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Charles D. and Mary Vaux Walcott
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THE GEOLOGY AND VERTEBRATE
PALEONTOLOGY OF UPPER EOCENE
STRATA IN THE NORTHEASTERN
PART OF THE WIND RIVER
BASIN, WYOMING

PART 2. THE MAMMALIAN FAUNA OF THE
BADWATER AREA

(WITH 3 PLATES)

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LEONTOLOGY OF UPPER EOCENE
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INTRODUCTION

The significance of the Wind River Basin in contributing information on mammalian faunas of upper Eocene time has been appreciated only during comparatively recent years. Although a rather meager fauna had been known from beds of Uintan equivalence below the Beaver Divide along the south side of the basin for many years, it is rather surprising that the occurrences on the north side were not earlier discovered, particularly in view of the long history of collecting associated with the adjacent lower Eocene Wind River formation. Discovery of the occurrence of upper Eocene mammalian remains along Badwater Creek near the site of the old Badwater Post Office by Wood, Seton, and Hares in 1936 was followed by investigations of others, notably those of Harry A. Tourtelot for the U. S. Geological Survey and parties for the Smithsonian Institution.

The present study stems largely from an interest in Eocene tapiroids, the upper Eocene representatives of which are so well represented here, and is in part a sequel to an earlier review of artiodactyls

¹ Part 1 of this paper is a study of the geologic relations, in preparation by Harry A. Tourtelot.

of this age. Misunderstandings in the past as to the characteristics and, in some instances, the age of related types, largely from inadequate original descriptions of forms in these two ungulate groups, early confused the picture and resulted in incorrect identifications and evidently misleading conclusions as to the horizon represented by the Badwater assemblage. It is hoped that the present review and revision will clarify the record and render more useful the information to be derived from this occurrence.

ACKNOWLEDGMENTS

I am particularly indebted to Dr. G. Edward Lewis of the U. S. Geological Survey for relinquishing to me for restudy this very interesting assemblage, and assuring me that no embarrassment would ensue. I wish also to acknowledge the helpful information furnished me by Harry A. Tourtelot both in the office and in the field. Tourtelot, obligingly and with contagious enthusiasm, showed me the more significant and likely collecting sites during our 1946 field exploration.

Investigation was immeasurably aided by my being permitted to examine and study related materials in universities and other museums, and by the loan of pertinent specimens in these collections for direct comparison. Acknowledgment is particularly due Dr. J. LeRoy Kay at the Carnegie Museum, Dr. Glenn L. Jepsen at Princeton University, Dr. George G. Simpson at the American Museum, and Dr. Joseph T. Gregory at Yale Peabody Museum. Dr. H. E. Wood, II, aided in furnishing information on materials in the original Badwater collection.

The exquisite pencil drawings depicting selected materials shown in plates 1-3 were prepared by Lawrence B. Isham, staff artist for the Department of Geology in the U. S. National Museum. Mr. Isham also prepared the chart showing the tapiroid sequence.

HISTORY OF INVESTIGATION

Discovery of upper Eocene vertebrate materials in the Badwater area was made by Wood, Seton, and Hares, as reported by them in 1936. Moreover, this would appear to be the first record for the occurrence of upper Eocene on the north side of the Wind River Basin. Recognized by Wood, Seton, and Hares were *Amynodon advenus*, *Telmatherium*, cf. *cultridens*, and a crocodile. Collections later (1942) secured by J. D. Love and G. E. Lewis from Lysite Mountain to the north of Badwater Creek, for Yale University, include remains identified by Lewis as *Telmatherium*, cf. *cultridens*, and an indeterminate

helaetid (this is *Dilophodon*). Nevertheless, significant collections, more representative of the fauna, were not obtained from these beds until Harry A. Tourtelot and his assistants secured for the U. S. Geological Survey in 1944 and 1945 the materials discussed in his maps and reports of 1946, 1948, and 1953. Identification of the Geological Survey material was made by G. E. Lewis and reported by him in 1947. Collections for the Smithsonian Institution were made by F. L. Pearce, Chester Gazin, and myself in 1946, and Pearce and I revisited the localities with good results in 1953. Other known collections include that made by A. E. Wood in 1948 for Amherst College, the small mammals represented having been described by him in 1949. Further collecting was done by Tourtelot and the unusual *Malaquiferus tourteloti* skull was found by him near Dry Creek in 1948. Materials secured by the U. S. Geological Survey also included a collection made by J. R. Hough in 1950, and in her 1955 report on the Sage Creek occurrence comparisons are made with portions of the Badwater fauna.

OCCURRENCE AND PRESERVATION OF MATERIAL

The principal occurrences for materials of the Badwater fauna are the low gray-green exposures along the south side of Badwater Creek between $2\frac{1}{2}$ and $3\frac{1}{2}$ miles almost due northwest of the site of the now abandoned Badwater Post Office. These are immediately to the south and to the southeast of the mouth of Clear Creek in the southeast part of section 14, the southwest part of section 13, and the northwest part of section 24, T. 39 N., R. 89 W. The above, together with other scattered localities, are shown on both the 1946 and 1953 maps of Tourtelot, as well as his map accompanying part 1 of this study.

The discovery of Badwater vertebrate remains by Wood, Seton, and Hares was made at a locality south of Badwater P.O. about 3 miles to the southeast of the above exposures and in section 32, T. 39 N., R. 88 W. Determinable remains have likewise been encountered on Lysite Mountain to the north of the Badwater area by Lewis and Love, probably in section 25, T. 42 N., R. 90 W. The Dry Creek exposures, almost certainly the same age as those on Badwater Creek, are about 20 miles due west and include the sites for the *Malaquiferus* and *Eomoropus* skulls, in the NW $\frac{1}{4}$ sec. 14 and the SE $\frac{1}{4}$ sec. 9, respectively, T. 39 N., R. 92 W.

Much of the fossil material encountered has been rather fragmentary although there are five comparatively good skulls in the National Museum-Geological Survey collections from there. Two of these are

of *Diplobunops* and the others are of *Protoreodon*, *Malaquiferus*, and *Eomoropus*. It is particularly noteworthy that although often much fractured, the remains show almost no distortion, a condition unusual in collections of Eocene age, particularly those from the Uinta basin. The bone for the most part is a light buff color and the teeth amber to dark brown. The beds themselves do not resemble exposures of the Uinta formation in Utah but much more closely resemble the light gray-green middle Eocene reworked volcanic ash of the Bridger formation in southwest Wyoming. The upper Eocene fossil-bearing beds in the Badwater area have been named the Hendry Ranch member by Mr. Tourtelot and regarded as a part of the Tepee Trail formation. Definition and description of these beds are included in part I of this paper.

THE BADWATER FAUNA

MARSUPIALIA? :

Didelphidae? :

Peratherium?, sp.

LAGOMORPHIA :

Leporidae :

Mytonolagus wyomingensis A. E. Wood

RODENTIA* :

Paramyidae :

Rapamys?, sp.

Sciuravus dubius A. E. Wood

Paramyid indet. (large)

Paramyid indet. (small)

Eomyidae :

Protadjidaumo?, sp.

Cricetidae :

Cricetid indet.

CARNIVORA :

Limnocyonidae :

Limnocyon?, sp.

Miacidae :

Miacis, cf. *robustus* (Peterson)

CONDYLARTHA :

Hyopsodontidae :

Hyopsodus, cf. *uintensis* Osborn

PERISSODACTYLA :

Equidae :

Ephippus, cf. *gracilis* (Marsh)

Ephippus, cf. *parvus* Granger

Brontotheriidae :

Brontotheriid indet.

Chalicotheriidae :

Eomoropus anarsius, new species

Helaletidae:

Desmatotherium woodi, new species*Dilophodon*, cf. *leotanus* (Peterson)

Hyracodontidae:

Epitriplops?, sp.

Amyodontidae*:

Amynodon advenus (Marsh)

ARTIODACTYLA:

Dichobunidae:

Pentacemylus?, sp.*Apriculus praeteritus*, new genus and species

Agriochoeridae:

Protoreodon, cf. *petersoni* Gazin*Protoreodon*, near *P. pumilus* (Marsh)*Protoreodon pearcei*, new species*Diplobunops*, cf. *matthewi* Peterson

Oromerycidae:

Malaquiferus tourteloti Gazin

Leptomerycidae:

Leptotragulus, cf. *medius* Peterson*Leptoreodon?*, sp.

* Rodents are as described by A. E. Wood from material in the collections at Amherst College and not represented in collections at the U. S. National Museum. The *Amynodon* material is that identified by H. E. Wood, II, in the collection of Wood, Seton and Hares.

CORRELATION AND AGE OF THE FAUNA

The fauna listed above is, of course, by present standards upper Eocene in age. Moreover, there would seem to be no doubt but that it is Uintan. Apparently not any of the forms here recognized are characteristically or exclusively Duchesnean. The general association of forms seen in the assemblage and the development reached in certain groups such as the agriochoerids rather strongly suggest an upper Uintan stage close to that at Myton pocket.

Considering first the reasons for not regarding the fauna as Duchesnean, only the rodent which A. E. Wood (1949) cited as questionably *Protadjidaumo* might be interpreted as this age. Nevertheless, this form is also older than Lapoint in age, as Kay (1953, p. 24) cites it as occurring in the Randlett fauna, and the latter I regard as but scarcely distinct from that of Myton, including it² (Gazin, 1955, chart 1) in the Uintan. The remainder of the fauna is composed of genera that so far as Duchesnean is concerned are characteristically earlier or common to both Uintan and Duchesnean. Thus, besides

² As currently being proposed by the Committee on Nomenclature and Correlation of North American Continental Tertiary of the Society of Vertebrate Paleontology.

Protadjidaumo, only *Epihippus*, *Amynodon*, and *Protoreodon* are common to the two, and the genera *Mytonolagus*, *Rapamys*, *Eomoropus*, *Epitriplopus*, *Pentacemylus*, *Diplobunops*, *Leptotragulus*, *Leptoreodon*, and possibly *Desmatotherium* and *Dilophodon* are characteristic of the Uintan. Some of these almost certainly gave rise to later types in the Oligocene but the genera in the latter group are not actually known in Duchesnean time. The genera *Sciuravus*, *Limnocyon*, and *Hyopsodus* are survivals from Bridgerian time and *Miacis* ranges through most of the Eocene.

