

MINIOCHOERINAE AND
OREONETINAE TWO
NEW SUBFAMILIES
OF OREODONTS

C. BERTRAND SCHULTZ AND
CHARLES H. FALKENBACH

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OF OREODONTS

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SEVENTH
CONTRIBUTION TO THE REVISION OF THE
OREODONTS (MERYCOIDODONTIDAE),
SUBFAMILIES 7 AND 8

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 - M. (P.) helprini*, new species, referred, S. Dak.
 - M. (P.) ottensi*, new species, referred, Nebr.
 - Platychoerus platycephalus* (Thorpe), referred, Wyo.
 - P. heartensis*, new species, holotype, N. Dak.
 - P. hatcreekensis*, new species, referred, Nebr.
 - Stenopsochoerus sternbergi*, new species, referred, Nebr.
 - S. berardae*, new species, referred, S. Dak.
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M. (Paraminiochoerus) gracilis (Leidy), referred, S. Dak.
M. (P.) affinis (Leidy), referred, Colo. and S. Dak.
M. (P.) helprini, new species, referred, S. Dak.
M. (P.) ottensi, new species, referred, Nebr.
Platychoerus platycephalus (Thorpe), referred, Wyo.
P. heartensis, new species, holotype, N. Dak.
P. hatcreekensis, new species, referred, Nebr.
Stenopsochoerus sternbergi, new species, referred, Nebr.
S. berardae, new species, holotype and referred, S. Dak.
S. (Pseudostenopsochoerus) chadronensis, new species, holotype, Wyo.
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Limneneles platyceps Douglass, holotype and referred, Mont.
? *L. spec. undet.*, example, Mont. (inferior and superior dentitions, and mandibular ramus)
Bathygenys alpha Douglass, holotype (mandibular ramus), Mont., and referred, Mont. and Wyo.
- Skeletal elements:
Limneneles platyceps Douglass, tentatively referred, Mont.
Bathygenys alpha Douglass, referred, Wyo.

INTRODUCTION

REPORT NUMBER SEVEN in the revision of the oreodonts (Merycoidodontidae) deals with two subfamilies—7, Miniochoerinae, and 8, Oreonetinae.¹ The Miniochoerinae, subfamily 7, embraces four new and closely related genera and two new subgenera, *Miniochoerus*, *M.* (*Paraminiochoerus*), *Platychoerus*, *Stenopsochoerus*, *S.* (*Pseudostenopsochoerus*), and *Parastenopsochoerus*. The size ranges from the smallest known oreodont from the Brule formation, *M.* (*Paraminiochoerus*) *gracilis*, with a skull somewhat smaller than examples of *Merychyus crabilli*, to *Miniochoerus cheyennensis*, with a skull comparable in size with that of *Merychyus arenarum*. The subfamily is represented by 475 skulls, mandibular rami, and skeletal elements (240 F.A.M., 130 U.N.S.M., and 105 in various other institutions). These are described or listed under six new genera and subgenera. Thirty-eight of these specimens, including three refigured types, representing 18 species (15 of which are new), are illustrated in 11 text figures. The drawings are reproduced at natural size and one-half natural size.

The Oreonetinae, subfamily 8, embraces two related genera, *Oreonetes* and *Limninetes*, and the questionably referred *Bathygenys*. The smallest known oreodont, *Bathygenys alpha* Douglass, has a skull comparable in size with that of a small rabbit. The larger skulls of *Oreonetes anceps* (Douglass) and *Limninetes platyceps* Douglass are approximately of the size of examples of *M.* (*Paraminiochoerus*) *gracilis* (Leidy). The subfamily Oreonetinae is represented by 29 skulls, mandibular rami, and skeletal elements (four F.A.M., 15 A.M., and 10 C.M.). Thirteen of these specimens, representing three species, a new subspecies, and one undetermined form, and including three refigured types, are reproduced in text figure 12 at

¹ Previous numbers by the same authors include: subfamily 1, Merycochoerinae (1940, Bull. Amer. Mus. Nat. Hist., vol. 77, art. 5, p. 213); 2, Ticholeptinae (1941, vol. 79, art. 1, p. 1); 3, Merychyinae (1947, vol. 88, art. 4, p. 161); 4, Promerycochoerinae (1949, vol. 93, art. 3, p. 73); 5, Phenacocoelinae (1950, vol. 95, art. 3, p. 91); and 6, Desmatochoerinae (1954, vol. 105, art. 2, p. 143).

The grouping of the two new subfamilies under one cover is for convenience in publishing and does not imply close relationship.

natural size and one-half natural size.

The series of 12 figures illustrates, in the case of the two subfamilies, the range in size, shape, and proportion of the skulls, mandibular rami, and limb elements. It is of interest to note the marked difference between the small (minute) auditory bullae of Miniochoerinae and the inflated bullae of the Oreonetinae; the comparison of the small M_1^1 of *Miniochoerus* and *M.* (*Paraminiochoerus*) with the larger M_1^1 of *Platychoerus*, *Stenopsochoerus*, *S.* (*Pseudostenopsochoerus*), and *Parastenopsochoerus*; the increase in size in the Miniochoerinae, especially in the skull in the sequence of the various phyla; and the difference between the dentition and occipital region in examples of the Miniochoerinae and *Merycoidodon*. The drawings were executed by Richard Cavalli, Russell F. Peterson, and the late Mrs. Helen Ziska under the supervision of Miss Hazel de Berard of the Frick Laboratory.

The writers are grateful to all who have helped to make these studies possible, particularly those² whose continued aid and encouragement have been previously acknowledged.

The following is a list of abbreviations of institutions cited:

A.M., the American Museum of Natural History
A.N.S.P., Academy of Natural Sciences of Philadelphia
C.M., Carnegie Museum of Pittsburgh
F.A.M., Frick Collection of American Mammals
P.U., Princeton University
U.C., University of California
U.N.S.M., University of Nebraska State Museum
U.S.N.M., United States National Museum
Y.P.M., Yale University, Peabody Museum

STRATIGRAPHIC RELATIONSHIPS

Remains of the Miniochoerinae, so far as known, have been restricted to the Chadron and Brule³ formations, or their approximate age equivalents in Colorado, Montana, Nebraska, North Dakota, South Dakota, and Wyoming; and of the Oreonetinae, to the middle

² *Idem*, 1940, p. 216; 1941, p. 5; 1947, p. 165; 1949, p. 79; 1950, p. 95; 1954, p. 153.

³ The uppermost portion of the "*Leptauchenia* Beds" (of some writers), which are considered to be Miocene in age, are excluded here. See Schultz and Falkenbach, 1954, p. 154.

EPOCH		GROUP		WHITE RIVER	
OLIGOCENE					
FORMATIONS	Zones	Chadron		Brule	
		Upper	Middle	Lower	
[MEMBERS] Whitney Orella	"D"	Subfamily 7 - MINIOCHOERINAE			
	"C"	I. <i>Miniochoerus</i>			
	"B"	II. <i>Platychoerus</i>			
	"A"	III. <i>Stenopsochoerus</i>			
Upper		Subfamily 8 - OREONETINAE			
		I. <i>Oreonetes</i> II. <i>Limnenetes</i> III. <i>Bathygenys</i>			
Middle		I. <i>Oreonetes</i> II. <i>Limnenetes</i> III. <i>Bathygenys</i>			
Lower		I. <i>Oreonetes</i> II. <i>Limnenetes</i> III. <i>Bathygenys</i>			

EXPLANATION OF CHART 1. The continued use of faunal zones¹ in this report is necessary to indicate approximate age equivalents in the various localities until definite geologic correlations can be established between the various Oligocene deposits in the Great Plains region.

The known geologic range of each genus and subgenus is indicated by a solid vertical line with a horizontal bar at either end. Where relationship between two phyla is questioned, the line is broken.

The numbers used here for species and subspecies are the same as those in the table of contents of this report. The numbers to the left of the vertical line indicate forms from the west-central Great Plains (Colorado, Nebraska, South Dakota, or Wyoming); those to the right, from localities outside this area (Montana or North Dakota).

Subfamily 7. Miniochoerinae

I. *Miniochoerus*, new genus

1. *M. battlecreekensis*, new species
2. *M. starkensis*, new species
3. *M. nicholsae*, new species
4. *M. cheyennensis*, new species

IA. *Miniochoerus* (*Paraminiochoerus*), new subgenus

1. *M. (P.) affinis* (Leidy)
2. *M. (P.) gracilis* (Leidy)
3. *M. (P.) helprini*, new species
4. *M. (P.) ottensi*, new species

II. *Platychoerus*, new genus

1. *P. platycephalus* (Thorpe)
2. *P. heartensis*, new species
3. *P. hatcreekensis*, new species

III. *Stenopsochoerus*, new genus

1. *S. sternbergi*, new species
2. *S. joderensis*, new species
3. *S. berardae*, new species

IIIA. *Stenopsochoerus* (*Pseudostenopsochoerus*), new subgenus

1. *S. (P.) chadronensis*, new species
- 1a. *S. (P.) chadronensis*, new geologic variety
2. *S. (P.) douglasensis*, new species
- 2a. *S. (P.) douglasensis*, new geologic variety
3. *S. (P.) reideri*, new species

IV. *Parastenopsochoerus*, new genus

1. *P. conversensis*, new species

Subfamily 8. Oreonetinae

I. *Oreonetes* Loomis

1. *O. anceps* (Douglass)
- 1a. *O. anceps douglassi*, new subspecies

II. *Limninetes* Douglass

1. *L. platyceps* Douglass
2. ?*L.* spec. undet.

III. *Bathyggenys* Douglass

1. *B. alpha* Douglass

¹ Falkenbach and Schultz, 1951, Guide Book, Fifth Field Conf., Soc. Vert. Paleont., p. 47; Skinner, *op. cit.*, p. 57 (North Dakota section); also Schultz and Falkenbach, 1954, p. 153.

part of the Chadron formation in Montana and Wyoming. (See chart 1, p. 382, illustrating the stratigraphic distribution.) Owing to the difficulties of geologic correlation between various areas that contain deposits of Brule age, the same faunal zones are used in chart 1 and throughout the text of the present paper as have been cited in the writers' previously published reports.

It is of interest that a paleosol complex occurs at the top of the deposits of each of the oreodont faunal zones in the Wyoming-Nebraska-South Dakota region. The apparent relationship of the faunal zones and the "fossil" soils is expressed in a preliminary report by Schultz, Tanner, and Harvey.¹

CHARACTERS IN AUDITORY BULLAE

The skulls of the *Miniochoerinae*, regardless of their geologic occurrence from the upper Chadron through "Zone D" of the Brule, exhibit small (minute) auditory bullae, characteristically even less inflated than the examples of *Oreonetinae* from the middle Chadron. Compared to the *Desmatochoerinae*² and *Merycoidodontinae* (yet to be reported upon), the bullae of the *Miniochoerinae* are similar to those from "Zone A" but definitely distinct from the inflated bullae of examples of the former two subfamilies occurring above that zone. In fact, there appear to be no examples of large bullae in any of these subfamilies from "Zone A." The development of the bulla seems to have been from small (minute) to large (inflated) instead of the reverse suggested by Scott, who believed that an inflated bulla "is a primitive condition." (See discussion in *Desmatochoerinae*,³ and this report, p. 391.)

It is of interest that Wortman⁴ noted the relationship of the size of the bullae to the geologic occurrence and concluded: "Among the oreodons all the skulls from the typical nodular layer are without inflated tympanic bulla. In the uppermost strata of the *Oreodon* Beds there is one skull in the collection which

has a very small bulla, while in the nodular layer of the *Protoceras* Beds all the skulls show a well-developed bulla." In the same report Wortman considered a skull, "*Oreodon*, 611," as coming from a zone "75 to 100 feet" above the "reddish gritty clay," and it is unquestionably the one he reported as from the "uppermost strata of the *Oreodon* Beds" and as having "a very small bulla." His reference to a "small" bulla, however, seems to have been in error, since Osborn and Wortman⁵ later referred the same skull to "*Oreodon*" *bullatus* and mentioned: "There is a single skull of this species in our collection (No. 611) which was obtained from the second 'nodular layer' from seventy-five to a hundred feet above the 'red layer' of the '*Oreodon* Bed.' It is a matter of much interest to note that the bullae are much more inflated than in either *O. culbertsonii* or *O. gracilis*." It should be repeated, however, that examples of *Miniochoerinae* with small bullae are found throughout the Brule formation.

RANGE OF VARIATION

The apparent range of variation in the basal lengths of the skulls and in the superior and inferior dentitions within the *Miniochoerinae* is shown in chart 2. The chart indicates a trend for the forms to become larger as they occur progressively higher in the geologic scale.

PROPORTIONS OF LENGTH OF LIMBS TO BASAL LENGTHS OF SKULLS

The limb elements of the *Miniochoerinae* are not well represented. The proportions between length of limbs and basal length of associated skull are presented in chart 3. Considerable variation and overlapping of measurements are apparent, and it is questionable whether the few available examples indicate the over-all aspect.

THE POLLEX IN MINIOCHOERINAE

The *Miniochoerinae* are the first oreodonts with a five-toed forefoot so far reported upon in the present series. Five-toed examples are listed under *M. (Paraminiochoerus)* (p. 407),

⁵ 1894, Bull. Amer. Mus. Nat. Hist., vol. 6, art. 7, p. 218, fig. 5c.

¹ 1955, Bull. Univ. Nebraska State Mus., vol. 4, no. 1, p. 4.

² Schultz and Falkenbach, 1954.

³ *Idem.*, 1954, p. 155.

⁴ 1893, Bull. Amer. Mus. Nat. Hist., vol. 5, art. 9, p. 105.

CHART 2
RANGE IN THE MINIOCHOERINAE

	No. of Ex- amples	SKULL		DENTITION							
		Basal Length ^a		P ¹ -M ³		P ₁ -M ₃		M ³ AP ^b		M ₃ AP	
		Range	Mean ^c	Range	Mean	Range	Mean	Range	Mean	Range	Mean
I. <i>Miniochoerus</i>											
<i>M. battlecreekensis</i> , "Zone A" Brule (Nebr., S. Dak., Wyo.)	21	137-144	139	64-73	60	70-77	74	14-17.5	15.5	17-20	18.8
<i>M. starkensis</i> , "Zone B" (Colo., Nebr., N. Dak.)	4	137-141	139	69-70	69.3	76	76	16-18	16.6	20.5-21.5	21
<i>M. nicholsae</i> , "Zone C" (Nebr., N. Dak.)	5	148-153	151	76-78	77	77-83	79	18.5-20.5	19.5	20-21.5	20.9
<i>M. cheyennensis</i> , "Zone D" (Nebr., S. Dak.)	4	156-168	161	77-84	80	85-92	89	18.5	18.5	22	22
IA. <i>M. (Paraminiochoerus)</i>											
<i>M. (P.) affinis</i> , "Zone A" (Colo. Nebr., S. Dak., Wyo.)	112	114-136	128.2	56-69	62.7	60-76	68	12-16.5	14.5	14.5-20	17.6
<i>M. (P.) gracilis</i> , "Zone A" (Nebr., S. Dak., Wyo.)	140	103-123	112	50-62	55	53-65	59	10.5-14.5	12.1	12.5-19.5	14.7
<i>M. (P.) helprini</i> , "Zone B" (Nebr., N. Dak., S. Dak.)	13	135-143	139	63-69	65	67-72	69	14.5-18	15.6	16.5-19.5	18.4
<i>M. (P.) otiensi</i> , "Zone C" (Nebr.)	4	142-147	144	66-73	69	77-80	79	15.5-18	16.7	18.5-20.5	19.5
II. <i>Platychoerus</i>											
<i>P. platycephalus</i> , "Zone A" (Nebr., S. Dak., Wyo.)	64	130-149	136.5	60-76	69	69-83	74	14-18.5	15.8	17-21	18.7
<i>P. heartensis</i> , "Zone B" (Nebr., N. Dak., S. Dak.)	7	129-146	141	64-71	69	67-78	75	16.5-18	17	19-20	19.5
<i>P. hatcreekensis</i> , "Zone C" (Nebr., S. Dak.)	14	148-169	153.9	72-83	75.5	80-85	83	18-21.5	19	21.5-24.5	22.6
III. <i>Stenopsochoerus</i>											
<i>S. sternbergi</i> , "Zone A" (Colo., Nebr., Wyo.)	33	124-143	131	59-72	66.8	63-75	72.1	13-17	15.4	14.5-20.5	18.2
<i>S. berardae</i> , "Zone C" (Nebr., S. Dak.)	9	150-161	155	68-82	75	75-85	81	15.5-19.5	17.7	21-23.5	22.3
IIIA. <i>S. (Parastenopsochoerus)</i>											
<i>S. (P.) chadronensis</i> , Chadron (Wyo.)	2	141-153	147	70.5-73.5	72	80	80	15-16.5	15.7	19.5-20.5	20
<i>S. (P.) chadronensis</i> , geol. var., "Zone A" (Nebr., Wyo.)	9	138-144	139.8	68-72.5	69.5	72-81	75.2	15-18	16	18-21	19.6
<i>S. (P.) douglasensis</i> , "Zone A" (Colo., Nebr., Wyo.)	19	135-152.5	144.8	71-76	73.4	75-82.5	78.1	16.5-18.5	17.2	18.5-21.5	20.1
<i>S. (P.) douglasensis</i> , geol. var., Chadron (Nebr., Wyo.)	3	143-145	144	74.5-76.5	75	81-82	81.5	16-17.5	17	20	20
IV. <i>Parastenopsochoerus</i>											
<i>P. conversensis</i> , "Zone A" (Wyo.)	2	134-137	135.5	69.5-70	69.7	—	—	15.5-16.5	16	—	—

^a All measurements in millimeters.^b AP, anteroposterior.^c Weighted mean.

CHART 3

PROPORTIONS OF LENGTHS OF LIMBS TO BASAL LENGTHS OF ASSOCIATED SKULLS
IN MINIOCHOERINAE

	Skull Basal Length (mm.)	Humerus B.L.	Radius B.L.	Ulna B.L.	Mc. III B.L.	Femur B.L.	Tibia B.L.	Mt. III B.L.
<i>Miniochoerus battle- creekensis</i>								
F:A.M. 49582	(138) ^a	—	—	—	—	.96	—	—
U.N.S.M. 28087	(139)	.83	—	—	—	.91	—	—
28179	(139)	.83	.71	—	—	.91	.84	—
<i>M. (Paraminiochoerus) affinis</i>								
F:A.M. 44997	131.5	.90	.67	.81	.33	.91	.88	—
45481	(136)	—	—	—	—	—	.88	.39
49533	140	—	—	—	—	.85	.80	—
49534	(133)	.84	—	.85	.30	.89	—	—
49573	(126)	—	—	—	—	.91	—	.42
A.M. 1290	131	—	.71	.91	—	—	—	—
1293	(131)	—	—	—	—	.92	.86	—
<i>M. (P.) gracilis</i>								
A.M. 12463	109	.91	—	—	—	—	—	—
F:A.M. 44962	(112)	.85	.63	.89	.31	.91	.90	.39
49521	(118)	.84	.64	.87	—	.91	—	—
49532	(123)	.85	.63	—	—	—	—	—
49547	(113)	—	—	.96	—	—	—	—
49562	111	.88	—	—	—	—	—	—
49592	(111)	.89	.71	.95	.32	—	—	—
P.U. 13626	(113.5)	.85	.68	.91	—	.92	.91	—
<i>M. (P.) ottensi</i>								
U.N.S.M. 28332	(142)	.86	.62	.85	—	.88	.88	—
<i>Platychoerus hat- creekensis</i>								
F:A.M. 45464A-B ^b	((148))	—	—	—	—	—	—	.39
<i>P. heartensis</i>								
F:A.M. 45467	(143)	—	—	—	—	—	.85	—
<i>P. platycephalus</i>								
F:A.M. 45191	(139)	—	.65	.86	.32	—	—	—
45338	131	.84	.64	.89	.32	.95	—	.43
45471	(138)	.83	—	—	—	—	—	—
45472	139	.81	—	—	.32	—	—	—
45476	(141)	.83	.70	—	—	.87	.85	—
<i>Stenopsochoerus berardae</i>								
F:A.M. 49617	(155)	—	—	—	—	.85	—	—
49618A ^b	161.5	.77	—	—	—	—	.77	—
49618B	156	.79	—	—	—	—	.79	—

CHART 3—Continued

	Skull Basal Length (mm.)	Humerus B.L.	Radius B.L.	Ulna B.L.	Mc. III B.L.	Femur B.L.	Tibia B.L.	Mt. III B.L.
<i>S. sternbergi</i>								
F:A.M. 49605	133	—	.61	.83	.29	—	.83	—
P.U. 11442	134	—	.58	—	.29	—	—	—
<i>S. (Pseudostenopsochoerus) chadronensis</i>								
F:A.M. 45489	141	—	.67	.85	.32	—	—	—
<i>S. (P.) douglasensis</i>								
F:A.M. 45492	152.5	.78	.60	.82	.29	.84	.79	.34
45330	(145)	.80	.68	.94	—	—	—	—
49569	(139)	.90	.70	.91	.33	—	—	—
49586	(142)	—	—	—	—	.89	.80	—
49616	(146)	—	.67	.89	.32	—	—	—

^a (), approximate; (()), estimated.

^b The skulls and limb elements were found associated; limbs may belong to either skull.

Stenopsochoerus (p. 435), and *S. (Pseudostenopsochoerus)* (p. 443), and are illustrated in figure 9. The pollex is retained in several individuals from the upper Chadron and from "Zone A" of the Brule, and is absent in available examples from higher horizons. Whether the Mc. I was absent in all members of the subfamily from these zones and tended to become progressively reduced and lost remains conjectural.

Scott,¹ in a report on the osteology of *Oreodon*, stated: "The most remarkable fact in the osteology of *Oreodon* is the presence of a rudimentary pollex, the only Artiodactyl in which it has ever been found." Later, Scott and Osborn² stated: "Most important is a specimen containing all the metacarpals and phalanges in undisturbed position, and this shows distinctly the presence of the pollex, as one of us* had previously shown to be true in the case of *O. culbertsonii*." (The footnote referred to Scott, 1884, *op. cit.*) At a still later date, Scott³ made a similar report: "A rudimentary thumb is present in the metacarpals. . . . I have been able to verify this by observation of several

specimens. . . . There is no question that the hand of *Oreodon* is normally pentadactyl." Thorpe⁴ noted: "The Eocene genera and *Merycoidodon* have five digits in the manus."

In a discussion of *Merycoidodon culbertsonii* Thorpe⁵ reported: "Cat. No. 12338 Y.P.M. is a partial skeleton. . . . The pes is excellently preserved, and the bones in articulation. On the ventral surface, close to Mt. II, there was found in the matrix a small elongated bone which certainly appears to represent the hallux. . . . There is no indication of any phalanges accompanying this first metatarsal, if such it is." The Miniochoerinae material examined by the present writers so far has not revealed any indication of the presence of the hallux.

COMPARISONS OF MINIOCHOERINAE, MERYCHYINAE, OREONETINAE, AND MERYCOIDODON

The remains of Miniochoerinae do not suggest close relationship with any other subfamily of oreodonts. The subfamily differs considerably from the Merychyinae⁶ in that the molars have shallow anterior and posterior fos-

¹ 1884, Proc. Amer. Assoc. Adv. Sci., 33d meeting, p. 493.

² 1887, Bull. Mus. Comp. Zool., vol. 13, p. 154.

³ 1890, Morph. Jahrb., vol. 16, p. 322, pl. 16, fig. 27.

⁴ 1923, Amer. Jour. Sci., ser. 5, vol. 6, p. 243.

⁵ 1937, Mem. Peabody Mus., vol. 3, pt. 4, p. 54.

⁶ Schultz and Falkenbach, 1947.

settes, thin enamel on the internal surface of the anterior and posterior crests, and minute auditory bullae. (See discussion, p. 391.) The fan-shaped occipital regions of the skulls of the Miniochoerinae, Oreonetinae, and Merychyinae are similar, with the larger skulls of the first subfamily approaching the size of those of the last. The first known geologic occurrence of the Merychyinae is in the Harrison formation, and the last appearance of the Miniochoerinae is in the upper part ("Zone D") of the Brule. Neither is known from the Gering and Monroe Creek deposits.

The major differences separating *Merycoidodon* from the genera of Miniochoerinae are as follows:

In *Merycoidodon* (1) the anterior portion of P^3 shows a marked reduction in size, while in the Miniochoerinae the reduction is slight; (2) the fossettes of the molars are deep and are retained until much worn, while in Miniochoerinae the fossettes are shallow and are lost with slight wear (see discussion, p. 391); (3) the supraoccipital wings are produced posteriorly for a greater distance beyond the occipital condyles than in the Miniochoerinae; (4) the supraoccipital wings are moderately spread, while in the Miniochoerinae they are greatly spread and incorporated into a fan-shaped occipital region. (See fig. 4.)

Among previously described species here transferred to the Miniochoerinae are *Miniochoerus* (*Paraminiochoerus*) *affinis* (Leidy), *M. (P.) gracilis* (Leidy), and *Platychoerus platycephalus* (Thorpe). Some previous reports that included these species should be reviewed at this time. Boardman Bump and Frederic B. Loomis¹ compared the variation of the skulls in the genus *Merycoidodon* and included the species *affinis* and *gracilis*, and stated: "What we did find is expressed in figures 1 and 2, namely that *M. gracilis* and *M. periculorum* are markedly uniform assemblages, while *M. affinis* and *M. culbertsonii* have narrow, medium or wide headed varieties. Nor is the narrow, medium or wide type correlated with size, occurring in both the longer and shorter skull." The species *Merycoidodon periculorum* and *M. culbertsonii* will be discussed by the present writers in a forthcoming report under

a separate subfamily. Figure 1 of Bump and Loomis represents the narrow-, medium-, and wide-skulled examples of "*Merycoidodon*" *affinis*. It is here suggested [from their illustrations only and granting that all their examples came from one faunal zone of the Brule ("Zone A")] that the narrow skulls may be referable to *Stenopsochoerus sternbergi*, the medium width may represent examples of *Miniochoerus* (*Paraminiochoerus*) *affinis* or *Platychoerus platycephalus*, and the wide examples may be referable to *Miniochoerus battlecreekensis* or even to small species of the Merycoidodontinae.

In figure 2 of Bump and Loomis, the variation in skull lengths and widths of *Merycoidodon gracilis* [= *M. (P.) gracilis*] is considered. Their specimens, however, may represent both *M. (P.) affinis* (their longer examples) and *M. (P.) gracilis* (their shorter examples).

It is evident within the oreodonts, particularly within forms from the Oligocene, that similarity of measurements or range in size of the skulls may not be indicative of a species or even close relationship. The actual characters (the shape of the skull and type of dentition), individual variation (including sex, if evident), as well as geologic occurrence must be considered. Sex variation is not apparent in the Miniochoerinae, unless perhaps the wider skulls represent males. The outstanding example of sex variation within the family occurs in the genus *Ustatchoerus*,² where the males are larger and more robust than the females.

The comparisons made by Bump and Loomis were based on specimens presumably from one zone of the Brule; hence certain trends were not indicated by the material. The skulls of *Miniochoerus battlecreekensis* are on the average longer and have a tendency to possess larger premolars than examples of *M. (Paraminiochoerus) affinis*; both species occur in "Zone A" of the Brule. In a consideration of these two forms alone, the difference could be erroneously attributed to sex or individual variation. When additional specimens of the genus and subgenus from "Zone B" of the Brule are included in the study, however, the fallacy of such a conclusion becomes apparent because two separate lines are then evident,

¹ 1930, Amer. Jour. Sci., ser. 5, vol. 20, no. 115, p. 17, figs. 1-2.

² Schultz and Falkenbach, 1941, p. 11, fig. 6.

i.e., examples of *M. starkensis* from "Zone B" (derived from examples of *M. battlecreekensis*) have premolars comparable with those of *M. battlecreekensis* from "Zone A," but the molars are considerably larger. In like comparisons between examples of *M. (P.) helprini* ("Zone B") and those of *M. (P.) affinis* ("Zone A"), the same conclusions may be drawn. The molars of *M. (P.) helprini*, however, did not increase in size to the extent that is evident in examples of *M. starkensis*. The evidence indicates that the forms of the generic sequence changed more rapidly than those of the subgeneric. Thus the species of the genus and subgenus from "Zone A" appear to be more closely related than do the species of the same two lines in "Zone B." In "Zone C" the phylogenetic lines are still more divergent.

It is thus apparent that the size and shape of the skull alone may be misleading when specimens are to be identified. The associated geologic data must also be considered in the establishment of phylogenetic relationships. For example, the skulls of *Platychoerus platycephalus* and *Miniochoerus battlecreekensis*, both from "Zone A," are comparable in length and general shape but represent two separate lines. In the former species the M^1 and the premolars are larger and the skull is decidedly more depressed than in the latter.

Bump and Loomis¹ further mentioned: "At first thought it might seem that *M. gracilis*, some 15% smaller and with little variability, might be the female of *M. affinis*; while *M. periculorum*, differing in a similar way, might be the female of *M. culbertsonii*. The only objection is in that, numerically, they should be more nearly equal. However, Dr. O'Hara has recently [1930] announced the finding of a skeleton of *M. culbertsonii* with twin embryos. . . . The individual [skull] indicates there is *no marked sex variation in size*; nor as far as we can see in any other part of the skull." This supports the present writers' contention that sex variation is not always apparent in oreodonts.

It is also of interest that Bump and Loomis considered individual skull parts, and prepared charts and measurements, to determine whether the variations were localized and whether other characters could be found which were more

stable than the indices of the over-all skull measurements. They concluded: "The only difference we found in taking limited parts of the skull was that the ranges of variation were larger in a part than in the whole. Nor could we find any dental characters which were not also very variable. The skull as a whole proved the best criterion for determining species."

The findings of Bump and Loomis concerning the variation of skull parts correspond to that disclosed by the present writers in *Merychyus crabilli*,² when a comparison was made of associated mature skulls of a single species. As for variability of dental characters, see the present report (p. 391) for a discussion of diagnostic differences between the dentitions of the Miniochoerinae and Merycoidodontinae.

Fred B. Phleger,³ in his report on "Relative growth and vertebrate phylogeny," which was based on Thorpe's⁴ phylogeny and measurements, stated: "The present writer has assumed that the species are valid ones and the measurements are correct." The proposed phylogeny by Schultz and Falkenbach,⁵ however, differs considerably from that of Thorpe, but it is not clear whether the measurements of Thorpe are based on a single individual or on several specimens. As an example, the measurements given by Thorpe⁶ for "*Ticholeptus*" *rusticus* are not of the holotype or even of a specimen referable to that species but of an example referred to *Ustatochoerus medius* (Leidy) by the present writers.⁷

Later Phleger and W. D. Putnam,⁸ in their "Analysis of *Merycoidodon* skulls," considered the skulls of *M. culbertsonii*, *M. periculorum*, "*M.*" *affinis*, and "*M.*" *gracilis* and reported: "It is true also that the frequency curves constructed from the present measurement data are bimodal for the genus, strongly suggesting the existence of two *Merycoidodon* 'groups'—the *M. gracilis* 'group' and the *M. culbertsonii* 'group.'" As previously mentioned in the present paper, two "groups" are obviously involved in these species. The species *affinis* and *gracilis*

² *Idem*, 1947, charts 3 and 4, pp. 268-269.

³ 1940, *Amer. Jour. Sci.*, vol. 238, p. 653.

⁴ 1937, *Mem. Peabody Mus.*, vol. 3 pt. 4, pp. 25, 279-291.

⁵ 1949, p. 80; 1954, p. 156.

⁶ *Op. cit.*, p. 287.

⁷ 1941, p. 31, specimen A.C. 19-104.

⁸ 1942, *Amer. Jour. Sci.*, vol. 240, p. 556.

¹ *Loc. cit.*

are not referable to the Merycoidodontinae, but rather to the Miniochoerinae, as is demonstrated by the characters of the skulls and dentitions (see p. 388).

The Phleger and Putnam study was based on "thirty-three specimens of *M. gracilis*; twenty-four of *M. affinis*." It is probable that other species of the Miniochoerinae were represented by these specimens, as was the case in the study of Bump and Loomis (see discussion, p. 388).

The remains of the Oreonetinae occurring in the middle part of the Chadron formation seem to represent end members of two closely related

phylogenetic lines. The deeply trenched fossettes of the molars and the well-inflated bullae are similar to those of the Merychyinae but differ from those of the Miniochoerinae. Examples of the Oreonetinae are known only from the Chadron (lower Oligocene), while the Merychyinae are reported from lower to upper Miocene deposits (the Harrison, Marsland, "Sheep Creek," and "Lower Snake Creek"). The skulls of the earlier Oreonetinae are smaller than those of the later Merychyinae, but no direct relationship between the two subfamilies is apparent.

DESCRIPTION OF MINIOCHOERINAE, NEW SUBFAMILY 7¹

SKULLS OF SMALL to medium size, dolichocephalic to mesocephalic; supraoccipital wings widely spread and incorporated into a fan-shaped occipital region, wings extended posteriorly for only a short distance to area above occipital condyles (supraoccipital wings with greater spread and decidedly less posterior projection than in examples of *Merycoidodon*, see discussion, p. 388); temporal ridge extends forward and outward to anterior border of postorbital process or to a point somewhat anterior (in *Merychys* the ridge extends to the posterior border of postorbital process); supra-orbital foramen usually with well-defined anterior groove, often extending forward and downward on side of face; anterior nasal-maxilla contact in area above C/; orbit small and roundish; nasals with slight anterior retraction; bulla small (minute in comparison with examples of *Merychys*), becoming slightly larger with posterior migration of hyoid pit in each successive species (upper Chadron through Brule) of respective generic and subgeneric lines; paroccipital process moderately light with antero-external area excavated, greatest diameter at approximately 45-degree angle to longitudinal axis of skull, base incorporated into fan-shaped occipital region; postglenoid process compressed anteroposteriorly, external border sloping inward and downward; glenoid surface usually arched anteroposteriorly; ascending ramus moderately high; prominent apophysis or process posterior to mandibular condyle; teeth brachyodont; C/ and P₁ large (no indication of large and small C/ and P₁ in same species as in *Merychys*); premolars from small to comparatively large; P¹-P⁴ each with anterior intermediate crest (in many instances the C/ has a definite ridge that appears to represent the anterior intermediate crest); posterior portion of M³ decidedly smaller than anterior portion; P⁴ with pillar-like primary cusp on internal side; superior and inferior molars with shallow fossettes (see discussion, p. 388); M₃ with moderately prominent heel.

¹ Compare with *idem*, 1940, p. 216; 1941, p. 6; 1947, p. 168; 1949, p. 85; 1950, p. 100; 1954, p. 163.

