most complete yet reported and several additions can be made to the descriptions of the species as given by Schultz and Falkenbach (1956, pp. 454-461).

Schultz and Falkenbach (1956) note a size difference and lighter premolars in one of the specimens formerly included in this species. They have assigned this specimen to subspecific position, *Oreonetes anceps douglassi*. In the M. S. U. material, one of the skulls is noticeably more robust in appearance and of a heavier build than the other two. The premolars of this specimen are also slightly larger and heavier than in these latter specimens and the muzzle is broader. Other than these slight differences, the specimens are identical. Rather than assign the more lightly built specimens to a subspecies, it seems more likely that the differences are attributable to sex or age. The more robust specimens could be male and the more slender specimens female or the heavier skull and mandibles could represent older animals than the smaller specimens. Therefore, all these specimens will be assigned to the species *O. anceps*.

M. S. U. 0912 is a nearly complete skull. This is the heavier specimen, presumed here to be male. In their revised description of *O. anceps*, Schultz and

Falkenbach questionably postulated that the orbit of this species was closed since the distance between the broken surface of the malar and the postorbital process of the frontal was short. Their postulate is incorrect. On M. S. U. 0912, the malar and postorbital processes are complete and separated by a gap of about 5 mm.

On M. S. U. 0912, there is only one infrorbital opening on each side of the rostrum. On another skull, M. S. U. 0762, each infrorbital foramen is divided, producing double foramina on each side of the rostrum. However, Schultz and Falkenbach do not consider this feature of any diagnostic value since one of their referred specimens apparently has a single foramen on one side and double foramina on the other.

M. S. U. 0784, another skull complete from the postorbital constriction forward to the premolars, differs from M. S. U. 0912 only in being more slender and in having a divided infraorbital foramen. Associated with the skull in the outcrop was a mandible, the head of a femur, a tibia, and most of the elements of a left pes. When uncovered, the elements of the pes were undisturbed and still attached to the tibia. Since the limbs of this animal are heretofore unknown, a description is given (see plate 6, figure 3).

The proximal portion of the tibia is missing. The cnemial crest appears, however, to continue for about one-third the length of that bone. The shaft has the typical artiodactyl shape, subtriangular proximally and compressed from anterior to posterior distally. The medial malleolus and the distal grooves are very much the same as on Merycoidodon gracilis.

The width of the astragalus is approximately one-half its length. The external condyle is much larger than the internal condyle making the proximal trochlea noticeably assymetrical. The distal trochlea is unlike *M. gracilis* in that it has a broad surface for the cuboid and a narrow one for the navicular. The reverse is true of *M. gracilis.* The calcaneum is laterally compressed and has a deep groove on the distal external face. The tuber of this specimen has been broken off. However, in another calcaneum, M.S.U. 0763, the tuber is clublike as in *M. gracilis.*

The navicular is much heavier than the ectocuneiform. The planar hook is prominent and extends down over the posterior projections of the heads of metatarsals III and IV.

The cuboid has a broad articular surface for the calcaneum and a narrower one for the astragalus. As in *M. gracilis,* the posterior hook-like process is broad and prominent, and two projecting facets face the navicular and the ectocuneiform.

The ectocuneiform, with which the mesocuneiform has coalesced, is rectangular and not as thin relative to the size of the pes as it is in *M. gracilis.* The entocuneiform is small and somewhat triangular in shape.

The metatarsus has four members, but only metatarsals II., III and IV, broken distally, are left on this specimen. The heads of metatarsals III and IV have posterior projections. The projection on metatarsal III is stouter than that on metatarsal IV.

The phalanges of the pes are not preserved.

The mandible of *O. anceps* increases in depth rather uniformly from the symphysis to the angular process which curves gently lingually. The mental foramen is located below and between $P_{\overline{2}}$ and $P_{\overline{3}}$. As noted in the skulls, some of the