The evidence for regarding the fauna as upper rather than lower Uintan pertains to the presence of *Mytonolagus*, the possible *Protadjidaumo*, and particularly to the stage of development shown in the *Protoreodon* and *Diplobunops* material. On the other hand, the presence of *Sciuravus* (doubtfully this genus according to Wood), *Limnocyon*, and *Eomoropus* might suggest an earlier horizon, but these are comparatively rare forms in Uintan deposits and their absence heretofore in beds as late as Uinta C is not nearly so significant as the fact that the agriochoerids are distinctly advanced over those of Uinta B time.

Question as to whether the Badwater fauna should be correlated with that from Myton pocket or with that known from the Randlett member may well have little significance. *Protadjidaumo* is not known from Myton pocket but the Badwater specimens are stated by A. E. Wood to consist of incisors only, so can scarcely merit serious debate. *Mytonolagus* is known from both levels but the Badwater form is a different species. *Dilophodon* ("Heteraletes") might suggest a relationship to the Randlett, but Uinta collections in the U. S. National Museum show that this form is present also in the Myton fauna. A slight evidence favoring the Myton fauna is seen in the artiodactyl species represented. Of the Badwater forms, *Protoreodon pumilus* is evidently present in all three occurrences, but *P. petersoni* and probably *P. pearcei* are known only in the Myton fauna. Also, the *Diplobunops* from Badwater resembles the Uinta form *D. matthewi* more closely than it does the broad-skulled *D. crassus*. It is entirely possible that, although a difference in stratigraphic level has been described for the Myton pocket and Randlett occurrences, the differences that may be pointed out are of ecologic significance, as suggested by the rather different nature of the deposits. The beds at the Myton pocket and Randlett occurrences received sedimentary materials from quite different rock sources. I have been unable to detect any change which can be regarded as evolutionary between forms common to the two levels.

Lack of uniformity of opinion regarding the source of Douglass's Eocene materials from the Sage Creek areas makes comparison with the fauna or faunas represented there decidedly unsatisfactory. I have not had the opportunity of studying the field occurrence firsthand so am unable to contribute any information to the stratigraphic picture. Nevertheless, from the materials that I have examined in the collections of Kay and of Hough, understood to be from a single horizon in the Eocene sequence, I find a comparatively close relationship between their fauna and the Badwater assemblage. While I do not concur in several of the identifications cited in Hough's (1955) paper, nor do I agree with the Duchesnean age assignment, there would appear to be a near equivalence in time, possibly also in environment, considering the similarity in faunal representation. With regard to the Douglass collection, I have seen only the helaetid and am reasonably convinced that it represents an advanced dilophodont distinct from the *Dilophodon* in Kay's collection. If, as Horace E. Wood (1934, p. 255) postulates, Douglass's amynodont might have weathered from the overlying Cook Ranch Oligocene, it is not impossible that the dilophodont did likewise and is a distinctly small and perhaps unprogressive species of *Protapirus*. In any case, its stage of development in the line of true tapirs postulated elsewhere in this paper would appear to be later than Uinta B. Recognition of the amynodont remains as *Amynodon advenus* by Wood in both the Douglass and Badwater collections would suggest a near equivalence in time. As to *Hyrachyus douglassi*, it would not appear to be as late as upper Uintan. *H. douglassi* and *Chasmotherooides*, cf. *intermedius* may well be Uinta B, or even earlier.

There remains consideration of the faunas from the Swift Current Creek beds of Saskatchewan and the Tapo Ranch horizon of the Sespe in California. Although the collections known from the Swift Current Creek beds consist of decidedly fragmentary materials there is suggestion of an age which might not be far removed from that at Badwater. Contributing to this is the association of lagomorph and *Hyopsodus* seen in both assemblages.

Of the horizons represented in the Sespe sequence, the Badwater would appear to be nearest to that represented at Tapo Ranch or C.I.T. locality 180. Although the species and most of the genera are not the same, the ages are probably not too different. The distinctive nature of the Tapo Ranch fauna may be largely due to its geographic remoteness.

SYSTEMATIC DESCRIPTION OF THE MAMMALIA

MARSUPIALIA?

DIDELPHIDAE?

PERATHERIUM?, sp.

The isolated lower molar, Amherst No. 10019, which A. E. Wood (1949) regarded as questionably representing *Metacodon* does not seem to me to be insectivore. His careful drawing of this tooth suggests possibly a closer relationship to the marsupials. I am particularly impressed by the lingual position of the hypoconulid, and the posterior deflection of the crest on which this cusp is located, away from the entoconid. The talonid appears to be quite different from the structure seen in *Ictops* and is unlike that, for example, in M_2 of *Metacodon mellingeri* where the hypoconulid is closely connected to the entoconid. For these reasons I have tentatively assigned this specimen to *Pera-therium?*, sp.

LAGOMORPHA

LEPORIDAE

MYTONOLAGUS WYOMINGENSIS Wood, 1949

Plate 1, figure 1

A. E. Wood (1949) has described several isolated teeth of *Mytonolagus* from the Badwater area and a comparatively unworn P^3 was designated the type of *Mytonolagus wyomingensis*. A right maxilla (U.S.N.M. No. 21090) with P^3 - M^2 collected by F. L. Pearce undoubtedly represents the same species. P^3 in this specimen, however, is more worn than in the type, although the teeth in general appear to be less worn than in the type of *Mytonolagus petersoni* which Burke (1934) described from Uinta C at Myton pocket. The teeth are strikingly like those in the type of *M. petersoni*, but it is noted that the hypostriae on M_2 and particularly M_1 are more persistent, extending nearly to the upper limit of the enamel lingually. The comparative weakness of the lingual fold toward the root of M^1 in *M. petersoni* was further noted in upper-tooth material of the Myton form in the collections of the National Museum. At least the hypostria extends nowhere near the upper limit of the enamel. Wood has regarded *M. wyomingensis* as perhaps more primitive than *M. petersoni*.

RODENTIA

Description of the known Rodentia in the Badwater fauna has been covered by A. E. Wood (1949). The collection described by him is at Amherst College.

CARNIVORA

LIMNOCYONIDAE

LIMNOCYON?, sp.

A maxillary fragment (U.S.N.M. No. 21088) with only P^4 may represent *Limnocyon*, but this is not certain. The specimen shows the infraorbital foramen immediately above and anterointernal to the anteroexternal root of P^4 , much as observed in *Limnocyon*. The tooth would appear to be a trifle smaller than in *Limnocyon douglassi* to judge by Peterson's (1919) illustration of this form. The Badwater tooth measures 9.6 mm. long by 9.4 transversely to base of enamel on the deuterocone.

MIACIDAE

MIACIS, cf. **ROBUSTUS** (Peterson), 1919

Plate 1, figure 2

A comparatively large miacid is represented by a lower jaw exhibiting the teeth P_4 to M_2 inclusive. *Miacis* would appear to be indicated by the distinctly basined form of the relatively small talonid of M_2 . The talonid of M_1 may likewise have been basined, although most of the superior surface of this portion of the carnassial is damaged so that its precise form is uncertain. It is, nevertheless, as in M_2 , short and decidedly narrower than the trigonid. M_3 is missing, represented by a single alveolus.

From measurements given by Peterson (1919), the type of *Miacis robustus* from the Uinta at Myton pocket is a little larger than the Badwater specimen. Peterson regarded P_4 and M_1 as subequal in size so that P_4 is evidently both relatively and actually larger in the type. This tooth, however, in U.S.N.M. No. 21087 closely resembles that of the type in the presence of a prominent anterior cusp and a strong talonid cusp, followed posteriorly by a well-developed cingulum. The abbreviation of the talonid in both M_1 and M_2 likewise suggests *M. robustus*.

The type of *Miacis uintensis* Osborn (1895) from Uinta B would appear from the scale of Osborn's illustration to be a little shorter

in length of cheek teeth and distinctly shallower jawed than the Badwater form. Moreover, P_4 in the type of Osborn's species apparently lacks the anterior cusp but has one more cusp on the posterior crest, to judge by the illustration (fig. 2), resembling more closely the referred tooth, A.M. No. 1895. M_1 is relatively smaller, and M_2 in Osborn's type has a higher trigonid and a less distinctly basined talonid.

Miacis gracilis Clark (1939) is, of course, a decidedly smaller species and P_4 is evidently characterized by two posterior cusps in addition to the cingulum.

MEASUREMENTS IN MILLIMETERS OF LOWER TEETH
IN *Miacis*, cf. *robustus*, U.S.N.M. NO. 21087

P_4 , anteroposterior diameter : transverse diameter.....	10.5 : 5.4
M_1 , anteroposterior diameter : transverse diameter of trigonid.....	13.0 : 7.5
M_2 , anteroposterior diameter : transverse diameter of trigonid.....	5.6 : 4.3

CONDYLARTHRA

HYOPSODONTIDAE

HYOPSODUS, cf. UINTENSIS Osborn, 1902

Plate 1, figure 3

A single *Hyopsodus* upper molar, U.S.N.M. No. 21089, may well represent *H. uintensis*, although some doubt may be entertained as comparisons involving such limited material cannot be entirely satisfactory. The tooth is about intermediate in size between M^1 and M^2 in the type, A.M. No. 2079, but resembles M^2 more closely than M^1 . The Badwater molar measures 4.3 mm. long by 5.6 transversely. This is too small to occlude properly with the type lower molar of *Hyopsodus fastigatus* Russell and Wickenden (1933) from the Canadian Swift Current Creek beds.

It is interesting to note that although the type, and presumably the two referred lower jaws mentioned by Osborn, are from the Uinta C of Utah, there is in the collections of the U. S. National Museum a lower jaw from Uinta B at White River pocket.