DISCUSSION

The diagnostic differences between forms of the Miniochoerinae and those of the genus *Merycoidodon* are discussed on page 388. The molars of the Miniochoerinae are unique in that the anterior and posterior fossettes are not deep, and the enamel on the internal surfaces of the anterior and posterior crests and crescents is thin. Unworn molars demonstrate the thin coating of enamel and the shallow fossettes, and in those with only moderate wear both the enamel and the fossettes are lost. In the Oreonetinae and *Merycoidodontinae*, as well as in the other subfamilies of the oreodonts, the anterior and posterior fossettes are deeper and the enamel on the internal surfaces of the anterior and posterior crests and crescents is definitely thicker than in the Miniochoerinae. The heavier enamel withstands wear and as a result the fossettes and well-defined borders of the crests and crescents are retained for a longer period of wear. (See discussion of dentitions, p. 388.)

Remains of Miniochoerinae are most abundant in "Zone A" of the Brule, but some specimens are known from zones "B," "C," and "D," also from the Chadron. All known oreodonts from "Zone A," regardless of subfamily, have small (minute) auditory bullae. In the *Desmatochoerinae*² and *Merycoidodontinae* the bullae are small in examples from "Zone A" but well inflated in those from "Zone B." Thus an example from either subfamily with an inflated bulla indicates an origin above "Zone A." In the Miniochoerinae, the bullae remain small in their occurrences throughout the Brule. There is a slight enlargement of the bullae from the upper zones but never to the degree of inflation found in other subfamilies. It must be noted that examples of the Oreonetinae occurring in the middle part of the Chadron have well-inflated bullae. The posterior migration of the hyoid pits of the bullae in the Miniochoerinae seems comparable to changes in the hyoid grooves in the *Desmatochoerinae*. In the latter group the hyoid grooves of the bullae are very prominent in examples from "Zone B" of the

² *Idem*, 1954, p. 155.

DISTINCTIVE CHARACTERS

	I. <i>Miniochoerus</i> (p. 392, figs. 1-2, 9-11)	IA. <i>M. (Paraminiochoerus)</i> (p. 402, figs. 3-4, 9-11)
Skull	Moderately high and broad	Moderately high and broad
Anterior border of maxilla with	Slight posterior slope	Less posterior slope than in <i>Miniochoerus</i>
Inferior border of ramus with downward curve	Gradual to moderately abrupt	Gradual
$P_1^1-M_1^1$	Small	Small
Anterior intermediate crest on P^4 placed	Internally	Externally
Comparison of species based on mean of skull basal lengths, dental series, and more robust molars, all progressively larger as listed from bottom to top	<i>M. cheyennensis</i> <i>M. nicholsae</i> <i>M. starkensis</i> <i>M. battlecreekensis</i>	<i>M. (P.) ottensi</i> <i>M. (P.) helprini</i> <i>M. (P.) affinis</i> <i>M. (P.) gracilis</i>

* Compare with *idem*, 1940, p. 216; 1941, p. 6; 1947, p. 168; 1949, p. 85; 1950, p. 100; 1954, p. 166.

^b The mean of the basal lengths is greater in *P. platycephalus*, but the means of $P_1^1-M_3^3$ are equal.

^c Although from "Zone A" of Brule, the means are less than in the other two species from the Chadron.

Brule, less so in "Zone C," and almost absent in "Zone D." In these respective stages the bullae become more inflated and rounded.

The importance of having exact geologic data for all specimens becomes very evident when changes such as these are investigated. The large Frick Laboratory and University of Nebraska State Museum Oligocene collections are well documented with geologic data. The South Dakota material was collected by Ralph Mefferd, Morris Skinner, and associates, and that from Nebraska and Wyoming under the supervision of the present writers.

Remains of *Miniochoerinae* are known from the Chadron and Brule formations of Colorado, Nebraska, North Dakota, South Dakota, and Wyoming.

I. *MINIOCHOERUS*, NEW GENUS

GENOTYPE: *Miniochoerus battlecreekensis*, new species.

DESCRIPTION

SKULL: Small to medium size; basal lengths ranging from 137 to 168 mm., widths from 74 to 108 mm.; mesocephalic; facial region deep; exoccipital foramen above base of paroccipital process moderately prominent to prominent; sagittal crest thin, not noticeably high; brain case inflated, decidedly narrower than in ex-

amples of *Platychoerus*; postorbital constriction averaging wider than in examples of *Stenopsochoerus*; frontals slightly convex laterally; nasals moderately broad, broader on average than those of *Miniochoerus (Paraminiochoerus)*; anterior nasal-maxilla contact above C/; orbit small; zygomatic arch lacking marked inward curve or notch posterior to orbit, as in examples of *Stenopsochoerus*, and with more or less sharp posterior rise to inferior border from a point below orbit; malar shallow to moderately deep below orbit; infraorbital foramen in area above P^8 ; lacrimal fossa small, shallow to moderately deep; depressed area on face above P^1-P^8 (infraorbital foramen at posterior border of depression); muzzle rather broad; anterior border of maxilla meeting nasal with very steep posterior slope (approaching perpendicular); occipital condyles of medium size; auditory bulla small (similar to those of *Prodesmatochoerus meekae*,¹ definitely unlike inflated bullae in *Merychyinae*² or *Oreonetinae*, p. 453); postglenoid process not excessively high, external border sloping at approximately 45-degree angle; posterior palate projecting only slightly beyond posterior of M^3 .

MANDIBLE: Moderately robust; postsymphysis

¹ *Idem*, 1954, p. 226.

² *Idem*, 1947.

OF THE MINIOCHOERINAE*

II. <i>Platychoerus</i> (p. 425, figs. 5-6, 9-11)	III. <i>Stenopsochoerus</i> (p. 435, figs. 6-7, 9-11)	IIIA. <i>S. (Pseudostenop- sochoerus)</i> (p. 443, figs. 8-9, 11)	IV. <i>Parastenop- sochoerus</i> (p. 450, figs. 6-7)
Low and broad	High and narrow	High and narrow	Moderately high and broad
Less posterior slope than in <i>Miniochoerus</i>	Slight posterior slope, more as in <i>Miniochoerus</i>	Less than in <i>Stenopsochoerus</i>	Greater than in other genera
Moderately abrupt	Gradual	Gradual	(Unknown)
Large Externally (minute) <i>P. hatcreekensis</i> <i>P. heartensis</i> ^b <i>P. platycephalus</i>	Large Externally (minute) <i>S. berardae</i> <i>S. joderensis</i> <i>S. sternbergi</i>	Large Externally (minute) <i>S. (P.) reideri</i> <i>S. (P.) chadronensis</i> <i>S. (P.) douglasensis</i>	Large Internally <i>P. conversensis</i>

sis below P_3 - P_4 ; ramus moderately deep, increasing in depth posteriorly; inferior border of ramus fairly straight with gradual to moderately abrupt downward curve posterior to M_3 ; posterior border of ascending ramus robust, inferior border with slight to noticeable inward curve.

DENTITION: C/ and P_1 moderately large to large; premolars small, not overly crowded; P_2 - M_1 with tendency to be slightly larger than in examples of *M. (Paraminiochoerus)*, definitely smaller than those of *Platychoerus* and *Stenopsochoerus*; external styles of superior molars from prominent to very prominent; anterior intermediate crest on P^4 prominent, usually situated closer to primary cusp than in examples of *M. (Paraminiochoerus)*.

LIMBS: Small size; moderately light to somewhat robust; length range within that found in Merychyinae.

MEASUREMENTS: Tables 1 and 3 (pp. 394 and 404).

ILLUSTRATIONS: Figures 1-2 (skulls, mandibles, and dentitions), 9-11 (limb elements).

DISCUSSION

The skulls of *Miniochoerus* are on the average larger than those of *M. (Paraminiochoerus)*. The moderately high and broad skulls of the genus and subgenus are diagnostically distinct from the low and broad examples of *Platychoerus* and the high and narrow examples of *Stenopsochoerus*.

It is of interest to note in examples of *Miniochoerus* that, although there was a definite enlargement of the molars during middle and upper Oligocene times, there was only a slight increase in the size of the premolars. In contrast, the premolars of most oreodonts increase in size more or less proportionately with the change in the molars.

The examples of *M. battlecreekensis* and *M. (P.) affinis* from "Zone A" of the Brule are similar in size and have many characters in common. These affinities seem to indicate a position in the phylogeny close to the divergence of the genus and subgenus, since the two lines are less similar in "Zone B" and still more divergent in "Zone C."

The proposed sequence of the species of *Miniochoerus* is as follows: *M. battlecreekensis* from "Zone A" of the Brule, *M. starkensis* from "Zone B," *M. nicholsae* from "Zone C," and *M. cheyennensis* from "Zone D."

DISTRIBUTION

The remains of *Miniochoerus* are not widely distributed. Four species are here recorded from the middle and upper Oligocene (Brule formation) of Colorado, Nebraska, North Dakota, South Dakota, and Wyoming. Four species of *M. (Paraminiochoerus)*, listed on page 404, are reported in many instances from the same deposits and localities as those of the genus. (See geologic distribution chart, p. 382.)

SUMMARY OF SPECIES AND TYPES

Four species of *Miniochoerus* from eight middle and upper Oligocene localities are here recorded:

1. *M. battlecreekensis*, new species, from Shannon County, South Dakota; referred re-

mains from Pennington County, South Dakota, Scotts Bluff and Sioux counties, Nebraska, and Niobrara County, Wyoming. ("Zone A" of Brule.)

HOLOTYPE: Skull and mandible, F:A.M. 45001. Figures 1-2.

TABLE 1

Miniochoerus, NEW GENUS. COMPARATIVE MEASUREMENTS* OF SKULLS AND MANDIBULAR RAMI

SKULL	<i>M. battlecreekensis</i> , new species	<i>M. starkensis</i> , new species	<i>M. nicholsae</i> , new species	<i>M. cheyennensis</i> , new species
	Holotype F:A.M. 45001	Holotype F:A.M. 45497	Holotype F:A.M. 49585	Holotype A.M. 9797
Stage of wear of teeth	(w)	(w)	(M+)	(w)
Length (including supraoccipital crest and incisors)	155.5	((155))	(164)	((175))
Basal length (from anterior notch of foramen magnum to posterior base of I ¹)	137	((141))	151	156
Width (max.)	(108)	94	(108)	(105)
Width of brain case (max.)	45.5	49.5	49	46
Width, interorbital (min.)	57	56	52	60
Distance from anterior rim of orbit to anterior base of C/.	58.5	57.5	62.5	71
Distance from anterior rim of orbit to supraoccipital crest	100	100.5	104	((108))
Length of nasals	—	48	(58)	—
Width of muzzle at infraorbital foramina	41.5	45	49.5	49
Width across canines	32.5	(35)	(35)	—
Length, C/-M ³ incl.	78.5	(78)	(84)	90
Length, P ¹ -M ³ incl.	69	69.5	76	78
Length, P ¹ -P ⁴ incl.	32.5	31.5	36	34
Length, M ¹ -M ³ incl.	37.5	41	45.5	46
Width of M ³ (max.)	15	16	17.5	19
Depth of malar below orbit	13	13.5	17	21
MANDIBULAR RAMUS			Referred A.M. 1322	Tentatively referred F:A.M. 49516
Stage of wear of teeth			(w ⁺)	(M+)
Length (max., including incisors)	133	—	—	—
Length, /C-condyle incl.	119.5	—	—	—
Depth of jaw under coronoid	69	72	64	68
Depth of jaw below anterior edge of M ₃	34.5	36.5	33	36.5
Length, /C-M ₃ incl.	82.5	—	—	—
Length, P ₁ -M ₃ incl.	76.5	(76)	—	((92))
Length, P ₁ -P ₄ incl.	33.5	(30)	—	—
Length, M ₁ -M ₃ incl.	43	46.5	48.5	48

* (), Approximate; (()), estimated. All measurements in millimeters.

2. *M. starkensis*, new species, from Stark County, North Dakota; referred remains from Weld County, Colorado, and Sioux County, Nebraska. ("Zone B" of Brule.)

HOLOTYPE: Partial skull and mandible, F: A.M. 45497. Figures 1-2.

3. *M. nicholsae*, new species, from Harding County, South Dakota; referred remains from South Dakota and Sioux County, Nebraska; tentatively referred from Harding County,

South Dakota. ("Zone C" of Brule.)

HOLOTYPE: Partial skull and skeletal elements, F: A.M. 49585. Figures 1, 2, and 11.

4. *M. cheyennensis*, new species, from Shannon County, South Dakota; referred remains from Weld County, Colorado; and tentatively referred from Shannon County, South Dakota, and Sioux County, Nebraska. ("Zone D" of Brule.)

HOLOTYPE: Skull, A.M. 9797. Figures 1-2.

DETAILED LISTS OF TYPES AND REFERRED SPECIMENS

MINIOCHOERUS

TOTAL AVAILABLE SPECIMENS: 38¹

1. *Miniochoerus battlecreekensis*,² new species

From "Zone A" of the Brule formation, Shannon County, South Dakota; referred remains from Pennington County, South Dakota; Scotts Bluff and Sioux counties, Nebraska; and Niobrara County, Wyoming

DESCRIPTION

SKULL: Small size; average size larger than examples of *M. (Paraminiochoerus) affinis* (occurring in the same faunal zone), approximate size of examples of *M. starkensis*, smaller than those of *M. nicholsae* and *M. cheyennensis*, usually more robust than those of *M. (P.) affinis* and *M. (P.) gracilis* (both from "Zone A"); nasals more robust on average than in examples of *M. (P.) affinis*, less robust than those of *M. nicholsae* and *M. cheyennensis*, comparable with those of *M. starkensis*; orbit small, slightly larger than in examples of *M. starkensis*, suboval in outline, longitudinal axis almost vertical; malar moderately shallow below orbit (comparable with examples of *M. starkensis*), less deep than those of *M. nicholsae* and *M. cheyennensis*; infraorbital foramen above posterior portion of P³; lacrimal fossa moderately deep, slightly deeper than in examples of *M. starkensis*, decidedly deeper than those of *M. nicholsae* and *M. cheyennensis*; occipital condyles lighter and smaller than in other examples of genus; paroccipital process comparable with other examples of subfamily from

"Zone A" of Brule, slightly smaller than in examples from above that zone; bulla smaller and hyoid pit more anterior than in other species of genus; postglenoid process moderately high but with less height and width than in examples of *M. starkensis*.

MANDIBLE: Postsymphysis below P₃; inferior border of ramus with gradual downward curve posterior to M₃, slightly less noticeable than in examples of *M. starkensis*, decidedly less so than in *M. nicholsae*; ascending ramus not so high as in examples of *M. starkensis* or *M. nicholsae*, inferior border with slight inward curve; condyle with external border higher and farther posterior than internal border, lighter and smaller than in other examples of genus.

DENTITION: Series moderately long and light, within length variation of examples of *M. starkensis*; C/ and P₁ moderately large; molars with less width (transversely) than in other examples of genus; external styles of superior molars prominent but less prominent than in other species of genus; P⁴ with less prominent anterior intermediate crest than in other examples of genus.

LIMBS: Moderately short and somewhat robust; usually longer and more robust than in examples of *M. (P.) affinis*.

MEASUREMENTS: Tables 1 and 3 (pp. 394 and 404).

ILLUSTRATIONS: Figures 1-2, 9-11.

DISCUSSION

Remains of *Miniochoerus battlecreekensis* possess somewhat lighter molars than the three other species of the genus. The skulls on the average are longer and more robust, the nasals

¹ Includes 21 F:A.M. and 12 U.N.S.M. specimens.

² Named for the Battle Creek locality, Shannon County, South Dakota, the area from which the holotype was secured.

wider, and the limb elements longer and more massive than in examples of *M. (P.) affinis*. Remains of *M. battlecreekensis* appear to have given rise to *M. nicholsae* of the more rapidly changing line (generic) and *M. (P.) affinis* seems to have given rise to *M. (P.) helprini* of the more static line (subgeneric); see discussion, page 389.

A certain amount of overlapping in the measurements of *M. battlecreekensis* and *M. (P.) affinis* is apparent, but this is to be expected in two closely related forms, near their point of divergence, and occurring in the same faunal zone ("Zone A" of the Brule). The former species, however, has the greater weighted means (see chart 2, p. 385). The overlapping of measurements may erroneously suggest the possibility of sex variation between the two forms in question rather than a generic and subgeneric division. With the study of additional material from the upper zones of the Brule, however, two separate lines become apparent.

The limb elements of *M. battlecreekensis* and *M. (P.) affinis* also aid in differentiation of the two forms, the examples of the former species being longer and more robust than those of the latter. A similar situation of overlapping skull measurements and differentiation in size of limbs has been reported¹ in two species of *Merychys* from the middle Miocene (lower Marsland). The measurements of the skulls of *M. arenarum* overlap those of *M. minimus*, but still show a greater weighted mean. At the same time, the limbs of the former species are longer than those of the latter.

The F.A.M. specimens from South Dakota were collected by Ralph Mefferd and Morris Skinner, 1938-1940; from Nebraska by Ove Kaisen and Morris Skinner, 1943; from Wyoming by George Sternberg, John C. Blick, and Charles H. Falkenbach, 1938-1943; U.N.S.M. material was collected by E. L. Blue, Thompson M. Stout, C. Bertrand Schultz, and associates, 1933-1935 and 1937-1940.

Twenty-five specimens are here recorded:

HOLOTYPE

Skull with I¹-I² br.² and I³-M³ and mandible with I₅-M₃. (w)³

F:A.M. 45001

From "Zone A" of Brule formation, area between Battle Creek Draw and Battle Creek Canyon, Cheyenne River drainage, Shannon County, South Dakota; collected by Ralph Mefferd and Morris Skinner, 1938

Figures 1-2

REFERRED FROM (A) SHANNON AND (B) PENNINGTON COUNTIES, SOUTH DAKOTA; (C) GENERAL AREA, SOUTH DAKOTA; (D) SCOTTS BLUFF AND (E) SIOUX COUNTIES, NEBRASKA; AND (F) NIOBRARA COUNTY, WYOMING

A. FROM CHEYENNE RIVER DRAINAGE, SHANNON COUNTY, SOUTH DAKOTA
FROM COTTONWOOD PASS AREA:

SKULL AND MANDIBLE (ATTACHED)		F:A.M.
Partial skull with P ¹ -M ³ and mandible with P ₁ (br.)-M ₃	(w)	45344

2 SKULLS

Partial skull with I ³ -M ³	(w)	45345
Anterior portion of skull with C/-M ³	(w)	45347

FROM BATTLE CREEK DRAW AREA:

SKULL		
Partial skull with C/(rt.)-M ³ br.	(w)	45003

¹ Schultz and Falkenbach, 1947, pp. 175, 204, 264.

² Abbreviations used in descriptions: alv., alveolus or alveoli; br., broken; erupt., erupting; rt., root or roots.

³ Stage of wear of teeth: (i), immature; (m), mature; (w), worn.

B. FROM IMLAY AREA, WHITE RIVER DRAINAGE, PENNINGTON COUNTY, SOUTH DAKOTA

SKULL AND MANDIBLE (ATTACHED)		F:A.M.
Anterior portion of skull with I^3 - M^3 and partial mandible with $/C$ - M_3	(w+)	44976

C. FROM GENERAL AREA,¹ SOUTH DAKOTA

SKULL AND MANDIBLE		A.M.
Partial skull with I^1 - C /rt. and P^1 (br.)- M^3 (P^2 br.) and partial mandible with I_1 - P_1 br. and P_2 - M_3	(w $\frac{1}{2}$)	598

D. FROM U.N.S.M. COLL. LOC. SF-101, SCOTTS BLUFF COUNTY, NEBRASKA

SKULL AND MANDIBLE (ATTACHED), IMMATURE		U.N.S.M.
Partial skull with I^3 - dP^2 - M^3 (germ) and mandible with I_1 (alv.)- dP_2 - M_2	(i)	28236

E. FROM HAT CREEK BASIN, CHEYENNE RIVER BASIN, SIOUX COUNTY, NEBRASKA
FROM U.N.S.M. COLL. LOC. SX-6:

SKULL AND MANDIBLE (ATTACHED), IMMATURE		U.N.S.M.
Partial skull with C - dP^3 br. and dP^4 - M^3 (erupt.) and mandible with dP_3 - M_3 (germ).	(i)	28306

FROM U.N.S.M. COLL. LOC. SX-8:

SKULL, MANDIBLE (ATTACHED), AND SKELETAL ELEMENTS		
Partial skull with C /(rt.)- M^3 , mandible with I_1 - C rt. and P_1 - M_3 , humerus, radius, partial ulna, 2 femora (1 partial), partial tibia, calcaneum, and fragments. Figures 9-11	(w)	28179

FROM U.N.S.M. COLL. LOC. SX-10:

SKULL, MANDIBLE, AND SKELETAL ELEMENTS		
Partial skull with C - M^3 (P^1 rt.), mandible with $/C$ - P_1 rt. and P_2 - M_3 (P_3 br.), partial scapula, humerus, partial radius, partial ulna, femur, partial tibia, partial pelvis, and fragments	(M+)	28087

FROM U.N.S.M. COLL. LOC. SX-37:

SKULL AND MANDIBLE		
Partial skull with C /(rt.)- M^3 (br.) (P^2 rt. and P^3 br.) and partial mandible with P_1 (rt.)- M_3 (br.)	(w)	28297

FROM NORTH OF HARRISON:

2 SKULLS AND MANDIBLES		
Partial skull with P^1 (alv.)- M^3 (br.) (P^3 rt. and M^1 - M^2 br.) and partial mandible with P_3 - M_3 (P_4 alv. and M_1 br.)	(w $\frac{1}{2}$ ++)	F:A.M. 49584
Anterior portion of skull with P^1 - M^3 (br.) and partial mandible with P_1 (br.)- M_3	(w+)	A.M. 1294

The American Museum's card catalogue gives the horizon as "*Protoceras*."

SKULL AND SKELETAL ELEMENTS		F:A.M.
Partial skull with C /(rt.)- M^3 , femur, partial tibia, pelvis, and vertebrae	(w $\frac{1}{2}$ ++)	49582

E'. FROM WHITE RIVER DRAINAGE, SIOUX COUNTY, NEBRASKA

FROM U.N.S.M. COLL. LOC. SX-17:

SKULL		U.N.S.M.
Skull with C /(rt.)- M^3	(M+)	28044

FROM U.N.S.M. COLL. LOC. SX-18:

¹ No specific locality given in records.

SKULL AND MANDIBLE (ATTACHED), IMMATURE		U.N.S.M.
Partial skull with C/(br.)-dP ¹ -M ³ (germ) (P ² -P ³ br.) and mandible with dP ₃ (br.)-M ₃ (germ)	(I)	28303
SKULL		
Partial skull with P ³ (br.)-M ³ (br.) (M ² br.)	(w+)	28319
FROM U.N.S.M. COLL. LOC. SX-23:		
SKULL		
Partial skull with C/(br.)-M ³ (P ¹ rt.)	(M)	28275
FROM U.N.S.M. COLL. LOC. SX-26:		
SKULL AND MANDIBLE (ATTACHED)		
Partial skull with I ² -M ³ (I ³ -C/ br.) and mandible with I ₂ -P ₁ br. and P ₂ -M ₃	(w)	28141
FROM U.N.S.M. COLL. LOC. SX-31:		
SKULL		
Partial skull with C/(br.)-M ³ (P ¹ rt.)	(M+)	28117

F. FROM HAT CREEK BASIN, CHEYENNE RIVER DRAINAGE,
NIOBRARA COUNTY, WYOMING

FROM NORTHEAST OF NODE:

SKULL AND MANDIBLE (ATTACHED)		F:A.M.
Partial skull with I ¹ -I ² rt. and I ³ -M ³ and mandible with P ₁ -M ₃	(w $\frac{1}{2}$)	45343
FROM SHACK DRAW:		

SKULL AND MANDIBLE (ATTACHED)		
Partial skull with C/(br.)-M ³ and mandible with I ₁ -I ₃ alv. and /C-M ₃	(w $\frac{1}{2}$ +)	44982

SKULL		
Partial skull with I ³ -M ³	(w+)	49579
FROM OLD WOMAN CREEK:		

SKULL		
Partial skull with P ¹ -M ³	(w $\frac{1}{2}$ +)	45018

2. *Miniochoerus starkensis*,¹ new species

From "Zone B" of the Brule formation, Stark
County, North Dakota; referred remains
from Weld County, Colorado; and
Sioux County, Nebraska

DESCRIPTION

SKULL: Small size; approximate size of larger examples of *M. battlecreekensis*, smaller than those of *M. nicholsae*; supraorbital foramina closer together than in examples of *M. battlecreekensis*; orbit small and round, smaller than those of *M. battlecreekensis*, approximately

¹ Named for Stark County, North Dakota, the area from which the holotype was secured.

equal to those of *M. nicholsae*; malar moderately shallow below orbit but deeper than in examples of *M. battlecreekensis* and less deep than in those of *M. nicholsae*; infraorbital foramen above posterior portion of P³; lacrimal fossa moderately deep, slightly larger but shallower than in examples of *M. battlecreekensis*, deeper than in those of *M. nicholsae*; occipital condyles moderately large, larger than in examples of *M. battlecreekensis*, lighter than in those of *M. nicholsae*; bulla small, slightly larger, and with hyoid pit more posterior than in examples of *M. battlecreekensis*, more like those of *M. nicholsae*.

MANDIBLE: Length and depth of ramus

within variation found in larger examples of *M. battlecreekensis*; postsymphysis below P_3 ; inferior border of ramus with gradual downward curve posterior to M_3 , less curve than in examples of *M. nicholsae*; ascending ramus higher than in examples of *M. battlecreekensis*, inferior border with slight inward curve similar to those of *M. battlecreekensis*, less inward curve than in those of *M. nicholsae*; condyle set approximately at right angle to axis of dental series, external border higher than internal border, similar to those of *M. nicholsae*, more robust than in those of *M. battlecreekensis*.

DENTITION: $C/$ and P_1 moderately large (known only from roots); premolars comparable with those of *M. battlecreekensis*; molars noticeably larger than those of latter species, smaller than those of *M. nicholsae*; external styles of superior molars more prominent than in examples of *M. battlecreekensis*.

LIMBS: Unknown.

MEASUREMENTS: Table 1 (p. 394)

ILLUSTRATIONS: Figures 1-2.

DISCUSSION

Remains of *Miniochoerus starkensis* occur

in "Zone B" of the Brule formation midway between *M. battlecreekensis* ("Zone A") and *M. nicholsae* ("Zone C"). Although some characters of *M. starkensis* closely resemble those of *M. nicholsae*, others strongly suggest *M. battlecreekensis*. This dual affinity is of interest, since in other subfamilies of the oreodonts from the Brule formation the "Zone B" species usually exhibit the characters of the "Zone C," rather than those of the "Zone A" species of the line. This is well demonstrated in the Desmatochoerinae, in which examples of *Subdesmatochoerus socialis*¹ from "Zone B" have well-inflated auditory bullae similar to those of related "Zone D" species rather than the small (minute) bullae seen in *Prodesmatochoerus meekae*² from "Zone A."

At the present time, no remains of *M. starkensis* have been reported from South Dakota. This fact, however, is not considered significant, since comparatively few Miniochoerinae remains have been secured from above "Zone A" of the Brule formation.

The F.A.M. specimens were collected by Ove Kaisen and Morris Skinner, 1944.

Four specimens are here recorded:

HOLOTYPE

Partial skull with $C/(\text{rt.})-M^3$ (P^2 rt.), partial mandible with P_1-P_2 rt. and P_3-M_3 and vertebrae. (w)

F:A.M. 45497

From "Zone B" of Brule formation, "5' below top of nodules," 7 mi. S. of South Heart, Stark County, North Dakota; collected by Ove Kaisen and Morris Skinner, 1944

Figures 1-2

REFERRED FROM (A) WELD COUNTY, COLORADO; AND (B) SIOUX COUNTY, NEBRASKA

A. FROM THE PAWNEE BUTTES AREA, WELD COUNTY, COLORADO

SKULL

Partial skull with $P^1(\text{rt.})-M^3$ (w⁺)

A.M.

9349

The American Museum's card catalogue records the horizon of the specimen as "Upper Oreodon."

B. FROM WEST OF JODER, WHITE RIVER DRAINAGE, SIOUX COUNTY, NEBRASKA

2 SKULLS AND MANDIBULAR RAMI

F:A.M.

Partial skull with $C/(\text{rt.})-M^3$ and partial mandible with P_1-P_3 br. and P_4-M_3 . (w⁺⁺)

45498

Partial skull with P^2-P^4 br. and M^1-M^3 and partial left ramus with M_3 . . . (w⁺⁺)

45499

The dentitions of the two above specimens are poorly preserved.

¹ Schultz and Falkenbach, 1954, p. 220.

² *Idem*, 1954, p. 226.

3. *Miniochoerus nicholsae*,¹ new species

From "Zone C" of the Brule formation, Harding County, South Dakota; referred remains from Sioux County, Nebraska; and tentatively referred from Harding County, South Dakota

DESCRIPTION

SKULL: Medium size, larger than examples of *M. battlecreekensis* and *M. starkensis*, smaller than holotype of *M. cheyennensis*; frontals moderately wide, wider and more convex than those of *M. starkensis*; orbit round and small; malar moderately deep below orbit, deeper than in examples of *M. battlecreekensis* and *M. starkensis*, approaching depth of that of holotype of *M. cheyennensis*; infraorbital foramen above posterior portion of P³; lacrimal fossa moderately shallow; occipital condyles slightly heavier than those of *M. starkensis*, slightly smaller than those of *M. cheyennensis*; paroccipital process more robust than in examples of *M. battlecreekensis* and *M. starkensis*; bulla slightly larger and hyoid pit more posterior than in examples of *M. battlecreekensis*, more like those of *M. starkensis*, smaller than in holotype of *M. cheyennensis*; postglenoid process wider transversely than in examples of *M. starkensis*.

MANDIBLE: Slightly longer than in examples of *M. battlecreekensis*, approaching in size those of *M. starkensis*; postsymphysis below P₄; inferior border of ramus with moderately abrupt

¹ Named in honor of Mrs. Rachel H. Nichols of the American Museum of Natural History, who has aided the writers in securing data on the various oreodonts in the American Museum collections.

downward curve posterior to M₃; inferior border of ascending ramus with prominent inward curve, more so than in examples of *M. starkensis*; condyle similar in size to those of *M. starkensis*, set approximately at right angle to axis of dental series, external border of condyle higher than internal border.

DENTITION: Length of series intermediate between those of *M. starkensis* and *M. cheyennensis*; C/ smaller than in examples of *M. cheyennensis*; premolars approximately equal to those of last-mentioned species; external styles of superior molars prominent.

LIMBS: Larger and more robust than in *M. battlecreekensis*. (Known only from partial tibia.)

MEASUREMENTS: Table 1 (p. 394).

ILLUSTRATIONS: Figures 1-2, 11.

DISCUSSION

Remains of *Miniochoerus nicholsae* are not well represented in the collections. The holotype consists of a partial skull, partial tibia, and vertebrae. The description of the mandible is based on two referred specimens. The height of the ascending ramus of A.M. 1322 is less than in examples of *M. starkensis*, while that of the second specimen, U.N.S.M. 28502, is approximately the same as in the mentioned form.

The F:A.M. specimens were gathered by Morris Skinner, 1945; and the A.M. material was collected by the American Museum of Natural History field party, 1894; and the U.N.S.M. example by the University of Nebraska State Museum field party, 1936.

Five specimens are here recorded:

HOLOTYPE

Partial skull with I¹-I³ alv. and C/-M³ (M² br.), partial tibia and vertebrae. (M+)

F:A.M. 49585

From "Zone C" of Brule formation, 2 mi. S. of Reva Gap, E. side of Slim Buttes, Harding County, South Dakota; collected by Morris Skinner, 1945

Figures 1-2, 11

REFERRED FROM (A) SOUTH DAKOTA; (B) SIOUX COUNTY, NEBRASKA; AND TENTATIVELY REFERRED FROM (C) HARDING COUNTY, SOUTH DAKOTA

A. FROM CHEYENNE RIVER DRAINAGE, SOUTH DAKOTA

SKULL AND MANDIBLE

Partial skull with P²-M³ (P⁴-M¹ br.) and partial mandible with P₃-M₃. Figure 2 (in part)

(w₊†)

A.M.
1322

B. FROM U.N.S.M. COLL. LOC. SX-22, WHITE RIVER DRAINAGE,
SIOUX COUNTY, NEBRASKA

SKULL AND MANDIBLE (ATTACHED)

U.N.S.M.

Partial skull with C/(br.)-M³ and partial mandible with P₁(br.)-M₃. (w) 28502

C. TENTATIVELY REFERRED FROM REVA GAP AREA, HARDING COUNTY,
SOUTH DAKOTA

2 MANDIBULAR RAMI

F:A.M.

Partial right ramus with P₁-P₂ rt. and P₃-M₃. (w+) 49614

Partial right ramus with P₁-P₃ rt. and P₄-M₃. (w++) 49615

The above two specimens are not complete enough for definite identification.

4. *Miniochoerus cheyennensis*,¹ new species
From "Zone D" of the Brule formation, Shannon
County, South Dakota; referred remains from
Weld County, Colorado; tentatively referred
from Shannon County, South Dakota

MEASUREMENTS: Table 1 (p. 394).

ILLUSTRATIONS: Figures 1 and 2.

DISCUSSION

The new species, *Miniochoerus cheyennensis*, represents the largest and geologically the latest known form of the genus and subfamily. It is here considered that examples of this species were derived from those of *M. nicholsae*. The American Museum's card catalogue records the occurrence of the type as "Top of the Oreodont beds or base of *Leptauchenia*." The present writers believe the type came from the latter ("Zone D" of the Brule).

DESCRIPTION

SKULL: Medium size; largest of subfamily; sagittal crest more prominent than in other species of genus; orbit small for size of skull; malar moderately deep below orbit, deeper than in examples of *M. nicholsae*; infarorbital foramen in area just posterior to P³; lacrimal fossa shallow, more so than in examples of *M. battlecreekensis*, approximately equal to those of *M. nicholsae*; occipital condyles larger than in examples of *M. battlecreekensis*; bulla larger and hyoid pit more posterior than in other species of genus.

MANDIBLE: Known only from tentatively referred specimens.

DENTITION: Series longer than in other examples of genus; C/ large; superior premolars small in comparison with molars, slightly larger than those of *M. nicholsae*; superior molars large and robust; external styles of superior molars very prominent; P⁴ with prominent anterior intermediate crest.

LIMBS: Unknown.

¹ Named for the Cheyenne River drainage of South Dakota, the area from which the type was collected.

² Schultz and Falkenbach, 1940, fig. 9 (in part).

The tentatively referred mandible, F:A.M. 49516, is the only known example of a ramus with characters and size comparable with those of the type skull. The dentition of the ramus is of interest in that M₁ and M₂ possess a small internal style on both lobes and M₃ has well-developed styles on the first and second lobes. These styles are not here considered as of diagnostic value, but rather as an individual development. There is a similar instance in *Brachyocrus siouense*,² example F:A.M. 36186, where the superior molars have well-developed, cervid-like styles.