Table 10

Comparative Measurements - <u>Oreonetes anceps</u>

Skull:	M.S.U. 0912	M.S.U. 0784	M.S.U. 0762	*Referred Specimen C.M. 1052
Greatest length of skull	106.0±	101.0±		111.0±
Greatest width of skull	63.0±			66.5±
Width of braincase	33.0±	31.0		32.5
Least interorbital width	30.3	29.0±	29.9	29.5
Width of muzzle at infraorbital foramina	23.0		20.6	27.0
Greatest width of palate at $M^{\underline{3}}$	21.5	19.0±	19.2	
Greatest width of palate at $P^{\underline{1}}$	14.8	12.0±	12.9	
Length, C - $M^{\underline{3}}$	55.1	53.8	55.1	56.5
Length, $P^{\underline{1}}$ - $M^{\underline{3}}$	49.3	47.5	49.3	49.0
Length, $P^{\underline{1}}$ - $P^{\underline{4}}$	22.4	21.5	22.2	23.0
Length, $M^{\underline{1}}$ - $M^{\underline{3}}$	27.0	25.7	27.1	26.5
Width of $M^{\underline{3}}$	11.7	11.6	11.7	11.8
Length of $M^{\underline{3}}$	10.1	10.2	10.2	10.5±

*Schultz, C. B., and Falkenbach, C. H., 1956, Bull. Amer. Mus. Nat. Hist., vol. 109, p. 455.

Table 10 (Continued)

Comparative Measurements - Oreonetes anceps

Mandible:	M.S.U. 0784	M.S.U. 0890	M.S.U. 0354	*Referred Specimen A.M.N.H. 9728
Maximum depth of jaw below $P_{\overline{4}}$	14.2	15.3	15.1	
Maximum depth of jaw below $M_{\overline{3}}$	23.0	23.4	23.0±	
Length, $P_{\overline{1}}$ - $M_{\overline{3}}$	49.8			51.5
Length, $P_{\overline{1}}$ - $P_{\overline{4}}$	20.0			20.5
Length, $M_{\overline{1}}$ - $M_{\overline{3}}$	29.8	30.2	30.5	31.0
Length, $M_{\overline{3}}$	13.4	13.6	13.5	14.0±
Width, $M_{\overline{3}}$	7.2	7.5	7.5	

*Schultz, C. B., and Falkenbach, C. H., 1956, Bull. Amer. Mus. Nat. Hist., vol. 109, p. 455.

mandibles appear lighter than others and are probably female.

The skull and mandible of this species is very adequately described in Schultz and Falkenbach (1956).

Many parts of this animal were found and listed under separate specimen numbers. These specimen numbers are listed in table 2 and their stratigraphic location is given in plate 2 (in folder). Measurements of the skulls and mandibles are given in table 10.

Limnetes platyceps Douglass

(Plate 7, figures 1, 2)

M. S. U. 0937, a nearly complete skull containing $P^{\underline{4}}$ - $M^{\underline{3}}$, agrees with C. M. 701, the holotype of *Limnetes platyceps* from Thompson Creek, Montana. The holotype and the M. S. U. skull are the only two known. Schultz and Falkenbach (1956, pp. 462-464) have given the most complete description of this species and only slight additions can be made from the present material.

The most anterior upper tooth known from this species is contained in a maxillary fragment, M. S. U. 0768, containing $P^{\underline{3}}$ - $M^{\underline{1}}$. In this specimen, $P^{\underline{3}}$ contains only one prominent, somewhat triangular, cusp and does not have the two pairs of crescents characteristic of the molars. $P^{\underline{4}}$ is much more molariform and has two double crescents. The inner crescents are not as well developed as they are on the molars.

M. S. U. 0793, a mandibular fragment containing $M_{\overline{1}}$ - $M_{\overline{3}}$ and M. S. U. 0915, an $M_{\overline{3}}$ are questionably referred to this species. No limb bones referable to *L. platyceps* were found. As noted above, most of the limb bones found are referable to *O. anceps*. The limb bones collected from McCarty's Mountain and questionably referred to L. platyceps by Schultz and Falkenbach undoubtedly belong to *O. anceps*.

Table 11

Comparative Measurements - Limnetes platyceps

	M. S. U. 0937	*Holotype C. M. 701
Length of skull posterior from $P\frac{3}{}$	86.0±	
Width of skull at $P\frac{4}{}$	57.0±	
Maximum width of brain case	32.0	34.5
Least interorbital width	30.0	33.0
Width of muzzle at infraorbital foramina	25.4	28.0±
Greatest width of palate at $M\frac{3}{}$	17.2	
Greatest width of palate at $P\frac{4}{}$	16.7	
Length, $P\frac{4}{}$ - $M\frac{3}{}$	32.1	
Length, $M\frac{1}{}$ - $M\frac{3}{}$	26.7	27.5±
Width, $M\frac{3}{}$	11.9	10.5±
Length, $M\frac{3}{}$	12.3	12.0±

*Schultz, C. B. and Falkenbach, C. H., 1956, Bull. Amer. Mus. Nat. Hist., vol. 109, p. 455.