Mention may also be made of an upper Eocene occurrence of *Hyopsodus* at the Beaver Divide. The specimen, an upper molar, comparable in size to the Badwater tooth, was collected by Van Houten in beds he early regarded as representing the Beaver Divide conglomerate. The locality in question is some distance away from the critical Wagonbed Springs section and Van Houten has since doubted³ the

³ Personal communication.

correlation so that the tooth may well have originated in the Uinta equivalent present in the sequence.

PERISSODACTYLA

EQUIDAE

EPIHIPPIUS, cf. GRACILIS (Marsh), 1871

Plate 1, figure 5

The rather scant material representing *Epihippus* was first encountered in the Badwater localities in 1953. A maxillary fragment, U.S.N.M. No. 21092, including P², P³, and part of P⁴ and a single lower molariform tooth, U.S.N.M. No. 21094, possibly M₂, represent an equid approximately the size of *Epihippus gracilis*.

P² in No. 21092 is advanced over *Orohippus* in the development of the lingual portion, but not nearly so molariform as in *Mesohippus*. The anterointernal cusp in this tooth appears weaker than in the type of *Epihippus parvus* as figured by Granger (1908), being scarcely more than a low crest, extending lingually from the lingual surface of the paracone rather than from a position anterior to the paracone. There is no evidence of a mesostyle on P². P³ would appear to be entirely molariform. The second premolar measures 6.7 mm. long by 5.8 transversely.

The lower molar, in comparison with Uintan horses, shows little of diagnostic importance other than size which is close to that of the preserved molar (M₁) in the type of *Epihippus uintensis* (Marsh), placed by both Marsh and Granger in synonymy with *E. gracilis*. The tooth is a little smaller, though scarcely if any more brachydont than *Epihippus (Duchesnehippus) intermedius*. The V-shaped crests of the lower molar, however, are a little less acute than in the Duchesnean horse. The metaconid and metastylid are separate at the apex but this has been noted in molars as well as premolars of both the Uintan and Duchesnean *Epihippus*. The tooth measures 9.0 mm. long by 6.3 wide.

EPIHIPPIUS, cf. PARVUS Granger, 1908

Plate 1, figure 6

The material of a smaller horse in the Badwater fauna likewise includes a maxillary portion with P² and P³, U.S.N.M. No. 21091, and an isolated lower molariform tooth, U.S.N.M. No. 21093. There is, in addition, the greater part of an isolated molariform upper cheek tooth.

P² in the specimen compared with *E. parvus* is distinctly more progressive looking than in No. 21092 believed close to *E. gracilis*. The anterointernal cusp is clearly defined on a crest extending posterolingually from a position anterior to the lingual surface of the paracone, somewhat as it appears in the type of *E. parvus*, but with the long diameter of the cusps directed a little more transversely than in the latter, so that the anterior portion of the tooth seems broader. Moreover, the outer wall shows evidence of an incipient mesostyle, better developed in the type, but no trace of which was found in P² of No. 21092. P² in No. 21091 measures 6.1 mm. long by 5.1 wide transversely; P³ is 6.7 by 6.9.

The lower molariform tooth is quite like that (No. 21094) compared to *E. gracilis* but distinctly smaller. It measures 7.8 mm. long by 6.3 wide, comparing favorably in length, but a little broader than molariform lower teeth in A.M. No. 2066 referred to *E. parvus*.

BRONTOTHERIIDAE

A fragmentary maxillary portion without teeth but showing root portions of the canine and first two premolars would appear to be of a titanotherid. Speculation as to the genus represented would be unwarranted. Enamel fragments of large teeth in the collection may also be titanotherid, but this is uncertain as they might equally well represent an amynodont rhinoceros.

The Badwater specimen cited by Wood, Seton, and Hares (1936) as *Telmatherium*, cf. *cultridens* is half of a lower molar which W. K. Gregory, in a note to Wood, observed, "Granger and I found this tooth to be close to M₂ of referred specimens of *Telmatherium cultridens*." There is, of course, a close resemblance; nevertheless, from the very fragmentary nature of the specimens it is extremely doubtful if among the several genera of Uintan titanotheres all can be excluded from consideration. The specimen from Lysite Mountain identified by G. E. Lewis (in Tourtelot, 1948) as *Telmatherium*, cf. *cultridens* I have not seen. It could not be located in the collections at Yale Peabody Museum.

CHALICOTHERIIDAE

EOMOROPUS ANARSIVS,⁴ new species

Plate 2, figures 1-3

Type.—Greater part of left side of skull and left ramus of mandible, U.S.N.M. No. 21097.

⁴ *Anarsios* (Gr.), incongruous, strange—in allusion to the large and unexpected canine.

Horizon and locality.—Hendry Ranch member of Tepee Trail formation on Dry Creek, SE $\frac{1}{4}$ sec. 9, near line between secs. 9 and 16, T. 39 N., R. 92 W., Wind River Basin, Wyo.

Specific characters.—Teeth only slightly larger than in *Eomoropus amarorum*, but skull proportions and depth of lower jaw much greater. Parastyle of upper molars increasingly prominent from M¹ to M³, considerably more extended anteroexternally than in *Eomoropus annectens*, and evidently more so than in *E. amarorum*.

Discussion.—One of the more important discoveries in the upper Eocene of the Wind River Basin is the skull and jaw material of the chalicothere, *Eomoropus*. The specimen (U.S.N.M. No. 21097) consists of the left half of the skull and left ramus of mandible, and was found by F. L. Pearce in exposures on an eastern tributary of the east fork of Dry Creek about 20 miles west of the Badwater Creek localities. The deposits here were mapped by Tourtelot⁵ as the same formation as that exposed along the south side of Badwater Creek and are believed to be the same age.

The species represented was earlier (Gazin, 1955, p. 77) thought to be *Eomoropus amarorum*, but subsequent direct comparison with the type, A.M. No. 5096, would seem to preclude this possibility. *E. amarorum* was described by Cope (1881) from a specimen consisting of the posterior portion of a skull, a lower jaw, and certain other portions of the skeleton illustrated by Osborn (1913), and derived from the Washakie Basin. According to Osborn, Cope's specimen probably came from near the base of Washakie B, or the upper Washakie. I suspect that the horizon represented is from higher in the Washakie than suggested, inasmuch as *E. amarorum* would appear to be more progressive than Uinta B *Eomoropus annectens*.

Comparison of *Eomoropus anarsius* with the type of *E. amarorum* shows similarities in the orbital region but the depth of the face below the lower margin of the orbit is conspicuously greater, also the post-orbital process of the frontal appears less prominent and overhanging. The lateral view of the squamosal is similar in the two with the relative position of the external auditory meatus with respect to the glenoid surface much the same. However, the distance between the last molar and the glenoid surface is about 30 percent greater in *E. anarsius*. Moreover, the depth of the lower jaw is also nearly 30 percent greater and the masseteric fossa is deeply impressed and better defined. The two animals would appear to be at about the same stage of maturity, with *E. amarorum* possibly a little older, to judge

⁵ U.S.G.S. Oil and Gas Investigations Map OM 124, sheet 1.

by wear of M_1 (compare height of cusps shown in lateral view, pl. 2, fig. 1, with Osborn's fig. 3A on p. 267, 1913).

Unlike the type of *E. amarorum*, the cranial portion of the *E. anarsius* skull is poorly preserved, but fortunately the side of the rostrum, missing in the former, is present in the Dry Creek specimen. Perhaps the most striking feature to be revealed by the *E. anarsius* rostrum is the enlarged canine, evidently not included in the dentition of *Moropus*. Absence of this tooth has been generally regarded as characterizing the family although in certain forms the complete formula is not known. The upper premolars were not preserved in

MEASUREMENTS IN MILLIMETERS OF DENTITION IN TYPE OF
Eomoropus anarsius, U.S.N.M. NO. 21097

Length of upper molar series, M^1 - M^3 inclusive, parallel to tooth row.....	54.4
M_1 , anteroposterior diameter perpendicular to anterior margin.....	14.9
M_1 , greatest transverse diameter across parastyle and protocone.....	16.7
M_2 , anteroposterior diameter perpendicular to anterior margin.....	19.0
M_2 , greatest transverse diameter across parastyle and protocone.....	23.5 ^a
M_3 , anteroposterior diameter perpendicular to anterior margin.....	19.6
M_3 , greatest transverse diameter across parastyle and protocone.....	25.0
Length of preserved lower cheek tooth series, P_3 - M_3 , inclusive.....	78.0
Length of lower premolars, P_3 - P_4	24.0
Length of lower molars, M_1 - M_3	54.0
P_3 , anteroposterior diameter: transverse diameter of talonid.....	12.8: 7.8
P_4 , anteroposterior diameter: transverse diameter of talonid.....	11.2: 8.1
M_1 , anteroposterior diameter: transverse diameter of talonid.....	13.9: 9.0
M_2 , anteroposterior diameter: transverse diameter of trigonid.....	16.9: 10.5
M_3 , anteroposterior diameter: transverse diameter of talonid.....	24.0: 10.5

^a Approximate.

No. 21097, but the three molars are complete. *Eomoropus* upper molars are characterized by a lophoid protocone and hypocone, more elongate than in *Moropus*, and with a distinct protoconule. The external wall exhibits a strikingly developed parastyle and a prominent, anteroposteriorly compressed mesostyle and paracone rib. The rib on the metacone is weak or wanting. M^3 exhibits a spurlike metacone directed nearly at right angles to the similarly developed mesostyle.

Comparison with upper teeth in Cope's type is limited to the lingual portion of M^3 and no significant differences are observed. Nevertheless, the anteroexternal root for M^2 and M^3 can be observed in Cope's specimen, and its position is not nearly so forward and outward as in *E. anarsius*, suggesting rather less extension of the parastyle in the molars. Comparison with the excellent upper cheek tooth series preserved in the type of *Eomoropus annectens*, which Peterson (1919)

described from the Uinta B horizon, shows that the Dry Creek specimen has molars rather similar, except that the parastyles are strikingly more outstanding and the teeth are about 20 percent larger. Moreover, the rib on the paracone, in keeping with the parastyle, is better developed.