The referred F:A.M. material was collected by William Klaus and John C. Blick, 1931, and the tentatively referred specimen by Ralph Melferd and Morris Skinner, 1940.

Four specimens are here recorded:

HOLOTYPE

Partial skull with C/-M³. (w)

A.M. 9797

From "Zone D" of Brule formation,
Sheep Mt., Cheyenne River drainage,
Shannon County, South Dakota; collected by Albert Thomson, 1902

Figures 1-2

REFERRED FROM (A) WELD COUNTY, COLORADO

A. FROM WEST OF PAWNEE BUTTES, WELD COUNTY, COLORADO

2 SKULLS

F:A.M.

Partial skull with C/ br. and P⁴(br.)-M³. (w) 45336

Partial skull with M¹(br.)-M³(br.) (w+) 45337

TENTATIVELY REFERRED FROM (B) SHANNON COUNTY, SOUTH DAKOTA

B. FROM AREA BETWEEN THE HEAD OF BIG CORRAL DRAW AND
COTTONWOOD CREEK, SHANNON COUNTY, SOUTH DAKOTA

MANDIBLE

F:A.M.

Partial mandible with P_1 (rt.)- M_3 . Figure 2 (M+) 49516

The premolars of the above specimen are large in comparison with the premolars of the type skull, and the molars are unique in having internal styles; see discussion, page 401.

IA. MINIOCHOERUS (PARAMINIOCHOERUS), NEW SUBGENUS

SUBGENOTYPE: *Miniochoerus* (*Paraminiochoerus*) *affinis* (Leidy).

DESCRIPTION

SKULL: Small size; basal lengths ranging from 107 to 147 mm., widths from 65 to 87 mm.; mesocephalic; small exoccipital foramen above base of paroccipital process; postorbital constriction with tendency to be narrower than in examples of genus; frontals narrower on average than those of *Miniochoerus*; nasals lighter on average than those of genus; anterior nasal-maxilla contact in area above posterior portion of C/; malar shallow below orbit, more so than in average examples of genus; infra-orbital foramen above posterior portion of P^3 to anterior portion of P^4 ; muzzle narrower than in average examples of genus; anterior border of maxilla meeting nasal with even steeper slope (almost perpendicular) than in examples of *Miniochoerus*.

MANDIBLE: Lighter than in average examples of *Miniochoerus*; ramus with less average depth than in comparable¹ examples of *Miniochoerus*; inferior border of ramus with gradual downward curve posterior to M_3 ; ascending ramus lower, and longer anteroposteriorly than in examples of *Miniochoerus*; inferior border with slight inward curve, latter comparable with those of *M. battlecreekensis*; condyle with tendency to be slightly smaller than in comparable examples of *Miniochoerus*.

DENTITION: Series of less average length than in comparable examples of *Miniochoerus*; C/ and P_1 moderately large, tendency to be lighter than in examples of genus; premolars not overly crowded; premolars and M_1^1 on average smaller than in genus; external styles

¹ "Comparable" is used to indicate examples of genus and subgenus that occur in the same faunal zone.

of superior molars prominent, approximately equal to those of *M. battlecreekensis*; anterior intermediate crest of P^4 usually situated more anteriorly than in examples of *Miniochoerus*.

LIMBS: Small size; similar to those of *Miniochoerus*.

MEASUREMENTS: Tables 2 and 3 (pp. 403 and 404).

ILLUSTRATIONS: Figures 3-4 (skulls, rami, and dentition), 9-11 (limbs).

DISCUSSION

The remains of *Miniochoerus* (*Paraminiochoerus*) resemble those of *Miniochoerus* to the extent that examples of the two forms cannot always be readily separated. Limb elements associated with the skulls have a definite diagnostic value, since the limbs representing the genus are usually longer and more robust than those attributed to the subgenus (see discussion, p. 396).

Examples of the genus and subgenus are very similar in "Zone A" of the Brule formation, less similar in "Zone B," and widely divergent in "Zone C," thereby demonstrating the presence of two lines with forms of the larger genus changing more rapidly than those of the smaller subgenus.

This subgenus includes two previously named species, *M. (P.) affinis* and *M. (P.) gracilis*, which prior to this report have been considered under the genus *Merycoidodon*. The comparison of the genera and subgenera of *Miniochoerinae* with the genus *Merycoidodon* is discussed on page 388.

The proposed geologic sequence of the species of *M. (Paraminiochoerus)* is as follows: *M. (P.) affinis* from "Zone A" of the Brule; *M. (P.) helprini* from "Zone B"; and *M. (P.) ottensi* from "Zone C." The small form, *M. (P.) gracilis*, also from "Zone A," appears to be a specialized side branch of the line.

TABLE 2

Miniochoerus (*Paraminiochoerus*), NEW SUBGENUS. COMPARATIVE MEASUREMENTS^a
OF SKULLS AND MANDIBULAR RAMI

SKULL	<i>M. (P.) affinis</i> (Leidy)			<i>M. (P.) gracilis</i> ^b (Leidy)		<i>M. (P.) helprini</i> , new species	<i>M. (P.) ottensi</i> , new species
	Holotype A.N.S.P. 10679	Referred ^c A.M. 6404	Referred F:A.M. 44977	Referred A.N.S.P. 10685	Referred F:A.M. 45363	Holotype F:A.M. 49501	Holotype U.N.S.M. 28336
Stage of wear of teeth	(w+)	(w+)	(w)	(w)	(M+)	(M+)	(w)
Length (including supraoccipital crest and incisors)	—	((140))	142	((115))	117.5	((154))	(155)
Basal length (from anterior notch of foramen magnum to posterior base of I ¹)	—	((130))	131.5	—	107	((143))	142
Width (max.)	((84))	((78))	83	76	74	(75)	86.5
Width of brain case (max.)	—	((39))	39	34.5	37	37	39
Width, interorbital (min.)	48.5	(49)	45	36	38	(44.5)	48
Distance from anterior rim of orbit to anterior base of C/	(51.5)	(54)	56	39	42.5	57	61.5
Distance from anterior rim of orbit to supraoccipital crest	—	87	87	74	75	((90))	94
Length of nasals	—	—	((49))	—	35.5	—	(49)
Width of muzzle at infraorbital foramina	39.5	(34)	35	31	31.5	37.5	37
Width across canines	(29)	—	25	23	25.5	((27))	(25)
Length, C/-M ³ incl.	(70)	(70)	73.5	(59)	62	78.5	83
Length, P ¹ -M ³ incl.	62.5	62.5	65	54	54.5	69	73.5
Length, P ¹ -P ⁴ incl.	27	27.5	30	25.5	26	31	32.5
Length, M ¹ -M ³ incl.	36.5	36	37.5	30.5	31	39	42.5
Width of M ³ (max.)	(13.5)	15.5	15.5	—	13	14.5	16.5
Depth of malar below orbit	13	15	16	10.5	11.5	17	16
MANDIBULAR RAMUS							Referred F:A.M. 45346
Stage of wear of teeth	—	—	—	—	—	(w+)	—
Length of (max., including incisors)	—	121	128.5	((95))	104	((126))	138.5
Length, /C-condyle incl.	—	109	113.5	((80))	90	((115))	127.5
Depth of jaw under coronoid	—	—	59	47	50	68 ^d	—
Depth of jaw below anterior edge of M ₃	—	28.5	30	22.5	24	30	33
Length, /C-M ₃ incl.	—	75.5	76	—	63.5	—	87
Length, P ₁ -M ₃ incl.	—	69.5	71.5	57.5	59	73	80.5
Length, P ₁ -P ₄ incl.	—	28	30	25	25	30	35
Length, M ₁ -M ₃ incl.	—	41	43	32.5	34	43	46.5

^a (), Approximate; (()), estimated. All measurements in millimeters.

^b Lectotype, A.N.S.P. 10692 (w⁺): M¹-M³=30; width of M³ (max.)=12.5.

^c Holotype of "*Merycoidodon coloradoensis*" (Cope).

^d From F:A.M. 49501.

TABLE 3

Miniochoerus, NEW GENUS, AND *M. (Paraminiochoerus)*, NEW SUBGENUS.
COMPARATIVE MEASUREMENTS^a OF SKELETAL ELEMENTS

	<i>M. battle-creekensis</i> , new species	<i>M. (P.) affinis</i> (Leidy)		<i>M. (P.) gracilis</i> (Leidy)	<i>M. (P.) ottensi</i> , new species
	Referred U.N.S.M. 28179	Referred F:A.M. 44977	Referred F:A.M. 45481	Referred F:A.M. 44962	Referred U.N.S.M. 28332
Length of humerus (articular)	115	119	—	95.5	123
Length of radius (articular)	98.5	88.5	—	71	88
Length of ulna (max.)	—	106	—	100	(121)
Length of metacarpal III (max.)	—	43.5	—	35.5	—
Length of femur (articular)	127	120	—	102.5	125
Length of tibia (articular)	117	116	119	101	125
Length of metatarsal III (max.)	—	—	53	(44)	—
Length of calcaneum (max.)	46	—	43	38	47.5

* (), Approximate. All measurements in millimeters.

DISTRIBUTION

Four species of *M. (Paraminiochoerus)* are known from the middle and upper Oligocene (Brule formation) of Colorado, Nebraska, North Dakota, South Dakota, and Wyoming. (See geologic distribution chart, p. 382.)

SUMMARY OF SPECIES AND TYPES

Four species of *Miniochoerus (Paraminiochoerus)* from 13 Oligocene (Brule) localities are here recorded:

1. *M. (P.) affinis* (Leidy), from South Dakota; referred remains from Fall River, Pennington, and Shannon counties, South Dakota; Logan and Weld counties, Colorado; Dawes, Scotts Bluff, and Sioux counties, Nebraska; and Converse, Laramie, and Niobrara counties, Wyoming. ("Zone A" of Brule.)

HOLOTYPE: Partial skull, A.N.S.P. 10679.

2. *M. (P.) gracilis* (Leidy), from South Dakota; referred remains from Pennington and Shannon counties, South Dakota; Logan and Weld counties, Colorado; Dawes, Scotts Bluff, and Sioux counties, Nebraska; and Niobrara County, Wyoming. ("Zone A" of Brule.)

LECTOTYPE: Partial right maxilla, A.N.S.P. 10692. Figures 3-4.

3. *M. (P.) helprini*, new species, from Sioux County, Nebraska; referred remains from Stark County, North Dakota, and Shannon County South Dakota. ("Zone B" of Brule.)

HOLOTYPE: Partial skull and partial mandible, F:A.M. 49501. Figures 3-4.

4. *M. (P.) ottensi*, new species, from Sioux County, Nebraska. ("Zone C" of Brule.)

HOLOTYPE: Skull and mandible, U.N.S.M. 28336. Figures 3-4.

DETAILED LISTS OF TYPES, REFERRED SPECIMENS, AND SYNONYMY

MINIOCHOERUS (PARAMINIOCHOERUS)

TOTAL AVAILABLE SPECIMENS: 270¹1. *Miniochoerus* (*Paraminiochoerus*)
affinis (Leidy)

From "Zone A" of the Brule formation, South Dakota; referred remains from Fall River, Pennington, and Shannon counties, South Dakota; Logan and Weld counties, Colorado; Dawes, Scotts Bluff, and Sioux counties, Nebraska; and Converse, Laramie, and Niobrara counties, Wyoming

Oreodon affinis LEIDY,² 1869, Jour. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 7, pp. 96, 105, pl. 9, fig. 3.

Merycoidodon affinis (Leidy), HAY, 1902, Bull. U. S. Geol. Surv., no. 179, p. 665. THORPE, 1937, Mem. Peabody Mus., vol. 3, pt. 4, p. 46, pl. 1, fig. 12.

Oreodon gracilis coloradoensis COPE, 1884, Proc. Amer. Phil. Soc., vol. 21, p. 511.

Oreodon coloradoensis (Cope), MATTHEW, 1909, Bull. U. S. Geol. Surv., vol. 361, p. 106.

Oreodon gracilis Leidy, referred only, OSBORN AND WORTMAN, 1894, Bull. Amer. Mus. Nat. Hist., vol. 6, art. 7, p. 216, fig. 5B.

Merycoidodon gracilis (Leidy), HAY (in part), 1902, *ibid.*, no. 179, p. 666. THORPE, 1937, *ibid.*, vol. 3, pt. 4, (in part), p. 56, fig. 7B.

CHARACTERS

SKULL: Small size; larger than examples of *Miniochoerus* (*Paraminiochoerus*) *gracilis*; length and width average less than in examples of *M. battlecreekensis* (from same faunal zone); larger examples equal in basal length to smaller examples of *M. (P.) helprini*; nasals broader than those of *M. (P.) gracilis*, tendency to be narrower than those of *M. battlecreekensis*; anterior nasal-maxilla contact area above and just posterior to C/; zygomatic arch lighter than in examples of *M. (P.) helprini*; malar deeper below orbit than in examples of *M. (P.) gracilis*, less deep than in *M. (P.) helprini*; infraorbital foramen above posterior por-

tion of P³; lacrimal fossa deeper than in examples of *M. (P.) helprini*; bulla comparable with those in other examples of *Miniochoerinae* from "Zone A," slightly smaller than those of *M. (P.) helprini*; postglenoid process lighter and with less height than in examples of *M. (P.) helprini*, larger than in *M. (P.) gracilis*.

MANDIBLE: Less robust than in examples of *M. battlecreekensis*; inferior border of ramus with more pronounced downward curve posterior to M₃ than in *M. (P.) gracilis*; condyle smaller and lighter than in *M. battlecreekensis*, set approximately at right angle to axis of dental series, external border higher than internal border.

DENTITION: Length of series averaging less than in examples of *M. battlecreekensis*, greater than in *M. (P.) gracilis*; external styles of superior molars more prominent than those of *M. (P.) gracilis*; P₃ with posterior intermediate crest.

LIMBS: Tendency to be shorter and lighter than those of *M. battlecreekensis*; considerably longer and more robust than those of *M. (P.) gracilis*.

MEASUREMENTS: Tables 2 and 3 (pp. 403-404).

ILLUSTRATIONS: Figures 3-4, 9-11.

DISCUSSION

In the foregoing list of characters of *Miniochoerus* (*Paraminiochoerus*) *affinis* ("Zone A" of the Brule), comparisons are made with examples of *M. battlecreekensis* ("Zone A"), *M. (P.) gracilis* ("Zone A") and *M. (P.) helprini* ("Zone B"). In the discussions of *M. battlecreekensis* and *M. (Paraminiochoerus)*, the problem of distinguishing between examples of *M. battlecreekensis* and *M. (P.) affinis* is considered. It is suggested that the two forms in question are close to the divergence of the generic and subgeneric lines, since the "Zone B" species, *M. starkensis* (derived from *M. battlecreekensis*) and *M. (P.) helprini* [derived from *M. (P.) affinis*], are well separated and much less closely related than are the "Zone A" forms.

"*Oreodon gracilis coloradoensis*" Cope³ is here considered a synonym of *M. (P.) affinis*,

³ See discussion, p. 406.

¹ Includes 117 F.A.M. and 90 U.N.S.M. specimens.

² Although Leidy considered this form as a species, he also referred to it as a variety of "*Oreodon*" *gracilis* [= *M. (P.) gracilis*, this report, p. 413] on p. 105, and in the explanation of the plates, p. 457, he stated "Variety of *O. gracilis*? OREODON AFFINIS," and the legend to pl. 9 states "*O. gracilis*."

rather than of *M. (P.) gracilis*. The dentition, especially the premolars of Cope's type, is larger and more robust than in examples of *M. (P.) gracilis*, and the skull length is greater. (See measurements, table 2, p. 403.) The difference between the larger dental series of the type of "*Oreodon gracilis coloradoensis*" [= *M. (P.) affinis*] and the smaller series of *M. (P.) gracilis* has not been previously noted. The difference may have been recognized by Cope¹ when he named his subspecies and by Matthew² when he raised the subspecies to specific rank. Hay³ considered the form *coloradoensis* synonymous with "*Merycoidodon*" *gracilis*, which was accepted by Thorpe.⁴ All these writers seemingly failed to consider the species *affinis* in making their comparisons.

In *Merychys*, Schultz and Falkenbach⁵ noted that within one species the C/ and P₁ may be either large or small, and the premolar series may also vary in the same way. These variations, however, are lacking in *Merychys* (*Metoreodon*) which evolved from *Merychys*. The variations noted in *Merychys* also are lacking in the *Miniochoerinae*. In *Platychoerus* and *Stenopsochoerus* the premolars and M₁ are definitely larger than those of *Miniochoerus* and *M. (Paraminiochoerus)*.

In a discussion of the species *M. (P.) gracilis*, Thorpe⁶ stated: "When Cope in 1884 described his subspecies *M. [Merycoidodon] g. coloradoensis*, there was apparently a considerable difference in size between his Colorado form and the majority of Leidy's South Dakota and Nebraska specimens. The Cope form was about one-seventh larger. In 1869 Leidy figured a specimen, now Cat. No. 136 U.S.N.M., a plesiotype of *M. gracilis*, which is exceedingly similar to Cope's type. However, since then there have been found considerable numbers of skulls of this species which show a wide range of intergradations from the Leidy to the Cope species. There are sexual, individual, and local variations, but they seem to be insufficient for division into subspecies." The *Miniochoerinae* include six forms from "Zone A" of the

Brule formation, three of which have been previously described. It seems reasonable to suspect that examples of the three new forms were also present in the collections previously studied (see Charles W. Gilmore's statement, p. 415, present report). Thus the inclusion of the six different forms into only three species would result in a definite increase in the amount of individual variation to be attributed to a single species.

As Thorpe noted, certain types of variation must be evaluated, but as mentioned elsewhere in the present report, sex variation within the *Miniochoerinae* is not apparent. Character trends, however, are also of the utmost importance, but frequently the trends involved are considered as individual rather than specific or even generic variation. This is especially true when the geologic occurrence of a specimen is not known, and without these data the phylogenetic trends may not be apparent. The intergradation in size of the skulls of the various forms from one faunal zone may be expected in any assemblage of oreodonts, more so when the specimens are enough alike to be considered under one subfamily. It should be noted that no remains referable to the *Miniochoerinae* have previously been reported from above "Zone A," hence the sequence of these small oreodonts was not recognized in previously studied collections.

Remains of *M. (Paraminiochoerus) affinis* heretofore have been referred to the genus *Merycoidodon*. As discussed in the foregoing pages, the fan-shaped occipital region of the skull and the shallow molar fossettes of this species differ considerably from the narrow occipital wings (produced posterior to the condyles) and the deep molar fossettes of *Merycoidodon*.

Leidy⁷ in the original description of "*Oreodon*" *affinis* stated of the holotype specimen that it "consists of the facial portion of a skull, which in size is as large as the corresponding portion of some skulls of *Oreodon culbertsonii*, but which exhibits more the peculiarities of *Oreodon gracilis*. . . . The teeth, though larger than is commonly the case in the latter, are yet smaller than in some specimens." Apparently Leidy considered that a closer relationship ex-

¹ 1884.

² 1909.

³ 1902, p. 666.

⁴ 1937, p. 56.

⁵ 1947, p. 172.

⁶ 1937, p. 57.

⁷ 1869, p. 105.

isted between examples of *M. (P.) affinis* and *M. (P.) gracilis* than with those of *Merycoidodon culbertsonii*, which is the conclusion of the present writers.

Thorpe¹ gave the geologic horizon of the holotype and referred remains as "lower and middle Oligocene (Chadron and lower Brule)," but all the material of *M. (P.) affinis* here considered indicates that the form is restricted to the lower part of the Brule ("Zone A").

The F:A.M. specimens here listed from South Dakota were collected by Ralph Mefferd

and Morris Skinner, 1938-1940; from Colorado, by William Klaus and John C. Blick, 1931; from Wyoming, by Gene Roll, Everett De Groot, George Sternberg, John C. Blick, and Charles H. Falkenbach, 1938-1944; and the U.N.S.M. examples from Nebraska and Colorado by E. L. Blue, Thompson M. Stout, C. Bertrand Schultz, and associates, 1933-1934 and 1936-1940.

One hundred and thirteen specimens are here recorded:

HOLOTYPE

Anterior portion of skull with C/-P³ rt. and P⁴-M³. (w+) A.N.S.P. 10679² From "Zone A" of Brule formation, White River drainage, South Dakota. Figured by Leidy, 1869, pl. 9, fig. 3; Thorpe, 1937, pl. 1, fig. 12

REFERRED FROM (A) TYPE AREA, SOUTH DAKOTA; (B) FALL RIVER, (C) PENNINGTON, (D) SHANNON COUNTIES, AND (E) GENERAL AREA, SOUTH DAKOTA; (F) LOGAN AND (G) WELD COUNTIES, COLORADO; (H) DAWES, (I) SCOTTS BLUFF, AND (J) SIOUX COUNTIES, NEBRASKA; (K) CONVERSE, (L) LARAMIE, AND (M) NIOBRARA COUNTIES, WYOMING

A. FROM TYPE AREA, WHITE RIVER DRAINAGE, SOUTH DAKOTA

SKULL A.N.S.P.
Partial skull with M¹-M³ (w+) 10699

B. FROM LITTLE BAD LANDS, OELRICHS, WHITE RIVER DRAINAGE, FALL RIVER COUNTY, SOUTH DAKOTA (Collected by Albert Thomson, 1940)

SKULL A.M.
Partial skull with P¹(rt.)-M³ (w) 39121

C. FROM P.U. COLL. LOC. 1016E, 2A, VALLEY OF BEAR CREEK, CHEYENNE RIVER DRAINAGE, PENNINGTON COUNTY, SOUTH DAKOTA (Collected by Princeton University Expedition, 1921)

SKULL AND MANDIBLE (ATTACHED) P.U.
Partial skull with I³-C/ rt. and P¹-M³ and mandible with I₁-P₁ rt. and P₂-M₃. . (w) 12622
The above specimen was referred to *Merycoidodon culbertsonii* by Sinclair.³

D. FROM CHEYENNE RIVER DRAINAGE, SHANNON COUNTY, SOUTH DAKOTA FROM COTTONWOOD PASS AREA:

SKULL, MANDIBLE, AND SKELETAL ELEMENTS F:A.M.
Skull with I¹(rt.)-M³ (I² rt.), mandible with I₁-M₃, 2 partial scapulae, 2 humeri (1 partial), 2 radii, 2 partial ulnae, partial manus, 2 femora, 2 tibiae, pelvis, and fragments. Figures 3-4, 9-11 (w) 44977

¹ 1937, p. 46.

² Thorpe, 1937, pp. 46 and 312, reported the number of the holotype as "A.N.S.P. 10680," from "the Niobrara River, Sioux County, Nebraska." This number, however, represents a fragment of a camel.

³ 1924, Proc. Amer. Phil. Soc., vol. 63, p. 102.

3 SKULLS AND MANDIBULAR RAMI

F:A.M.

Partial skull with I ³ -P ¹ rt. and P ² -M ³ and partial right ramus with /C(rt.)-M ₃ (P ₁ br.)	(w)	44974
Partial skull with I ¹ -P ¹ rt. and P ² -M ³ and mandible (attached) with I ₁ -P ₁ rt. and P ₂ -M ₃	(w)	45006
Partial skull with dP ² (br.)-M ³ (P ² -P ⁴ germs) and mandible (attached) with P ₁ (erupt.)-M ₃	(-m)	49598

SKULL

Anterior portion of skull with C/(rt.)-M ³ (br.) (P ⁴ -M ² br.)	(m)	49600
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FROM SHEEP MT. AREA:

2 SKULLS AND MANDIBLES

Skull with I ³ -P ¹ rt. and P ² -M ³ and mandible with I ₁ (alv.)-M ₃	(w+)	44973
Partial skull with I ³ -M ³ and mandible (attached) with P ₁ -M ₃ (P ₁ -P ₃ br.)	(w+)	44975

FROM BATTLE CREEK DRAW AREA:

2 SKULLS AND MANDIBLES (ATTACHED)

Partial skull with P ¹ (br.)-dP ³ -M ³ (erupt.) and mandible with dP ₄ -M ₃ (erupt.)	(i)	49599
Partial skull with C/-M ³ and mandible with I ₂ -M ₃	(w+)	49622

FROM LITTLE CORRAL DRAW AREA:

2 SKULLS

Partial skull with C/(rt.)-M ³	(w)	45002
Partial skull with P ² -M ³	(w+)	49623

E. GENERAL AREA,¹ SOUTH DAKOTA

AMERICAN MUSEUM EXPEDITION, 1892:

2 SKULLS

A.M.

Partial skull with C/(rt.)-M ³	(m+)	596
The above specimen was figured by Osborn and Wortman, 1894, fig. 5, as " <i>Oreodon gracilis</i> "; by Thorpe, 1937, fig. 7B, as " <i>Merycoidodon gracilis</i> ."		
Partial skull with C/(br.)-M ³	(w)	599

FROM CHEYENNE RIVER DRAINAGE, 1894:

SKULL, MANDIBLE, AND SKELETAL ELEMENTS

Partial skull with C/(rt.)-M ³ , partial mandible with P ₂ (rt.)-M ₃ , limb fragments and vertebrae.	(w+)	1309
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SKULL AND MANDIBLE (ATTACHED)

Skull with C/(br.)-M ³ , partial mandible with /C(alv.)-M ₃ (P ₁ -P ₂ rt.)	(w+)	1306
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F. FROM LOGAN COUNTY, COLORADO

FROM CEDAR CREEK (COPE COLLECTION, 1879):

SKULL, MANDIBLE, AND SKELETAL ELEMENTS

Partial skull with C/(rt.)-M ³ , mandible with I ₁ -M ₃ , pelvis and vertebrae. Figures 3-4	(w+)	A.M. 6404
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The type description of "*Oreodon gracilis coloradoensis*" by Cope was based upon this specimen.

FROM HORSE CREEK AREA (COPE COLLECTION, 1879):

SKULL AND MANDIBLE

Skull with C/(br.)-M ³ and mandible with I ₂ -I ₃ rt. and /C-M ₃	(w+)	6405
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FROM QUESTIONABLE AREA (COPE COLLECTION, 1879):

¹ No specific locality given in records.

SKULL AND MANDIBLE (ATTACHED)		A.M.
Partial skull with C/-M ³ and mandible with I ₇ /C rt. and P ₁ -M ₃ (br.) . . .	(w+)	6407

SKELETAL ELEMENTS

2 partial humeri, 2 radii (1 partial), 2 femora (1 partial), 2 tibiae, 2 astragali, calcaneum, manus elements, and vertebrae. Figure 11	6409
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FROM LEWIS CREEK (COLLECTED BY W. D. MATTHEW, H. T. MARTIN, AND T. MAXWELL, 1898):

3 SKULLS AND MANDIBLES (ATTACHED) WITH SKELETAL ELEMENTS

Partial skull with I ³ -M ³ , partial mandible with /C-M ₃ , partial tibia, and manus elements	(w)	8872
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The partial tibia listed above seems to be too large for this species.

Partial skull with C/-M ³ , partial mandible with P ₁ (br.)-M ₃ , and vertebral fragments	(w)	8875
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The above specimen may represent a large example of *M. (P.) gracilis*.

Skull with I ² -M ³ (C/rt.), mandible with /C-M ₃ , partial scapula, 2 humeri (1 partial), 2 radii (1 partial), 2 partial ulnae, 2 partial manus, partial femur, partial pelvis, partial pes, vertebrae, ribs, and fragments	(w+)	8915
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The above manus has five digits.

G. FROM PAWNEE CREEK AREA, WELD COUNTY, COLORADO

SKULL AND MANDIBLE (ATTACHED) WITH SKELETAL ELEMENTS

Partial skull with P ³ -M ³ , mandible with P ₁ -M ₃ (P ₂ absent), femur, partial pelvis, and vertebrae.	(w)	F:A.M. 49539
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2 SKULLS AND MANDIBLES

Partial skull with C/(br.)-M ³ and mandible (attached) with I ₂ -M ₃	(w)	44994
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The above skull seems narrow for this species but this may be due to crushing.

Partial skull with I ¹ -M ³ (I ² -P ¹ rt. and M ¹ br.) and partial mandible with I ₁ -P ₁ rt. and P ₂ -M ₃ (P ₄ rt.)	(m+)	U.N.S.M. 28116
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6 SKULLS

Partial skull with C/(br.)-M ³ (P ¹ br.)	(w+)	F:A.M. 44966
Partial skull with P ¹ -M ³	(w+)	44978
Left anterior portion of skull with C/(br.)-M ³	(m+)	44979
Partial skull with C/-M ²	(w+)	44995

The premolars of the above specimen are unusually large.

Brain case and partial right maxilla with P ¹ -P ⁴	(w+)	49509
Partial skull with dP ¹ -M ²	(i)	49542

MAXILLA

Right maxilla with P ¹ (br.)-M ³ (P ⁴ -M ³ br.)	(w)	49510
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3 MANDIBLES

3 partial mandibles with		
P ₁ (br.)-M ₃ (br.) (P ₂ and M ₂ br.)	(w+)	49511
/C-M ₃ (P ₄ and M ₁ br.)	(w+)	49512
/C-P ₃ rt. and dP ₄ (br.)-M ₃ (germ)	(i)	49513

2 MANDIBULAR RAMI

Partial right ramus with P ₁ -P ₂ rt. and P ₃ -M ₃	(w+)	49514
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The M₁ of the above specimen is unusually large for this species.

Partial left ramus with M ₁ (br.)-M ₃	(w+)	49543
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2 SKULLS AND MANDIBULAR RAMI, IMMATURE

Skull with C/-dP ² -M ³ and mandible (attached) with /C-dP ₂ -M ₂	(i)	A.M. 9345
Posterior portion of skull and partial right ramus with P ₁ -dP ₂ -M ₂	(i)	9346

SKULL, IMMATURE		F:A.M.
Anterior portion of skull with C/-dP ² -M ³	(i)	9348
H. FROM U.N.S.M. COLL. LOC. DW-3, WHITE RIVER DRAINAGE, DAWES COUNTY, NEBRASKA		
SKULL		U.N.S.M.
Partial skull with C/-P ² rt. and P ³ -M ³	(M+)	28056
I. FROM SCOTTS BLUFF COUNTY, NEBRASKA		
FROM NEAR SCOTTS BLUFF MONUMENT (COLLECTED BY D. S. SHELLY, 1874):		
SKULL		Y.P.M.
Partial skull with I ¹ (alv.)-M ³	(M+)	12748
Designated as Plesiotype of <i>M. (P.) affinis</i> by Thorpe, 1937.		
FROM SCOTTS BLUFF MONUMENT, U.N.S.M. COLL. LOC. SF-101:		
2 SKULLS AND MANDIBLES		U.N.S.M.
Partial skull with C/-M ³ (P ¹ br.) and mandible with I ₂ (rt.)-M ₃ (/C rt.). . . .	(w)	28151
Partial skull with P ¹ -dP ² -M ² and mandible (attached) with P ₁ (br.)-dP ₂ -M ₂ .	(i)	28318
4 SKULLS		
4 partial skulls with		
I ¹ (rt.)-M ³	(w)	28120
M ³	(w)	28157
M ² -M ³	(w)	28158
P ¹ (rt.)-M ³ (P ³ rt.)	(M+)	28174
SKULL AND MANDIBLE (ATTACHED)		
Partial skull with P ² -M ³ and mandible with P ₁ -M ₃	(M+)	28041
J. FROM HAT CREEK BASIN, CHEYENNE RIVER DRAINAGE, SIOUX COUNTY, NEBRASKA		
FROM NORTH OF HARRISON:		
2 SKULLS, MANDIBULAR RAMI, AND SKELETAL ELEMENTS		
Skull with I ¹ -I ² alv. and I ³ -M ³ , mandible (attached) with P ₁ -M ₃ , partial hu- merus, radius, ulna, and atlas	(w)	A.M. 1290
Partial skull with C/-P ¹ rt. and P ² -M ³ , right ramus with I ₁ -P ₂ rt. and P ₃ -M ₃ , calcaneum, pelvis, and fragments	(w†)	Y.P.M. 12227
The above specimen was collected by W. S. Benton, on the Warbonnett Ranch, 1914. Thorpe, 1937, designated the specimen as a plesiotype of <i>M. (P.)</i> <i>affinis</i> . The calcaneum is decidedly longer than in other examples of species.		
SKULL AND MANDIBLE		A.M.
Partial skull with C/(br.)-M ³ and mandible with /C-P ₁ rt. and P ₂ (br.)-M ₃ . .	(M+)	1316
SKULL AND SKELETAL ELEMENTS		
Partial skull with I ² -I ³ alv. and C/(rt.)-M ³ , femur and tibia	(M+)	1293
The American Museum catalogue records the horizon as " <i>Protoceras</i> ? beds," for specimens A.M. 1290, 1316 and 1293.		
SKELETAL ELEMENTS		
2 femora (1 partial), 2 tibiae, 2 astragali, 2 calcanea (1 partial), manus, and 2 partial pedes		P.U. 11398
The above manus has five digits. Collected by Gidley and Wells; figured by Scott, 1940, pl. 71, figs. 11 and 15. The manus and one of the pedes were illus- trated and considered by Scott to be the same individual as that of the skele- ton of <i>M. (P.) gracilis</i> , P.U. 13626.		
FROM U.N.S.M. COLL. LOC. SX-1:		
SKULL		U.N.S.M.
Partial skull with P ¹ -P ² rt. and P ³ (br.)-M ³	(w†)	28046
FROM U.N.S.M. COLL. LOC. SX-4:		

5 SKULLS AND MANDIBULAR RAMI		U.N.S.M.
Partial skull with C/(rt.)-dP ² -M ³ (erupt.) and mandible (attached) with P ₁ -dP ₂ -M ₃ (erupt.)	(i)	28106
Partial skull with I ¹ -M ³ and mandible (attached) with I ₁ -M ₃	(w)	28132
Partial skull with I ¹ -I ³ alv. and C/(br.)-M ³ (br.) and mandible (attached) with /C-M ₃	(w)	28176
Partial skull with C/(rt.)-dP ² -M ² and mandible (attached) with P ₁ (br.)-dP ₂ -M ₂	(i)	28290
Partial skull with C/(rt.)-M ³ (P ¹ br.) and partial right ramus with P ₂ (rt.)-M ₃	(w+)	28298

2 SKULLS

Skull with C/(rt.)-M ³	(w+)	28126
Skull with C/(rt.)-M ³	(m+)	28163

FROM U.N.S.M. COLL. LOC. SX-5:

SKULL AND MANDIBLE (ATTACHED)

Partial skull with I ³ -M ³ (C/ br.) and mandible with I ₁ -M ₃	(w)	28164
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FROM U.N.S.M. COLL. LOC. SX-6:

2 SKULLS

Partial skull with C/(br.)-M ³	(m+)	28503
Partial skull with I ¹ -M ³ (C/ br. and P ¹ -P ² rt.)	(m+)	28047

FROM U.N.S.M. COLL. LOC. SX-16:

SKULL

Skull with I ³ -C/ rt. and P ¹ -M ³	(w ⁺ ₊)	28504
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FROM U.N.S.M. COLL. LOC. SX-37:

3 SKULLS AND MANDIBULAR RAMI

Anterior portion of skull with C/(rt.)-M ³ and mandible with P ₁ (br.)-M ₃	(m)	28131
Partial skull with P ³ -M ³ (br.) (M ¹ -M ² br.) and partial mandible with M ₁ (rt.)-M ₃	(w ⁺ ₊)	28175
Anterior portion of skull with P ³ -M ³ and partial right ramus with I ₂ -C alv. and P ₁ (rt.)-M ₃ (br.) (P ₂ br.)	(w+)	28292

SKULL

Anterior portion of skull with C/(rt.)-M ³ (P ¹ br.)	(w ⁺ ₊)	28291
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FROM ? HAT CREEK BASIN (COLLECTED BY A. C. BATES):

SKULL AND MANDIBLE (ATTACHED), IMMATURE

Partial skull with P ¹ -dP ² -M ² and mandible with I ₁ -C rt. and P ₁ -dP ₂ -M ₂	(i)	342
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J'. FROM WHITE RIVER DRAINAGE, SIOUX COUNTY, NEBRASKA

FROM U.N.S.M. COLL. LOC. SX-17:

2 SKULLS AND MANDIBLES

Partial skull with I ³ -M ³ and mandible (attached) with I ₁ -I ₃ alv. and /C(rt.)-M ₃	(w+)	28129
Partial skull with dP ² -M ² and partial mandible with dP ₃ (br.)-M ₂	(i)	28295

2 SKULLS

Anterior portion of skull with I ¹ -M ³	(w)	28284
Anterior portion of skull with C/-P ¹ rt. and P ² (br.)-M ³ (br.)	(w ⁺ ₊)	28307

FROM U.N.S.M. COLL. LOC. SX-18:

SKULL

Anterior portion of skull with C/(br.)-M ³	(w+)	28305
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FROM U.N.S.M. COLL. LOC. SX-19:

SKULL

Anterior portion of skull with C/(rt.)-M ³ (P ¹ br.)	(w ⁺ ₊)	28282
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FROM U.N.S.M. COLL. LOC. SX-22:

2 SKULLS		U.N.S.M.
Partial skull with C/(rt.)-M ³	(w+)	28122
Partial skull with C/-P ¹ rt. and P ² (br.)-M ³	(w+)	28278
FROM U.N.S.M. COLL. LOC. SX-25:		
SKULL		
Partial skull with C/(rt.)-M ³	(w)	28166
FROM U.N.S.M. COLL. LOC. SX-26:		
SKULL		
Partial skull with C/(rt.)-M ³	(m)	28315
FROM U.N.S.M. COLL. LOC. SX-32:		
SKULL AND MANDIBLE (ATTACHED), IMMATURE		
Partial skull with C/(br.)-dP ² -M ² and mandible with /C-P ¹ rt. and dP ² -M ² . (I)		28304
K. FROM 6-9 MI. S.E. OF DOUGLAS, CONVERSE COUNTY, WYOMING		
SKULL AND MANDIBLE (ATTACHED), IMMATURE		
Skull with C/(erupt.)-dP ¹ -M ¹ (germ) and mandible with I ₁ -C rt. and dP ¹ -M ₁ (germ).	(I)	F:A.M. 49527
SKULL AND SKELETAL ELEMENTS		
Partial skull with I ¹ -M ³ (P ³ rt.), 2 femora, 2 tibiae, 2 astragali, 2 calcanea (1 partial), pes elements, and fragments. Figure 11 (in part)	(w+)	45481
The dentition of the above specimen is poorly preserved.		
SKULL		
Partial skull with P ² -M ³	(w)	45010
L. FROM 7 MI. S. OF PINE BLUFFS, LARAMIE COUNTY, WYOMING		
(Collected by American Museum Expedition, 1902)		
SKULL AND MANDIBULAR RAMUS		A.M.
Partial skull with P ¹ -M ³ and partial left ramus with /C-M ₂	(M+)	9799
SKULL		
Partial skull with C/(rt.)-M ³ (P ¹ -P ² br.).	(w+)	9800
M. FROM HAT CREEK BASIN, CHEYENNE RIVER DRAINAGE, NIOBRARA COUNTY, WYOMING		
FROM SHACK DRAW AREA:		
SKULL, MANDIBLE (ATTACHED), AND SKELETAL ELEMENTS		
Partial skull with C/-M ³ , mandible with I ₃ -M ₃ , 2 partial humeri, 2 femora, 2 partial tibiae, 2 partial fibulae, astragalus, partial calcaneum, partial pes, and partial pelvis	(M+)	F:A.M. 49573
The above femur is intermediate in length between examples <i>M. (P.) affinis</i> and those of <i>M. (P.) gracilis</i> . The pes, however, is equal to other examples of this species.		
3 SKULLS AND MANDIBLES (ATTACHED)		
Partial skull with I ¹ -M ³ (C/ rt.) and mandible with I ₁ -I ₂ rt. and I ₃ -M ₃	(w+)	45348
Partial skull with I ¹ -M ³ and mandible with I ₂ -M ₃	(w+)	49574
Skull with I ¹ -M ³ and mandible with /C-M ₃	(w)	49575
8 SKULLS		
8 partial skulls with		
C/-P ¹ rt. and P ² -M ³	(w+)	44972
C/-P ² rt. and P ³ -M ³	(w+)	44984
C/(br.)-M ³	(M+)	45349
I ¹ -M ³	(M)	45350

		F:A.M.
C/-M ³ (P ² -P ³ alv.)	(M)	49577
C/(br.)-dP ² -M ²	(I)	49580
C/(br.)-dP ¹ -M ²	(I)	49596
C/(br.)-M ³	(W)	49630
FROM INDIAN CREEK AREA:		
3 SKULLS AND MANDIBLES (ATTACHED) WITH SKELETAL ELEMENTS		
Skull with C/-dP ² -M ³ (erupt.), mandible with P ₁ -dP ₂ -M ₂ , partial scapula, partial humerus, radius, partial ulna, manus, and vertebrae	(I)	49526
The above manus has five digits.		
Skull with I ² (rt.)-M ³ (I ³ alv., C/ and P ² br.), mandible with I ₁ -C alv. and P ₁ -M ₃ , 2 femora (1 partial), tibia, fibula, calcaneum, astragalus, partial pelvis, and vertebrae	(W)	49533
Approaching size of <i>M. (P.) helprini</i> .		
Skull with C/-M ³ , mandible with I ₁ -I ₃ rt. and /C-M ₃ , 2 partial scapulae, 2 humeri, partial radius, ulna, 2 femora, manus and pes elements, astragalus, calcaneum, vertebrae, and ribs	(W)	49534
3 SKULLS AND MANDIBLES		
Partial skull with C/-M ³ and mandible (attached) with /C(rt.)-M ₃ (P ₁ br.)	(W)	44987
Skull with C/(rt.)-M ³ and partial mandible with P ₁ (br.)-M ₃ (P ₄ -M ₃ br.)	(M)	49537
Skull with I ¹ -M ³ and mandible (attached) with I ₁ (br.)-M ₃	(W)	49629
2 SKULLS		
Skull with I ² -P ¹ br. and P ² -M ³	(M+)	44969
The above specimen may represent a large example of <i>M. (P.) gracilis</i> .		
Right posterior portion of skull with P ³ -M ³	(W+)	49597
FROM 5 MI. N.E. OF HAT CREEK STORE:		
MANDIBLE		
Partial mandible with I ₁ -C rt. and P ₁ (br.)-M ₃	(M+)	49601
FROM NORTH OF NODE:		
SKULL AND MANDIBLE (ATTACHED), IMMATURE		
Partial skull with C/-dP ² -M ² and mandible with I ₁ -C rt. and P ₁ -dP ₂ -M ₂	(I)	49595

2. *Miniochoerus* (*Paraminiochoerus*) *gracilis* (Leidy)

From "Zone A" of the Brule formation, South Dakota; referred remains from Pennington and Shannon counties, South Dakota; Logan and Weld counties, Colorado; Dawes, Scotts Bluff, and Sioux counties, Nebraska; and Niobrara County, Wyoming

Oreodon gracile LEIDY, 1851, Proc. Acad. Nat. Sci. Philadelphia, vol. 5, p. 239.

Oreodon gracilis LEIDY, 1852, in Owen, Report of a geological survey of Wisconsin, Iowa and Minnesota and incidentally a portion of Nebraska Territory, p. 550, pl. 11, figs. 2-3, pl. 13, figs. 5-6; 1854, Smithsonian Contrib. Knowledge, vol. 6, art. 7, p. 53, pl. 5, figs. 3-4, pl. 6, figs. 1-7; 1869, Jour. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 7, p. 94, pl. 6, figs. 2-3. SCOTT, 1890, Morph. Jahrb., vol. 16, fig. 1, pl. 13, fig. 5.

Oreodon minor COPE, 1888, Amer. Nat., vol. 22, p. 1094, *nomen nudum*.

Merycoidodon gracilis (Leidy), HAY, 1902, Bull. U. S. Geol. Surv., no. 179, p. 666. GILMORE, 1906, Proc. U. S. Natl. Mus., vol. 31, p. 513, pl. 12. MATTHEW, 1932, Bull. Dept. Geol. Sci., Univ. California, vol. 22, no. 2, p. 13, pls. 2-3. THORPE, 1937, Mem. Peabody Mus., vol. 3, pt. 4, p. 56, fig. 7 (= *Miniochoerus affinis*), pl. 1, figs. 4-5 (fig. 5 = *M. affinis*), pl. 41. SCOTT, 1940, Trans. Amer. Phil. Soc., new ser., vol. 28, pt. 4, p. 670, pl. 71.

CHARACTERS

SKULL: Smallest in *Miniochoerinae*, larger examples approach the smaller ones of *M. (P.) affinis*; sagittal crest higher on average than in examples of *M. (P.) affinis*; brain case well inflated, more so than in average examples of latter species; frontals less convex transversely than those of *M. (P.) affinis*; nasals moderately light, slight anterior retraction; anterior nasal-maxilla contact above and posterior to C/; supraorbital foramina with tendency to be farther apart in examples of *M. (P.)*

affinis; malar averaging less depth below orbit than in examples of *M. (P.) affinis*; infraorbital foramen above P^3 ; lacrimal fossa smaller and with less depth than in examples of *M. (P.) affinis*; occipital condyles lighter than those of latter species.

MANDIBLE: Examples lighter and smaller than those of *M. battlecreekensis*; condyle lighter than in examples of *M. (P.) affinis*, external border higher and more anterior than internal border.

DENTITION: Series lightest known of Mini-choerinae, length averaging less than in examples of *M. (P.) affinis*.

LIMBS: Shortest and lightest in Mini-choerinae.

MEASUREMENTS: Tables 2 and 3 (pp. 403 and 404).

ILLUSTRATIONS: Figures 3-4, 9-11.

DISCUSSION

The characters of *Miniochoerus (Paraminiochoerus) gracilis* are compared with those of *M. battlecreekensis* and *M. (P.) affinis*, since all three species are from "Zone A" of the Brule formation, and in many instances from the same localities. Examples of *M. (P.) gracilis* seem to represent a side spur in the phylogeny of the subgenus that did not survive or give rise to a form in "Zone B." At first it may be thought that examples of *M. (P.) gracilis* are the female forms of *M. (P.) affinis*. The former, however, can usually be recognized because they have lighter teeth, smaller-sized skulls, and lighter and shorter limbs than *M. (P.) affinis*. As previously mentioned, sex variation is not apparent in the Mini-choerinae. (See discussion of differences between genus and subgenus, p. 393.)

Hay's¹ decision to place the species *gracilis* under the genus *Merycoidodon* was accepted by Scott,² who stated: "This is the smallest species of the genus [*Merycoidodon*] and seemingly distinct, yet transitions to *M. culbertsonii* are not wanting. After size, the most characteristic feature of *M. gracilis* is the form of the occiput, in which the wing-like projections are extremely short, so that the appearance of the skull in side view is very different." Thorpe³

considered the difference pointed out by Scott as of specific value only and stated, "... the supraoccipital crest is less produced than in other species of the genus [*Merycoidodon*], and the small wings are far apart." Thorpe used more or less the same description for both the species *affinis*⁴ (this report, p. 405) and *platycephalus*⁵ (this report, p. 427). On the characters of *Merycoidodon culbertsonii*, Thorpe⁶ reported, "The supraoccipital crest is produced aft and beyond the occipital condyles, the wings are wide-spread." The present writers do not consider the supraoccipital wings in examples of *M. culbertsonii* as widespread, i.e., in comparison with examples of *M. (P.) gracilis*, or in fact with any other examples of the Mini-choerinae. Scott did note the difference of the occiput in the side view of the two forms in question. The shape of the occiput is one of the characters that the present writers have used to separate the Mini-choerinae from the Merycoidodontinae.

Thorpe⁷ designated the cotypes of *M. (P.) gracilis* as specimens A.N.S.P. 10682-10691 inclusive. Specimens A.N.S.P. 10682 and 10683 are partial limb elements which appear to be too large for this species. The balance of Thorpe's cotypes do not appear to agree with Leidy's original description. The present writers, however, found additional specimens in the collections of the Academy of Natural Sciences of Philadelphia and believe that the partial maxilla, A.N.S.P. 10692, is the one described by Leidy⁸ in the following statement: "Several fragments were then exhibited of a much smaller animal than the last [*O. priscum* = *Merycoidodon culbertsonii*], consisting of the greater part of the inferior and superior maxillae, the latter containing the 4th premolar and the true molars perfect, having the same form as those of *Oreodon priscum*. To this species, the name *Oreodon gracile* was given." In the accompanying table, the maxilla measurements were given, "Line of superior true molars [M^1-M^3] . . . 14 lines [= 29.7 mm.]." The maxilla, A.N.S.P. 10692, here chosen as a lectotype, has P^4-M^3 , with M^1-M^3 measuring 30 mm. A second maxilla, A.N.S.P. 10694, is here

¹ 1937, p. 46.

² 1937, p. 59.

³ 1937, p. 48.

⁴ 1937, p. 56.

⁵ 1851, p. 239; see fig. 4, present report.

¹ 1902, p. 666.

² 1940, p. 670.

³ 1937, p. 57.

considered as part of the same individual as A.N.S.P. 10692.

In a later discussion of the species *gracilis*, Leidy¹ reported, "Upon the teeth of the latter [*O. gracilis*] the enamel is thinner relatively upon the external concave faces of the inner lobes of the upper molars, and the internal faces of the other lobes of the lower molars than in *O. culbertsonii*." This is the first reference indicating that there was a recognizable difference between the enamel surfaces of the molars of *M. (P.) gracilis* and those of examples of *Merycoidodon*. This statement by Leidy seems to refer to the thin-enameled and shallow fosses of the molars in the Miniochoerinae (see discussion, p. 391).

It is of interest that Gilmore² recognized the need of further study of the small *gracilis*-like oreodonts. He reported, "It seems quite probable, after a superficial examination of several individuals in the collection of the [National] Museum, that there is more than one species of small Oreodonts, and a careful study of a good series would undoubtedly be rich in scientific results."

In a discussion of *M. (P.) gracilis*, Scott³ referred specimens P.U. 11398 and 11442 to this species. The present writers, nevertheless, consider the former as typical of *M. (P.) affinis* (present report, p. 405), and the later as typi-

cal of *Stenopsochoerus sternbergi* (present report, p. 438). It should also be noted that Scott illustrated the skeletal parts of "*Merycoidodon*" *gracilis* on plate 71 and stated in the explanation of the plate (p. 744): "All figures drawn from one individual, Princeton Mus., No. 13626. . . ." However, the manus and pes, illustrated on plate 71, figures 11 and 15, respectively, represent a larger individual, P.U. 11398, referable to *M. (P.) affinis*, as mentioned above.

Matthew⁴ described a skeleton of *M. (P.) gracilis*, U.C. 31046, which was not critically examined by the present writers. From the illustrations it would appear that Matthew was correct in referring it to this species. The illustration shows that the manus has five digits.

The F.A.M. specimens from South Dakota were collected by Ralph Mefferd and Morris Skinner, 1938-1940; from Wyoming by Gene Roll, Everett DeGroot, George Sternberg, John C. Blick, and Charles H. Falkenbach, 1938 and 1943-1944; from Nebraska by George Sternberg, John C. Blick, and Charles H. Falkenbach, 1944; from Colorado by William Klaus and John C. Blick, 1931; and the U.N.S.M. examples from Nebraska by E. L. Blue, Thompson M. Stout, C. Bertrand Schultz, and associates, 1933-1938 and 1940.

One hundred and forty specimens are here recorded:

LECTOTYPE

Partial right maxilla with P⁴-M³. (w+) A.N.S.P. 10692 From "Zone A" of Brule formation, "White River, South Dakota," "Nebraska Territory" = South Dakota; Leidy Collection
Figures 3-4

Partial left maxilla with M¹-M³. (w+) 10964

The above two maxillae are here considered as belonging to one individual.

REFERRED FROM (A) GENERAL AREA, SOUTH DAKOTA; (B) PENNINGTON AND (C) SHANNON COUNTIES, SOUTH DAKOTA; (D) LOGAN AND (E) WELD COUNTIES, COLORADO; (F) DAWES, (G) SCOTTS BLUFF, AND (H) SIOUX COUNTIES, NEBRASKA; AND (I) NIOBRARA COUNTY, WYOMING

A. FROM GENERAL AREA,⁵ SOUTH DAKOTA

FROM WHITE RIVER DRAINAGE:

	2 SKULLS AND MANDIBLES (ATTACHED)	A.N.S.P.
Skull with C/-P ² br. and P ³ -M ³ and mandible with I ₁ -C rt. and P ₁ -M ₃ . . . (w)		10685
Partial skull with C/(br.)-M ³ and mandible with I ₁ -C rt. and P ₁ (br.)-M ₃ . . . (w)		10686

¹ 1852, p. 551.

² 1906, p. 514.

³ 1940, pp. 671-675.

⁴ 1932, p. 15, pls. 2-3.

⁵ No specific locality recorded.

3 SKULLS		A.N.S.P.
Partial skull with C/-P ¹ br. and P ² -M ³	(w+)	10684
Anterior portion of skull with C/-P ³ rt. and P ⁴ -M ³ br.	(w+)	10687
Cranium		10688
3 MANDIBULAR RAMI		
Partial left ramus with I ₅ -P ₂ rt. and P ₈ -M ₃ (br.)	(w+)	10689
Partial left ramus with P ₁ -M ₃	(w+)	10690
Partial right ramus with M ₁ (br.)-M ₂	(w+)	10691
The above eight specimens were designated as part of the cotypes by Thorpe, 1937.		
2 SKULLS		
Anterior portion of skull with I ³ (br.)-M ³ (C/ and M ² -M ³ br.)	(w+)	10697
Partial skull with C/(rt.)-M ³	(w)	10698
The premolars of the above specimen are unusually large for this species.		
MANDIBULAR RAMUS		
Partial right ramus with P ₃ (rt.)-M ₁	(w+)	10695
The above three specimens were not included in the cotypes by Thorpe, 1937.		
SKULL, MANDIBLE, AND SKELETAL ELEMENTS		
Anterior portion of skull with I ² -M ³ (br.) (I ³ -P ² br.), mandible with /C-M ₃ (M ₁ -M ₂ br.), and most of skeleton.	(w+)	U.S.N.M. 2455
The above skeletal elements, which include a manus with five digits, were collected by N. H. Darton, 1897. Later they were illustrated by Gilmore, 1906, pl. 12 (in part). The skeleton is mounted with skull and mandible, U.S.N.M. 136.		
SKULL AND MANDIBLE		
Skull with I ¹ -M ³ and mandible with I ₁ -M ₃	(w)	136
The above specimen was figured by Leidy, 1869, pl. 6, figs. 2-3; Gilmore, 1906, pl. 12 (in part); Thorpe, 1937, pl. 1, figs. 4-5. The skull and mandible are now mounted with the skeleton mentioned above, U.S.N.M. 2455.		
2 SKULLS		
Partial skull with C/-M ¹ rt. and M ² -M ³	(w)	2539
The above skull was collected by Dr. John Evans and was figured by Leidy, 1854, pl. 6, figs. 4 (in part).		
Partial skull with C/(br.)-dP ² -M ² (P ¹ rt.)	(i)	15570
The bullae of the above specimen, although very small, seem more rounded than other examples of this species. The skull was collected by Dr. John Evans and figured by Leidy 1854, pl. 5, figs. 3-4; pl. 6, fig. 6 (in part).		
MANDIBULAR RAMUS		
Partial right ramus with I ₁ -P ₃ rt. and P ₄ -M ₃ (rt.)	(w+)	12334
The above ramus was figured by Leidy, 1854, pl. 6, figs. 4 (in part) and 5.		
FROM CHEYENNE RIVER DRAINAGE, 1894:		
2 SKULLS AND MANDIBLES (ATTACHED) WITH SKELETAL ELEMENTS		
Partial skull with I ¹ (br.)-M ³ (I ² and M ² -M ³ br.), mandible with I ₁ (br.)-M ₃ , 2 humeri (1 partial), partial radius, partial ulna, 2 partial femora, manus and pes elements, pelvis, and vertebrae	(w)	A.M. 1304
Partial skull with C/(br.)-M ³ , mandible with /C-P ₁ br. and P ₂ -M ₃ , humerus, partial radius, partial ulna, partial femur, pelvis, vertebrae, and fragments	(w+)	12463
The above specimen is only partially prepared.		
SKULL		
Anterior portion of skull with P ² (br.)-M ³	(M+)	1315

B. FROM CHEYENNE RIVER DRAINAGE, PENNINGTON COUNTY, SOUTH DAKOTA
FROM SOUTH OF SCENIC (COLLECTED BY WALTER GRANGER, ALBERT THOMSON, AND EDWIN H. COLBERT,
1939 AND 1941):

3 SKULLS AND MANDIBLES		A.M.
Partial skull with C/(rt.)-M ³ and mandible (attached) with P ₂ -M ₃	(w+)	38933
The above ramus had been fractured and then healed in life.		
Partial skull with C/(br.)-M ³ (P ² br.) and mandible with I ₃ -P ₂ rt. and P ₃ -M ₃	(w+)	39003
Anterior portion of skull with C/(rt.)-M ³ and partial mandible (attached) with I ₃ -M ₃ (br.)	(w+)	39547
3 SKULLS		
Anterior portion of skull with C/-M ³	(M+)	38947
Partial skull with C/(rt.)-M ³ (P ¹ br.)	(w+)	39431
Partial skull with C/-M ³	(M+)	39432

FROM 4 MI. S. OF SCENIC (COLLECTED BY GLENN JEPSEN AND ASSOCIATES, 1930-1932):

SKULL AND MANDIBLE (ATTACHED) WITH SKELETAL ELEMENTS		
Skull with I ² -M ³ , mandible with /C-M ₃ , scapula, humerus, radius, ulna, 2 femora, 2 tibiae, 2 astragali, 2 calcanea, partial pes, vertebrae, and fragments.	(w)	P.U. 13626
The above specimen was figured by Scott, 1940, pl. 71, figs. 1-10 and 12-14.		
SKULL AND MANDIBLE (ATTACHED)		
Skull with I ¹ -M ³ and mandible with I ₁ -C rt. and P ₁ -M ₃	(w+)	13688

C. FROM CHEYENNE RIVER, SHANNON COUNTY, SOUTH DAKOTA

FROM HEAD OF QUINN DRAW:

SKULL AND MANDIBLE (ATTACHED) WITH SKELETAL ELEMENTS		
Partial skull with I ¹ (alv.)-M ³ , mandible with I ₁ -M ₃ , scapula, 2 humeri, 2 radii, 2 ulnae, partial manus, 2 femora, 2 tibiae, astragalus, calcaneum, partial pes, pelvis, and vertebrae. Figures 9-11 (in part)	(w+)	F:A.M. 44962

FROM WEST BIG CORRAL DRAW:

SKULL AND MANDIBLE (ATTACHED), IMMATURE		
Partial skull with C/(rt.)-dP ² -M ² and mandible with I ₂ -C rt. and P ₁ -dP ₄ -M ₂ (I)	(I)	49594

D. FROM LOGAN COUNTY, COLORADO

FROM LEWIS CREEK (COLLECTED BY T. MAXWELL, 1898):

SKULL AND MANDIBULAR RAMUS		A.M.
Partial skull with C/(rt.)-M ³ (P ¹ br.) and partial right ramus with M ₂ (br.)-M ₃	(M+)	8873
FROM HORSETAIL CREEK (COPE COLLECTION, 1898):		

SKULL		
Skull with C/-M ³	(M+)	6412

E. FROM PAWNEE CREEK AREA, WELD COUNTY, COLORADO

2 SKULLS, MANDIBULAR RAMI, AND SKELETAL ELEMENTS		
Posterior portion of skull with M ² -M ³ , partial mandible with M ₂ (br.)-M ₃ , humerus, radius, partial ulna, and atlas	(w+)	F:A.M. 49540
The dentition of the above specimen is large for this species, but this may be due to crushing. The limb elements, however, are comparable with other examples of the species.		
Partial skull with C/-M ³ , mandible (attached) with I ₁ -I ₃ alv. and /C-M ₃ , partial humerus, vertebrae, and fragments	(w+)	A.M. 9343

2 SKULLS AND MANDIBULAR RAMI			F:A.M.
Partial skull with P ³ -M ³ and partial mandible (attached) with P ₃ (rt.)-M ₃ . . .	(w)	44964	
Left and right maxillae with C/(rt.)-M ³ and partial right ramus with P ₂ (br.)-M ₂ (br.)	(w ⁺)	49531	

2 SKULLS			
Partial skull with I ¹ -I ² rt. and I ³ -M ³	(w+)	44965	
Partial skull with C/-P ² rt. and P ³ -M ³	(w+)	44967	

MANDIBULAR RAMUS			
Partial right ramus with /C-P ₄ rt. and M ₁ -M ₃ (br.)	(w+)	49515	

SKELETAL ELEMENTS			
Ulna, 2 femora, tibia, 2 calcanea, vertebrae, and fragments		49544	

F. FROM DAWES COUNTY, WHITE RIVER DRAINAGE, NEBRASKA

FROM 4 MI. N.E. OF CHADRON:

SKULL			F:A.M.
Skull with I ¹ -I ³ rt. and C/(br.)-M ³	(w)	44963	

FROM 4½ MI. N.W. OF HORN:

SKULL, MANDIBLE, AND SKELETON			U.C.
Skull, mandible, and partial skeleton. Figured by Matthew 1932, pls. 2-3 . . .		31046	
Not examined critically by present writers. Illustration shows five digits in manus.			

G. FROM SCOTTS BLUFF COUNTY, NEBRASKA

FROM U.N.S.M. COLL. LOC. SF-101:

SKULL			U.N.S.M.
Partial skull with P ⁴ (erupt.)-M ³ (erupt.)	(-m)	28318	

FROM U.N.S.M. COLL. LOC. SF-102:

SKULL			
Skull with I ³ -M ³	(w ⁺⁺)	28134	

[No DATA]:

SKULL, IMMATURE			
Partial skull with C/(rt.)-dP ² -M ³ (germ)	(i)	28316	

H. FROM HAT CREEK BASIN, CHEYENNE RIVER DRAINAGE, SIOUX COUNTY, NEBRASKA

FROM NORTH OF HARRISON:

5 SKULLS AND MANDIBULAR RAMI			F:A.M.
Skull with C/(rt.)-M ³ and mandible (attached) with P ₁ -M ₃	(w)	49519	
Skull with I ¹ -M ³ and mandible (attached) with I ₁ (br.)-M ₃ and fragments . . .	(w)	49555	
Skull with I ³ -M ³ and mandible (attached) with I ₁ -I ₃ rt. and /C-M ₃	(w+)	49556	
Skull with P ¹ (br.)-M ³ and partial right ramus with P ₃ -M ₃ (P ₄ -M ₁ br.)	(w ⁺⁺)	49557	
Skull with C/-dP ² -M ³ (germ) and mandible (attached) with /C-dP ₂ -M ₃ (germ) . . .	(i)	49558	

SKULL			
Skull with C/(rt.)-M ³ (P ¹ rt.)	(w)	49523	

FROM U.N.S.M. COLL. LOC. SX-1:

5 SKULLS AND MANDIBULAR RAMI			U.N.S.M.
Skull with I ¹ -I ³ alv. and C/-M ³ and mandible (attached) with I ₁ -I ₂ alv. and I ₃ -M ₃	(w)	28121	
Partial skull with C/(rt.)-M ³ and mandible (attached) with /C-P ₁ rt. and P ₂ -M ₃	(w+)	28155	

Partial skull with I ¹ -C/rt. and dP ¹ (br.)-M ³ (germ) and mandible with I ₁ (erupt.)-dP ₂ -M ₃ (germ) (I ₂ /C rt.)	(I)	U.N.S.M. 28285
Partial skull with C/(br.)-dP ² -M ³ (germ) and mandible (attached) with P ₁ -dP ₂ -M ₂	(I)	28310
Partial skull with C/(br.)-dP ² -M ³ (germ) and mandible (attached) with I ₁ -dP ₂ -M ₂ (I ₁ -I ₂ erupt. and I ₃ rt.)	(I)	28325

SKULL

Partial skull with C/(rt.)-M ³ (M ¹ br.)	(w ⁺)	28049
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FROM U.N.S.M. COLL. LOC. SX-4:

4 SKULLS AND MANDIBLES

Partial skull with I ³ (rt.)-M ³ and partial mandible with P ₃ (br.)-M ₃	(w ⁺)	28111
Partial skull with C/(rt.)-M ³ and partial mandible with P ₃ -M ₂ (rt.)	(w)	28501
Anterior portion of skull with I ² (alv.)-M ³ (I ³ and C/rt.) and partial mandible (attached) with I ₁ -I ₃ alv. and /C(br.)-M ₃	(w+)	28289
Partial skull with P ¹ -dP ² -M ³ and partial mandible with I ₂ /C br. and P ₁ (rt.)-dP ₂ -M ₂	(I)	28505

2 SKULLS

2 partial skulls with C/-P ¹ rt. and P ² -M ³	(w+)	28152
C/(rt.)-M ³ (P ¹ and M ¹ br.)	(M+)	28160

FROM U.N.S.M. COLL. LOC. SX-5:

3 SKULLS AND MANDIBLES

Partial skull with P ³ -M ³ (M ¹ br.) and partial mandible with P ₁ (rt.)-M ₃ (P ₂ br.)	(M+)	28038
Skull with I ² -M ³ (C/rt.) and mandible with I ₁ -M ₃	(M)	28054
Partial skull with C/(rt.)-M ³ and mandible (attached) with I ₁ -I ₃ rt. and /C(br.)-M ₃ (P ₁ br.)	(M)	28299

4 SKULLS

Skull with I ¹ -I ³ rt. and C/-M ³	(w ⁺)	28053
Skull with C/-M ³	(w ⁺)	28055
Partial skull with C/(rt.)-M ³	(M)	28279
Partial skull with C/(rt.)-M ³	(M+)	28309

FROM U.N.S.M. COLL. LOC. SX-6:

6 SKULLS AND MANDIBLES

Partial skull with C/(br.)-M ³ and partial mandible with M ₁ -M ₃	(M)	28118
Partial skull with P ² -M ³ and mandible (attached) with P ₂ -M ₃	(M+)	28300
Partial skull with C/(br.)-dP ² -M ³ (germ) and mandible (attached) with dP ₂ -M ₂	(I)	28311
Partial skull with dP ³ -M ³ (germ) and mandible (attached) with dP ₄ -M ₃ (germ)	(I)	28322
Skull with I ³ -M ³ (C/br.) and mandible (attached) with I ₁ -I ₂ alv. and I ₃ -M ₃	(w)	28506
Partial skull with P ³ -M ³ and mandible (attached) with P ₁ -P ₂ rt. and P ₃ -M ₃	(w)	28507

6 SKULLS

6 partial skulls with I ² -I ³ alv. and C/(rt.)-M ³ (P ¹ rt. and P ² br.)	(M+)	28170
C/(rt.)-M ³	(w ⁺)	28153
C/(rt.)-M ³	(w ⁺)	28280
C/(rt.)-M ³	(w)	28302
C/(rt.)-dP ² -M ³ (germ)	(I)	28312
C/(rt.)-dP ² -M ³ (erupt.)	(I)	28234

FROM U.N.S.M. COLL. LOC. SX-11:

SKULL AND MANDIBLE		U.N.S.M.
Partial skull with I ¹ -I ³ rt. and C/(br.)-M ³ (P ¹ -P ² rt.) and partial mandible with /C-M ₃ (P ₁ br.)	(w+)	28045
FROM U.N.S.M. COLL. LOC. SX-12:		
SKULL AND MANDIBLE (ATTACHED)		
Partial skull with I ³ (rt.)-M ³ (C/-P ¹ br.) and mandible with I ₁ -I ₂ alv. and I ₃ -M ₃	(w+)	28115
FROM U.N.S.M. COLL. LOC. SX-14:		
SKULL		
Partial skull with C/(rt.)-M ³ (P ¹ rt.)	(w+)	28130
FROM U.N.S.M. COLL. LOC. SX-37:		
SKULL		
Partial skull with C/(rt.)-M ³	(M+)	28043
FROM U.N.S.M. COLL. LOC. SX-38:		
SKULL AND MANDIBLE (ATTACHED)		
Partial skull with C/(br.)-M ³ and mandible with /C(rt.)-M ₃	(w)	28156
2 SKULLS		
Partial skull with C/-P ³ rt. and P ⁴ -M ³ (br.)	(w ⁺⁺)	28172
Partial skull with I ³ -M ³	(M+)	28313
FROM U.N.S.M. COLL. LOC. SX-39:		
2 SKULLS AND MANDIBLES		
Partial skull with P ² -M ³ and partial mandible (attached) with P ₃ -M ₃	(w)	28167
Partial skull with P ¹ (rt.)-M ³ (M ² br.) and partial mandible with M ₁ -M ₃	(w+)	28296
H'. FROM WHITE RIVER DRAINAGE, SIOUX COUNTY, NEBRASKA		
FROM U.N.S.M. COLL. LOC. SX-17:		
SKULL AND MANDIBLE		U.N.S.M.
Partial skull with C/(br.)-M ³ and mandible with P ₂ -P ₃ rt. and P ₄ -M ₃	(M+)	28140
SKULL, IMMATURE		
Anterior portion of skull with C/(rt.)-dP ² -M ³ (germ) (P ¹ br.)	(i)	28314
FROM U.N.S.M. COLL. LOC. SX-18:		
SKULL AND MANDIBLE (ATTACHED)		
Skull with C/(br.)-M ³ and mandible with P ₁ (rt.)-M ₃	(M)	28050
2 SKULLS		
Partial skull with C/-P ¹ rt. and P ² -M ³	(w+)	28051
Anterior portion of skull with C/-P ² rt. and P ³ -M ³	(M)	28293
FROM U.N.S.M. COLL. LOC. SX-25:		
SKULL		
Partial skull with C/(rt.)-M ³	(w+)	28154
FROM U.N.S.M. COLL. LOC. SX-31:		
SKULL		
Right anterior portion of skull with P ¹ (rt.)-M ³	(w ⁺⁺)	28301

I. FROM HAT CREEK BASIN, CHEYENNE RIVER DRAINAGE,
NIOBRARA COUNTY, WYOMING

FROM SHACK DRAW:

3 SKULLS AND MANDIBLES (ATTACHED) WITH SKELETAL ELEMENTS

Skull with I ² -M ³ , mandible with I ₁ -M ₃ , partial scapula, 2 humeri, 2 radii (1 partial), 2 ulnae (1 partial), manus, 2 partial femora, partial tibiae, vertebrae, and ribs	(w+)	49592
Partial skull with I ¹ -I ³ br. and C/-M ³ , mandible with I ₁ -M ₃ , and vertebrae	(w ₊ ⁺)	49565A
Partial skull with dP ⁴ (br.)-M ³ (erupt.), mandible with P ₃ -dP ₄ -M ₃ (erupt.), and partial femur	(i)	49565B

The above two specimens were found associated in the field.