Family HYPERTRAGULIDAE

Leptomeryx *cf.* *blacki* Stock

(Plate 8, figures 1, 2)

M.S.U. 0881, a left mandible containing $P_{\overline{4}}$ - $M_{\overline{3}}$ and the alveoli of $P_{\overline{1}}$ - $P_{\overline{3}}$, is very small and agrees in size with *Leptomeryx* *blacki* described by Stock (1949, p. 243). The horizontal ramus is long and slender and the symphysis is horizontal.

M.S.U. 0756, a right $M_{\overline{3}}$; M.S.U. 0880, a right $M_{\overline{1}}$; M.S.U. 0363, a right $M_{\overline{3}}$; and M.S.U. 0934, a fragment of a mandible containing $P_{\overline{2}}$ - $P_{\overline{4}}$, compare with the mandible and are described together. Although small, these specimens are distinctly larger than in *Leptomeryx* *minutus* described by Peterson (1934, p. 386) from the Duchesne River fauna.

The only notable difference between the M.S.U. material and the type of *L.* *blacki* from the Titus Canyon fauna is the presence, in the McCarty's Mountain specimens, of a small, but distinct diastema between $P_{\overline{1}}$ and $P_{\overline{2}}$. Stock noted no diastema between these teeth in *L.* *blacki.* $P_{\overline{1}}$ is not present in the type, but, judging from the size of the alveoli, Stock noted that $P_{\overline{1}}$ appeared to be larger than in species of *Leptomeryx* from the White River and Pipestone faunas. This is not necessarily true. If the alveoli of the McCarty's Mountain ramus were enlarged slightly posteriorly, there would be no diastema and $P_{\overline{1}}$ would appear to be larger than it actually is. This may be the condition of the California mandible.

$P_{\overline{1}}$ is single rooted and canineform. $P_{\overline{2}}$ and $P_{\overline{3}}$ are basically triconodont, but

Table 12

Comparative Measurements - *Leptomeryx cf. blacki* and *L. blacki*

	M. S. U. 0881	M. S. U. 0934	M. S. U. 0880	M. S. U. 0756	*Holotype C.I.T.3560	*Paratype C.I.T. 3561
Depth of ramus below $P_{\overline{4}}$	7.5	7.0				
Depth of ramus below $M_{\overline{3}}$	$9.0^{\pm}$					
Length, $P_{\overline{1}}$ - $M_{\overline{3}}$	33.0					
Length, $M_{\overline{1}}$ - $M_{\overline{3}}$	20.1					
Length, $P_{\overline{3}}$		4.8				
Length, $P_{\overline{4}}$	5.2	5.5				5.0
Length, $M_{\overline{1}}$	5.8		5.3		5.4	4.9
Length, $M_{\overline{2}}$	6.0					
Length, $M_{\overline{3}}$	8.8			8.3		

*Stock, C., 1949, Carnegie Inst. Wash. Publ. 584, p. 243.

the posterior cusp is complicated by two ridges which trend posteriorly and laterally. As in *L. blacki* and in marked contrast to *L. minutus,* the crest extending from the principal cusp of $P_{\overline{4}}$ has a short spur which projects posteriorly into the posterior basin.

The molars have the typical selenodont pattern characteristic of the group, but, between the external crescents, is a prominent cuspule which, in $M_{\overline{1}}$ is coalesced to the side of the anterior crescent.

The anterior mental foramen is located below and slightly posterior to $P_{\overline{1}}$. The posterior mental foramen is located below $P_{\overline{4}}$.

Leptomeryx *cf.* *minutus* Peterson

(Plate 8, figures 3, 4)

Leptomeryx *minutus*, named from a fragmentary right mandible discovered in the Duchesne River fauna is the smallest hypertragulid known. M.S.U. 0742, part of a left mandible with $P_{\overline{4}}$ - $M_{\overline{3}}$, differs considerably from those described above under *L.* *blacki*.

$P_{\overline{4}}$ has the basic *Leptomeryx* crown pattern. Peterson's description of this tooth (1934, p. 386) in the type of *L.* *minutus* has the principal cusp and the adjacent inner cusp "more" separated than in other species of this genus. This is not the case in the M.S.U. specimen. With this exception, M.S.U. 0742 appears very nearly the same as *L.* *minutus*. The crest extending backward from the principal cusp of $P_{\overline{4}}$ bears a very small spur. On a worn specimen the spur would very likely be lost.