The lower teeth of *E. anarsius* are quite similar to those in *E. amarorum* and about the same size, although the anterior premolars may be relatively a little larger. *E. amarorum* includes all the lower cheek teeth from P_2 to M_3 , inclusive. In No. 21097 only P_2 of this series is missing, although the inner walls of M_2 and M_3 are not complete. As Osborn has shown, these teeth are much like those in *Moropus*; however, in the earlier form P_2 is a relatively larger tooth and M_3 retains a prominent hypoconulid. Moreover, as observed in occlusal view of the Dry Creek specimen, the crista obliqua in all the cheek teeth following P_2 joins the posterior wall of the trigonid somewhat more buccally and lower than in *Moropus*, so that the W-pattern is not so well developed.

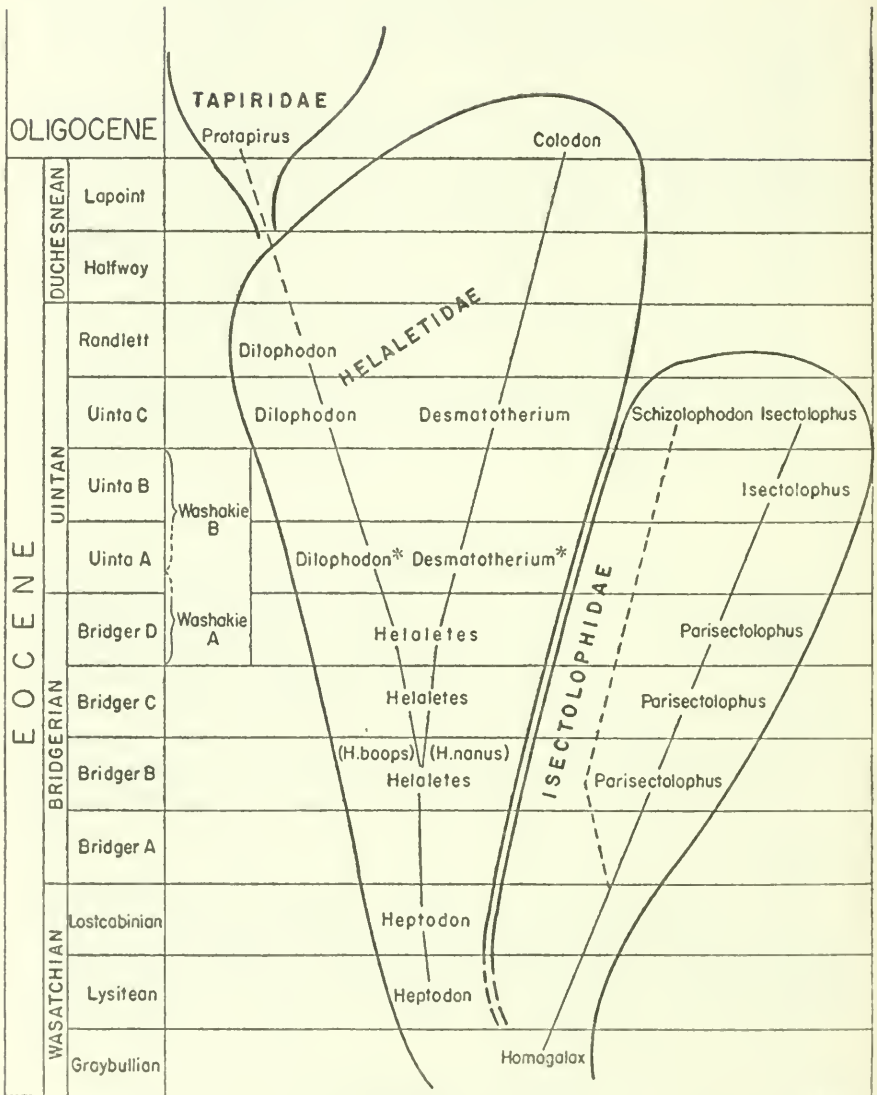
HELALETIDAE

Simpson (1945) included the Helaletidae in the Tapiroidea, an arrangement which is distinctly preferable to including it, as Scott (1941) has, in the Rhinoceroidea. Scott, moreover, included the hyrachyids in the Helaletidae, and although there is much to be said for such a grouping, as the hyrachyids are in many ways intermediate between the tapiroids and rhinocerotids and show certain marked resemblances to *Helalates*, nevertheless the family distinction as the Hyrachyidae within the Rhinoceroidea, as advocated by H. E. Wood, II (1934) and retained by Simpson (1945), may well be more desirable.

The Eocene tapiroids are structurally a comparatively conservative group, distinguished from one another by relatively small and seemingly unimportant differences. Nevertheless, at least two families, the Helaletidae and Isectolophidae, should probably be recognized for North American forms.

DESMATOTHERIUM Scott, 1883

Originally described by Scott as coming from the Bridger Eocene, it is now understood that the type of *Desmatotherium guyotii* came from the Washakie beds (see Granger, 1909, p. 22) and is in all likelihood upper Eocene rather than Bridgerian in age. Peterson (1919, p. 127) was evidently in error in citing the locality for this specimen as "Henry's Fork, Wyoming."



*Exact horizon uncertain

FIG. 1.—Suggested phylogenetic arrangement of North American Eocene tapiroids.

Scott's generic comparisons were made largely with *Hyrachyus*, from which it clearly differs. I am convinced, however, that a distinctly closer relationship to *Heleletes* is indicated. The Badwater, Sage Creek, and Washakie materials together provide the evidence showing the sequence from Bridgerian *Heleletes* through Uintan *Desmatotherium* to Oligocene *Colodon*. As a consequence, *Desmatotherium* should be included in the Heleletidae, as Simpson (1945) has indicated, not with *Hyrachyus* as Peterson (1919) placed it. On the other hand, the subfamily separation of the Colodontinae from the Heleletinae made by Wortman and Earle (1893), which Simpson has preserved, cannot now be reconciled with the sequential arrangement indicated above.

DESMATOTHERIUM WOODI,⁶ new species

Plate 2, figure 4

Type.—Right maxilla with P³-M³ (P⁴ incomplete), U.S.N.M. No. 20200.

Horizon and locality.—Hendry Ranch member of Tepee Trail formation on south side of Badwater Creek, SW cor., SE $\frac{1}{4}$ sec. 14, T. 39 N., R. 89 W., Wind River Basin, Wyo.

Specific characters.—Upper molar teeth approximately 20 percent smaller than in *Desmatotherium guyotii* Scott or *Desmatotherium kayi* Hough. Upper premolars smaller than in these species but relative size intermediate between them and closer to *D. guyotii*.

Discussion.—Four incomplete upper dentitions and a number of isolated teeth, including some from the lower series, all from the Badwater Creek localities, represent the species *D. woodi*. Two of these, part of the type and two upper premolars (part of U.S.N.M. No. 20202) were figured by Hough (1955, pl. 8, figs. 6 and 9) as material referred to the Sage Creek species *D. kayi*. I have examined all the Sage Creek specimens together with the Badwater material and find there is no overlap in observed size range for each. The type of the Sage Creek species is nearly 20 percent larger than that of the Badwater form. *D. kayi* was described as close in size to *D. "guyotii"* but with smaller premolars. The premolars of *D. woodi* are a little smaller than in *D. kayi*, but the ratio of their size to that of the molars is more nearly as in *D. guyotii*.

The principal feature of the upper dentition of *Desmatotherium*, distinguishing it from *Hyrachyus*, is the more progressive condition of the premolars. The divided lingual portion of P³ and P⁴ gives these

⁶ Named for H. E. Wood, II, in appreciation of his work on the Hyrachyidae.

teeth a distinctly more molariform appearance. Resemblance is immediately seen to the earlier *Helaletes nanus* (genotype) which in a similar way is distinguished from *Helaletes boöps*. Washakie *D. guyotii* is a much larger form than *Helaletes nanus*, but *D. woodi* is nearly intermediate. Certain of the larger Bridger individuals with progressive premolars, referred to *H. nanus*, make a close approach to *D. woodi* in size but the separation of the lingual cusps of P^3 and P^4 in any case is clearly not so well effected.

Resemblance of *Desmatotherium* upper teeth to those of *Colodon* is perhaps even more striking; nevertheless, *Colodon* can with little doubt be defended as distinct from *Desmatotherium*. The premolars of *Colodon*, particularly P^2 , would appear to be more progressive and, as shown in illustrations given by Scott (1941, pl. 81) of *Colodon occidentalis*, the posterior upper premolars, noticeably P^3 , would appear to have better defined, more clearly separated, transverse lochs. Moreover, a comparison of measurements shows that although *D. guyotii* is comparable to *Colodon occidentalis* in size, the latter has distinctly wider teeth both in the premolar and molar series. This is perhaps most noticeable in the appearance of the posterior loph of the anterior molars which is decidedly longer in the illustration of *Colodon*.

Lower teeth of *Desmatotherium* are rather poorly represented, except in the Sage Creek collections. They are not known for *D. guyotii* and only certain isolated teeth and tooth fragments are included in the materials of *D. woodi*. Characters of the lower teeth of *D. kayi* were briefly discussed by Hough but somewhat further description, particularly a comparison with the earlier *Helaletes*, seems indicated.

Lower premolars of *Desmatotherium* in comparison with those of *Helaletes* are noticeably shortened anteriorly and relatively broad. Particularly significant is the distinctly larger entoconid which in *Colodon* is quite as large as the hypoconid. There is little evidence for an entoconid in lower premolars of *Hyrachyus*. The progressive development of the entoconid toward *Colodon*, and shortening of the trigonid, give the premolars a more molariform appearance, but the entoconid remains distinct from the hypoconid so that a completely lophoid posterior crest as in the molars is never reached.

The lower molars of *D. kayi*, as in *Helaletes* and unlike *Hyrachyus*, show clear-cut transverse lochs with only a very subdued crista between them, a tooth form already realized in *Heptodon*. The parastylid, particularly on M_3 , seems more reduced in *Desmatotherium* than in *Helaletes* and much more reduced than in *Hyrachyus*. The hypoconulid on M_3 may be slightly more reduced than in either *Helaletes* or *Colodon*. The lower molars of *Colodon*, in addition to

their relatively greater width, are more nearly symmetrical bilaterally, exhibiting a slight crest forward from both the entoconid and metaconid, quite matching those of the labial side.