3 ASSOCIATED SKULLS AND MANDIBULAR RAMI

Skull with I ³ (rt.)-M ³ and mandible (attached) with I ₃ -M ₃	(w+)	45189A
Partial skull with C/(br.)-M ³ (br.) (M ³ br.) and right ramus with /C-M ₃ (P ₂ -P ₃ absent and P ₄ br.)	(w+)	45189B
Skull with C/(alv.)-M ³	(w)	45189C

SKULL AND MANDIBLE (ATTACHED) WITH SKELETAL ELEMENTS

Skull with I ¹ -I ³ rt. and C/-M ³ , mandible with /C-M ₃ , humerus, radius, partial ulna, manus elements, partial femur, partial tibia, and vertebrae	(w+)	49532
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The above skull is large for this species. The dentition and limb elements, however, indicate this form.

6 SKULLS AND MANDIBULAR RAMI

Partial skull with P ¹ -M ³ and right ramus (attached) with I ₁ -C rt. and P ₁ (br.)-M ₃	(w)	44961
Partial skull with P ¹ -M ³ and mandible (attached) with /C(rt.)-M ₃	(w+)	45088
Skull with I ¹ -M ³ and mandible with I ₁ -M ₃ . Figures 3-4	(M+)	45363
Skull with I ¹ -M ³ and mandible (attached) with I ₁ -M ₃	(w ₊ ⁺)	49566
Partial skull with C/(br.)-M ³ and partial mandible with /C-M ₃	(w)	49624
Partial skull with P ¹ -M ³ and right ramus with /C-P ₁ rt. and P ₂ -M ₃	(w ₊ ⁺)	49625

2 SKULLS AND SKELETAL ELEMENTS

Skull with I ¹ (alv.)-M ³ (I ² alv. and C/ br.), partial femur, and atlas	(w ₊ ⁺)	44956
Skull with I ² -M ³ (C/ br.), humerus, and vertebrae	(M+)	49562

13 PARTIAL SKULLS

13 partial skulls with C/-P ¹ rt. and P ² -M ³ (P ³ br.)	(w)	44957
The above P ² -P ⁴ seem large for this species.		
C/(br.)-M ³ (M ¹ -M ² br.)	(M+)	44958
C/(br.)-M ³	(w)	44959
C/-P ¹ rt. and P ² -M ³ (P ² -P ⁴ erupt.)	(-M)	44960
P ¹ -M ³	(M)	45052
C/(br.)-M ³	(w+)	45341
C/-M ³	(w+)	45342
I ³ (br.)-M ³ (C/ br.)	(M)	49563
I ² -M ³ (C/-P ¹ br.)	(M)	49564
I ¹ -I ³ rt. and C/(br.)-M ³	(M+)	49578
The above skull is large for this species; however, the dentition is comparable.		
C/(rt.)-M ³	(w)	49626
C/(rt.)-M ³	(M+)	49627
I ¹ -I ² alv. and I ³ -M ³	(w ₊ ⁺)	49631

MANDIBLE

Mandible with I ₃ -M ₃ (/C alv.)	(w)	49593
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FROM INDIAN CREEK AREA:

3 SKULLS, MANDIBLES, AND SKELETAL ELEMENTS

Skull with C/-M ³ , mandible (attached) with /C-M ₃ , humerus, radius, ulna, 2 femora, vertebrae, and ribs	(w+)	F:A.M. 49521
The above skull is large for this species. The dentition and limbs, however, suggest this form.		
Skull with I ² -M ³ , mandible (attached) with I ₁ -C alv. and P ₁ -M ₃ , and atlas . .	(w)	49535
The dentition of the above specimen is large for this species.		
Skull with C/-M ³ , partial mandible with M ₃ br., partial humerus, and ulna . .	(w)	49547

6 SKULLS AND MANDIBLES

Skull with C/(br.)-M ³ and mandible (attached) with P ₁ -M ₃	(w ₊)	45339
Skull with C/(br.)-M ³ and partial mandible (attached) with M ₃ br.	(w)	45340
The above skull is within the size variation of this species, but the premolars approach examples of <i>M. (P.) affinis</i> .		
Skull with C/-M ³ and mandible (attached) with I ₂ -M ₃ (I ₃ alv.)	(w)	49522
Skull with I ¹ -M ³ (C/ br.) and mandible (attached) with I ₁ -M ₃	(w+)	49529
Partial skull with I ² -M ³ and mandible (attached) with I ₁ -M ₃	(w+)	49530A
Mandible with I ₁ -M ₃	(w+)	49530B
The above two specimens were found associated in the field.		
Anterior portion of skull with P ³ -M ³ (br.) and partial mandible with P ₄ -M ₁ . .	(w)	49628

2 SKULLS

Skull with C/(rt.)-M ³	(w)	45188
Skull with C/(br.)-M ³	(w ₊)	49528

3. *Miniochoerus* (*Paraminiochoerus*) *helprini*,¹ new species

From "Zone B" of the Brule formation, Sioux County, Nebraska; referred remains from Stark County, North Dakota; and Shan-non County, South Dakota

DESCRIPTION

SKULL: Small size; average examples larger than those of *M. (P.) affinis*; zygomatic arch with more vertical depth than those of previously mentioned species; malar with tendency to be deeper below orbit than in examples of *M. (P.) affinis*; infraorbital foramen above posterior portion of P³ to anterior portion of P⁴; lacrimal fossa with tendency to be shallow, more so than in examples of *M. (P.) affinis*; postglenoid process moderately robust, external border steeper than in examples of *M. (P.) affinis*.

MANDIBLE: Larger and more robust than in examples of *M. (P.) gracilis*, approximately

equal in size to those of *M. (P.) affinis*; condyle larger and external border with less anterior position than in *M. (P.) affinis*.

DENTITION: Length of series averaging longer than in examples of *M. (P.) affinis*; premolars with tendency for less crowding than in other examples of subgenus (some examples with small diastema between P¹ and P²); molars considerably lighter than in examples of *M. starkensis* (both from "Zone B").

LIMBS: Approximately equal to those of *M. (P.) affinis*. (Known only from fragmentary evidence.)

MEASUREMENTS: Table 2 (p. 403).

ILLUSTRATIONS: Figures 3-4, 9-11.

DISCUSSION

It is noteworthy that the similarities between examples of *Miniochoerus* (*Paraminiochoerus*) *affinis* (from "Zone A" of the Brule) and *M. (P.) helprini* ("Zone B") are much more apparent than between those of *Miniochoerus battlecreekensis* ("Zone A") and *M. starkensis* ("Zone B"). This strengthens the evidence previously mentioned (p. 389) that forms of the generic line, *Miniochoerus*, developed more

¹ Named in honor of Mr. Sydney Helprin of the Frick Laboratory, who has given considerable editorial aid to the writers on the oreodont manuscripts.

rapidly than did those of the subgenus, *M.* (*Paraminiochoerus*).

The F:A.M. specimens from Nebraska and North Dakota were gathered by Ove Kaisen and Morris Skinner, 1944; from South Dakota

by Ralph Mefferd and Morris Skinner; and the U.N.S.M. example from Nebraska was collected by the University of Nebraska State Museum field party, 1936.

Thirteen specimens are here recorded:

HOLOTYPE

Skull with C/(rt.)-M³ and partial mandible with M₃. (M+)

F:A.M. 49501

From "Zone B" of Brule formation, W. of Joder, "Toadstool Park" area, White River drainage, Sioux County, Nebraska; collected by Ove Kaisen and Morris Skinner, 1944

Figures 3-4

REFERRED FROM (A) SIOUX COUNTY, NEBRASKA; (B) STARK COUNTY, NORTH DAKOTA; AND (C) SHANNON COUNTY, SOUTH DAKOTA

A. FROM SIOUX COUNTY, NEBRASKA

FROM TYPE AREA, W. OF JODER, WHITE RIVER DRAINAGE:

SKULL AND MANDIBLE

Partial skull with P⁴-M³ and partial mandible with P₁(alv.)-M₃ (P₁-P₄ rt.) . . . (w) F:A.M. 49502

SKULL

Partial skull with I²-I³ rt. and C/(br.)-M³ (P¹ br.) (M+) 49503

FROM U.N.S.M. COLL. LOC. SX-6, CHEYENNE RIVER DRAINAGE:

SKULL

Partial skull with C/-P¹ rt. and P²-M³ (M¹ rt.) (M) U.N.S.M. 28508

B. FROM 7 MI. S. OF SOUTH HEART, STARK COUNTY, NORTH DAKOTA

2 SKULLS, MANDIBULAR RAMI, AND SKELETAL ELEMENTS

F:A.M.

Partial skull with P³(erupt.)-dP⁴-M², partial mandible (attached) with P₃ (erupt.)-dP₄-M₁, vertebrae and fragments (i) 49505A

Partial left ramus with M₂(br.)-M₃ (M) 49505B

The above two specimens were found associated in the field, from "top of nodules."

Anterior portion of skull with P¹-dP²-M³(erupt.), partial mandible with P₁(br.)-dP₂-M₃(erupt.), 2 partial humeri, 2 partial femora, 2 partial tibiae, and fragments (i) 49506

SKULL AND MANDIBLE

Partial skull with C/(br.)-M³ (P¹-P³ rt.) and partial mandible with P₁(rt.)-M₃ . . . (w) 49504

MANDIBULAR RAMUS, IMMATURE

Partial left ramus with P₂(rt.)-dP₃-M₂ (i) 49507

C. FROM SHANNON COUNTY, SOUTH DAKOTA

FROM W. SIDE OF SHEEP MT. RANGE, CHEYENNE RIVER DRAINAGE:

MAXILLA AND MANDIBLE

Partial right maxilla with P⁴-M³(br.) and partial mandible with P₁(rt.)-M₁ (right side) and M₂-M₃ (left side) (w) F:A.M. 49602

FROM CORRAL DRAW AREA, ABOUT 2 MI. S.W. OF COTTONWOOD PASS, CHEYENNE RIVER DRAINAGE:

SKULL AND MANDIBLE, IMMATURE

P.U.

Partial skull with C/(br.)-dP²-M² and partial mandible with P₁(br.)-dP₂-M₂ . . . (i) 12632

The above specimen was referred to *M. (P.) gracilis* by Sinclair,¹ who re-

¹ 1924, Proc. Amer. Phil. Soc., vol. 63, p. 102.

ported it as coming from the "Upper Nodular Zone." The Princeton Museum catalogue records: "60' above Titanotheres beds contact, top of red layer, upper zone of Rusty Nodules, Lower Oreadon," which agrees with the present writers' usage of "Zone B" of the Brule.

FROM E. SIDE OF HARNEY SPRINGS, WHITE RIVER DRAINAGE:

SKULL, MANDIBLE, AND SKELETAL ELEMENTS

Partial skull with C/(br.)-M³, mandible with /C-P₂ rt. and P₃-M₃, partial humerus, partial radius, 2 partial femora, 2 partial tibiae, astragalus, partial calcaneum, and pelvic fragments. Figures 4, 9-11 (w†) F:A.M. 45346

The ascending ramus of the above specimen is not so high as in the type.

SKULL AND MANDIBLE (ATTACHED)

Partial skull with P¹-M³ and mandible with P₁(rt.)-M₃ (w†) 45051

4. *Miniochoerus* (*Paraminiochoerus*)
ottensi,¹ new species

From "Zone C" of the Brule formation,
Sioux County, Nebraska

MEASUREMENTS: Tables 2 and 3 (pp. 403 and 404).

ILLUSTRATIONS: Figures 3-4, 9-11.

DISCUSSION

The specific difference between *Miniochoerus* (*Paraminiochoerus*) *ottensi* and *M. (P.) helprini* is based primarily on the slightly larger premolars and the noticeably larger molars of the former species. This difference in dentition follows the pattern evident in other forms of the subfamily, i.e., examples from "Zone C" of the Brule have larger dentitions than those from "Zone B."

The U.N.S.M. specimens were collected by E. L. Blue, Thompson M. Stout, C. Bertrand Schultz, and associates, 1932-1939, and the F:A.M. examples by Ove Kaisen and Morris Skinner, 1944.

Four specimens are here recorded:

DESCRIPTION

SKULL: Slightly larger on average than examples of *M. (P.) helprini*; infraorbital foramen above anterior border of P⁴.

MANDIBLE: Similar to those of *M. (P.) helprini*; condyle slightly longer transversely than in examples of mentioned species.

DENTITION: Series averaging longer than in examples of *M. (P.) helprini*; premolars, with exception of P¹, longer and wider than those of *M. (P.) helprini*; molars noticeably longer and wider than those of above-mentioned species.

LIMBS: Fore limbs equal in length but more robust, and hind limbs longer and more robust than in *M. (P.) affinis*; proximal and distal ends more robust than in *M. (P.) helprini*.

HOLOTYPE

Skull with I²-M³ and mandible with I₁-M₃. (w) U.N.S.M. 28336 From "Zone C" of Brule formation, U.N.S.M. coll. loc. SX-15, Hat Creek basin, Cheyenne River drainage, Sioux County, Nebraska
Figures 3-4

REFERRED FROM SIOUX COUNTY, NEBRASKA

FROM U.N.S.M. COLL. LOC. SX-12, HAT CREEK BASIN, CHEYENNE RIVER DRAINAGE:

SKULL, MANDIBLE (ATTACHED), AND SKELETAL ELEMENTS

Skull with I³(alv.)-M³, mandible with P₁-M₃, 2 humeri, 2 radii, 2 partial ulnae, 2 partial manus, 2 femora, 2 tibiae, astragalus, 2 calcanea, 2 partial pedes; astragalus and calcaneum of second individual. Figures 9-11 (in part) (w) U.N.S.M. 28332

¹Named in honor of Mr. John Ottens of the Frick Laboratory, who has aided in the preparation of the oreadonts.

FROM U.N.S.M. COLL. LOC. SX-20, WHITE RIVER DRAINAGE:

	SKULL AND MANDIBLE (ATTACHED)	U.N.S.M.
Partial skull with P^1 (rt.)- M^3 and partial mandible with P_2 (rt.)- M_3	(w)	28509

FROM W. OF JODER, WHITE RIVER DRAINAGE:

	SKULL	F:A.M.
Partial skull with $C/$ (br.)- M^3	(M+)	49546

II. PLATYOCHOERUS, NEW GENUS

GENOTYPE: *Platychoerus platycephalus* (Thorpe).

DESCRIPTION

SKULL: Small to medium size; basal lengths ranging from 129 to 158 mm., widths from 80 to 106 mm.; mesocephalic; low and rather broad, wider than average examples of *Stenopsochoerus*; facial region not so deep as in *Miniochoerus*; exoccipital with small foramen within oblong depression above base of paroccipital process; sagittal crest moderately prominent; postorbital constriction wider than in examples of *Stenopsochoerus*, similar to those of *Miniochoerus* and *M. (Paraminiochoerus)*; brain case inflated, rather low and expanded laterally; frontals broad and flat with tendency for shallow posterior depression; nasals broad with slight anterior retraction; anterior nasal-maxilla contact above posterior portion of $C/$; supraorbital foramen with anterior groove extending forward and downward on side of face; orbit subround, posterior pillar somewhat more robust than usual in subfamily; zygomatic arch with noticeable posterior rise of inferior border from below orbit; posterior border of squamosal low; malar shallow to moderately deep below orbit; infraorbital foramen in area above P^3 - P^4 ; lacrimal fossa small, moderately deep; shallow depressed area on face above P^1 - P^3 (infraorbital foramen at posterior of depression); anterior border of maxilla with very abrupt rise to nasal contact, similar to that of *Miniochoerus*; occipital condyles of medium size; paroccipital process moderately light; bulla small, typical of subfamily; postglenoid process moderately light, compressed anteroposteriorly, not so high as in *Miniochoerus*, external border with less slope than in latter genus; posterior palate without noticeable projection posterior to M^3 .

MANDIBLE: Moderately light to moderately robust; postsymphysis below P_3 ; ramus shal-

low to deep, increasing in depth posteriorly; inferior border of ramus straight, with a moderately sharp downward curve posterior to M_3 ; posterior border of ascending ramus moderately robust, inferior border with inward curve.

DENTITION: Moderately heavy; $C/$ and P_1 moderately large; premolars and M_1^1 larger than in examples of *Miniochoerus* and *M. (Paraminiochoerus)*, approximately equal to those of *Stenopsochoerus*; premolars slightly crowded to crowded; external styles of superior molars moderately prominent.

LIMBS: Small size, moderately light, but more robust than in *Stenopsochoerus*.

MEASUREMENTS: Tables 4 and 5 (pp. 426 and 427).

ILLUSTRATIONS: Figures 5-6 (skulls, rami, and dentitions), 9-11 (limbs).

DISCUSSION

The skulls of *Platychoerus* are readily distinguished from other examples of the Miniochoerinae in being low and broad. The large P_2^1 - M_1^1 of examples of *Platychoerus* are diagnostically different from the noticeably smaller ones of *Miniochoerus* and *M. (Paraminiochoerus)*, but similar to those of *Stenopsochoerus*.

The genotypic species, *Platychoerus platycephalus* (Thorpe), has previously been considered under the genus *Merycoidodon*. The fan-shaped occipital region and shallow molar fossettes, however, differ from the posteriorly projected supraoccipital wings and deeply trenched molars of *Merycoidodon*. The difference between examples of *Merycoidodon* and those of the Miniochoerinae is discussed on page 388.

The inclusion of high and low skulls within one subfamily is similar to that reported in the Phenacocoelinae,¹ in which the skulls of *Phenacocoelus* are low compared with those of *Hyp-*

¹ Schultz and Falkenbach, 1950, pp. 106, 113.

siops. This similarity is of interest, as throughout the oreodonts certain parallel trends or characters are apparent in several subfamilies, although they may range in varied geologic periods.

The proposed sequence of *Platychoerus* is as follows: *P. platycephalus* from "Zone A" of

the Brule; *P. heartensis* from "Zone B"; and *P. hatcreekensis* from "Zone C."

DISTRIBUTION

The remains of *Platychoerus* are known from three species here recorded from the middle and upper Oligocene (Brule formation)

TABLE 4

Platychoerus, NEW GENUS. COMPARATIVE MEASUREMENTS^a OF SKULLS AND MANDIBULAR RAMI

SKULL	<i>P. platycephalus</i> (Thorpe)		<i>P. heart-</i> <i>ensis</i> , new species	<i>P. hatcreek-</i> <i>ensis</i> , new species
	Holotype Y.P.M. 12752	Referred F:A.M. 45338	Holotype F:A.M. 45467	Holotype F:A.M. 45463
Stage of wear of teeth	(w $\frac{1}{2}$ +)	(w+)	(w+)	(w)
Length (including supraoccipital crest and incisors)	(155)	145	((157))	((161))
Basal length (from anterior notch of foramen magnum to posterior base of I ¹)	((139))	131	((147))	((151))
Width (max.)	(85)	86	100	((105))
Width of brain case (max.)	45	41.5	44	42
Width, interorbital (min.)	55	49.5	55	(77)
Distance from anterior rim of orbit to anterior base of C/	60	56.5	56.5	61.5
Distance from anterior rim of orbit to supraoccipital crest	92	90.5	100	((107))
Length of nasals	52	46.5	56	—
Width of muzzle at infraorbital foramina	46.5	39	42.5	53
Width across canines	—	33	(35)	((37))
Length, C/-M ³ incl.	74.5	77.5	76.5	83
Length, P ¹ -M ³ incl.	66	70	69	72.5
Length, P ¹ -P ⁴ incl.	34.5	32.5	31	27.5
Length, M ¹ -M ³ incl.	34.5	40	(42)	45
Width of M ³ (max.)	16.5	15	16	19
Depth of malar below orbit	16.5	13.5	13.5	16
MANDIBULAR RAMUS			Referred F:A.M. 49545	Referred F:A.M. 45464A
Stage of wear of teeth	—	—	(w $\frac{1}{2}$)	(w)
Length (max., including incisors)	—	123	126	((143))
Length, /C-condyle incl.	—	115	(104)	((131))
Depth of jaw under coronoid	—	57	64	((69))
Depth of jaw below anterior edge of M ₃	—	29.5	31	33
Length, /C-M ₃ incl.	—	81	(72.5)	—
Length, P ₁ -M ₃ incl.	—	74.5	67.5	(85)
Length, P ₁ -P ₄ incl.	—	31.5	29.5	(32)
Length, M ₁ -M ₃ incl.	—	42.5	39	(43)

^a (), Approximate; (()), estimated. All measurements in millimeters.

of Colorado, Nebraska, North Dakota, South Dakota, and Wyoming. (See geologic distribution chart, p. 382.)

SUMMARY OF SPECIES AND TYPES

Three species of *Platychoerus* from eight middle and upper Oligocene (Brule) localities are here recorded:

1. *P. platycephalus* (Thorpe), from Scotts Bluff County, Nebraska; referred remains from Dawes and Sioux counties, Nebraska, Logan County, Colorado, Shannon County, South Dakota, and Converse and Niobrara counties, Wyoming. ("Zone A" of Brule.)

HOLOTYPE: Skull, ramus, and skeletal elements, Y.P.M. 12752.

2. *P. heartensis*, new species, from Stark County, North Dakota; referred remains from Dawes and Sioux counties, Nebraska, and Shannon County, South Dakota. ("Zone B" of Brule.)

HOLOTYPE: Skull, mandible, and skeletal elements, F:A.M. 45467. Figures 5, 9-11.

3. *P. hatcreekensis*, new species, from Sioux County, Nebraska; referred remains from Shannon County, South Dakota. ("Zone C" of Brule.)

HOLOTYPE: Skull, F:A.M. 45463. Figure 5.

TABLE 5

Platychoerus, NEW GENUS. COMPARATIVE MEASUREMENTS^a OF SKELETAL ELEMENTS

	<i>P. platycephalus</i> (Thorpe)		<i>P. heart-</i> <i>ensis</i> , new species	<i>P. hatcreek-</i> <i>ensis</i> , new species
	Referred F:A.M. 45338	Referred F:A.M. 45476	Referred F:A.M. 45467	Referred F:A.M. 45464A-C
Length of humerus (articular)	110	118	—	—
Length of radius (articular)	84	99	—	—
Length of ulna (max.)	(116)	—	—	—
Length of metacarpal III (max.)	42.5	—	—	—
Length of femur (articular)	124.5	123	—	—
Length of tibia (articular)	—	120	121.5	—
Length of metatarsal III (max.)	56.5	—	—	57.5
Length of calcaneum (max.)	—	—	—	45

^a (), Approximate. All measurements in millimeters.

DETAILED LISTS OF TYPES, REFERRED SPECIMENS, AND SYNONYMY

PLATYCHOERUS

TOTAL AVAILABLE SPECIMENS: 87¹

1. *Platychoerus platycephalus* (Thorpe)

From "Zone A" of the Brule formation, Scotts Bluff County, Nebraska; referred remains from Dawes and Sioux counties, Nebraska; Logan County, Colorado; Shannon County, South Dakota; and Converse and Niobrara counties, Wyoming

Merycoidodon platycephalus THORPE, 1921, Amer. Jour. Sci., ser. 5, vol. 2, p. 339, figs. 1-2;

¹ Includes 65 F:A.M. and 19 U.N.S.M. specimens.

1937, Mem. Peabody Mus., vol. 3, pt. 4, p. 59, figs. 25-27.

CHARACTERS

SKULL: Small size; smallest of genus; nasals not so broad as in other species of genus; infra-orbital foramen above P³; auditory bulla slightly smaller than in examples of *P. heartensis*.

MANDIBLE: Ramus shallow, less deep than in other species of genus; ascending ramus with less height than in other examples of genus; condyle with external border higher than internal border.

DENTITION: Length of series averaging the same as in examples of *P. heartensis*; lightest known of genus; C/ and P₁ moderately light and long; premolars with less crowding than in examples of *P. hatcreekensis*; P₂-P₃ with posterior intermediate crest.

LIMBS: Light, lightest and smallest of genus; approaching examples of *M. (Paraminiochoerus) affinis*.

MEASUREMENTS: Tables 4 and 5 (pp. 426 and 427).

ILLUSTRATIONS: Figures 5-6, 9-11.

DISCUSSION

The holotype skull of *Platychoerus platycephalus*, Y.P.M. 12752, has an over-all length approaching that of the holotype of *P. heartensis*, but its basal length and width are less. The average skull examples of *P. platycephalus* are shorter, narrower, and lighter than those of *P. heartensis*. It should be noted that all the skulls of *Platychoerus* are low and wide; thus any crushing would cause the skull to be slightly longer and wider than normal. It is possible that the holotype of *P. platycephalus* may have come from a higher part of "Zone A" than other examples of the species. The characters, exclusive of the over-all length of the skull, compare more readily with referred examples of *P. platycephalus* from "Zone A" than they do with those of *P. heartensis* from "Zone B."

Thorpe,¹ in a discussion of the dentition of *P. platycephalus*, stated: "... a marked charac-

ter is the considerably smaller size of the hypocones in relation to the protocones of all molars. This is especially noticeable in M³. These lobes are proportionately smaller than in any other species of the genus [*Merycoidodon*]." The present writers consider the proportions of the hypocone to the protocone usually comparable in most of the oreodonts from the Oligocene. In the Miniochoerinae, however, the posterior portion of M³ is decidedly smaller than the anterior portion.

Thorpe also suggested that his specific characters might be due to senility or that possibly his type specimen was pathologic. The present writers, with 64 specimens of this species available, see no reason to question Thorpe's holotype. Perhaps the sagittal crest of Thorpe's specimen is more robust than in average examples, but it is within the expected individual variation of a species.

The referred F.A.M. specimens from Wyoming were collected by Gene Roll, Everett De Groot, Nelson J. Vaughan, George Sternberg, John C. Blick, and Charles H. Falkenbach, 1938-1945, and Paul Miller, 1927; from South Dakota by Ralph Mefferd, Ove Kaisen, and Morris Skinner, 1938 and 1944; from Nebraska by George Sternberg, John C. Blick, and Charles H. Falkenbach, 1944; and the University of Nebraska State Museum examples from Nebraska by E. L. Blue, Thompson M. Stout, C. Bertrand Schultz, and associates, and those from Wyoming by Guy Johnson, 1933-1940.

Sixty-four specimens are here recorded:

HOLOTYPE

Skull with C/-P³ rt. and P⁴-M³ (M¹-M³ br.), fragments of rami, partial radius, and vertebrae. (w^{††})

Y.P.M. 12752

From "Zone A" of Brule formation, near Scotts Bluff Monument, Scotts Bluff County, Nebraska; collected by M. H. Clifford, 1874

Figured by Thorpe, 1921, figs. 1-2; 1937, figs. 25-27

REFERRED FROM (A) SCOTTS BLUFF, (B) DAWES, AND (C) SIOUX COUNTIES, NEBRASKA; (D) LOGAN COUNTY, COLORADO; (E) SHANNON COUNTY, SOUTH DAKOTA; AND (F) CONVERSE AND (G) NIOBRARA COUNTIES, WYOMING

A. FROM NEAR SCOTTS BLUFF MONUMENT, U.N.S.M. COLL. LOC. SF-101, SCOTTS BLUFF COUNTY, NEBRASKA

SKULL

Partial skull with C/-P² rt. and P³-M³ (w)

U.N.S.M.
28514

¹ 1937, p. 60.

B. FROM U.N.S.M. COLL. LOC. DW-104, WHITE RIVER DRAINAGE,
DAWES COUNTY, NEBRASKA

SKULL AND MANDIBLE (ATTACHED)		U.N.S.M.
Skull with I ¹ (rt.)-M ³ (I ² rt.) and mandible with /C(rt.)-M ₃	(w+)	28162

C. FROM HAT CREEK BASIN, CHEYENNE RIVER DRAINAGE,
SIOUX COUNTY, NEBRASKA

FROM NORTH OF HARRISON:

SKULL AND SKELETAL ELEMENTS		F:A.M.
Partial skull with P ¹ (alv.)-M ³ (P ² br.), 2 partial tibiae, and fragments.	(w $\frac{1}{2}$)	49554

2 SKULLS

Partial skull with C/(br.)-M ³	(w $\frac{1}{2}$)	49552
Partial skull with P ¹ -M ³	(w+)	49553

FROM U.N.S.M. COLL. LOC. SX-4:

SKULL		U.N.S.M.
Partial skull with C/(rt.)-M ³	(M)	28286

FROM U.N.S.M. COLL. LOC. SX-5:

SKULL AND MANDIBLE (ATTACHED)		
Partial skull with C/(rt.)-M ³ (P ¹ br.) and mandible with /C(rt.)-M ₃	(w)	28125

C'. FROM WHITE RIVER DRAINAGE, SIOUX COUNTY, NEBRASKA

FROM U.N.S.M. COLL. LOC. SX-20:

SKULL		U.N.S.M.
Partial skull with P ¹ -P ³ br. and P ⁴ -M ³	(w)	28029

FROM U.N.S.M. COLL. LOC. SX-24:

2 SKULLS

Partial skull with P ² -M ³	(M+)	28052
Crushed, partial skull with C/(rt.)-dP ² -M ² (P ¹ br.)	(I)	28177

FROM U.N.S.M. COLL. LOC. SX-25:

SKULL, IMMATURE

Partial skull with C/-P ³ rt. and dP ⁴ -M ²	(I)	28159
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FROM U.N.S.M. COLL. LOC. SX-28:

SKULL

Partial skull with C/-P ³ rt. and P ⁴ (br.)-M ³ (M ¹ br.)	(w)	28173
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D. FROM LOGAN COUNTY, COLORADO

(Collected by Barnum Brown and H. T. Martin, 1898)

SKULL		A.M.
Partial skull with C/-P ² rt. and P ³ -M ³	(w)	8895

Included under the above number is a fragment of a right ramus which has a considerably more robust dentition than that of the skull, and also represents an older individual.

E. FROM SHANNON COUNTY, SOUTH DAKOTA

FROM BIG CORRAL DRAW, CHEYENNE RIVER DRAINAGE:

SKULL AND MANDIBLE

Anterior portion of skull with C/(rt.)-M ³ and partial mandible with P ₁ -P ₂ rt. and P ₃ -M ₃	(w $\frac{1}{2}$)	F:A.M. 45005
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FROM HEAD OF BATTLE CREEK DRAW, CHEYENNE RIVER DRAINAGE:

SKULL		F:A.M.
Partial skull with C/(rt.)-M ³ (P ¹ -P ² rt.)	(M)	45004

FROM 5 MI. N.W. OF SLIM BUTTE, WHITE RIVER DRAINAGE:

2 SKULLS		
Partial skull with P ² -M ³	(W)	45470
Partial skull with dP ¹ -M ³ (P ² -P ⁴ erupt.)	(I)	49551

F. FROM CONVERSE COUNTY, WYOMING

FROM 12 MI. S.E. OF DOUGLAS:

SKULL AND MANDIBLE (ATTACHED) WITH SKELETAL ELEMENTS		F:A.M.
Skull with C/(br.)-M ³ , mandible with I ₁ -C rt. and P ₁ -M ₃ , radius, ulna, partial manus, partial tibia, and vertebrae	(W+)	45191

FROM 8-9 MI. S.E. OF DOUGLAS:

3 SKULLS AND MANDIBLES (ATTACHED) WITH SKELETAL ELEMENTS		
Skull with I ¹ -M ³ , mandible with I ₁ -M ₃ , partial scapula, 2 humeri, partial radius, 2 partial ulnae, vertebrae, and ribs	(W)	45471
Skull with I ¹ -M ³ , mandible with I ₁ -M ₃ , 2 partial scapulae, 2 humeri (1 partial), 2 partial radii, 2 partial ulnae, 2 partial manus, and vertebrae. Figure 9 (in part)	(W+)	45472
The above manus has five digits.		
Skull with I ² -M ³ , mandible with I ₁ -M ₃ , 2 humeri, 2 radii, 2 partial ulnae, manus elements, 2 femora, 2 tibiae, partial pes, pelvis, and vertebrae. Figure 11 (in part)	(W+)	45476
The above manus has five digits.		