The molars have the characteristic selenodont pattern of the genus. $M_{\overline{3}}$ differs from the other two molars in having a prominent cuspule on the internal side of the tooth at the point where the crescentic heel joins the posterior double crescent.

The posterior mental foramen is located below $P_{\overline{3}}$.

Several very small astragali were found which could belong to either of the two small artiodactyls discussed above. They are not assigned to either group, but,

Table 13

Comparative Measurements - Leptomeryx minutus and L. cf. minutus

	*L. minutus C. M. 11913	L. cf. minutus M. S. U. 0742
Depth of ramus below $P_{\overline{4}}$		6.0
Depth of ramus below $M_{\overline{3}}$		8.2
Length, $P_{\overline{4}}$ - $M_{\overline{3}}$		21.0
Length, $P_{\overline{4}}$ - $M_{\overline{2}}$	13.0	13.5
Length, $P_{\overline{4}}$	4.0	4.0
Length, $M_{\overline{1}}$	4.0	4.5
Length, $M_{\overline{2}}$	4.5	5.0
Length, $M_{\overline{3}}$		7.5

*Peterson, O., 1934, Ann. Carnegie Mus., vol. 23, p. 386.

since the fauna includes more material from L. cf. blacki, these astragali likely belong to this group.

Artiodactyla incertae sedis

Not all of the artiodactyls present in this fauna were small as is shown by M. S. U. 0794, a very large selenodont molar. The width of this tooth is 15.4 mm and the length at least 18.0 mm. It may belong to a species of Merycoidodon.

Many fragmentary bones and teeth were collected from the area which are not described here. Most of them are only questionably identifiable and they would not add to the present study.

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PLATES

Plate 3

Figure

1. *Ischyromys pliacus* Troxell, occlusal view of lower cheek teeth, M. S. U. 0936 (upper), M. S. U. 0866 (lower). X2.4
2. Cylindrodonts, note variation in position of mental foramina. X2
3. *Ardynomys occidentalis* Burke, occlusal view of upper dentition and anterior part of skull, M. S. U. 0923. X1.7