As previously noted, there seems little doubt but that a phyletic sequence is indicated from *Helaletes* through *Desmatotherium* to

MEASUREMENTS IN MILLIMETERS OF UPPER DENTITIONS
OF *Desmatotherium woodi*

	U.S.N.M. No. 20200 Type	U.S.N.M. No. 20201	U.S.N.M. No. 20202
Length of upper premolar series, P ¹ -P ⁴ , inclusive			33.3
P ¹ , anteroposterior diameter: greatest transverse diameter			7.5: 6.0
P ² , anteroposterior diameter			8.3: —
P ³ , anteroposterior diameter: greatest transverse diameter		9.0: 11.7	8.9: 11.8
P ⁴ , anteroposterior diameter: greatest transverse diameter	8.8: 12.4	9.2: 12.7	9.1: 12.6
			U.S.N.M. No. 20204
Length of upper molar series, parallel to tooth row	37.5		
M ₁ , anteroposterior diameter perpendicular to anterior margin	11.0	11.0	
M ₁ , transverse diameter across parastyle and protocone	14.0	13.8	
M ₂ , anteroposterior diameter perpendicular to anterior margin	12.9		12.8
M ₂ , transverse diameter across parastyle and protocone	15.8		15.0
M ₃ , anteroposterior diameter perpendicular to anterior margin	13.7		13.0
M ₃ , transverse diameter across parastyle and protocone	15.6		15.1

Colodon, and this may logically include *Heptodon* in the lower Eocene which, in addition to a much reduced P₁, has only slightly less progressive premolars than *Helaletes*. The four genera are not readily separated on the basis of molar teeth but a progressive change in the premolars is noted, more precocious in tapiroid character than in contemporary isctolophodont and dilophodont forms (as well as harychyd). Nevertheless, this line evidently did not give rise to true tapirs.

DILOPHODON Scott, 1883

Dilophodon was described by Scott (1883) in the same publication as *Desmatotherium* and, as in the case of *D. guyotii*, the type of *Dilophodon minusculus* was attributed to the Bridger Eocene. It is clear that Scott regarded the Washakie beds as Bridger and it is from the Washakie Basin rather than the Bridger Basin, as indicated by Granger (1909, p. 22), that the *D. minusculus* type originated. Granger has the species listed as representing Washakie A, but I suspect that the horizon for this, as well as *D. guyotii*, is B, particularly since both are known from the upper Eocene elsewhere and neither has turned up in the rather extensive collections known from the Bridger proper.

Dilophodon is clearly related to *Helaletes* but represents a line separate from that of *Desmatotherium*, possibly derived from the species *Helaletes boöps*, having the less progressive premolars or, as seems more than likely, from a somewhat earlier stage. It is not certainly demonstrated that *Dilophodon* gave rise to *Protapirus* but, as far as can be determined, this upper Eocene form possesses all, or nearly all, the requirements in the structure of the teeth that might be sought for in the Eocene ancestor of the true tapirs.

DILOPHODON, cf. LEOTANUS (Peterson), 1931

Plate I, figures 7, 8

The type of Peterson's *Heteraletes leotanus* from the Randlett locality exhibits beyond doubt an immature dentition so that the characters attributed to the premolar series, particularly the "molariform P₄," apply to the deciduous series, and hence do not serve to distinguish *Heteraletes* from *Dilophodon*.

In the Badwater collection there is a right mandibular ramus (U.S.N.M. No. 20207, figured by Hough, 1955) including all the lower cheek teeth, and both maxillae of a skull (U.S.N.M. No. 21098) with P³-M³ represented, although P⁴, M¹, and M² are not complete. There are in addition almost a dozen isolated teeth or portions of teeth. Comparison between the Badwater and Randlett materials is limited to M₁ and M₂. These teeth in No. 20207 are close in size to those in the type, although possibly a trifle wider, and have similar completely lophoid transverse crests with practically no development of a crista obliqua.

The Badwater form clearly represents a species with smaller teeth than the Washakie *Dilophodon minusculus*, but the lower jaw is deeper and a little more robust. Moreover, the symphysis is broader and ex-

tends posteriorly to a position much farther back than in *D. minusculus*. The width of the lower teeth is not significantly different but those in the Badwater form are a little shorter, particularly in the premolar region. A peculiar parallel with the *Desmatotherium* line is noted in the anteroposterior shortening of the anterior or trigonid portion of the premolars, suggesting that the Badwater form is a little more advanced than *D. minusculus*. This is not an unreasonable suggestion since the Washakie horizon represented by the latter, though possibly earlier than Uinta B, is certainly not later. *D. minusculus* lower teeth, compared in turn with those in *Helaletes*, are seen to resemble them very closely. I note only the somewhat more progressive premolars with distinctly more basined talonids, and the presence of a hypoconulid on M_3 .

Dilophodon leotanus, though having lower premolar trigonids shortened from the *Helaletes* stage, has these portions developed for the most part about as in *Protapirus*, not so abbreviated as in *Colodon*. However, P_2 in the *D. leotanus* specimen at hand is relatively undeveloped. Although this tooth shows characters which are probably variable, the paraconid and metaconid are scarcely more than crests, somewhat as in *Colodon*. Nevertheless, the talonid is more nearly similar to that in *Protapirus* in that the crest of the hypoconid appears to be more median in position as it approaches the trigonid, producing a rather distinctive labial fold or depression.

In the lower molars the parastyle development is rather similar to that of *Protapirus*, although the crosslophs seem more clean-cut.

Significant features are seen in the upper teeth of the Badwater species, and except for M^3 , these teeth were hitherto not known for *Dilophodon*. It may be noted in particular that P^3 and P^4 (P^1 and P^2 are not known) have a single, undivided lingual cusp or deuterocone as in *Helaletes boöps*, not divided as in the *Desmatotherium-Colodon* line, and that in M^1 and M^2 the metacone, though exhibiting a heavy cingulum externally, is not concave but distinctly convex labially, so that the metacone has a little more conical appearance. Its form, however, is not quite comparable to that in *Homagalax* or in the middle and upper Eocene isectolophids which, as Hatcher (1896) pointed out, are not entirely suited in this detail as potential ancestors of *Protapirus*. The form of the metacone is unlike *Desmatotherium* or *Colodon* and different than in most of the *Helaletes* material examined, although in some specimens of the latter the concavity is not emphasized and much of the *Heptodon* material would not be excluded as potentially ancestral.

The combination of characters seen in the upper dentition is highly suggestive of *Protapirus* and the possibility of an ancestral relationship is not precluded by the characters of the lower dentition, as it so

MEASUREMENTS IN MILLIMETERS OF DENTITIONS IN SPECIES OF
Dilophodon

		<i>D.</i> , cf. <i>leotanus</i> U.S.N.M. No. 21098
Length of upper dentition, P ² -M ³ inclusive.....		39.0°
Length of upper premolars, P ² -P ⁴ inclusive, at alveoli.....		17.0°
Length of upper molar series, M ¹ (at alveolus)-M ³ inclusive.....		23.2
P ³ , anteroposterior diameter: transverse diameter.....		5.7: 8.2
M ² , anteroposterior diameter perpendicular to anterior margin.....		8.2°
M ² , transverse diameter across parastyle and protocone.....		9.8°
M ³ , anteroposterior diameter perpendicular to anterior margin.....		8.7
M ³ , transverse diameter across parastyle and protocone.....		10.4
	<i>D. minus-</i> <i>culus</i> P.U. No. 10019 Type	<i>D.</i> , cf. <i>leotanus</i> U.S.N.M. No. 20207
Length of lower cheek tooth series, P ₂ -M ₃ inclusive.....	46.6	41.1
Length of lower premolar series, P ₂ -P ₄ inclusive.....	18.7	16.2
Length of lower molar series, M ₁ -M ₃ inclusive.....	28.3	25.4
P ₂ , anteroposterior diameter: greatest transverse diameter	5.6: 3.4	4.8: 3.5
P ₃ , anteroposterior diameter: greatest transverse diameter	6.5: 4.6	5.7: 4.5
P ₄ , anterioposterior diameter: greatest transverse diameter	6.8: 5.5	6.1: 5.2
M ₁ , anteroposterior diameter: transverse diameter of trigonid	8.1: 5.2	7.2: 5.2
M ₂ , anteroposterior diameter: transverse diameter of trigonid	9.4: 5.9	8.8: 6.1
M ₃ , anteroposterior diameter: transverse diameter of trigonid	10.6: 6.3	10.1: 6.5

° Estimated.

clearly is in the isectolophid line. The phyletic position of *Dilophodon* with respect to *Protapirus* had been suspected by Peterson (1919, p. 113) on the basis of the lower dentition, and the likelihood of such a relationship seems greatly strengthened by information furnished by the upper cheek teeth of *Dilophodon*, cf. *leotanus*.

HYRACODONTIDAE

EPITRIPOPLUS?, sp.

Plate 1, figure 4

A lower jaw fragment with a well-worn cheek tooth, U.S.N.M. No. 21099, evidently a molar, and fragments of two lower molars belonging to another specimen are surely rhinocerotid and would appear to be hyracodont rather than hyrachyid. I am, nevertheless, unable to determine whether the form represented is *Prothyracodon*, *Triplopus*, or *Epitriplopus*. The Badwater teeth are closer in size to those in *Epitriplopus uintense* than they are to those in *Prothyracodon obliquidens*. The teeth also strongly resemble, but are much smaller in size than in the Lapoint hyracodont which Peterson unfortunately named *Mesamynodon medius*. The lower tooth in No. 21099 measures 16.2 mm. long by 11.1 mm. wide.

Dr. H. E. Wood concurs with me that, of the various possible allocations which may be made of this material, *Epitriplopus* is the most probable.

ARTIODACTYLA

DICHOBUNIDAE

PANTACEMYLUS?, sp.