2 SKULLS AND MANDIBLES		
Skull with C/-M ³ and partial mandible with I ₁ (alv.)-M ₂	(M+)	45169
Skull with I ² -dP ¹ -M ³ (erupt.) and mandible (attached) with I ₁ -dP ₃ -M ₂ (erupt.)	(I)	49525

2 SKULLS AND MANDIBULAR RAMI		
Partial skull with I ¹ -I ³ rt. and C/(br.)-M ³ and right ramus with P ₁ -P ₂ rt. and P ₁ -M ₃ (M ₂ br.)	(M+)	45007
The above specimen is larger than average examples of this species and approaches the size of those of <i>P. heartensis</i> .		
Skull with I ¹ (rt.)-M ³ (C/-P ¹ br. and P ² rt.) and right ramus with I ₃ -M ₃ (/C-P ₂ br.)	(W+)	45488

6 SKULLS		
6 skulls with C/-M ³	(W+)	45008
C/-P ¹ rt. and P ² -M ³	(W+)	45009
P ¹ (rt.)-M ³	(M)	45013
I ¹ -M ³ (P ² -M ² br.)	(W)	45171
I ¹ -M ³	(M+)	45473
P ⁴ -M ³ rt.		49603

2 PARTIAL SKULLS		
Partial skull with C/-P ¹ rt. and P ² -M ³	(W)	45093
Partial skull with P ¹ -dP ² -M ³ (erupt.)	(I)	49609

FROM U.N.S.M. COLL. LOC. WYO-3, SAME AREA AS ABOVE (COLLECTED BY GUY JOHNSON):

SKULL AND MANDIBLE		U.N.S.M.
Skull with C/-P ¹ rt. and P ² -M ³ (P ³ br.) and partial mandible with P ₁ -P ₄ rt. and M ₁ -M ₃	(W+)	28088

SKULL AND SCAPULA		U.N.S.M.
Skull with C/-M ³ and partial scapula	(w+)	28107
3 SKULLS		
3 partial skulls with		
I ¹ (alv.)-M ³	(M)	28110
C/(br.)-M ³	(M+)	28112
I ¹ -I ³ alv. and C/(br.)-M ³ (P ¹ -P ² rt. and P ³ -M ² br.)	(w+)	28281

G. FROM CHEYENNE RIVER DRAINAGE, NIOBRARA COUNTY, WYOMING

FROM INDIAN CREEK AREA:

3 SKULLS, MANDIBULAR RAMI, AND SKELETAL ELEMENTS		F:A.M.
Partial skull with C/-M ³ , partial mandible with I ₁ -M ₃ , partial humerus, partial ulna, partial femur, partial tibia, and 2 metapodials	(M+)	45190
Skull with I ¹ -M ³ , mandible with I ₁ -M ₃ , 2 partial scapulae, 2 humeri (1 partial), 2 radii, 2 partial ulnae, partial manus, 2 femora (1 partial), partial tibia, partial fibula, astragalus, partial pes, pelvis, vertebrae, and ribs. Figures 5-6, 9-11	(w+)	45338
Partial skull with I ¹ -I ³ alv. and C/-M ³ (C/-P ¹ br.), partial left ramus with I ₃ /C rt. and P ₁ (br.)-M ₃ (br.), partial humerus, 2 partial radii, 2 partial tibiae, and partial pelvis	(M+)	49536

SKULL AND MANDIBLE

Partial skull with C/-P ³ rt. and P ⁴ (br.)-M ³ and mandible with I ₁ -P ₂ rt. and P ₃ -M ₃	(w ⁺ †)	45000
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SKULL

Partial skull with C/-P ¹ rt. and P ² -M ³	(w)	45092
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FROM OLD WOMAN CREEK AREA:

SKULL AND MANDIBLE (ATTACHED)		
Partial skull with I ² -C/ rt. and P ¹ -M ³ and mandible with P ₁ (rt.)-M ₃	(w ⁺ †)	44998

6 SKULLS

6 partial skulls with		
C/(rt.)-M ³ (P ¹ rt.)	(M)	44971
I ² -I ³ alv. and C/(rt.)-M ³ (P ¹ rt.)	(w+)	44996
C/(alv.)-M ³ (P ¹ -P ² and M ¹ -M ² br.)	(w ⁺ †)	44997
C/(rt.)-M ³ (P ¹ -P ² br.)	(w ⁺ †)	44999
C/(rt.)-M ³	(M+)	45475
C/(br.)-M ³	(w+)	49524

FROM SHACK DRAW AREA:

2 SKULLS, MANDIBULAR RAMI, AND VERTEBRAE		
Skull with C/-M ³ , mandible with P ₁ (br.)-M ₃ , and vertebrae	(w ⁺ †)	49571
Skull with C/-M ³ , partial left ramus (attached) with M ₃ br., and atlas	(w+)	49572

SKULL AND MANDIBLE

Skull with I ² (rt.)-M ³ and mandible with I ₁ -I ₃ rt. and /C-M ₃	(w ⁺ †)	49576
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4 SKULLS

4 partial skulls with		
C/-P ¹ rt. and P ² -M ³ (br.)	(M+)	44970
P ⁴ -M ³	(w+)	45080
C/(br.)-M ³ (P ¹ br.)	(w)	45087
C/-P ² rt. and P ³ -M ³	(w+)	45089

FROM SPRING DRAW AREA:

SKULL		
Partial skull with C/(rt.)-M ³ (P ² -P ⁴ erupt.)	(-M)	44968

FROM S.W. END OF SEAMEN HILLS:

SKULL AND MANDIBLE (ATTACHED)		F:A.M.
Partial skull with I ¹ -M ³ (C/-P ¹ br.) and mandible with I ₁ -P ₁ rt. and P ₂ -M ₂	(w)	45474

2 SKULLS

Partial skull with I ¹ -I ³ alv. and C/-M ³	(w ⁺)	44988
Partial skull with dP ¹ (br.)-M ³ (germ)	(I)	49619

FROM 5 MI. N.E. OF HAT CREEK STORE:

SKULL

Partial skull with P ¹ (br.)-M ³ (P ² br.)	(w)	45017
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FROM GENERAL AREA (COLLECTED BY PAUL MILLER, 1927):

SKULL AND MANDIBLE, IMMATURE

Skull with I ³ -dP ¹ -M ³ (germ) and mandible with I ₁ (rt.)-dP ₂ -M ₂	(I)	49604
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2. *Platychoerus heartensis*,¹ new species

From "Zone B" of the Brule formation, Stark County, North Dakota; referred remains from Shannon County, South Dakota; and Dawes and Sioux counties, Nebraska

DESCRIPTION

SKULL: Moderately small size, larger and considerably wider than examples of *P. platycephalus*, slightly smaller than those of *P. hatcreekensis*; nasals broad, wider than in *P. platycephalus*; infraorbital foramen above posterior portion of P³.

MANDIBLE: Ramus more robust and deeper than in examples of *P. platycephalus*, approaching size and robustness of those of *P. hatcreekensis*; ascending ramus tending to be higher than in *P. platycephalus*; external border of condyle higher and more anterior than internal border.

DENTITION: Length of series within variation of larger examples of *P. platycephalus* and smaller examples of *P. hatcreekensis*, lighter than those of latter, more comparable with those of former; C/ and P₁ moderately large; premolars with less crowding than in examples of *P. hatcreekensis*.

LIMBS: Longer and more robust than in ex-

amples of *P. platycephalus*, approaching those of *P. hatcreekensis*.

MEASUREMENTS: Tables 4 and 5 (pp. 426 and 427).

ILLUSTRATIONS: Figures 5-6, 9-11.

DISCUSSION

Platychoerus heartensis represents a form in which the characters are more or less intermediate between those of *P. platycephalus* and those of *P. hatcreekensis*, but with stronger affinities to the latter. In chart 2 (p. 385) the mean of the basal lengths of the skulls of *P. heartensis* is greater than that of *P. platycephalus*. The means of the lengths of P₁¹-M₂³ are about the same, yet the molars of the former species are more massive.

The North Dakota specimens were collected by Ove Kaisen and Morris Skinner, 1944; the F:A.M. specimens from Sioux County, Nebraska, were collected by George Sternberg, John C. Blick, and Charles H. Falkenbach, 1942-1943; and the U.N.S.M. examples from Nebraska by E. L. Blue, Thompson M. Stout, C. Bertrand Schultz, and associates, 1933 and 1940.

Seven specimens are here recorded:

HOLOTYPE

Partial skull with C/(rt.)-M ³ (P ² and M ¹ br.), partial mandible with P ₃ (rt.)-M ₃ , partial humerus, 2 partial femora, tibia, fibula, astragalus, vertebrae, and pelvis. (w+)	F:A.M. 45467
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From "Zone B" of Brule formation, "top of nodules," 7 mi. S. of South Heart, Heart River drainage, Stark County, North Dakota; collected by Ove Kaisen and Morris Skinner, 1944
Figures 5, 9-11

¹ Named for the Heart River drainage, the area from which the holotype was secured.

REFERRED FROM (A) SHANNON COUNTY, SOUTH DAKOTA, AND (B) DAWES AND (C) SIOUX COUNTIES, NEBRASKA

A. FROM CORRAL DRAW, CHEYENNE RIVER DRAINAGE, SHANNON COUNTY, SOUTH DAKOTA

(Collected by T. B. Lander, 1922)

SKULL AND MANDIBLE (ATTACHED)

P.U.

Skull with C/(br.)-M³ and mandible with I₁-C rt. and P₁-M₃ (w) 12761

The above specimen was cited by Sinclair¹ and referred to *Merycoidodon culbertsonii periculatorum*, from the Upper Nodular Zone. The Princeton University catalogue states: "Upper Zone of Rusty Nodules, lower Oreadon," which corresponds to the faunal "Zone B" of the Brule of the present writers.

B. FROM U.N.S.M. COLL. LOC. DW-104, WHITE RIVER DRAINAGE, DAWES COUNTY, NEBRASKA

SKULL AND ATLAS

U.N.S.M.

Partial skull with P¹-M³(br.) (P³-M² rt.), and atlas (w⁺) 28135

C. FROM SIOUX COUNTY, NEBRASKA

FROM U.N.S.M. COLL. LOC. SX-37, CHEYENNE RIVER DRAINAGE:

SKULL AND MANDIBLE (ATTACHED)

U.N.S.M.

Partial skull with C/-M³ and mandible with P₁-M₃ (w) 28513

FROM JODER AREA, WHITE RIVER DRAINAGE:

3 SKULLS AND MANDIBLES

Partial skull with C/(rt.)-M³ and partial mandible (attached) with I₁-P₁ rt. and P₂-M₃ (w) F:A.M. 45469

Partial skull with C/(rt.)-M³(br.) (P¹-P² rt. and P³ br.) and mandible (attached) with I₁ and M₁-M₃ (w⁺) 45477

Skull with I¹(rt.)-M³ (P¹-P² rt.) and mandible with I₁-M₃ (I₂ and /C absent) and atlas. Figure 6 (in part) (w⁺) 49545

3. *Platychoerus hatcreekensis*,² new species

From "Zone C" of the Brule formation, Sioux County, Nebraska; referred remains from Shannon County, South Dakota

DESCRIPTION

SKULL: Medium size, largest known of genus; more robust than examples of *P. heartensis* and *P. platycephalus*; width greater than in those of the latter, approximately equal to those of the former; nasals wider than in other examples of genus; infraorbital foramen above P⁴; posterior palate with slightly more posterior projection than in other species of genus.

MANDIBLE: More robust, larger and deeper than in examples of *P. platycephalus*, tendency to be slightly larger than those of *P. heartensis*;

condyle larger than those of *P. platycephalus* and slightly larger than those of *P. heartensis*, condyle set approximately at right angle to axis of dental series, external border higher than internal border.

DENTITION: Series with tendency to be longer and definitely more robust than in other examples of genus; C/ and P₁ large; premolars crowded, decidedly more so than in other species of genus.

LIMBS: Approximately equal to examples of *P. heartensis* but more robust, longer and more robust than those of *P. platycephalus*.

MEASUREMENTS: Tables 4 and 5 (pp. 426 and 427).

ILLUSTRATION: Figures 5-6, 9-11.

DISCUSSION

The larger and more robust skull, the slightly larger auditory bulla, and the more robust dentition of *Platychoerus hatcreekensis* are con-

¹ 1924, Proc. Amer. Phil. Soc., vol. 63, p. 102.

² Named for the Hat Creek Basin of Nebraska and Wyoming.

siderably different from those of *P. platycephalus* from "Zone A" of the Brule.

The three species of *Platychoerus* are noteworthy in demonstrating size and character changes in a direct line of development. In this genus a closer relationship exists between species occurring in zones "B" and "C" than between those in zones "A" and "B."

The holotype and the F:A.M. specimens

from Nebraska were collected by Ove Kaisen, Morris Skinner, George Sternberg, John C. Blick, and Charles H. Falkenbach, 1944; the U.N.S.M. examples from Nebraska by E. L. Blue, Thompson M. Stout, and associates, 1936; and those from South Dakota by Ralph Mefferd and Morris Skinner, 1938.

Sixteen specimens are here recorded:

HOLOTYPE

Partial skull with C/(rt.)-M ³ . (w)	F:A.M. 45463	From "Zone C" of Brule formation, 10 mi. N. of Harrison, Hat Creek Basin, Cheyenne River drainage, Sioux County, Nebraska; collected by Ove Kaisen, Morris Skinner, George Sternberg, John C. Blick, and Charles H. Falkenbach, 1944
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Figure 5

REFERRED FROM (A) SIOUX COUNTY, NEBRASKA, AND (B) SHANNON COUNTY, SOUTH DAKOTA

A. FROM SIOUX COUNTY, NEBRASKA

FROM 10 MI. N. OF HARRISON, HAT CREEK BASIN, CHEYENNE RIVER DRAINAGE:

3 ASSOCIATED SKULLS, MANDIBLES, AND SKELETAL ELEMENTS

Partial skull with P ¹ -M ³ and mandible with P ₁ (br.)-M ₃ . Figure 6	(w)	F:A.M. 45464A
Partial skull with C/-M ³ (br.) (P ¹ alv., P ⁴ -M ¹ rt.) and partial mandible (attached) with /C-M ₂	(w)	45464B
Fragments of skull with M ² -M ³ and partial mandible (attached) with P ₄ -M ₃	(w)	45464C
Fragments of humerus, partial femur, 2 partial tibiae, 2 astragali, 2 calcanea, 2 partial pedes, pelvis, and fragments. Figures 10-11		45464A-C

The above three skulls, mandibles, and skeletal elements were found associated in the field. The limbs were not articulated nor directly associated with any one of these skulls.

3 ASSOCIATED SKULLS AND MANDIBLES (ATTACHED) WITH SKELETAL ELEMENTS

Partial skull with M ¹ (rt.)-M ³ and partial mandible with P ₁ (br.)-M ₃	(w+)	45465A
Partial skull with I ² -M ³ (C/-P ¹ rt.) and partial mandible with P ₁ -M ₃	(w+)	45465B
Partial skull with C/(rt.)-M ³	(w)	45465C
Partial scapula, 2 partial humeri, partial radius, and 2 partial ulnae. Figures 9-10 (in part)		45465A-C

The above three skulls, mandibles, and limb elements were found associated in the field. The limb elements were not articulated nor directly associated with any one of these skulls.

SKULL

Partial skull with C/-P ² alv. and P ³ -M ³ br.	(w ⁺)	45466
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FROM U.N.S.M. COLL. LOC. SX-12, CHEYENNE RIVER DRAINAGE:

SKULL

Skull with P ¹ -M ³	(w ⁺)	U.N.S.M. 28510
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The dentition of the above specimen is poorly preserved.

FROM U.N.S.M. COLL. LOC. SX-20, WHITE RIVER DRAINAGE:

SKULL AND MANDIBLE

Partial skull with P ¹ (rt.)-M ³ (M ¹ -M ² br.) and partial mandible with P ₁ -M ₃	(w)	28511
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SKULL		U.N.S.M.
Partial skull with C/(rt.)-M ³ (P ¹ , P ² , P ⁴ rt. and M ¹ -M ² br.)	(M+)	28512
The above two specimens seem to be larger than the holotype.		

B. FROM 5 MI. N.W. OF SLIM BUTTE, WHITE RIVER DRAINAGE, SHANNON COUNTY, SOUTH DAKOTA

SKULL, MANDIBLE, AND VERTEBRAE		F:A.M.
Partial skull with C/(br.)-M ³ (P ¹ -M ¹ br.), mandible with P ₄ -M ₃ , and vertebrae (w)		49559

2 SKULLS AND SKELETAL ELEMENTS

Skull with C/-M ³ and partial humerus. Figure 5 (in part)	(M+)	49560
Skull with C/-P ² rt. and P ³ -M ³ br. and partial femur	(w†)	49561

III. STENOPOCHOERUS, NEW GENUS

GENOTYPE: *Stenopsochoerus sternbergi*, new species.

DESCRIPTION

SKULL: Small to medium size; basal lengths ranging from 129 to 161.5 mm., widths from 64 to 88 mm.; dolichocephalic to mesocephalic; exoccipital with moderately prominent foramen above base of paroccipital process; sagittal crest moderately prominent but not noticeably high; brain case inflated and elongated, narrow in comparison with that of *Platychoerus* (somewhat similar to that of *Desmatochoerinae*¹); postorbital constriction noticeably narrower than in other genera of *Miniochoerinae*; frontals convex laterally; nasals narrow to moderately broad, with slight anterior retraction; anterior nasal-maxilla contact above C/; orbit small and roundish; zygomatic arch with prominent posterior rise of inferior border from below orbit, and with marked inward curve or notch posterior to orbit; malar moderately shallow to moderately deep below orbit; infraorbital foramen above P³; lacrimal fossa small, noticeably deep; slightly depressed area above P¹-P⁴ (infraorbital foramen at posterior border of depression); muzzle narrow; anterior border of maxilla almost perpendicular to nasal contact (similar to that of *Miniochoerus*); occipital condyles of medium size; auditory bulla small, typical of subfamily; postglenoid process moderately light, compressed anteroposteriorly, similar to that of *Platychoerus* (not so high as in *Miniochoerus*, external border with less slope than in latter genus); posterior palate extending posteriorly for slight distance beyond M³.

MANDIBLE: Moderately light to moderately robust; postsymphysis below area between P₃

and P₄; ramus moderately shallow to moderately deep; ramus increasing in depth posteriorly; inferior border of ramus almost straight; ascending ramus with slight inward curve to inferior border, posterior border moderately robust; condyle with external border more anterior than internal border.

DENTITION: Heavy; C/ and P₁ moderately large; premolars moderately large and somewhat crowded; M₁¹ large [P₂¹-M₁¹ decidedly larger than examples of *Miniochoerus* and *M. (Paraminiochoerus)*, approximately equal to those of *Platychoerus*]; external styles of superior molars very prominent; M³ with slightly larger posterior portion than in other examples of *Miniochoerinae*.

LIMBS: Small size, and moderately light.

MEASUREMENTS: Tables 6 and 7 (pp. 436 and 437).

ILLUSTRATIONS: Figures 6-7 (skulls, rami, and dentitions), 9-11 (limbs).

DISCUSSION

The genus *Stenopsochoerus* embraces forms with comparatively long, high, and narrow skulls which have a noticeably narrow postorbital constriction. The dentitions, especially the P₂¹-M₁¹, are larger and more massive than in examples of *Miniochoerus* and *M. (Paraminiochoerus)*, more like those of *Platychoerus*. The skulls of the latter genus, however, differ from those of *Stenopsochoerus* in being flat, low, and wide. The skulls of *Stenopsochoerus* are somewhat similar in outline to those of *Prodesmatochoerus*,² but examples of the latter genus have deeper fossettes on the molars and longer and higher sagittal crests, with supraoccipital wings projecting decidedly farther posteriorly.

¹ Schultz and Falkenbach, 1954.

² Schultz and Falkenbach, 1954, p. 225.

TABLE 6

Stenopsochoerus, NEW GENUS, *S. (Pseudostenopsochoerus)*, NEW SUBGENUS, AND *Parastenopsochoerus*, NEW GENUS. COMPARATIVE MEASUREMENTS^a OF SKULLS AND MANDIBULAR RAMI

SKULL	<i>S. sternbergi</i> , new species	<i>S. joderensis</i> , new species	<i>S. berardae</i> , new species	<i>S. (P.) chadronensis</i> , new species	<i>S. (P.) douglasensis</i> , new species	<i>S. (P.) reideri</i> , new species	<i>P. conversensis</i> , new species
	Holotype F:A.M. 44980	Holotype F:A.M. 45483	Holotype F:A.M. 49617	Holotype F:A.M. 45489	Holotype F:A.M. 45492	Holotype F:A.M. 49620	Holotype F:A.M. 45011
Stage of wear of teeth . . .	(w ₊)	(w ₊ ⁺)	(w ₊)	(w)	(w)	(w ₊ ⁺)	(m)
Length (including supraoccipital crest and incisors)	(146)	(160)	175	154.5	163	(172)	151.5
Basal length (from anterior notch of foramen magnum to posterior base of I ¹)	131	(140)	((155))	141	151.5	156	144.5
Width (max.)	(79)	((73))	((88))	((90))	83	(100)	81
Width of brain case (max.)	38.5	42	40	45.5	38.5	45	41.5
Width, interorbital (min.)	46.5	(44)	53	(47)	48	51.5	48.5
Distance from anterior rim of orbit to anterior base of C/	58.5	61	68	61.5	66	67.5	57
Distance from anterior rim of orbit to supraoccipital crest	(85.5)	(94)	105.5	96	94.5	(102)	93.5
Length of nasals	49.5	57	(62)	56	57	62	49.5
Width of muzzle at infraorbital foramina	35	34	41	49.5	37.5	45	38.5
Width across canines	30	30	26.5	31	34.5	30	26.5
Length, C-M ³ incl.	77.5	80	85.5	84	88	87.5	77
Length, P ¹ -M ³ incl.	68.5	68	77.5	73.5	78	78	70
Length, P ¹ -P ⁴ incl.	31	30.5	36	34	33	34	31.5
Length, M ¹ -M ³ incl.	38.5	43	44.5	42.5	45	46	42
Width of M ³ (max.)	17	18	17	16.5	17.5	19	16
Depth of malar below orbit	12.5	20	18.5	15	15	16.5	11
MANDIBULAR RAMUS							
Length (max., including incisors)	128.5	135	(147)	132.5	141.5	154	—
Length, /C-condyle incl. . .	112	121.5	135	121.5	127	134.5	—
Depth of jaw under coronoid	59	74	(82)	67	63	(67)	—
Depth of jaw below anterior edge of M ₃	29.5	36.5	40	31.5	28	32.5	—
Length, /C-M ₃ incl.	77.5	81	91	88	91	89	—
Length, P ₁ -M ₃ incl.	72.5	76	85	80	82.5	83	—
Length, P ₁ -P ₄ incl.	30	31.5	33	34	33.5	34	—
Length, M ₁ -M ₃ incl.	42	44.5	52	46.5	49	50	—

^a (), Approximate; (()), estimated. All measurements in millimeters.

The proposed phylogenetic sequence of *Stenopsochoerus* is as follows: *S. sternbergi* from "Zone A" of the Brule; *S. joderensis* from "Zone B"; and *S. berardae* from "Zone C."

DISTRIBUTION

Three species of *Stenopsochoerus* are known from the middle and upper Oligocene (Brule formation) of Colorado, Nebraska, South Dakota and Wyoming. (See geologic distribution chart, p. 382.)

SUMMARY OF SPECIES AND TYPES

Three species of *Stenopsochoerus* from eight middle and upper Oligocene (Brule) localities are here recorded:

1. *S. sternbergi*, new species, from Niobrara

County, Wyoming; referred remains from Converse County, Wyoming, Logan County, Colorado, and Dawes and Sioux counties, Nebraska. ("Zone A" of Brule.)

HOLOTYPE: Skull and mandible, F:A.M. 44980. Figures 6-7.

2. *S. joderensis*, new species, from Sioux County, Nebraska. ("Zone B" of Brule.)

HOLOTYPE: Partial skull and mandible, F:A.M. 45483. Figures 6-7.

3. *S. berardae*, new species, from Harding County, South Dakota; referred remains from Fall River and Shannon counties, South Dakota, and Sioux County, Nebraska. ("Zone C" of Brule.)

HOLOTYPE: Skull, mandible, and skeletal elements, F:A.M. 49617. Figures 6, 7, 10.

TABLE 7

Stenopsochoerus, NEW GENUS, AND *S. (Pseudostenopsochoerus)*, NEW SUBGENUS. COMPARATIVE MEASUREMENTS^a OF SKELETAL ELEMENTS

	<i>S. sternbergi</i> , new species	<i>S. berardae</i> , new species		<i>S. (P.) chadronensis</i> , new species	<i>S. (P.) douglasensis</i> , new species
	Referred F:A.M. 49605	Holotype F:A.M. 49617	Referred F:A.M. 49618A-B	Holotype F:A.M. 45489	Holotype F:A.M. 45492
Length of humerus (articular)	—	—	124	—	119.5
Length of radius (articular)	81.5	—	—	((95))	92
Length of ulna (max.)	110	—	—	—	124.5
Length of metacarpal III (max.)	38 ^b	—	—	45 ^b	44.5 ^b
Length of femur (articular)	—	132	—	—	128
Length of tibia (articular)	110.5	—	(124)	—	120
Length of metatarsal (max.)	—	—	—	—	(52.5)
Length of calcaneum (max.)	41.5	—	46	—	44

^a (), Approximate; (()), estimated. All measurements in millimeters.

^bForefoot with five digits.

DETAILED LISTS OF TYPES AND REFERRED SPECIMENS

STENOPSOCHOERUS

TOTAL AVAILABLE SPECIMENS: 44¹1. *Stenopsochoerus sternbergi*,² new species

From "Zone A" of the Brule formation, Niobrara County, Wyoming; referred remains from Converse County, Wyoming; Logan County, Colorado; and Dawes and Sioux counties, Nebraska

DESCRIPTION

SKULL: Small size, smallest known examples of genus; larger examples approaching size of holotype of *S. joderensis* [approximately same length but decidedly narrower than examples of *M. (Paraminiochoerus) affinis*]; dolichocephalic; sagittal crest moderately prominent, not so high as in other species of genus; frontals less convex laterally than in other species of genus; nasals lightest and narrowest of genus; zygomatic arch less robust and with less posterior rise to inferior border than in other species of genus; malar moderately shallow below orbit, noticeably less deep than in other species of genus; lacrimal fossa moderately deep; bulla smallest of genus; postglenoid process with less height and width (transversely) than in holotype of *S. joderensis*, more equal to those of *S. berardae*; posterior palate with less posterior projection beyond M^3 than in examples of *S. berardae*.

MANDIBLE: Less robust than in other examples of genus; ramus moderately shallow, shallowest of genus; inferior border of ramus with slight downward curve posterior to M_3 (curve lacking in other two species of genus); ascending ramus with less depth than in other examples of genus; condyle lighter than in other species of genus, external border higher and slightly more posterior than internal border.

DENTITION: Length of series shortest of genus, longer examples approach length of series in holotype of *S. joderensis*; premolars comparable in size with those of other species of genus; molars smaller than in other species of genus.

LIMBS: Tendency to be larger than in examples of *M. (Paraminiochoerus) gracilis*,

¹ Includes 32 F.A.M. and 9 U.N.S.M. specimens.

² Named in honor of Mr. George Sternberg, who has helped to bring together the Oligocene collection of the Frick Laboratory.

slightly smaller than those of *M. (P.) affinis*, shorter than those of *S. (Pseudostenopsochoerus) douglasensis*, all from "Zone A" of Brule formation.

MEASUREMENTS: Tables 6 and 7 (pp. 436 and 437).

ILLUSTRATIONS: Figures 6-7, 9-11.

DISCUSSION

Stenopsochoerus sternbergi, the genotypic species, is represented by more specimens than any other species of the genus. In general appearance, the skull resembles examples of *Prodesmatochoerus meekae*.³ The latter skulls, however, differ from those of *S. sternbergi* in having deeply trenched molars and paroccipital wings projecting posteriorly beyond the condyles. It is noteworthy that examples of *P. meekae* (from "Zone A" of the Brule) have small auditory bullae similar to those of all the Miniochoerinae regardless of faunal zone. *Prodesmatochoerus meekae*, however, apparently gave rise to *Subdesmatochoerus socialis* (from "Zone B") which had inflated bullae.⁴

Examples of *S. sternbergi* with the narrow postorbital constriction are readily distinguished from the less constricted examples representing other genera and species of the Miniochoerinae from "Zone A." The dentition of this species differs from examples of *Miniochoerus* and *M. (Paraminiochoerus)* from "Zone A" in having larger P_2^1 - M_1^1 .

It is of interest but not of particular significance to note that examples of *S. sternbergi* have not been recorded from South Dakota.

The remains of *Stenopsochoerus sternbergi* in the Frick Laboratory collection from Nebraska and Wyoming were collected by John Lynch, Everett De Groot, Gene Roll, Nelson J. Vaughan, George Sternberg, and Charles H. Falkenbach, 1938, 1943, and 1945; and additional remains from Nebraska were collected by Ove Kaisen and Morris Skinner, 1944. The referred specimens in the University of Nebraska State Museum series were assembled by E. L. Blue, Thompson M. Stout, C. Bertrand Schultz, and associates, 1933-1935, and 1938.

Thirty-three specimens are here recorded:

³ Schultz and Falkenbach, 1954, p. 226.

⁴ See *idem*, 1954, p. 220, fig. 21.

HOLOTYPE

Skull with I ¹ -M ³ (I ² -I ³ alv.) and mandible with I ₁ (rt.)-M ₃ . (w+)	F:A.M. 44980	From "Zone A" of Brule formation, Old Woman Creek area, Hat Creek Basin, Cheyenne River drainage, Niobrara County, Wyoming; collected by Gene Roll and Charles H. Falkenbach, 1938
		Figures 6-7

REFERRED FROM (A) NIOBRARA AND (B) CONVERSE COUNTIES, WYOMING;
(C) LOGAN COUNTY, COLORADO; AND (D) DAWES AND
(E) SIOUX COUNTIES, NEBRASKA

A. FROM HAT CREEK BASIN, CHEYENNE RIVER DRAINAGE,
NIOBRARA COUNTY, WYOMING

FROM TYPE AREA, OLD WOMAN CREEK:

2 SKULLS AND MANDIBLES

Skull with I ³ -P ¹ rt. and P ² -M ³ and mandible with I ₁ -P ₁ rt. and P ₂ -M ₃	(w ⁺)	F:A.M. 44981
Partial skull with I ¹ -M ³ and mandible (left ramus attached to skull) with I ₁ -M ₃	(M+)	45078

FROM SHACK DRAW AREA:

6 SKULLS AND MANDIBLES (ATTACHED)

Partial skull with P ¹ (rt.)-M ³ (P ² , M ¹ -M ² br.) and mandible with P ₂ (br.)-M ₃	(w+)	44983
Partial skull with I ³ -M ³ and mandible with P ₁ -M ₃	(w)	45050
Partial skull with I ¹ (alv.)-M ³ and mandible with I ₂ -M ₃	(M+)	45079
Partial skull with I ¹ (br.)-M ³ and mandible with I ₃ (rt.)-M ₃	(w)	45086
Partial skull with I ² -M ³ and mandible with I ₁ -M ₃ (/C rt.)	(w ⁺)	49567
Partial skull with P ³ -dP ⁴ -M ³ (germ) and mandible with P ₂ -dP ₄ -M ₁	(i)	49568

2 MANDIBLES

Mandible with P ₂ (br.)-M ₃	(M+)	49606
Mandible with P ₁ -P ₂ rt. and dP ₃ -M ₃	(i)	49608

B. FROM CONVERSE COUNTY, WYOMING

FROM 6-9 MI. S.E. OF DOUGLAS:

4 SKULLS AND MANDIBULAR RAMI (ATTACHED)

Partial skull with C/(br.)-M ³ and mandible with /C(rt.)-M ₃	(w)	F:A.M. 45478
Skull with I ¹ -I ³ alv. and C/-M ³ and mandible with /C-M ₃	(w+)	45479
Partial skull with C/(germ)-dP ² -M ¹ and left ramus with I ₁ -P ₁ rt. and P ₂ -dP ₃ -M ₁	(i)	45480
Anterior portion of skull with I ¹ -I ³ rt. and C/-M ³ (P ² -M ³ br.) and partial mandible with I ₁ -C rt. and P ₁ -M ₃	(w)	49610

2 SKULLS

Skull with C/(br.)-M ³	(w+)	44992
Partial skull with C/(germ)-dP ² -M ² (erupt.)	(i)	45482

FROM BRIDGE AREA, 10 MI. S.E. OF DOUGLAS:

2 MANDIBLES

Mandible with I ₁ -I ₃ rt. and /C-M ₃	(w ⁺)	49607
Mandible with I ₁ -M ₃	(w+)	49612

C. FROM LOGAN COUNTY, COLORADO

(Collected by Barnum Brown and Maxwell, 1898)

2 SKULLS AND MANDIBLES (ATTACHED)

Partial skull with C/(br.)-M ³ and mandible with P ₁ -M ₃	(w+)	A.M. 8900
Partial skull with C/-M ³ and mandible with I ₁ -M ₃ (I ₃ -C br.) and skeletal fragments	(w)	8923

D. FROM U.N.S.M. COLL. LOC. DW-104, WHITE RIVER DRAINAGE,
DAWES COUNTY, NEBRASKA

SKULL AND MANDIBLE (ATTACHED)		U.N.S.M.
Skull with I ¹ -M ³ and mandible with I ₁ (br.)-M ₃	(w)	28169

E. FROM HAT CREEK BASIN, CHEYENNE RIVER DRAINAGE,
SIOUX COUNTY, NEBRASKA

FROM N. OF HARRISON:

SKULL, MANDIBLE, AND SKELETAL ELEMENTS		F:A.M.
Skull with I ¹ -M ³ , mandible with I ₁ -M ₃ , partial humerus, 2 radii, 2 ulnae (1 partial), 2 manus, 2 tibiae (1 partial), astragalus, 2 calcanea (1 partial), and vertebrae. Figures 9-11 (in part)	(w)	49605
The above manus has five digits.		

SKULL AND MANDIBLE (ATTACHED)		
Skull with I ³ -M ³ and mandible with I ₂ (alv.)-M ₃	(w)	45487

FROM 1 MI. W. OF TOADSTOOL PARK:

MANDIBLE		
Partial mandible with I ₃ -M ₃	(w ⁺)	49518

FROM U.N.S.M. COLL. LOC. SX-4:

SKULL AND MANDIBLE (ATTACHED)		U.N.S.M.
Skull with C/-M ³ (P ¹ absent) and mandible with P ₁ (br.)-M ₃	(w ⁺)	28137

SKULL		
Partial skull with C/(rt.)-M ³ (P ¹ -P ² rt.)	(w)	28132

FROM U.N.S.M. COLL. LOC. SX-5:

SKULL AND MANDIBLE (ATTACHED)		
Partial skull with I ³ -M ³ and mandible with /C(rt.)-M ₃	(w)	28058

FROM U.N.S.M. COLL. LOC. SX-6:

SKULL AND MANDIBLE (ATTACHED)		
Partial skull with C/(rt.)-M ³ and partial mandible with P ₂ -M ₃	(w)	28515

E'. FROM WHITE RIVER DRAINAGE, SIOUX COUNTY, NEBRASKA

FROM U.N.S.M. COLL. LOC. SX-17:

2 SKULLS AND MANDIBLES		U.N.S.M.
Partial skull with C/(rt.)-M ³ and mandible (attached) with I ₁ -C alv. and P ₁ (rt.)-M ₃ (P ₂ rt.)	(w)	28039
Partial skull with M ² -M ³ and partial mandible with M ₃ br.	(w)	28124

FROM U.N.S.M. COLL. LOC. SX-18:

SKULL		
Anterior portion of skull with C/(rt.)-M ³ (P ¹ br.)	(w ⁺)	28308

FROM SAND CREEK (COLLECTED BY J. W. GIDLEY, 1899):

SKULL, MANDIBLE, AND SKELETAL ELEMENTS		P.U.
Skull with I ² -M ³ (M ¹ br.), mandible (attached) with I ₁ -M ₃ , 2 radii, 2 partial ulnae, 2 manus, partial astragalus, and fragments	(w)	11442
The manus of the above specimen has five digits. Scott, 1940, p. 674, referred this specimen to " <i>Merycoïdodon</i> " <i>gracilis</i> .		