Plate 3

1

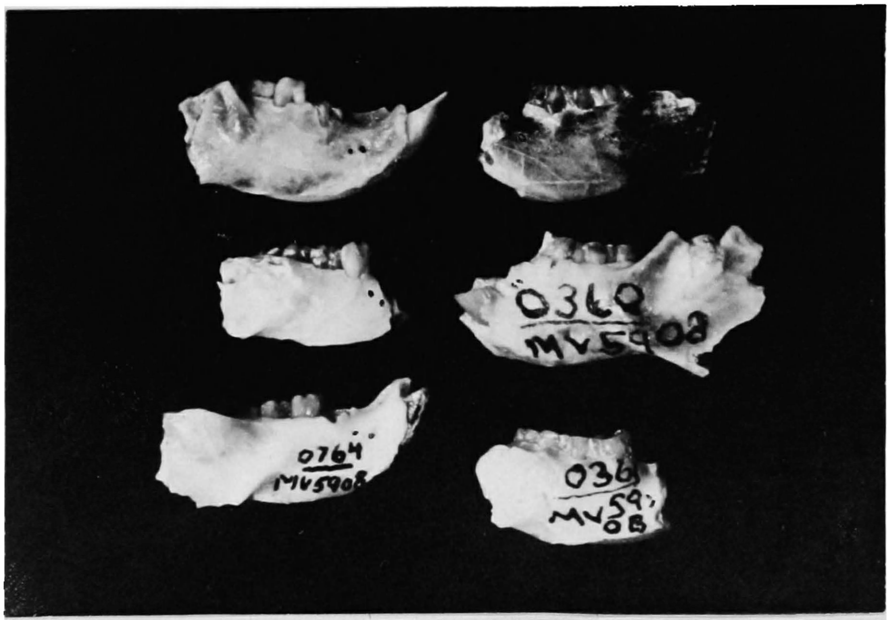

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Plate 4

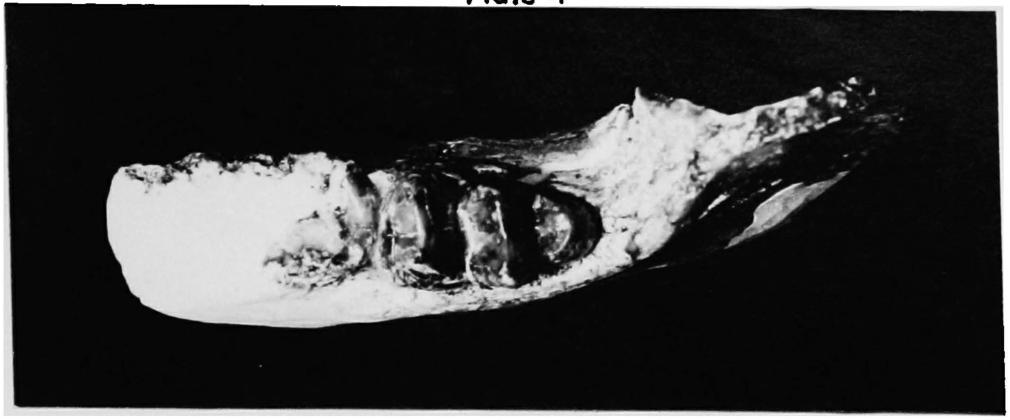
Figure

1. *Colodon? cingulatus* Douglass, M. S. U. 0879, $M_{\overline{3}}$ and part of right mandible. X1.7

2. *Colodon cf. kayi* Hough, M. S. U. 0939, $M_{\overline{2}}$ - $M_{\overline{3}}$ of left mandible. X3

3. *Caenopus sp.*, M. S. U. 0772, occlusal view of upper dentition from $P^{\underline{3}}$ - $M^{\underline{3}}$. X1

Plate 4



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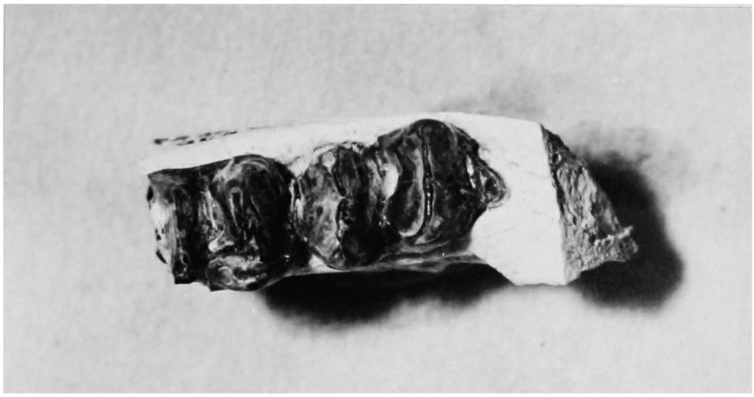

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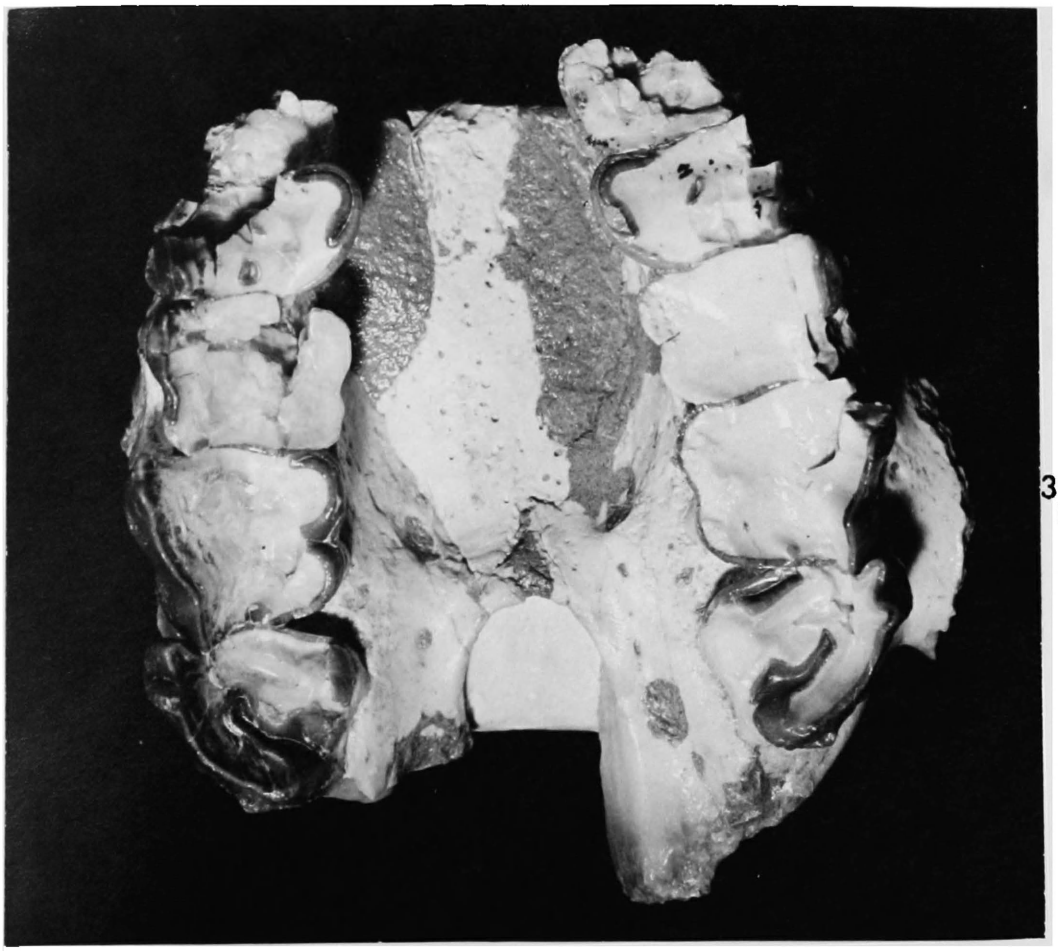