A homacodont that may well be *Pentacemylus* is represented by the posterior two-thirds of M_3 . There is no certainty, however, that the form is not *Mytonomeryx*. The tooth conforms closely in form of cusps and is only very slightly smaller than in *Pentacemylus progressus*. It does not appear to represent the smaller *Bunomeryx*.

APRICULUS,⁷ new genus

Type.—*Apriculus praeteritus*, new species.

Generic characters.—Simple conical cusps on upper molars as in *Helohyus*, but these teeth more nearly quadrate with large lingually placed metaconule on all three. Cingulum continuous around molars without external styles and without evidence of a hypocone. Protoconule slightly better defined than in *Helohyus*. P^1 with single primary cusp and deuterocone.

Discussion.—*Apriculus* is almost certainly a descendant of Bridgerian *Helohyus* and belongs in the Helohyinae, but its trend has been

⁷ *Apriculus*, diminutive of *Aper* (L.), wild boar.

more conservative and along a line independent of that for *Achaenodon*. Change from *Helohyus* has been the increase in size of the metaconule, and the shift to a more lingual position. This is particularly noticeable for M^3 which, rather than having a triangular outline, has achieved the quadrate form of the anterior molars with the metaconule equally well developed. There is, however, no evidence of the development posteriorward of M^3 as in *Perchoerus*; nor do any of the molars show development of a "pseudometaconule" anterolateral to the metaconule.

Distinction from *Achaenodon* is seen not only in the very much smaller size of *Apriculus* so far as known, but in the retention and marked development of the protoconule.

APRICULUS PRAETERITUS,⁸ new species

Plate 3, figure 1

Type.—Right maxilla with P^4 - M^3 (teeth incomplete), U.S.N.M. No. 21100.

Horizon and locality.—Hendry Ranch member of Tepee Trail formation on south side of Badwater Creek, SW cor., $SE\frac{1}{4}$ sec. 14, T. 39 N., R. 89 W., Wind River Basin, Wyo.

Specific characters.—Size of upper molars very close to that for *Helohyus plicodon*. Other differences included in description of genus.

Discussion.—The type maxilla with somewhat damaged upper teeth is the only known specimen of this comparatively late survival of a *Helohyus*-like dichobunid. The upper molars, though comparable in size to those of *Helohyus plicodon*, are perhaps a little narrower transversely, as the basal slope of the protocone and cingulum median to it do not extend so far lingually. The anterointernal and posterointernal portions of the molars are more nearly equal in lingual extent.

Precise measurements of the individual teeth in the type of *Apriculus praeteritus* cannot be obtained because of breakage; nevertheless over-all dimensions can be determined and the length of the preserved portion of the upper cheek tooth series, P^4 - M^3 inclusive, is found to be 30 mm. The molar series is about 24.5 mm. long. M^2 is estimated to be about 8.7 (anteroposteriorly) by 10.6 mm.

In size, upper molars of *Apriculus praeteritus* are only a little larger than the dichobunid tooth figured by Russell and Wickenden (1933).

⁸ *Praeteritus*, overlooked or passed over—overlooked in recent review of collections for upper Eocene artiodactyl study.

The Swift Current Creek⁹ specimen, however, is distinctly less quadrate, and the metaconule, rather than occupying the posterolingual angle of the tooth, is between the protocone and metacone. Moreover, there appears to be a hypocone, or at least a well-developed crest, posterior to the protocone. The structural resemblance of this tooth to both the leptchoerids and diacodexids was noted by Russell and Wickenden. Possibly further evidence bearing on the relationship suggested (Gazin, 1955) for these two groups is to be found in the Swift Current Creek beds when the fauna from there is better known.

Apriculus praeteritus will not be confused with the *Helohyus*?, sp. described by Peterson (1934) from the Lapoint Duchesnean. Although direct comparison in details of teeth is precluded by the different nature of the known material, the disparity in size is alone conclusive, at least as far as species are concerned. The Lapoint specimen, as indicated by Peterson, is rather close in size to *Helohyus lentus*, and although the premolar, disregarding the small parastylid, is rather like that in Bridger *H. lentus*, the molar is not particularly close. The paraconid in M_1 , as shown in Peterson's illustration, is much too far forward. *Helohyus* in general does not show the crest extending posteriorly from the protoconid or the triangular-shaped basin formed between this crest and crista obliqua observed in the Lapoint M_1 . In *Helohyus* the low crista obliqua extends forward to a much more buccal position on the trigonid, with a well-formed basin posterolingual to this crest.

I strongly suspect that the Lapoint specimen is a very small entelodont. The crest pattern of the molar which Peterson so clearly described and as outlined above, while unlike that of *Helohyus*, can be clearly, though weakly, discerned in unworn first and second lower molars of *Archaeotherium*. In a footnote Peterson called attention to the resemblance of P_4 to that in *Archaeotherium*, but discredited such a relationship by the presence of a paraconid on M_1 . This reasoning I cannot understand, as the lingual portion of the trigonid of not too well worn lower molars in the Oligocene form usually shows two

⁹ Omitting consideration of the Saskatchewan Swift Current Creek beds and fauna in my review of upper Eocene artiodactyls was a regrettable oversight and should in no way be regarded as implying a lack of significance. The materials, though fragmentary, give us the only glimpse so far obtained of the nature of the upper Eocene fauna at a latitude so far north. It is only from such Canadian discoveries that speculation by various paleontologists on the possibility of more northern origins of early Tertiary groups with obscure ancestry may be evaluated.

clearly defined and well-separated cusps. Whether the anterior of these originated by twinning or from the cingulum, or whether the two cusps are actually the metaconid and metastylid, would not seem to alter the picture. If subsequent material should demonstrate that the Lapoint specimen is indeed of a small primitive entelodont the possibility of the entelodonts having originated early in the Helohyinae would not seem to be precluded. Although Peterson's specimen is unlike *Helohyus* in details seemingly on a generic level, the bunodont form of the Lapoint molar could possibly be regarded as a modification from that of *Helohyus* or *Lophiohyus*. The interval from Bridger to Lapoint time would seem entirely adequate.

I agree with Peterson that the Lapoint specimen is probably inadequate as a type, nevertheless its possible new-born significance may warrant a name, if for no other purpose than as a handle for discussion purposes. I propose the new name *Dyscritochoerus*¹⁰ *lapointensis*.¹¹ The type is the lower jaw portion described by Peterson, C.M. No. 11912.¹² It might tentatively be aligned with the entelodonts. If *Dyscritochoerus* is in truth a link between the entelodonts and the helohyids its position in the uppermost Eocene is reasonable and would not necessarily imply an Oligocene age for the Lapoint horizon.

AGRIOCHOERIDAE

PROTOREODON, cf. PETERSONI Gazin, 1955

Plate 3, figure 4

Not more than four specimens represent a distinctly small species of *Protorcodon* in the Badwater fauna. Three of these are isolated teeth, but one, U.S.N.M. No. 21101, is a right maxilla including M¹-M³. The teeth correspond closely in size to those in Uinta C *Protorcodon petersoni*, and, like that species, the protoconule is rather weak, not so emphasized as in earlier Uinta C *Protorcodon minor*. The molar series in No. 21101 is 20.0 mm. long.

PROTOREODON, near P. PUMILUS (Marsh), 1875

There are about 18 specimens of a comparatively large form of *Protorcodon*. Most of these are isolated teeth, although a few are jaw or maxillary fragments with two or three teeth, generally broken.

¹⁰ *Dyskritos* (Gr.), hard to determine or doubtful, and *choiros* (Gr.), pig.

¹¹ *lapointensis*, from the town and horizon Lapoint.

¹² Dr. Kay informs me that he has been unable to locate this specimen in the collections at the Carnegie Museum.

These teeth are all of about the size of those in Uintan *P. pumilus*. There is, moreover, no certain evidence that another species such as *Protoreodon primus* is not represented.

PROTOREODON PEARCEI,¹³ new species

Plate 3, figures 7, 8

Type.—Skull, jaws, and other portions of skeleton, U.S.N.M. No. 20305.

Horizon and locality.—Hendry Ranch member of Tepee Trail formation on south side of Badwater Creek, SW $\frac{1}{4}$ sec. 13 near line between sections 13 and 24, T. 39 N., R. 89 W., Wind River Basin, Wyo.

Specific characters.—Larger and more robust than *Protoreodon pumilus*, very close in size to *Diplobunops matthewi*. Marked diastema between canine and P¹.

Discussion.—Although this specimen had been early regarded as *Protoreodon primus* (see Hough, 1955) it is readily distinguished from this species and the advanced *Protoreodon pumilus annexens* by its distinctive size. It is much more easily confused with the equally large *Diplobunops matthewi*. There are several isolated teeth and incomplete dentitions that appear to represent this very large protoreodont, but a number, more fragmentary or too well worn, cannot be allocated as between this form and *Diplobunops*, cf. *matthewi*.

The skull of *Protoreodon pearcei* differs rather noticeably from that of *Diplobunops*, cf. *matthewi* in the Badwater collection (see Gazin, 1955, pls. 10-12) in the anterior extremity of the rostrum. Although the canines are actually larger and as far apart in *P. pearcei*, the snout extremity does not appear so bluntly expanded, evidently because the palate is not so noticeably constricted behind P¹. There is a diastema between the canine and P¹ about the same length as in the *Diplobunops* specimen but there is no diastema behind P¹, and the premolars are distinctly crowded. P² shows a slight basin posterointernally but no deutocone. P³ has a smaller deutocone but a distinctly better defined basin posterointernally than in the *Diplobunops* material, and in P⁴ there is clearer evidence of a tritocone. The upper molars show more lingually sweeping outer crescents and the protoconule may be a little weaker. This is particularly true of M³.

The lower jaw is not so constricted through the symphyseal portion as it is in the *Diplobunops* material figured by Scott (1945, pl. 5, fig.

¹³ Named for Franklin L. Pearce, who found the type specimen.

2). P_1 is a very large caniniform tooth, closely followed by the succeeding, noticeably overlapping premolars. I have not observed significant differences in the lower premolars and molars although from the material at hand the lower cheek teeth of *P. pearcei* are a little narrower than in *D.*, cf. *matthewi*.