2. *Stenopsochoerus joderensis*,¹ new species
From "Zone B" of the Brule formation, Sioux
County, Nebraska

DESCRIPTION

SKULL: Moderately small size; larger than examples of *S. sternbergi*, smaller than those of *S. berardae*; mesocephalic; frontals more convex laterally than in examples of *S. sternbergi*, more like those of *S. berardae*; nasals moderately robust, similar to those of last-mentioned species; malar moderately deep below orbit; auditory bulla slightly larger than in examples of *S. sternbergi*; postglenoid process higher and wider transversely and with more abrupt slope to external border than in other examples of genus.

MANDIBLE: Moderately small size; slightly more robust than in examples of *S. sternbergi*; ramus deeper than in latter species, within variation of examples of *S. berardae*; inferior border of ramus straight, but sloping noticeably downward posteriorly, similar to those of *S. berardae*; condyle moderately robust, more so than in examples of *S. sternbergi*, external border higher and more posterior than internal

border.

DENTITION: Series slightly longer than in largest example of *S. sternbergi*, within range of variation of those of *S. berardae*; premolars approximately equal in size to those of *S. sternbergi* and *S. berardae*; molars larger than in former species, smaller than in latter; external styles of superior molars somewhat more prominent than in *S. sternbergi*.

LIMBS: Unknown.

MEASUREMENTS: Table 6 (p. 436).

ILLUSTRATIONS: Figures 6-7.

DISCUSSION

Stenopsochoerus joderensis is represented by the holotype and only one referred, immature specimen. The dentition of the type is poorly preserved, but the characters mentioned above are clearly observable. The sagittal crest of the skull is broken, and indications are that it was higher than in examples of *S. sternbergi*.

The holotype was collected by Ove Kaisen and Morris Skinner, 1944, and the referred specimen by George Sternberg, John C. Blick, and Charles H. Falkenbach, 1944.

Two specimens are here recorded:

HOLOTYPE

Partial skull with I¹-M³ (C/-P² and M¹-M² br.) and partial mandible with I₁-M₃ (I₁-P₁ and P₃-P₄ br.). (w⁺)

F:A.M. 45483

From faunal "Zone B" of Brule formation, "Toadstool Park" area, W. of Joder, White River drainage, Sioux County, Nebraska

Figures 6-7

REFERRED FROM HAT CREEK BASIN, CHEYENNE RIVER DRAINAGE, SIOUX COUNTY, NEBRASKA

SKULL AND MANDIBLE (ATTACHED), IMMATURE

F:A.M.

Partial skull with dP³-M³(germ) and partial mandible with M₁-M₂ (r)

49520

3. *Stenopsochoerus berardae*,² new species
From "Zone C" of the Brule formation, Harding County, South Dakota; referred remains from Fall River and Shannon counties, South Dakota, and Sioux County, Nebraska

DESCRIPTION

SKULL: Medium size, largest known of genus, slightly larger than examples of *S.*

(*Pseudostenopsochoerus*) *chadronensis* (from Chadron); mesocephalic; frontals markedly convex transversely; nasals moderately broad, slightly more anterior retraction than in examples of *S. joderensis* and *S. sternbergi*; zygomatic arch with sharp posterior rise of inferior border from below orbit, more pronounced than in *S. sternbergi*; malar moder-

¹ Named for the area near Joder railroad siding, east of "Toadstool Park," the locality from which the holotype was collected.

² Named in honor of Miss Hazel de Berard, staff artist of the Frick Laboratory, who has supervised the drawing of the illustrations used in the present revision of the oreodonts.

ately deep below orbit, deeper than those of *S. sternbergi*; lacrimal fossa small but rather deep; occipital condyles of medium size; auditory bulla small¹; postglenoid process narrower transversely than in other species of genus²; posterior palate with greater posterior projection than in other species of genus.

MANDIBLE: Larger than in other species of genus; slightly more robust than those of *S. sternbergi*, comparable with those of *S. joderensis*; ramus decidedly deeper than in examples of *S. sternbergi*; inferior border of ramus straight, but sloping noticeably downward posteriorly; condyle with external and internal borders on horizontal plane (in other two species of genus external border higher than internal border).

DENTITION: Series averaging longer than in holotype of *S. joderensis*, longer than in examples of *S. sternbergi*; premolars comparatively small, approximately equal in size to those of *S. sternbergi*; molars decidedly larger than those of latter species, somewhat larger than those of holotype of *S. joderensis*.

LIMBS: Longer and more robust than those

of *S. sternbergi*.

MEASUREMENTS: Tables 6 and 7 (pp. 436 and 437).

ILLUSTRATIONS: Figures 6-7, 9-11.

DISCUSSION

Remains of *Stenopsochoerus berardae* represent the last known geologic occurrence in the generic line. It is noteworthy that although the skull is larger and comes from "Zone C" of the Brule formation, the premolars are similar in size to those of *S. sternbergi* from "Zone A." The molars, however, are considerably larger than those of the latter species. It is also of interest to note that the narrow postorbital constriction is continued through the generic phylum.

The referred F:A.M. remains were gathered by Ove Kaisen and Morris Skinner, 1944-1945; and George Sternberg, John C. Blick, and Charles H. Falkenbach, 1944; and the U.N.S.M. example was collected by C. Bertrand Schultz and associates, 1935.

Nine specimens are here recorded:

HOLOTYPE

Partial skull with I¹-M³, mandible with /C-M₃, femur, partial tibia, and fragments. (w+)

F:A.M. 49617

From "Zone C" of Brule formation, 2 mi. S. of Reva Gap, E. side of Slim Buttes,³ Harding County, South Dakota; collected by Morris Skinner, 1945

Figures 6-7, 10

REFERRED FROM (A) FALL RIVER AND (B) SHANNON COUNTIES, SOUTH DAKOTA; AND (C) SIOUX COUNTY, NEBRASKA

A. FROM 7 MI. N.W. OF SLIM BUTTE,³ WHITE RIVER DRAINAGE, JUST WEST OF SHANNON COUNTY LINE IN FALL RIVER COUNTY, SOUTH DAKOTA

2 ASSOCIATED SKULLS, MANDIBLES, AND SKELETAL ELEMENTS

F:A.M.

Partial skull with I¹-M³ and mandible with I₁-M₃. Figure 7 (in part) (w+)

49618A

Partial skull with I³(rt.)-M³ and mandible with P₁-M₃. Figure 7 (in part) (w)

49618B

Partial scapula, 3 humeri (2 partial), partial radius, 3 partial ulnae, 3 tibiae (2 partial), 3 astragali (1 partial), 3 calcanea (1 partial), partial pes, vertebrae, and fragments. Figures 9-11

49618A-B

¹ No complete examples of the bullae are known. The area for the bulla, however, suggests a small uninflated type similar to all examples of *Miniochoerinae*.

² The description of the postglenoid process is based on two referred skulls which are lighter in construction than the average. These skulls may represent the female of the species. This variation, however, has not been noted within forms from "Zone A" of the Brule, which are decidedly better represented in the collections than those from zones "B," "C," and "D."

³ It is to be noted that there is a Slim Butte in Shannon County and Slim Buttes in Harding County, both localities in South Dakota.

The above two skulls, mandibles, and skeletal elements were found associated in the field. The limbs may belong to either skull. The M^3 's of each skull are figured (fig. 7) to demonstrate individual variation found in associated individuals.

B. FROM 5 MI. N.W. OF SLIM BUTTE, WHITE RIVER DRAINAGE,
SHANNON COUNTY, SOUTH DAKOTA

SKULL, MANDIBLE, AND VERTEBRAE

F:A.M.

Partial skull with C/- M^3 , mandible with P_1 - M_3 , and vertebrae (w $\frac{1}{2}$ +) 49570

C. FROM SIOUX COUNTY, NEBRASKA

FROM N. OF HARRISON, HAT CREEK BASIN, CHEYENNE RIVER DRAINAGE:

2 SKULLS AND MANDIBLES

Anterior portion of skull with C/- M^3 (br.) (P^1 and M^1 - M^2 br.) and partial mandible with P_1 - M_3 (M_2 br.) (w $\frac{1}{2}$) F:A.M. 45484

P^4 slightly larger than in holotype.

Partial skull with C/(br.)- M^3 (P^2 absent and M^1 - M^3 br.) and mandibular fragments (w $\frac{1}{2}$) 45486

P^4 wider than usual.

FROM W. OF JODER, WHITE RIVER DRAINAGE:

SKULL AND MANDIBLE (ATTACHED)

Anterior portion of skull with C/- M^3 (br.) (P^1 absent) and partial mandible with P_1 (br.)- M_3 (br.) (w $\frac{1}{2}$) 45485

FROM U.N.S.M. COLL. LOC. SX-23, WHITE RIVER DRAINAGE:

SKULL

U.N.S.M.

Anterior portion of skull with C/- M^3 (br.) (P^1 absent) (M+) 28287
The P^4 of above specimen is larger than in holotype.

IIIA. STENOPSOCHOERUS (PSEUDO-STENOPSOCHOERUS), NEW SUBGENUS

SUBGENOTYPE: *Stenopsochoerus* (*Pseudostenopsochoerus*) *chadronensis*, new species.

DESCRIPTION

SKULL: Small to medium size; basal lengths ranging from 138 to 156 mm., widths from 72 to 100 mm.; dolichocephalic to mesocephalic; sagittal crest moderately high; brain case inflated and elongated; postorbital constriction wider than in *Stenopsochoerus*; frontals less convex than in the latter genus; nasals narrow to wide; anterior nasal-maxilla contact above C/ to P^1 ; orbit small and roundish; zygomatic arch moderately robust, with inward curve or notch posterior to orbit; malar moderately deep below orbit; infraorbital foramen above posterior portion of P^3 ; lacrimal fossa deep, moderately large to large, more prominent than in *Stenopsochoerus*; depressed area above P^1 - P^3 ;

anterior border of maxilla with abrupt rise to nasals, but less than in *Stenopsochoerus*; occipital condyles of moderate size, comparable with those of *Stenopsochoerus*; paroccipital process light, compressed anteroposteriorly; bulla small; postglenoid process rather light, more abrupt slope to external border than in *S. sternbergi*; posterior palate projecting posteriorly from center of last lobe of M^3 to slightly posterior to M^3 .

MANDIBLE: Rather robust; postsymphysis below P_3 ; ramus moderately shallow; inferior border of ramus almost straight with slight downward curve posterior to M_3 , similar to those of *S. sternbergi*; condyle set approximately at right angle to axis of dentition, external border of condyle slightly higher than internal border.

DENTITION: Moderately heavy to heavy; premolars slightly crowded to crowded; P^1_2 - M^1_1 large, similar to those of *Stenopsochoerus*,

larger than those of *Mimiochoerus*; external styles of superior molars prominent; P^1 - P^4 with more prominent anterior intermediate crest than in examples of *Stenopsochoerus*.

LIMBS: Small size and moderately light.

MEASUREMENTS: Tables 6 and 7 (pp. 436 and 437).

ILLUSTRATIONS: Figures 8-9 (skulls, rami, and dentitions), 9-11 (limbs).

DISCUSSION

Stenopsochoerus (*Pseudostenopsochoerus*) embraces forms which seem to have close affinities to *Stenopsochoerus*, i.e., in the shape of the skull and the type of dentition. The skulls of *S. (P.) chadronensis* and *S. (P.) douglasensis* average longer than do those of *S. sternbergi*, the first from the Chadron and the latter two from "Zone A" of the Brule. The skull of the holotype of *S. (P.) reideri* from the Chadron is approximately the same length as examples of *S. berardae* from "Zone C" of the Brule. Thus the range of the skull lengths of the subgenus from the Chadron and "Zone A" of the Brule is as great as that found in the genus from "Zone A" through "Zone C."

Evidence at hand suggests that there may be two distinct phylogenetic lines represented in this subgenus and that *S. (P.) chadronensis* is not in the same line of development as *S. (P.) douglasensis*. The skulls of the former species possess a more inflated brain case and wider postorbital constriction than those of the latter. The possibility of two distinct lines is further strengthened by the geologic occurrence of examples of both types of skulls in the Chadron and faunal "Zone A" of the Brule. The differences noted could hardly be considered as individual variation. In order to note the occurrence of both types of skulls in the Chadron and Brule, the writers have listed them as geologic varieties under the respective species.

Remains of a manus with five digits are here

listed (see fig. 9), thus providing another example of the five digits of the forefoot occurring in "Zone A" of the Brule.

DISTRIBUTION

Examples of *Stenopsochoerus* (*Pseudostenopsochoerus*) are known from three species here recorded from the lower and middle Oligocene (Chadron and Brule ["Zone A"] formations) of Colorado, Nebraska and Wyoming. (See geologic distribution chart, p. 382.)

SUMMARY OF SPECIES AND TYPES

Three species of *Stenopsochoerus* (*Pseudostenopsochoerus*) from five lower and middle Oligocene (Chadron and Brule) localities are here recorded:

1. *S. (P.) chadronensis*, new species, from Niobrara County, Wyoming. (Chadron.)

HOLOTYPE: Skull, mandible, and skeletal elements, F:A.M. 45489. Figures 8-11.

1a. *S. (P.) chadronensis*, geologic variety, from Converse and Niobrara counties, Wyoming, and Sioux County, Nebraska. ("Zone A" of Brule.)

EXAMPLE: Skull and mandible, F:A.M. 45168.

2. *S. (P.) douglasensis*, new species, from Converse County, Wyoming; referred remains from Niobrara County, Wyoming, Logan and Weld counties, Colorado, and Sioux County, Nebraska. ("Zone A" of Brule.)

HOLOTYPE: Skull, mandible, and skeletal elements, F:A.M. 45492. Figures 8-11.

2a. *S. (P.) douglasensis*, geologic variety, from Converse and Niobrara counties, Wyoming, and Sioux County, Nebraska. (Chadron.)

EXAMPLE: Skull, U.N.S.M. 28128.

3. *S. (P.) reideri*, new species, from Niobrara County, Wyoming. (Chadron.)

HOLOTYPE: Skull and mandible, F:A.M. 49620. Figures 8-9.

DETAILED LISTS OF TYPES AND REFERRED SPECIMENS

STENOPSOCHOERUS (PSEUDO-STENOPSOCHOERUS)

TOTAL AVAILABLE SPECIMENS: 34¹1. *Stenopsochoerus* (*Pseudostenopsochoerus*) *chadronensis*,² new species

From the Chadron formation, Niobrara County, Wyoming; referred remains from Converse County, Wyoming; and Sioux County, Nebraska; and (1a) a geologic variety from the Brule formation ("Zone A"), Converse and Niobrara counties, Wyoming; and Sioux County, Nebraska

DESCRIPTION

SKULL: Small size; smaller than holotype of *S. (P.) reideri*; mesocephalic; sagittal crest prominent; brain case wide and expanded, more inflated than in *S. (P.) douglasensis*; postorbital constriction wider than in *S. (P.) douglasensis*; exoccipital with prominent elongated groove above base of paroccipital process; frontals less convex laterally at external border than in examples of *S. (P.) reideri*, resulting in less depth between superior border of orbit and superior plane of frontal; nasals moderately narrow and light, tendency to be lighter than in examples of *S. (P.) douglasensis*; anterior nasal-maxilla contact in area above P¹; zygomatic arch with less posterior rise to inferior border than in latter species; malar moderately deep below orbit, deeper than in average examples of *S. sternbergi*; lacrimal fossa moderately deep, larger than in *S. (P.) douglasensis*; paroccipital process light, tapering rapidly to inferior border, lighter than in examples of *S. (P.) douglasensis*; posterior border of palate projecting posteriorly to center of last lobe of M³, less posterior extension than in *S. (P.) douglasensis* and *S. (P.) reideri*.

MANDIBLE: Condyle larger than in examples of *S. sternbergi*, smaller than that of *S. (P.) reideri*.

DENTITION: Length of series of holotype shorter than that of holotype of *S. (P.) douglasensis*, but, on average, examples approximately equal, smaller than in holotype of *S. (P.) reideri*; premolars crowded; P²-P³ and

P¹-P³ set at slight angle to alveolar border, less angle than in holotype of *S. (P.) reideri*.

LIMBS: Approximately equal to those of *S. (P.) douglasensis*, larger than in *S. sternbergi*.

MEASUREMENTS: Tables 6 and 7 (pp. 436 and 437).

ILLUSTRATIONS: Figures 8-11.

DISCUSSION

Remains of *S. (Pseudostenopsochoerus) chadronensis* occur in the upper part of the Chadron formation, i.e., from within 10 to 15 feet below the "upper Purplish White layer"³ which is used by the field parties of the Frick Laboratory and the University of Nebraska State Museum as a division marker between the Chadron and Brule formations in the Hat Creek Basin of Nebraska and Wyoming. Examples of the geologic variety occur above the "upper Purplish White layer." The skulls of this species differ in certain characters and trends from those of *S. (P.) douglasensis* from "Zone A" of the Brule.

In examples of *S. (P.) chadronensis*, the auditory bulla is slightly larger than in *Stenopsochoerus sternbergi* (from "Zone A"). It is more comparable with those of *S. joderensis* (from "Zone B") and *S. berardae* (from "Zone C"). The size range of skulls of *S. (P.) chadronensis* and *S. (P.) douglasensis* has a larger weighted mean than other forms of the Miniochoerinae from "Zone A" of the Brule (see chart 2).

The holotype of *S. (P.) chadronensis* has five digits in the manus. There is not sufficient material, however, to assume that all examples of the species had five digits in the forefoot.

The various weighted means shown in chart 2 indicate a tendency for *S. (P.) chadronensis*, geologic variety from "Zone A" of the Brule, to be smaller on the average than examples of *S. (P.) chadronensis* from the Chadron.

The F:A.M. specimens representing this species from Wyoming were collected by George Sternberg, John C. Blick, and Charles H. Falkenbach, 1944; and those from Nebraska by Ove Kaisen and Morris Skinner, 1944.

Eleven specimens are here recorded:

³ Schultz and Stout, 1938, Bull. Geol. Soc. Amer., vol. 49, no. 12, pt. 2, p. 1921.

¹ Includes 31 F:A.M. and 2 U.N.S.M. specimens.

² Named for the Chadron formation, from which the holotype and referred specimens were secured.

HOLOTYPE

Skull with I ¹ -M ³ , mandible with I ₁ -M ₃ (I ₂ rt.), partial scapula, 2 partial radii, 2 partial ulnae, and manus. (w)	F:A.M. 45489	From Chadron formation, below the "upper Purplish White layer," S.W. end of Seamen Hills, Hat Creek Basin, Cheyenne River drainage, Niobrara County, Wyoming; collected by George Sternberg, John C. Blick, and Charles H. Falkenbach, 1944
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Figures 8-11

The above forefoot has five digits.

REFERRED FROM TYPE AREA, S.W. END OF SEAMEN HILLS, HAT CREEK BASIN, CHEYENNE RIVER DRAINAGE, NIOBRARA COUNTY, WYOMING

SKULL AND MANDIBLE	F:A.M.
Skull with I ³ -M ³ and mandible (attached) with /C-M ₃ (w ⁺)	45490
The above skull is crushed, thus increasing the length of the skull and the width of the postorbital constriction.	

1A. GEOLOGIC VARIETY FROM "ZONE A" OF BRULE FORMATION

DISCUSSION

The following listed material was collected from "Zone A" of the Brule formation, but does not differ noticeably from examples of

this species occurring in the Chadron formation. The skulls are, however, distinguished from those of *S. (P.) douglasensis* from "Zone A" in having a more inflated brain case and wider postorbital constriction. (See discussion, p. 444.)

EXAMPLE

Skull with I ³ -M ³ and mandible with I ₂ -M ₃ . (w)	F:A.M. 45168	From "Zone A" of Brule formation, 8 mi. S.E. of Douglas, Converse County, Wyoming; collected by George Sternberg, 1943
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REFERRED FROM (A) CONVERSE AND (B) NIOBRARA COUNTIES, WYOMING, AND (C) SIOUX COUNTY, NEBRASKA

A. FROM 6-9 MI. S.E. OF DOUGLAS, CONVERSE COUNTY, WYOMING

SKULL AND MANDIBLE	F:A.M.
Skull with I ³ -M ³ and mandible with I ₁ -C rt. and P ₁ -M ₃ (w)	49508
3 SKULLS	
Partial skull with C/(rt.)-M ³ (P ₁ br.) (w)	44991
Partial skull with I ³ -P ₂ rt. and P ³ -M ³ (w)	44993
Skull with I ¹ -I ³ rt. and C/(br.)-M ³ (w ⁺)	45012

B. FROM HAT CREEK BASIN, CHEYENNE RIVER DRAINAGE, NIOBRARA COUNTY, WYOMING

FROM SPRING DRAW AREA:

2 SKULLS AND MANDIBLES (ATTACHED)	F:A.M.
Partial skull with C/ br. and P ³ -M ³ (br.) and mandible with /C-M ₃ (w)	44986
Skull with C/(rt.)-M ³ and mandible with P ₂ -M ₃ (M+)	45192

FROM OLD WOMAN CREEK AREA:

SKULL, MANDIBLE (ATTACHED), AND SKELETAL ELEMENTS	
Skull with I ¹ -M ³ , mandible with /C-M ₃ , femur, tibia, astragalus, partial pelvis, and vertebrae. (w)	49586

C. FROM E. END OF HAT CREEK BASIN, CHEYENNE RIVER DRAINAGE,
SIOUX COUNTY, NEBRASKA

SKULL, MANDIBLE, AND SKELETAL ELEMENTS

Skull with I²-M³, mandible (left ramus attached) with /C(alv.)-M₃, partial scapula, humerus, 2 radii, 2 ulnae, calcaneum, metacarpal III, vertebrae, and ribs; partial humerus associated with foregoing but too large for this species. (w₊⁺) F:A.M. 49569

2. *Stenopsochoerus* (*Pseudostenopsochoerus*) *douglasensis*,¹ new species

From "Zone A" of the Brule formation, Converse County, Wyoming; referred remains from Niobrara County, Wyoming; Logan and Weld counties, Colorado; and Sioux County, Nebraska; and (2a) a geologic variety from Chadron formation, Converse and Niobrara counties, Wyoming; and Sioux County, Nebraska

DESCRIPTION

SKULL: Within size range of examples of *S. (P.) chadronensis*; exoccipital with small foramen above base of paroccipital process; brain case narrower and less inflated than in *S. (P.) chadronensis*; postorbital constriction narrower than in *S. (P.) chadronensis*; frontals similar to those of latter species, less convex laterally than in holotype of *S. (P.) reideri*; nasals with tendency to be more robust than those of *S. (P.) chadronensis*; anterior nasal-maxilla contact above and just posterior to C/; zygomatic arch with less posterior rise than in holotype of *S. (P.) reideri*; malar moderately light below orbit; lacrimal fossa as deep as but slightly larger than in examples of *S. (P.) chadronensis*; paroccipital process more robust than those of latter species; posterior palate projecting posteriorly for short distance beyond M³.

MANDIBLE: Similar to those of *S. (P.) chadronensis*.

DENTITION: Length of series averaging less than in examples of *S. (P.) chadronensis*; tendency for premolars to be more crowded than those of latter species.

LIMBS: Approximately equal to those of *S. (P.) chadronensis*, somewhat lighter than in *S. berardae*, and larger than those of *S. sternbergi*.

MEASUREMENTS: Tables 6 and 7 (pp. 436 and 437).

ILLUSTRATIONS: Figures 8-11.

¹ Named for the town of Douglas, Converse County, Wyoming, which is near the locality from which the holotype was secured.

DISCUSSION

Examples of *S. (Pseudostenopsochoerus) douglasensis* differ from those of *S. (P.) chadronensis* in having a tendency for the facial region of the skull to be slightly longer and for the superior molars to be slightly wider. These tendencies are intentionally omitted from the description, because there are only a few known examples of the latter species. The possession of wide molars is characteristic of the Miniochoerinae, and the molar becomes progressively wider in species occurring higher in the geologic scale.

Examples of *Stenopsochoerus sternbergi* are distinguished from those of *S. (P.) douglasensis* by having a shorter basal length of the skull, lighter nasals, a more abrupt posterior rise of the zygomatic arch, more crowded premolars, and a tendency for larger molars.

The long, high, and narrow skull of *S. (P.) douglasensis* is readily distinguished from the low, flat, and wide skull of *Platychoerus platycephalus*, both occurring in faunal "Zone A." The larger premolars of *S. (P.) douglasensis* are diagnostically different from the smaller ones of *Miniochoerus battlecreekensis* and *M. (Paraminiochoerus) affinis*, all from "Zone A" of the Brule.

The presence of a five-toed manus in the Miniochoerinae in both the late Chadron and early Brule formations is evidenced by the holotypes of *S. (P.) chadronensis* and *S. (P.) douglasensis*.

In chart 2, the weighted means of the measurements of the dental series indicate that in the geologic variety of *S. (P.) douglasensis* from the Chadron the lengths are slightly greater on the average than in examples of the species from faunal "Zone A" of the Brule.

The F:A.M. specimens from Wyoming were gathered by John Lynch, Everett De Groot, Nelson J. Vaughan, Gene Roll, George Sternberg, John C. Blick, and Charles H. Falkenbach, 1938 and 1942-1945; those from Nebraska by George Sternberg, John C. Blick, and Charles H. Falkenbach, 1944; those from

Colorado by William Klaus and John C. Blick, 1931; and the A.M. material was collected by an American Museum Expedition, 1898, and

the U.N.S.M. specimen by C. Bertrand Schultz and associates, 1935.

Twenty-two specimens are here recorded:

HOLOTYPE

Skull with I ¹ -M ³ , mandible with I ₁ -M ₃ (I ₃ rt.), partial scapula, humerus, radius, ulna, manus elements, 2 femora, 2 tibiae, astragalus, calcaneum, vertebrae, and ribs. (w)	F:A.M. 45492	From "Zone A" of Brule, 8 mi. S.E. of Douglas, Converse County, Wyoming; collected by George Sternberg, John C. Blick, and Charles H. Falkenbach, 1943 Figures 8-11
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The above manus has five digits; see figure 9.

REFERRED FROM (A) CONVERSE AND (B) NIOBRARA COUNTIES, WYOMING;
(C) LOGAN AND (D) WELD COUNTIES, COLORADO; AND
(E) SIOUX COUNTY, NEBRASKA

A. FROM TYPE AREA, 6-9 MI. S.E. OF DOUGLAS, CONVERSE COUNTY, WYOMING

SKULL, MANDIBLE (ATTACHED), AND SKELETAL ELEMENTS

Partial skull with I ² -M ³ , mandible with P ₂ -M ₃ , calcaneum, and fragments of manus	(w+)	F:A.M. 45496
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7 SKULLS AND MANDIBLES (ATTACHED)

Skull with I ² -M ³ and mandible with I ₃ -M ₃	(w)	44989
Skull with I ¹ -M ³ and mandible with I ₁ -C rt. and P ₁ -M ₃	(w)	44990
Skull with I ¹ -I ² rt. and I ² -M ³ and mandible with I ₁ -I ₃ rt. and /C-M ₃	(w+)	45493
Skull with I ² -M ³ and mandible with I ₁ -M ₃ (I ₂ -I ₃ br.)	(w+)	45494
Partial skull with I ¹ -M ³ and mandible with I ₁ -M ₃	(w)	45495
Skull with I ¹ (rt.)-M ³ (I ³ rt.) and mandible with I ₃ -P ₁ br. and P ₂ -M ₃	(w+)	49517
Skull with I ¹ -M ³ and mandible with I ₁ -M ₃	(w)	49538

MANDIBLE

Partial mandible with I ₁ (rt.)-M ₃	(w+)	49613
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B. FROM HAT CREEK BASIN, CHEYENNE RIVER DRAINAGE, NIOBRARA COUNTY, WYOMING

FROM INDIAN CREEK AREA:

2 SKULLS AND MANDIBLE (ATTACHED) WITH SKELETAL ELEMENTS

Partial skull with I ² -M ³ , mandible with I ₁ -M ₃ , 2 humeri, 2 radii (1 partial), 2 ulnae (1 partial), and 2 partial manus	(w)	F:A.M. 45330
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The above manus has five digits.

Partial skull with I ¹ (alv.)-M ³ , mandible with I ₁ -M ₃ , partial humerus, radius, ulna, partial manus, partial femur, partial pelvis, and fragments.	(w)	49616
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FROM SPRING DRAW AREA:

3 SKULLS AND MANDIBLES (ATTACHED)

Partial skull with C/-P ¹ rt. and P ² (br.)-M ³ and partial mandible with M ₁ -M ₃	(w)	44985
Partial skull with I ² -M ³ and mandible with I ₁ -M ₃	(w)	45085
Partial skull with P ¹ (rt.)-M ³ (M ¹ br.) and partial mandible with I ₁ -C rt. and P ₁ -M ₃	(w+)	45170

FROM NORTH OF NODE:

SKULL AND MANDIBLE (ATTACHED), IMMATURE

Partial skull with P ¹ -dP ² -M ³ and partial mandible with P ₁ (br.)-dP ₂ -M ₃	(i)	49611
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C. FROM LEWIS CREEK, LOGAN COUNTY, COLORADO

SKULL AND MANDIBLE (ATTACHED) WITH SKELETAL ELEMENTS

A.M.

Partial skull with I¹(alv.)-M³, mandible with I₁-M₃, and fragments of femur . (w)

8869

D. FROM PAWNEE CREEK AREA, WELD COUNTY, COLORADO

SKULL AND MANDIBLE, IMMATURE

Partial skull with P¹-dP³(erupt.) and partial mandible with /C(rt.)-dP₂-M₃
(erupt.) (i)

F:A.M.

49541

E. FROM U.N.S.M. COLL. LOC. SX-23, WHITE RIVER DRAINAGE,
SIOUX COUNTY, NEBRASKA

SKULL

U.N.S.M.

Partial skull with M²-M³ br. (w¹⁺)

28165

The field record for this incomplete specimen gives the geologic horizon as "lower Whitney" (faunal "Zone C"), which may indicate that this species is not restricted to "Zone A." Examples from zones "B" and "C" are needed, however, before the exact geologic range of this species can be determined.

2A. GEOLOGIC VARIETY FROM
CHADRON FORMATION

DISCUSSION

The following specimens, although from the

Chadron formation, are similar to those from the Brule, differing primarily from examples of *S. (P.) chadronensis* from the Chadron in having skulls that possess a less inflated brain case and narrower postorbital constriction.

EXAMPLE

Partial skull with C/(rt.)-M³. (m)

U.N.S.M. 28128

From Chadron formation, U.N.S.M. Coll. Loc. Wyo-3, 7 mi. S.E. of Douglas, Converse County, Wyoming; collected by Guy Johnson, 1938

REFERRED FROM (E) NIOBRARA COUNTY, WYOMING, AND (F) SIOUX COUNTY,
NEBRASKAE. FROM S.W. END OF SEAMEN HILLS, HAT CREEK BASIN, CHEYENNE
RIVER DRAINAGE, NIOBRARA COUNTY, WYOMING

SKULL AND MANDIBLE

Partial skull with I¹-I² rt. and I³-M³ (P¹ and P²-M² absent) and partial mandible with P₁-M₃ (P₃-P₄ rt. and M₂ br.) (w+)

F:A.M.

45491

F. FROM HAT CREEK BASIN, N. OF HARRISON, CHEYENNE RIVER DRAINAGE,
SIOUX COUNTY, NEBRASKA

SKULL AND MANDIBLE

F:A.M.

Posterior portion of skull with C/-P¹ br. and P²-M³ and partial mandible with P₁-M₃ (w)

49621

3. *Stenopsochoerus* (*Pseudostenopsochoerus*) *reideri*,¹ new species

From the Chadron formation, Niobrara County, Wyoming

DESCRIPTION

SKULL: Medium size (although from Chadron formation, approximately equal in size to examples of *Miniochoerus cheyennensis* from upper Brule ["Zone D"]); mesocephalic;

wider, and with greater width at postorbital constriction than in examples of *S. (P.) chadronensis*; exoccipital with small foramen above base of paroccipital process; frontals more convex laterally than in examples of latter species,

¹ Named in honor of Mr. Henry Reider, chief preparator of the University of Nebraska State Museum, who has supervised the preparation of many of the Nebraska specimens used in the present revision of the oreodonts.

creating greater depth between superior border of orbit and superior plane of frontal; temporal ridge extending outward to approximate center of superior border of orbit; nasals robust, wider than in other species of subgenus, with slight, if any, anterior retraction; anterior nasal-maxilla contact above diastema between $C/$ and P^1 ; zygomatic arch moderately light, with moderately sharp posterior rise to inferior border; malar moderately shallow below orbit, comparable to those of *S. (P.) douglasensis*; infraorbital foramen above posterior border of P^3 ; lacrimal fossa large and deep (larger than in other species of subgenus); facial depression above P^1 - P^3 , less pronounced than in examples of *S. (P.) chadronensis*; paroccipital process moderately light, lighter than in examples of *S. (P.) douglasensis*; postglenoid process with more gradual slope to external border than in other examples of subgenus; posterior palate projecting to posterior border of M^3 .

MANDIBLE: Ramus increasing in depth posteriorly; inferior border of ramus straight, with a gradual downward curve posterior to M_3 , more like those of *S. sternbergi* and more pronounced than in other species of subgenus.

DENTITION: Series longer and more robust

than in other species of subgenus; premolars crowded, more so than in other species of subgenus; P^1_2 - P^3_3 inclusive set at angle to alveolar borders, P^2_2 set more obliquely than found in other examples of this subfamily.

LIMBS: Unknown.

MEASUREMENTS: Table 6 (p. 436).

ILLUSTRATIONS: Figures 8-9.

DISCUSSION

The holotype of *S. (Pseudostenopsochoerus) reideri* is unique in that the skull and dentition are larger than in any other known species of the *Miniochoerinae* from the Chadron or faunal "Zone A" of the Brule formation. It is of interest that the skull and dentition of the holotype, although from the Chadron, approach the size of examples of *Miniochoerus nicholsae* and *Platychoerus hatcreekensis*, both from "Zone C." In the holotype, the anterior groove of the supraoccipital foramen is less marked than usual in the subgenus, but this feature may be attributable to individual variation.

The size and character variations may represent a new genus, but with only one example available, it seems advisable to refer it to this subgenus.

One specimen is here recorded:

HOLOTYPE

Skull with I^1 - M^3 and mandible with I_1 - M_3 . (w_1^+)

F:A.M. 49620

From Chadron formation, below the "upper Purplish White layer" of Seamen Hills, Hat Creek Basin, Cheyenne River drainage, Niobrara County, Wyoming; collected by George Sternberg, John C. Blick, and Charles H. Falkenbach, 1944

Figures 8-9

IV. PARASTENOPSOCHOERUS, NEW GENUS

GENOTYPE: *Parastenopsochoerus conversensis*, new species.