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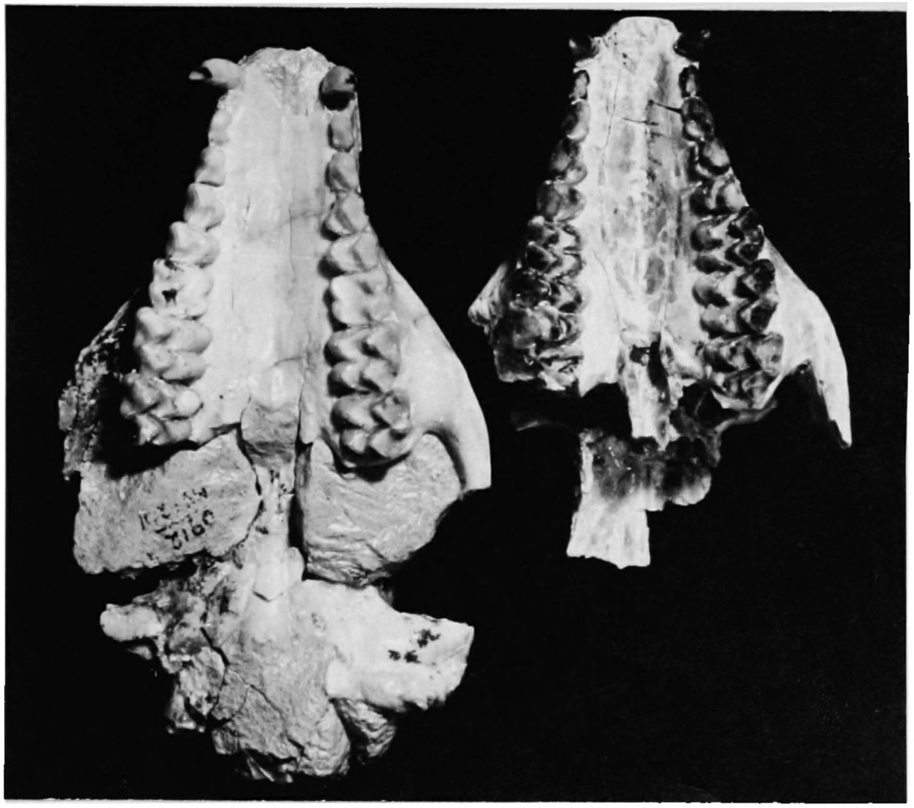
Plate 5

Figure

1. *Oreonetes anceps* Douglass, skulls of slender (right) and robust (left) individuals, occlusal view, M. S. U. 0912 left, M. S. U. 0762 right. X.9
2. *Oreonetes anceps* Douglass, dorsal view of skulls in figure 1. X.9