Protoreodon pearcei makes a close approach to *Agriochœrus antiquus* in size and in the presence of a short though distinct diastema between the upper canine and P^1 . There is, however, no diastema between P_1 and P_2 . Moreover, the posterior premolars above and below are not nearly so progressive. Also, the protoconule, though very weak on M^3 , is clearly defined on M^1 and M^2 .

I am not certain that this species is represented in Uinta collections, but a robust jaw from Leland Bench Draw with closely crowded premolars and no diastema between P_1 and P_2 may represent *P. pearcei* rather than *Diplobunops matthewi*. Measurements of this jaw were given (Gazin, 1955, p. 64) in comparison with the type materials, showing the shortness of the space occupied by the premolar sequence.

Protoreodon pearcei is apparently represented in the Sage Creek area collections by a skull which has the Carnegie Museum number 8927. It was collected by J. L. Kay in 1940 and the catalog card carries the information "Spring Gulch, Sage Creek." The information "Oligocene (Cook Ranch)" also appears on the label, but this information is surely a misinterpretation of the horizon represented. The skull was figured by Hough (1955, pl. 8, fig. 8) as "*Mesagriochœrus*, cf. *primus*" and the catalog number is incorrectly cited as "9827."

Measurements for the teeth in the type of *P. pearcei* are given with those for *Diplobunops*, cf. *matthewi* in the following section.

DIPLOBUNOPS, cf. MATTHEWI Peterson, 1919

Plate 3, figure 6

In contrast to the rather small ratio of *Diplobunops* to *Protoreodon* specimens encountered in the Uinta basin, *Diplobunops* is almost as abundant in the Badwater collection as *Protoreodon*. Remains of this comparatively large agriochœrid include some of the better preserved materials representative of the fauna and the least distorted known for the genus. Two excellent skulls were collected by Harry A. Tourtelot, one of these, U.S.N.M. No. 20303, has been previously figured (Gazin, 1955, pls. 10-12).

The distinction between *Diplobunops* and *Protoreodon* on the basis of isolated teeth is difficult to make, particularly in the Badwater materials, because with the recognition of the equally large *Pro-*

MEASUREMENTS IN MILLIMETERS OF DENTITIONS IN SPECIMENS OF
Protoreodon pearcei AND *Diplobunops*, CF. *matthewi*

	<i>D.</i> , cf. <i>matthewi</i>		<i>P.</i> <i>pearcei</i> U.S.N.M. No. 20305 Type
	U.S.N.M. No. 20304	U.S.N.M. No. 20303	
Length of upper dentition, C (at alveolus)- M ³ , inclusive		96.5	90.5
Length of upper dentition, P ¹ -M ³ , inclusive.		83.0	74.0
Upper premolar series, P ¹ -P ⁴ , inclusive.		44.0	36.5
Upper molar series, M ¹ -M ³ , inclusive.	39.5	40.0 ^a	39.6
C, anteroposterior diameter (at alveolus): greatest transverse diameter.		7.7:7.1	11.0:8.7
P ¹ , anteroposterior diameter: greatest trans- verse diameter		9.0:3.8	7.7:4.3
P ² , anteroposterior diameter: greatest trans- verse diameter	9.6:5.9	10.3:6.4	11.1:6.5 ^a
P ³ , anteroposterior diameter: transverse di- ameter *	10.2:10.2	10.3:9.8	11.1:9.5
P ⁴ , anteroposterior diameter: transverse di- ameter	10.1:12.3	10.0:12.9	10.2:12.5
M ¹ , anteroposterior diameter: transverse di- ameter *	12.8:15.1	12.0 ^a :—	12.5:13.5
M ² , anteroposterior diameter: transverse di- ameter	13.8:16.6	13.8:17.5	13.7:16.6
M ³ , anteroposterior diameter: transverse di- ameter	13.7:18.0	14.0 ^a :19.5 ^a	15.0:18.3
Length of lower cheek tooth series, P ₁ (at alveolus)-M ₃ , inclusive			82.5
Length of lower premolar series, P ₁ (at alveolus)-P ₄ , inclusive		43.2	38.3
Length of lower molar series, M ₁ -M ₃ , in- clusive			44.0
P ₁ , anteroposterior diameter (at alveolus): greatest transverse diameter.			10.0:8.3
P ₂ , anteroposterior diameter: greatest trans- verse diameter		10.0:5.3	9.5:4.6
P ₃ , anteroposterior diameter: greatest trans- verse diameter		11.0:7.0	10.8:6.2
P ₄ , anteroposterior diameter: greatest trans- verse diameter		12.2:8.0	11.5:7.2
M ₁ , anteroposterior diameter: transverse di- ameter of talonid.			10.9:8.1
M ₂ , anteroposterior diameter: transverse di- ameter of talonid		14.4:11.3 ^a	13.0 ^a :9.3
M ₃ , anteroposterior diameter: transverse di- ameter of trigonid.		—:10.7	20.3:10.4

^a Approximate.

* Measurements of posterior upper premolars are taken anteroposteriorly across outer portion and transversely perpendicular to outer margin. Those of upper molars are taken anteroposteriorly perpendicular to anterior margin and transversely across anterior portion of tooth, lingually to base of enamel or cingulum.

torcodon pearcei size is no longer an aid. Teeth of *Diplobunops* are slightly less selenodont. The inner and outer crests of the upper molars are seemingly farther apart with the outer cusps a trifle more erect and their apices more buccal or not so lingually directed. The cusps or crests of the lower molars have a slightly more inflated or obtuse look and may be relatively broader. There is, of course, variation in both forms; moreover, these characters of the teeth are scarcely of generic significance and seem somewhat distinctive only between contemporaries in these groups in the higher horizons of Uintan time. *Diplobunops*, so far as known, did not progress much beyond the *Protorcodon* tooth structure characterizing Uinta B time. The genera are, as I have attempted to show earlier (1955), very closely related and their skulls may be distinguished essentially on the different character of the anterior part of the snout.

OROMERYCIDAE

MALAQUIFERUS TOURTELOTI Gazin, 1955

Plate 3, figure 2

The type of this form is from the Dry Creek occurrence some 20 miles to the west of the Badwater Creek localities. Its description and illustration were included in an earlier paper (1955, pl. 16), and need not be repeated here. An isolated oromerycid upper molar (U.S.N.M. No. 21102) in the Badwater collection exhibits the same rectangular form, rugosity, posteriorly bifurcate protocone, and outstanding ribs on the outer cusps as in *Malaquiferous tourteloti*. It corresponds closely in form and size, and in the possession of a slightly outward-deflected metastyle to M^3 . It differs in having a heavier, antero-posteriorly developed mesostyle. The shape of this tooth is entirely different, although structurally related to that in *Oromeryx plicatus*. Likewise, it would not be confused with the comparatively large *Protylopus? annectens*.

This tooth lends support to the belief that the Dry Creek occurrence is probably equivalent in time to that at Badwater, a conclusion earlier reached on the basis of lithology, and the general upper Eocene indication by the presence of *Eomoropus*.

LEPTOMERYCIDAE

LEPTOTRAGULUS, cf. MEDIUS Peterson, 1919

Plate 3, figure 5

Two lower jaw portions, and probably several of the isolated molars, represent a form close or identical to the upper Uintan *Leptotragulus*

medius. One of the jaw portions (U.S.N.M. No. 21104) with P_4 and M_1 falls within the size range of the Myton material, but the other (U.S.N.M. No. 21103), which has P_3 - M_1 , is a little larger than any in the above series. Nevertheless the latter is closer in size of teeth to *L. medius* than it is to *L. proavus*. The structure of the lower premolars in these jaws corresponds very closely to that regarded as characterizing *Leptotragulus*.

The teeth in both Nos. 21103 and 21104 are significantly smaller than in the type of *Leptotragulus? significans* Russell from the Kishenehn beds in British Columbia. Although I have not examined the Kishenehn specimen, from Russell's clear description and stereoscopic illustrations I would favor referring his form to *Leptomeryx* rather than *Leptotragulus*. As a consequence, there would seem to be somewhat better evidence for the Oligocene age postulated by Russell as an alternate possibility for the Canadian occurrence.

LEPTOREODON?, sp.

Plate 3, figure 3

A couple of isolated premolars in the collection, a little smaller than in *Leptoreodon marshi* but not greatly different in size from *Leptotragulus medius*, exhibit a well-defined metaconid. In one of these the metaconid is opposite the protoconid and shows a well-defined groove between them anteriorly, much as in characteristic material of *Leptoreodon*. The parastylid, however, is a well-developed column distinct from the anterior crest of the protoconid, suggestive of *Leptomeryx*. Nevertheless, as in *Leptoreodon* and unlike *Leptomeryx*, the talonid basin is formed by the posteroexternal crest swinging lingually near its posterior extremity, joined only by a weak spur from the metaconid. In *Leptomeryx*, the hypoconid and entoconid in P_4 are in most cases sharply separated and join forward with the protoconid and metaconid respectively. The second isolated P_4 exhibits a parastylid much as in *Leptotragulus*, but the metaconid, though weak, is distinct and unlike *Leptotragulus*. This tooth has a very primitive look and may not represent any known leptotragulids.

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EXPLANATION OF PLATES

PLATE I

LAGOMORPH, CARNIVORE, CONDYLRARTH, AND PERISSODACTYLS FROM
THE BADWATER UPPER EOCENE

- FIG. 1. *Mytonolagus wyomingensis* A. E. Wood: Right maxilla (U.S.N.M. No. 21090), occlusal view of teeth. $4\times$ natural size. Badwater upper Eocene, Wind River Basin, Wyo.
- FIG. 2. *Miacis*, cf. *robustus* (Peterson): Left ramus of mandible (U.S.N.M. No. 21087), occlusal and lateral views. Natural size. Badwater upper Eocene, Wind River Basin, Wyo.
- FIG. 3. *Hypopsodus*, cf. *uintensis* Osborn: Right upper molar (U.S.N.M. No. 21089), occlusal view. $4\times$ natural size. Badwater upper Eocene, Wind River Basin, Wyo.
- FIG. 4. *Epitriplopus?*, sp.: Left lower molar (U.S.N.M. No. 21099), occlusal view. Natural size. Badwater upper Eocene, Wind River Basin, Wyo.
- FIG. 5. *Epihippus*, cf. *gracilis* (Marsh): Right maxilla (U.S.N.M. No. 21092), occlusal view. Twice natural size. Badwater upper Eocene, Wind River Basin, Wyo.
- FIG. 6. *Epihippus*, cf. *parvus* Granger: Right maxilla (U.S.N.M. No. 21091), occlusal view. Twice natural size. Badwater upper Eocene, Wind River Basin, Wyo.
- FIGS. 7, 8. *Dilophodon*, cf. *leotanus* (Peterson): 6, Right upper cheek teeth (U.S.N.M. No. 21098), occlusal view (incomplete P⁴ reversed from left side). 7, Right lower cheek teeth (U.S.N.M. No. 20207), occlusal view. One and one-half times natural size. Badwater upper Eocene, Wind River Basin, Wyo.