Plate 5



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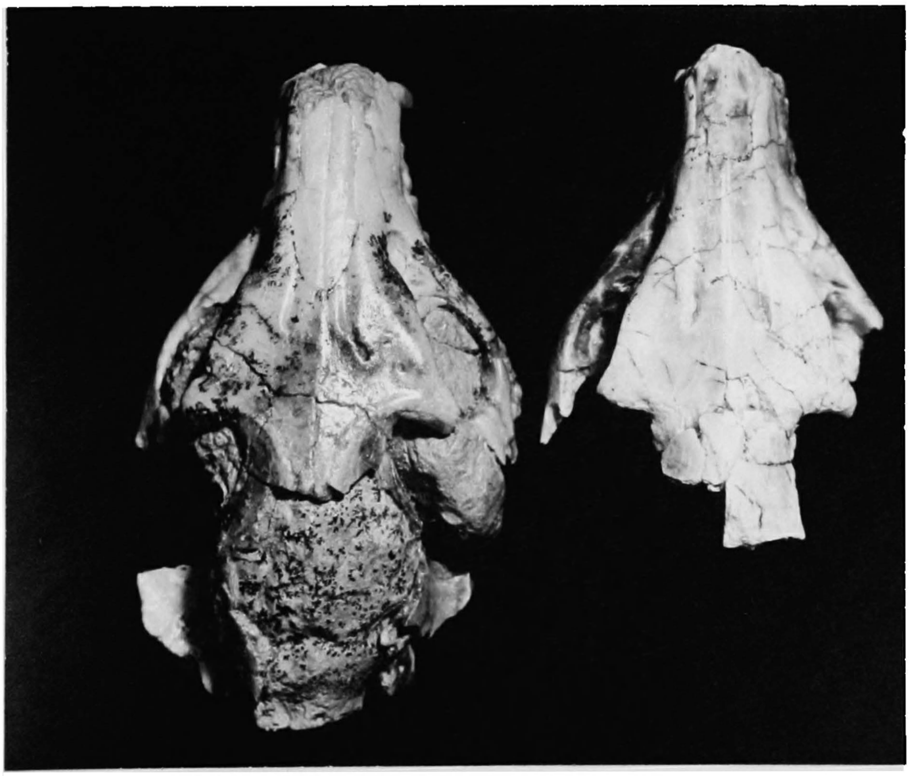

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Plate 6

Figure

1. *Oreonetes anceps* Douglass, skull, M.S.U. 0912, and part of mandible, M.S.U. 0890. X.9
2. *Oreonetes anceps* Douglass, occlusal view of left mandible, M.S.U. 0784. X1.5
3. *Oreonetes anceps* Douglass, tibia, metatarsals II, III, and IV, and elements of left pes, M.S.U. 0784, M.S.U. 0752. X1.5

Plate 6

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Plate 7

Figure

1. *Limnetes platyceps* Douglass, lateral view of skull, M. S. U. 0937. X1.2

2. *Limnetes platyceps* Douglass, ventral view of skull, M. S. U. 0937, containing $P^{\underline{4}}$ - $M^{\underline{3}}$. X1.2

Plate 7

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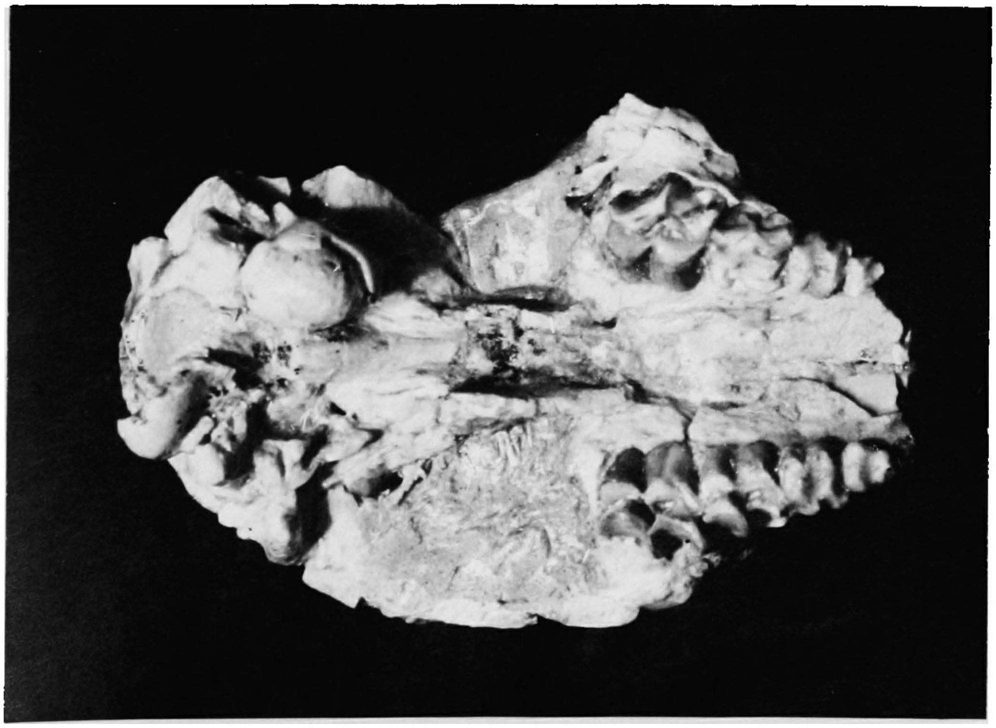