PLATE 2

PERISSODACTYLS FROM THE DRY CREEK AND BADWATER UPPER EOCENE

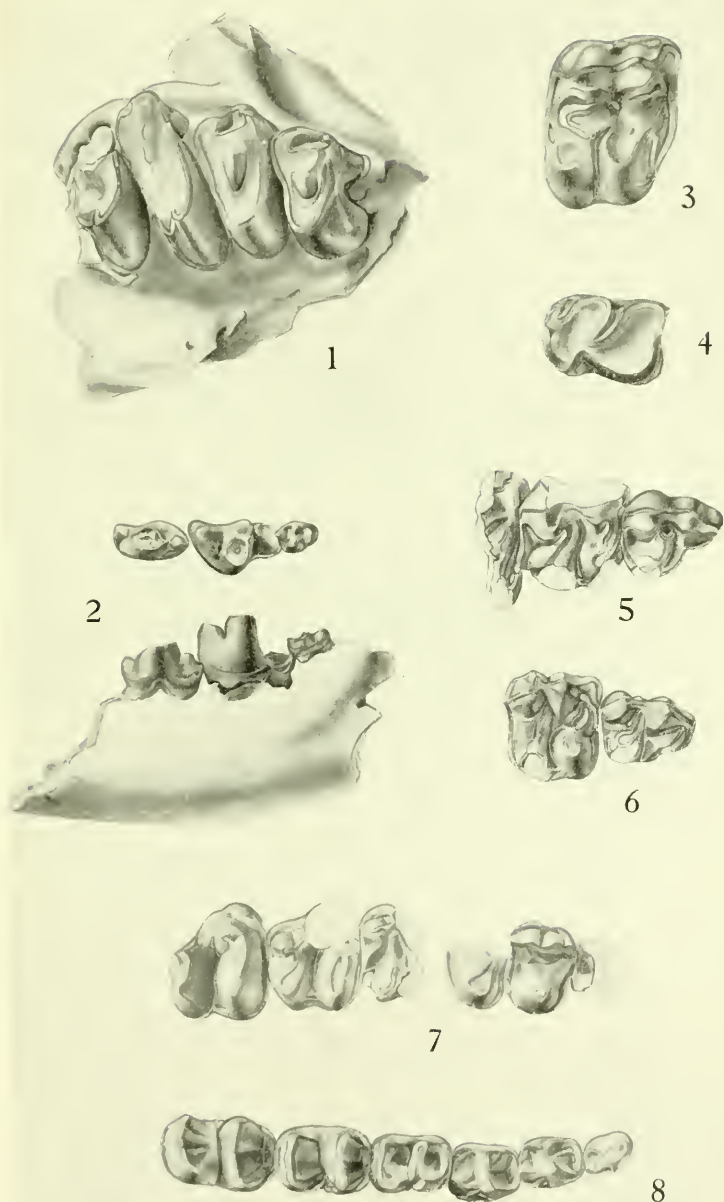
- FIGS. 1-3. *Eomoropus anarsius*, new species: 1, Skull and left ramus of mandible (U.S.N.M. No. 21097), type specimen, lateral view. Two-fifths natural size. 2, Left upper molars (U.S.N.M. No. 21097), type specimen, occlusal view. Natural size. 3, Left lower cheek teeth (U.S.N.M. No. 21097), type specimen, occlusal view. Natural size. Dry Creek upper Eocene, Wind River Basin, Wyo.
- FIG. 4. *Desmatotherium woodi*, new species: Composite right upper cheek tooth series; premolars (U.S.N.M. No. 20202), occlusal view; molars (U.S.N.M. No. 20200), type specimen, occlusal view. Natural size. Badwater upper Eocene, Wind River Basin, Wyo.

PLATE 3

ARTIODACTYLS FROM THE BADWATER UPPER EOCENE

- FIG. 1. *Apriculus procteritus*, new genus and species: Right maxilla (U.S.N.M. No. 21100), type specimen, occlusal view. Twice natural size. Badwater upper Eocene, Wind River Basin, Wyo.

- FIG. 2. *Malaquiferus tourteloti* Gazin: Right upper molar (U.S.N.M. No. 21102), occlusal view. Twice natural size. Badwater upper Eocene, Wind River Basin, Wyo.
- FIG. 3. *Leptoreodon?*, sp.: Left P₄ (U.S.N.M. No. 21105), occlusal view. Twice natural size. Badwater upper Eocene, Wind River Basin, Wyo.
- FIG. 4. *Protoreodon*, cf. *petersoni* Gazin: Right maxilla (U.S.N.M. No. 21101), occlusal view. Twice natural size. Badwater upper Eocene, Wind River Basin, Wyo.
- FIG. 5. *Leptotragulus*, cf. *medius* Peterson: Right ramus of mandible (U.S.N.M. No. 21103), occlusal and lateral views. Twice natural size and natural size, respectively. Badwater upper Eocene, Wind River Basin, Wyo.
- FIG. 6. *Diplobunops*, cf. *matthewi* Peterson: Right upper cheek tooth series (U.S.N.M. No. 20304), occlusal view (P² and P³ restored from left side). Natural size. Badwater upper Eocene, Wind River Basin, Wyo.
- FIGS. 7, 8. *Protoreodon pearcei*, new species: 7, Right upper cheek teeth (U.S.N.M. No. 20305), type specimen, occlusal view. Natural size. 8, Right lower cheek teeth (U.S.N.M. No. 20305), type specimen, occlusal view (P₁ reversed from left side). Natural size, Badwater upper Eocene, Wind River Basin, Wyo.



LAGOMORPH, CARNIVORE, CONDYLRARTH, AND PERISSODACTYLS FROM THE BADWATER UPPER EOCENE

(See explanation of plates at end of text.)



1



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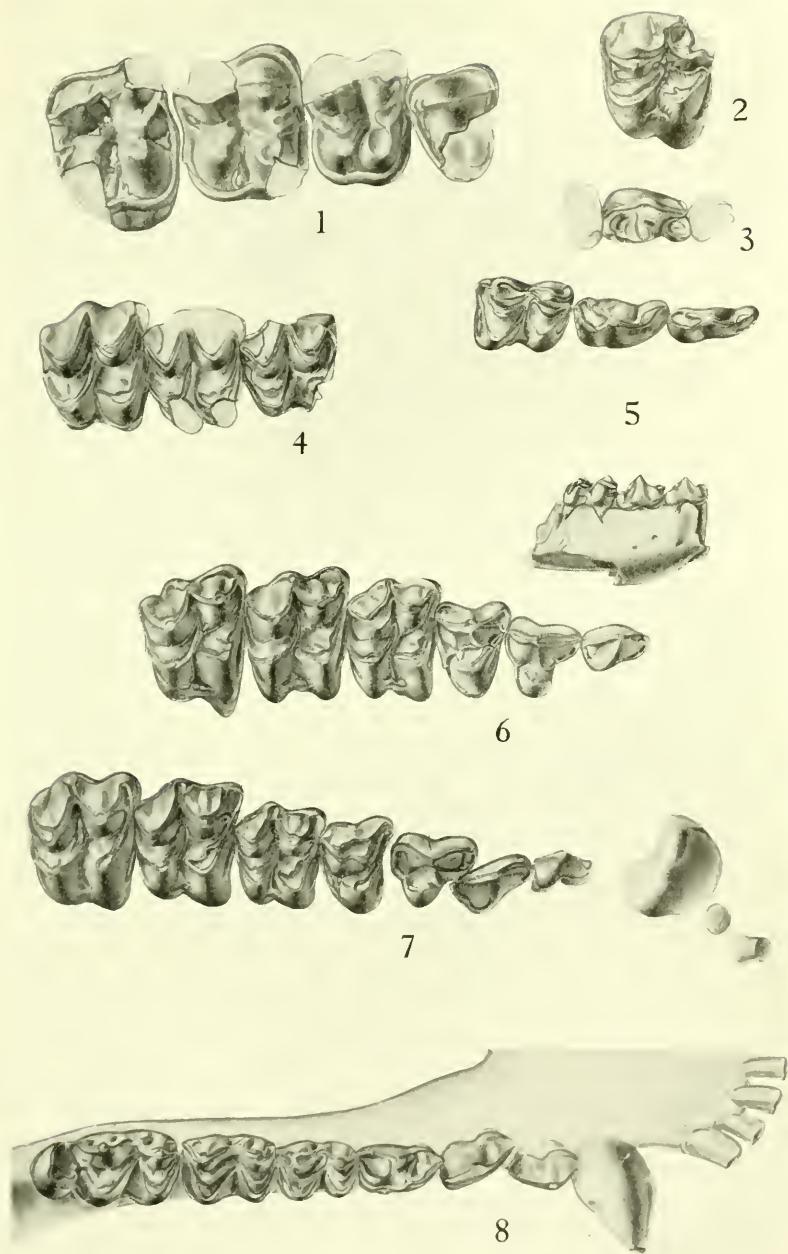


3



4

PERISSODACTYLS FROM THE DRY CREEK AND BADWATER UPPER EOCENE
(See explanation of plates at end of text.)



ARTIODACTYLS FROM THE BADWATER UPPER EOCENE
(See explanation of plates at end of text.)