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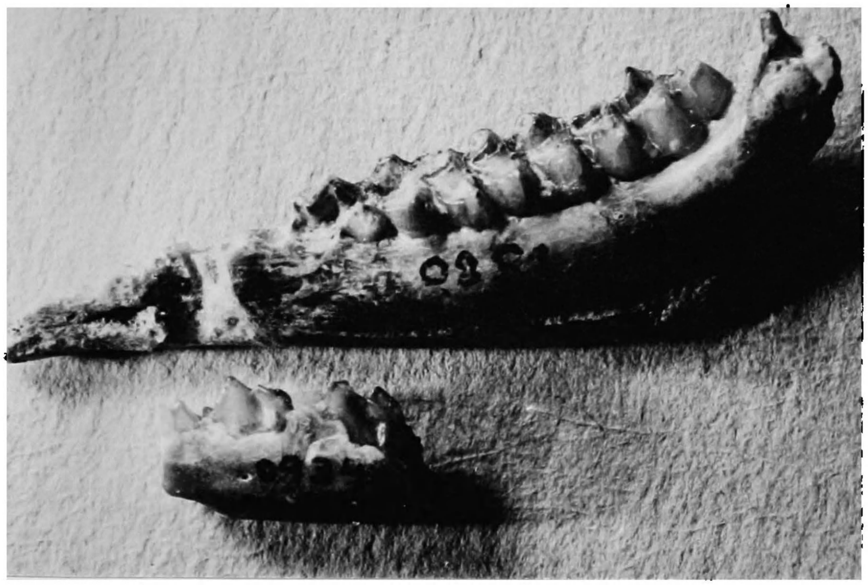
Plate 8

Figure

1. *Leptomeryx cf. blacki* Stock, lateral view of parts of left mandibles, M.S.U. 0881 (upper), M.S.U. 0934 (lower). X2.3
2. *Leptomeryx cf. blacki* Stock, occlusal view of parts of left mandibles containing $P_{\overline{2}}$ - $M_{\overline{3}}$, M.S.U. 0881 (upper), M.S.U. 0934 (lower). X2.3
3. *Leptomeryx cf. minutus* Peterson, lateral view of left mandible with $P_{\overline{4}}$ - $M_{\overline{3}}$, M.S.U. 0742. X2
4. *Leptomeryx cf. minutus* Peterson, occlusal view of left $P_{\overline{4}}$ - $M_{\overline{3}}$, M.S.U. 0742. X2.3

Plate 8



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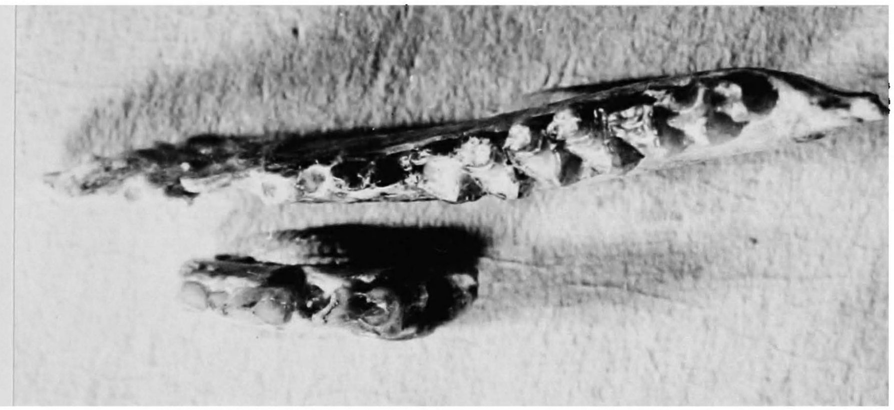

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