DESCRIPTION

SKULL: Small size; basal length 137 mm., width 81 mm., within size variation of examples of *S. (Pseudostenopsochoerus) douglasensis*; mesocephalic; supraoccipital wings widely spread, incorporated into a fan-shaped occipital region, somewhat less pronounced than in other genera of *Miniochoerinae*; sagittal crest short, very low, with a short depressed area above

postglenoid process, posterior portion forming a short noticeable crest (differing considerably from the long and moderately prominent sagittal crest of other genera of *Miniochoerinae*); brain case inflated, more so than in *Stenopsochoerus*; postorbital constriction considerably wider than in *Stenopsochoerus*; frontals moderately broad and somewhat convex laterally; nasals moderately broad, with more anterior retraction than in other genera of subfamily; anterior nasal-maxilla contact above P^1 ; supraorbital foramen lacking anterior groove usually present in other genera of subfamily; orbit

moderately small and round; zygomatic arch moderately light, with slight inward curve or notch posterior to orbit; malar shallow below orbit; infraorbital foramen above posterior portion of P^3 to anterior portion of P^4 ; lacrimal fossa moderately large and very deep; depressed area above P^1 - P^4 shallow (infraorbital foramen at posterior of depression); muzzle moderately broad in contrast to narrow muzzle in *Stenopsochoerus*; anterior border of maxilla with less abrupt rise to nasal contact than in other genera of subfamily; occipital condyles large, larger and more widespread than in other species of the Miniochoerinae from "Zone A" of the Brule; paroccipital process wide at base; auditory bulla small, slightly larger than in examples of *Stenopsochoerus* from "Zone A" of Brule; postglenoid process moderately high, similar to *Miniochoerus*; posterior palate extending to middle portion of M^3 .

MANDIBLE: Unknown.

DENTITION: Heavy; C/ small; P^1 - M^1 moderately large, comparable with those of *Stenopsochoerus*, *S. (Pseudostenopsochoerus)*, and *Platychoerus*, larger than in average examples of *Miniochoerus* and *M. (Paraminiochoerus)*; external styles of superior molars moderately prominent; P^1 - P^4 each with anterior intermediate crest.

LIMBS: Unknown.

MEASUREMENTS: Table 6 (p. 436).

ILLUSTRATIONS: Figures 6-7.

DISCUSSION

The new genus, *Parastenopsochoerus*, represents a form that has certain characters in common with *Miniochoerus*, *Stenopsochoerus*, and *Platychoerus*, but differs diagnostically in possessing a short sagittal crest—a distinction that should not, however, exclude the genus from the subfamily. A similar case has been observed in the Desmatochoerinae¹ where a long and high sagittal crest is noted in *Desmatochoerus* while in *Pseudodesmatochoerus* the crest is short and low.

DISTRIBUTION

One species of *Parastenopsochoerus* is known from the middle Oligocene ("Zone A" of Brule formation) of Wyoming. (See geologic distribution chart, p. 382.)

SUMMARY OF SPECIES AND TYPE

One species of *Parastenopsochoerus* from one Oligocene (Brule) locality is here recorded:

1. *P. conversensis*, new species, from Converse County, Wyoming. ("Zone A" of Brule.)

HOLOTYPE: Skull, F.A.M. 45011. Figures 6-7.

DETAILED LIST OF TYPE AND REFERRED SPECIMEN

PARASTENOPSOCHOERUS

TOTAL AVAILABLE SPECIMENS: 2

1. *Parastenopsochoerus conversensis*,²
new species

From "Zone A" of the Brule formation, Converse County, Wyoming

DESCRIPTION

SKULL: Small size; see generic characters.

MANDIBLE: Unknown.

DENTITION: See generic characters.

LIMBS: Unknown.

MEASUREMENTS: Table 6 (p. 436).

ILLUSTRATIONS: Figures 6-7.

DISCUSSION

Parastenopsochoerus conversensis is represented by only two skulls from one area. Both specimens are decidedly different from other species of the Miniochoerinae. As noted in the generic description, the skull is similar to examples of *Miniochoerus* except for the low and short sagittal crest and the large occipital condyles. The dentition, however, is more like that of *Platychoerus* and *Stenopsochoerus*. Certain other characters of *P. conversensis* are similar to those of *Miniochoerus* and *Stenopsochoerus*, implying a common ancestry.

The holotype and referred specimen were collected by George Sternberg, 1943.

Two specimens are here recorded:

from which the holotype and referred specimen were secured.

¹ Schultz and Falkenbach, 1954, pp. 177 and 203.

² Named for Converse County, Wyoming, the area

HOLOTYPE

Skull with I¹-M³. (M)

F:A.M. 45011

From "Zone A" of Brule formation, 8
mi. S.E. of Douglas, Converse County,
Wyoming; collected by George Stern-
berg, 1943
Figures 6-7

REFERRED FROM TYPE AREA, 8 MI. S.E. OF DOUGLAS,
CONVERSE COUNTY, WYOMING

SKULL

Skull with I¹(br.)-M³ (C/ br.) (W+)

F:A.M.
49642

DESCRIPTION OF OREONETINAE, NEW SUBFAMILY 8¹

THE NEW SUBFAMILY Oreonetinae includes the genera *Oreonetes* Loomis and *Limnenetes* Douglass and also the questionably referred *Bathysgenys* Douglass. Oreodonts of very small to small size [largest examples approaching those of *Miniochoerus* (*Paraminiochoerus*) *gracilis*, p. 413, the smallest species of Miniochoerinae]; skulls mesocephalic; supraoccipital wings small and moderately spread, incorporated into a fan-shaped occipital region; orbits roundish, moderately small for size of skulls (see discussion concerning orbits, p. 457); temporal ridge moderately prominent, extending forward and outward to and above postorbital process of frontal; auditory bullae well inflated, subround in outline [longer anteroposteriorly than transversely, decidedly different from the small (minute) examples of Miniochoerinae and *Merycoidodon*]; P³ subtriangular in outline, anterior portion reduced in size (decidedly more reduction than in examples of Miniochoerinae or Merychyinae, more like *Protoreodon* from the Eocene); molars with deep fossettes.

DISCUSSION

Loomis² and Thorpe³ discussed the relationship of *Oreonetes* and *Limnenetes* and illustrated a proposed phylogeny. Scott,⁴ under a heading "Central Tribe-Oreonetes-Merycoidodon-Eporeodon" reported: "It seems to be the logical course to begin the treatment of the genera of the family with this tribe, from which all others were probably derived, either directly or indirectly, and which was the longest-lived of them all, ranging from the upper Eocene through the lower Pliocene, with comparatively little modification of limbs or skull. The first of the White River members of this series is *Oreonetes* of the Chadron substage."

¹ See p. 391 for previously described subfamilies. Subfamilies 7 (Miniochoerinae) and 8 (Oreonetinae) are presented under one cover as a means of convenience in publishing and not as an indication of close relationship.

² 1924, Ann. Carnegie Mus., vol. 15, nos. 2-3, p. 369, fig. 1.

³ 1937, Mem. Peabody Mus., vol. 3, pt. 4, p. 26, fig. 2.

⁴ 1940, Trans. Amer. Phil. Soc., new ser., vol. 28, pt. 4, p. 650.

⁵ 1940, p. 689.

Scott⁵ also discussed Loomis' and Thorpe's statements in reference to the genus *Limnenetes*, noting the problems. All three authors considered *Oreonetes* and *Merycoidodon* to be in the same phylogenetic line, and *Limnenetes* and *Leptauchenia* in another line. Simpson⁶ described similar relationships, placing *Oreonetes* in the Merycoidodontinae and *Limnenetes* in the Leptaucheninae.

Perhaps the major reason why these authors related *Oreonetes* to the Merycoidodontinae was the fact that both Loomis and Thorpe considered examples of *Oreonetes anceps* as having small auditory bullae (not inflated), similar to examples of *Merycoidodon culbertsonii*. Scott, however, did point out that the bulla of *Oreonetes anceps* must have been inflated (see discussion, p. 456). The inflated bullae and the fan-shaped occipital regions of *Oreonetes* and *Limnenetes* are distinctly different from the small bullae and posteriorly projecting occipital wings of *Merycoidodon culbertsonii* (see discussion, p. 388). As to the actual relationship of *Limnenetes* to *Leptauchenia*, the present writers fail to see any direct connection between the two forms. It seems reasonable to suspect that the ancestors of the leptauchenids would have possessed some indications of facial vacuities, but *Limnenetes* does not exhibit this character. It is true, however, that *Oreonetes*, *Limnenetes*, and the leptauchenids all have well-inflated and rounded auditory bullae, but it is here considered that the former two genera represent end members of two phyla. The leptauchenids, representing a diversified group with at least three distinct phylogenetic lines, will be the basis for a forthcoming paper.

Prior to the present report, examples of *Miniochoerus* (*Paraminiochoerus*) *gracilis*, *M. (P.) affinis*, and *Platychoerus platycephalus* have actually been referred to the genus *Merycoidodon* (see p. 388 for comparison of Miniochoerinae and *Merycoidodon*). Certain superficial characters (including size) of *Oreonetes* are similar to those of the three above-named species, which may have influenced the conclusions of previous writers concerning the rela-

⁶ 1945, Bull. Amer. Mus. Nat. Hist., vol. 85, pp. 148-149.

tionship of *Oreonetes* to *Merycoidodon*. The deep fossettes of the molars and the inflated bullae of *Oreonetes* are diagnostically different from the shallow molar fossettes and the small (minute) bullae of *Miniochoerinae*. It is of interest that the fully inflated bullae of the *Oreonetinae* are similar to the inflated bullae found in examples from "Zone D" of the Brule in other subfamilies of the oreodonts (the only exception is in the *Miniochoerinae* in which the bullae remained small).

The present writers consider the small (slightly inflated) bulla as a primitive character and the large (inflated) bulla as an advanced or specialized character.¹ Although there is more material available now from the Chadron formation than when previous reports were published,

the present writers still have not found evidence of any close relationship between the *Oreonetinae*, the *Merycoidodontinae*, and the *Miniochoerinae*.

The genus *Bathygenys*, represented by the species *B. alpha* Douglass, is provisionally placed in the subfamily *Oreonetinae*. Unfortunately neither the previously available material, nor an additional specimen recently collected from Wyoming (including the first known partial skull, associated mandible, and some skeletal elements, F.A.M. 45334), is complete enough to show a definite subfamily relationship.

Oreonetinae remains are known only from the middle part of the Chadron formation. (See geologic distribution chart, p. 382.)

DISTINCTIVE CHARACTERS* OF THE OREONETINAE

	I. <i>Oreonetes</i> (p. 454, fig. 12)	II. <i>Limnenetes</i> (p. 461, fig. 12)	III. <i>Bathygenys</i> (p. 464, fig. 12)
Skull	Small, moderately light	Small, moderately robust	Extremely small, light
Infraorbital foramen above	P ³	P ⁴	Questionable, definitely anterior to P ⁴
Lacrimal fossa	Large, deep	Small, shallow	(Unknown)
Dentition	Brachyodont, small, light	Brachyodont, tendency to be more hypsodont than in <i>Oreonetes</i>	Brachyodont, very small, light
Limbs	Unknown	Questionably moderate in size	Small in size

* *Idem*, 1940, p. 216; 1941, p. 6; 1947, p. 168; 1949, p. 85; 1950, p. 100; 1954, p. 164.

I. OREONETES² LOOMIS

Oreonetes LOOMIS, 1924, Ann. Carnegie Mus., vol. 15, p. 370. THORPE, 1937, Mem. Peabody Mus., vol. 3, pt. 4, p. 42. SCOTT, 1940, Trans. Amer. Phil. Soc., new ser., vol. 28, pt. 4, p. 650.

GENOTYPE: *Oreonetes anceps* (Douglass).

CHARACTERS

SKULL: Small size; approximate basal length 100 mm., width 66.5 mm.; superior contour slightly arched; supraoccipital wings small, moderately spread, incorporated into fan-shaped occipital flare; sagittal crest moderately prominent, low, with tendency for posterior down-

ward slope; brain case inflated; frontals moderately broad; nasals long and light; supraorbital foramina close together, anterior groove extending forward and downward on side of face to infraorbital foramen; orbit questionably closed posteriorly (see discussion, p. 457); malar moderately shallow below orbit; zygomatic arch moderately light, slight posterior rise of inferior border, shallowest point posterior to orbit; infraorbital foramen above P³; lacrimal fossa large and deep, anterior and inferior border folded (exceptionally well defined), shallow extension onto malar (entirely different from small and shallow fossa of *Limnenetes*—in fact, unique in oreodonts); slight depression on side of face above P²–P³; occipital condyles light but moderately spread, equal to examples of *Limnenetes*, smaller than those of

¹ Schultz and Falkenbach, 1954, p. 155, chart 2.

² The genus *Oreonetes* was included in the subfamily *Merycoidodontinae* by Simpson, 1945, Bull. Amer. Mus. Nat. Hist., vol. 85, p. 148.

TABLE 8

Oreonetes LOOMIS, *Limnenetes* DOUGLASS, AND *Bathysgenys* DOUGLASS. COMPARATIVE MEASUREMENTS^a OF SKULLS AND MANDIBULAR RAMI

SKULL	<i>O. anceps</i> (Douglass)		<i>O. anceps</i> <i>douglassi</i> , new sub- species	<i>L. platy-</i> <i>ceps</i> Douglass	<i>L. spec.</i> undet.	<i>B. alpha</i> Douglass	
	Holotype C.M. 745	Referred C.M. 1052	Holotype C.M. 11256	Holotype C.M. 701	Example C.M. 1086	Holotype C.M. 708	Referred F:A.M. 45334
Stage of wear of teeth . . .	(w+)	(w+)	(w+)	(w+)	(r)	(w)	(w+)
Length (including supraoc- cipital crest and incisors)	—	((111))	—	((108))	—	—	((82))
Basal length (from anterior notch of foramen mag- num to posterior base of I ¹)	—	(100)	—	((96))	—	—	((70))
Width (max.)	—	(66.5)	—	65.5	—	—	((38))
Width of brain case (max.)	—	32.5	—	34.5	—	—	—
Width, interorbital (min.)	—	29.5	—	33	—	—	—
Distance from anterior rim of orbit to anterior base of C/	—	40	—	((39))	—	—	—
Distance from anterior rim of orbit to supraoccipital crest	—	(68)	—	((71))	—	—	—
Width of muzzle at infra- orbital foramina	—	27	25	((28))	—	—	—
Width across canines . . .	—	(22)	22.5	—	—	—	—
Length, C-M ³ incl. . . .	(55)	56.5	51.5	((52))	—	—	—
Length, P ¹ -M ³ incl. . . .	(46.5)	49	43.5	((44.5))	—	—	—
Length, P ¹ -P ⁴ incl. . . .	(21.5)	23	21.5	((19))	—	—	—
Length, M ¹ -M ² incl. . . .	18	16	14.5	(18)	23.7	—	10
Length, M ¹ -M ³ incl. . . .	27.7	26.5	22.2	(27.5)	—	—	16.5
Width of M ³ (max.) . . .	11.6	11.8	9.1	(10.5)	—	—	6.3
Length of M ³	(11.5)	(10.5)	(8.5)	(12) ^b	—	—	(6.5)
Depth of malar below orbit	9.3	9.2	8.5	10	—	—	5.2
MANDIBULAR RAMUS		A.M. 9728		Referred C.M. 1118			
Stage of wear of teeth . . .		(w+)		(M+)			
Length (max., including in- cisors)	—	—	—	—	—	—	((65))
Depth of jaw below ante- rior edge of M ₃	—	17	—	16.5	—	—	13.5
Length, /C-M ₃ incl. . . .	—	—	—	57	—	—	38
Length, P ₁ -M ₃ incl. . . .	—	51.5	—	52.5	—	—	35
Length, P ₁ -P ₄ incl. . . .	—	20.5	—	24.5	—	((17.5))	17
Length, M ₁ -M ₂ incl. . . .	—	18	—	13.5	23	—	10.4
Length, M ₁ -M ₃ incl. . . .	—	31	—	28.5	—	—	28
Length of M ₃	—	(14)	—	(12)	—	—	(8.5)

^a (), Approximate; (()), estimated. All measurements in millimeters.

^b A.M. 9729.

TABLE 9

Limnenetes platyceps DOUGLASS. MEASUREMENTS^a OF SKELETAL ELEMENTS

	Tentatively referred, C.M. 1184
Length of humerus (articular)	84
Length of tibia (articular)	107.5
Length of metacarpal III (max.)	43.5

^a All measurements in millimeters.

Miniochoerinae; paroccipital process (known from incomplete process only) light with excavated external surface; auditory bulla¹ moderately large, well inflated with large and prominent posterior external hyoid pit and short groove; postglenoid process moderately robust, rather long vertically, compressed anteroposteriorly, with external border sloping abruptly inward and downward; glenoid surface narrow anteroposteriorly; posterior palate extending approximately to anterior lobe of M³.

MANDIBLE: Postsymphysis below anterior portion of P₄; ramus moderately deep with slight increase in depth from symphysis to a point posterior to M₃.

DENTITION: Brachyodont; superior premolars slightly crowded; inferior premolars with slight overlapping of P₁-P₃; external styles of superior molars prominent; width of hypocone of M³ decidedly less than that of protocone; anterior intermediate crest weak on P²-P³, exceptionally weak on P⁴.

LIMBS: Unknown.

MEASUREMENTS: Table 8 (p. 455).

ILLUSTRATIONS: Figure 12.

DISCUSSION

Examples of *Oreonetes* are distinctive from those of *Limnenetes* in having a less robust skull but with decidedly larger and deeper lacrimar fossae. Loomis² and Thorpe³ considered the bulla of *Oreonetes anceps* as being very small, basing their conclusions on the referred skull, C.M. 1052, which lacks the tympanic bulla but possesses the "inner ear." The latter actually was considered to be the bulla. Scott,⁴

who was the first to publish the fact that the bullae of the referred specimen were not preserved (the present writers also have independently arrived at the same conclusion), reported: "The tympanic bullae are described as 'tiny' by Loomis [*loc. cit.*] but, as a matter of fact, they have both been lost from the type-specimen [should have been referred specimen] and the convex, inflated-looking periotics have been mistaken for the tympanics. Possibly, they were not ossified, but this is unlikely and it is much more probable that they were loosely attached to the skull and were lost before fossilization. On the right side of the skull a part of the bony tubular meatus remains in place between the postglenoid and posttympanic process of the squamosal, but has no internal connection, the supposed bulla being altogether separate from it. The bullae, when present, were decidedly smaller than in *Limnenetes*, is shown by the vacant spaces for them."

The present writers agree with Scott except for the last part of his statement, i.e., that the auditory bullae were decidedly smaller than those of *Limnenetes*. The available area for the bulla on the left side of the skull in question is smaller than the like area on the right side, the latter having sufficient space for a bulla slightly narrower than that of *Limnenetes*. The specimen, A.M. 9728, here referred to *Oreonetes anceps* has a bulla slightly narrower than that of *Limnenetes* which would be the approximate size for the right side of the referred skull of *O. anceps*.

Clarification concerning the holotype of *Oreonetes anceps* seems to be necessary since Scott⁵ stated, "Loomis' type specimen (C.M. No. 1052), which by a curious concatenation of cir-

¹ See following discussion.

² 1924, p. 369.

³ 1937, p. 42.

⁴ 1940, p. 651.

⁵ 1940, p. 650.

cumstances, is not the type of Douglass' *Limnenetes anceps*, but [is] a referred specimen of this species." Loomis,¹ however, had reported, "The genus is based on the species *L. ? anceps*, which was founded on a palate [C.M. 745], but the skull since found on Big Hole River, north of Dillon, Montana, and numbered 1052 in the Carnegie Museum, gives the characters which make the genus." There is no doubt that the holotype, C.M. 745, and the referred specimen, C.M. 1052, belong to the same species.

Douglass,² Loomis,³ Thorpe,⁴ and Scott⁵ all considered the orbit of *Oreonetes anceps* as being open posteriorly. The orbit of the holotype, C.M. 745, is not complete, but the referred skull, C.M. 1052, possesses a postorbital process of the frontal with a perfect surfaced border. The postorbital pillar of the malar, however, has a broken surface on the right side of the skull, and on the left side it has been restored. The distance between the complete postorbital process of the frontal and the broken surface of the postorbital process of the malar is short. Thus the orbit must have been nearly closed, or perhaps entirely so. The four above-mentioned authors also agreed that the orbit of the holotype of *Limnenetes platyceps* was open posteriorly. In the holotype of that species, C.M. 701, the postorbital process of the frontal, nevertheless, seems to have the same shape and surface as that of *O. anceps*. The postorbital process of the malar is cracked, but the bone continues upward and touches the postorbital process of the frontal. The connecting portion of bone appears to be embedded in the original matrix. It is possible that additional preparation has been done in recent years, as the orbit of the left side has been restored as closed, yet Douglass⁶ illustrated the orbit as open on both sides.

A further discussion of the generic characters of *Oreonetes* by Loomis⁷ is noteworthy: "... there are certain other features, which may have generic value; but, until more species are found, this is not certain. These features, to which I refer, are the deep, sharply bounded antorbital

fossa and the double opening of the infraorbital foramen." Scott⁸ in a discussion of the infraorbital foramen reported, "... whether the divided infraorbital foramen is constant, material is insufficient to decide." The present writers do not consider that the divided infraorbital foramen is of diagnostic value, since the holotype, C.M. 745, and the referred, C.M. 303, each have a single foramen while the referred, C.M. 1052, has a single foramen on the left side and a "divided" one on the right.

Loomis, Thorpe, and Scott, in the discussions cited above, all agreed that the genus *Oreonetes* was the probable ancestral form to *Merycoidodon*. The fan-shaped occipital region and the well-inflated bulla of *Oreonetes*, however, are decidedly different from the posteriorly projected supraoccipital wings and very small bulla of *Merycoidodon* (see discussion, p. 388).

Hay⁹ placed the genera *Oreonetes* and *Limnenetes* under the Dichobunidae. Thorpe,¹⁰ in reference to Hay's conclusions, stated: "Hay (1930, p. 755) classified *Oreonetes* and *Limnenetes* under the Dichobunidae, without stating any of his reasons for so doing. I consider these genera to be true merycoidodonts and classify them unreservedly with that family."

The genus *Bathygenys* was placed in the Merycoidodontidae by Hay¹¹ and Thorpe.¹² Scott¹³ considered the genus under the heading "Genera Incertae Sedis," and reported, "There can be little question that both [*Bathygenys* and *Trigenicus*] are properly included in the Merycoidodontidae." Simpson¹⁴ followed Scott and listed both genera under "Merycoidodontidae incertae sedis." It is apparent that all authors, including the present workers, agree that *Bathygenys* should be included in the Merycoidodontidae. Concerning the position of *Trigenicus*, it should be pointed out that Hay¹⁵ and Matthew¹⁶ placed the genus under the Hypertragulidae, and that Thorpe made no mention of the genus and presumably believed, as do the

² 1940, p. 651.

³ 1902, Publ. Carnegie Inst. Washington, no. 390, vol. 2, p. 755.

⁴ 1937, p. 42.

⁵ 1902, p. 779.

⁶ 1937, p. 42.

⁷ 1940, p. 710.

⁸ 1945, Bull. Amer. Mus. Nat. Hist., vol. 85, p. 149.

⁹ 1902, p. 810.

¹⁰ 1909, Bull. U. S. Geol. Surv., no. 316, p. 104.

¹ 1924, p. 370.

² 1901, Trans. Amer. Phil. Soc., new ser., vol. 20, p. 263.

³ 1924, p. 369.

⁴ 1937, p. 42.

⁵ 1940, p. 650.

⁶ 1901, pl. 9, figs. 5-6.

⁷ 1924, p. 370.

present writers, that *Trigenicus* is not an oreodont.

DISTRIBUTION

Oreonetes remains are not well represented in the collections, nor are they widely distributed. One species and a subspecies from the middle part of the Chadron formation of Montana are here recorded. (See geologic distribution chart, p. 382.)

SUMMARY OF SPECIES AND TYPES

One species and one subspecies of *Oreonetes*

from three Oligocene (Chadron) localities are here recorded:

1. *O. anceps* (Douglass), from Gallatin County, Montana; referred remains from Beaverhead and Jefferson counties, Montana. (Chadron.)

HOLOTYPE: Partial skull, C.M. 745. Figure 12.

1a. *O. anceps douglassi*, new subspecies, from Beaverhead County, Montana. (Chadron.)

HOLOTYPE: Partial skull, C.M. 11256. Figure 12.

DETAILED LISTS OF TYPES, REFERRED SPECIMENS, AND SYNONYMY

OREONETES

TOTAL AVAILABLE SPECIMENS: 17

1. *Oreonetes anceps* (Douglass)

From the middle part of the Chadron formation, Gallatin County, Montana; referred remains from Beaverhead and Jefferson counties, Montana

Limnenetes (?) *anceps* DOUGLASS, 1901, Trans. Amer. Phil. Soc., new ser., vol. 20, p. 262.

Oreonetes anceps (Douglass), LOOMIS, 1924, Ann. Carnegie Mus., vol. 15, nos. 2-3, p. 373, fig. 3, pl. 53, fig. 1, pl. 54 (in part). THORPE, 1937, Mem. Peabody Mus., vol. 3, pt. 4, p. 43, pl. 1, figs. 6 (in part)-8, pl. 2, fig. 1. SCOTT, 1940, Trans. Amer. Phil. Soc., new ser., vol. 28, pt. 4, p. 650, pl. 68.

Limnenetes species,¹ MATTHEW, 1903, Bull. Amer. Mus. Nat. Hist., vol. 19, art. 6, p. 222 (in part).

CHARACTERS

SKULL: Approximate size of examples of *Limnenetes platyceps*; slightly larger than holotype of *O. anceps douglassi*, slightly smaller than those of *Miniochoerus* (*Paraminiochoerus*) *gracilis*, noticeably larger than examples of *Bathygenys alpha*; orbit questionably closed posteriorly (see discussion, p. 457); nasals longer and lighter than in example of *L. platyceps*; less distance from posterior border of M³ to postglenoid process than found in *L. platyceps*.

MANDIBLE: Ramus slightly deeper than in

examples of *L. platyceps*; condyle moderately light, external border higher and directed more posteriorly than internal border.

DENTITION: Series approximately same length as those of *L. platyceps*, longer than in type of *O. anceps douglassi*, less length than in examples of *M. (Paraminiochoerus) gracilis*, decidedly longer and larger than those of *Bathygenys alpha*; P¹-P⁴ each with weak anterior intermediate crest; M³ with more width than length (anteroposteriorly).

LIMBS: Unknown.

MEASUREMENTS: Table 8 (p. 455).

ILLUSTRATIONS: Figure 12.

DISCUSSION

Oreonetes anceps was described and questionably referred to the genus *Limnenetes* by Douglass.² Later Loomis³ based a new genus, *Oreonetes*, on the same material and an additional skull (C.M. 1052) but considered the auditory bulla of the latter specimen as being "tiny" (see discussion, p. 456). Thorpe⁴ accepted the new genus and Loomis' description of the bulla. The bulla of *O. anceps*, however, is large (inflated) as was noted by Scott (see discussion, p. 456), whose conclusion was substantiated by further preparation of an American Museum specimen (A.M. 9728). The marked differences between the lacrimal fossae of *Oreonetes* and those of *Limnenetes* separate

¹ No specimens were cited by number, but the general description and locality suggests the material listed on p. 460.

² 1901, p. 262.

³ 1924, p. 373.

⁴ 1937, p. 43.

the two forms generically (see fig. 12). Throughout the oreodonts, the lacrimal fossae have proved to be of diagnostic value and are constant in shape within a genus.

Matthew¹ discussed various rami under "*Limnenetes* species," but the specimen numbers were not cited. Diligent search by Mrs. Rachel Nichols of the American Museum staff has failed actually to connect any specimens with Matthew's report, although a tray of material from the Pipestone Springs area, Montana, was found, which may represent the specimens in question.

The premolars of the examples listed under *Oreonetes anceps* are worth noting. Although at this time they do not appear to have diagnostic value, future additional material may prove otherwise. The P³ and P⁴ of *O. anceps* are much more complicated than in typical oreodonts from the Oligocene; P³ has the anterior intermediate crest forming external and internal pits, the latter being more prominent; in P⁴ the intermediate crest does not extend directly to the

anterior border of the tooth, but is interrupted by an anterior bar. In the holotype, C.M. 745, the intermediate crest of P⁴ has a posterior fold. In the referred, A.M. 9728, the intermediate crest of P⁴ lacks the bar, but the crest does possess minute anterior and posterior folds. In the referred, C.M. 1052, the P³ and P⁴ are comparable with those of A.M. 9728, except that the external anterior pit is less pronounced. In example C.M. 303 (referred to *Limnenetes platyceps* by Loomis, 1924), the dentition is less worn and the same characters are present as in C.M. 1052. The complicated P³ and P⁴ of *O. anceps* are not comparable to the complex premolars of *Ustatochoerus* in the Ticholeptinae.² Both *Oreonetes* and *Ustatochoerus* represent end members of separate phyla in which complicated premolars developed independently.

The limb elements are referred to *Limnenetes platyceps* only questionably, as they were not found associated with a dentition (see discussion, p. 463).

Sixteen specimens are here recorded:

HOLOTYPE

Anterior portion of skull with C/(rt.)-M³ (P¹-P² alv.). (w+)

C.M. 745

From Chadron formation, Thompson Creek, near Three Forks, Gallatin County, Montana; collected by Earl Douglass, 1899

Figured by Thorpe, 1937, pl. 2, fig. 1

This report, figure 12

REFERRED FROM (A) GALLATIN, (B) BEAVERHEAD AND (C) JEFFERSON COUNTIES, MONTANA

A. FROM TYPE AREA, THOMPSON CREEK, GALLATIN COUNTY, MONTANA

SKULL AND MANDIBLE

Inferior portion of skull with C/(br.)-M³ and partial mandible with P¹-M³. (w+)

A.M. 9728

Collected by Albert Thomson and Walter Granger, 1902

Figure 12

The above is the first known specimen to demonstrate the type of bulla associated with the genus *Oreonetes*. (See discussion, p. 456.)

MANDIBULAR RAMUS, IMMATURE

Right ramus with dP₂-M₂ (P₂ germ). (i)

9727

1902

B. FROM McCARTY'S MOUNTAIN REGION, BEAVERHEAD COUNTY, MONTANA

SKULL AND MANDIBULAR RAMUS

Partial skull with C/-M³ and partial left ramus with P₂-P₄ and M₂(br.)-M₃. (w+)

C.M. 1052

Collected by Earl Douglass, 1903

Figured by Loomis, 1924, fig. 3; pl. 53, fig. 1; pl. 54 (in part); Thorpe, 1937, fig. 3, pl. 1, figs. 6 (in part) and 7-8; Scott, 1940, pl. 68

This report, figure 12

¹ 1903, p. 222.

² Schultz and Falkenbach, 1941, p. 10.

SKULL

Anterior portion of skull with P ¹ -M ² (br.). (M+)	C.M. 303	From Big Hole River, S. of McCarty's Mountain; collected by Earl Douglass, 1902 Figured by Loomis, 1924, fig. 2 This report, figure 12
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Loomis referred the above specimen to *Limnetales platyceps* and Thorpe considered it as a plesiotype of the same species (see discussion, p. 462).

SKULL AND MANDIBULAR RAMUS

Anterior portion of skull with C/(rt.)-M ³ (P ¹ br.) (w)	F:A.M. 45352A	From McCarty's Mountain Locality; collected by Nelson J. Vaughan and Charles H. Falkenbach, 1942
Partial right ramus with P ₁ -M ₃ (br.). (w)	45352B	From McCarty's Mountain Locality; collected by Dan Krochak and Charles H. Falkenbach, 1954

The above two specimens are apparently from one individual although collected 12 years apart.

C. FROM PIPESTONE SPRINGS, JEFFERSON COUNTY, MONTANA
(COLLECTED BY AMERICAN MUSEUM FIELD PARTY, 1902)

10 MANDIBULAR RAMI

Six partial right rami with		A.M.
P ₄ (br.)-M ₃ (br.)	(M+)	9674
M ₁ (br.)-M ₂	(w)	9677
M ₂	(w)	9677
M ₂	(w+)	9677
M ₂ -M ₃ (br.)	(w+)	9678
M ₃ br.	(w)	9678
Four partial left rami with		
M ₁ (br.)-M ₂	(w+)	9675
M ₂	(w+)	9675
M ₃	(w)	9676
M ₂	(M+)	9677

See discussion on page 459 concerning these 10 specimens.

1a. *Oreonetes anceps douglassi*,¹
new subspecies

From the middle part of the Chadron formation,
Beaverhead County, Montana

ate crest and intermediate crescent.

LIMBS: Unknown.

MEASUREMENTS: Table 8 (p. 455).

ILLUSTRATIONS: Figure 12.

DESCRIPTION

SKULL: Slightly smaller than examples of *O. anceps*. (Known from anterior portion only.)

MANDIBLE: Unknown.

DENTITION: Series of less length than in examples of *O. anceps*; premolars smaller and lighter than those of mentioned species; P² with anterior intermediate crest (P³ lacks crest); P⁴ with anterior bar between intermedi-

DISCUSSION

The holotype of the new subspecies differs from examples of *O. anceps* in its smaller size and lighter premolars. The size difference between the premolars of the species and subspecies is marked [approximately the same ratio exists between premolars of examples of *Miniochoerus* (larger) and *M. (Paraminiochoerus)* (smaller)]. The presence or absence of the crests on the premolars of *O. anceps douglassi*, which may well depend on the stage of wear of the teeth, is not considered to be of diagnostic value.

¹ Named in honor of Mr. Earl Douglass, who collected and described most of the material included in the *Oreonetinae*.

Loomis¹ considered the partial skull, C.M. 11256 (holotype of this subspecies), as referable to *O. anceps* and reported, "No. 11,256 is the muzzle of a slightly smaller individual." Thorpe² agreed with Loomis but considered the

specimen as a paratype of *O. anceps*. Additional material may prove the subspecies to be of specific rank, or even to represent a new subgenus.

One specimen is here recorded:

HOLOTYPE

Anterior portion of skull with C/-M³.
(w†)

C.M. 11256

From Chadron formation, Big Hole River, S. of McCarty's Mountain, Beaverhead County, Montana; collected by Earl Douglass, 1903
Figure 12

II. LIMNENETES DOUGLASS

Limnenetes DOUGLASS, 1901, Trans. Amer. Phil. Soc., ser. 2, vol. 2, p. 259. LOOMIS, 1924, Ann. Carnegie Mus., vol. 15, nos. 2-3, p. 370. THORPE, 1937, Mem. Peabody Mus., vol. 3, pt. 4, p. 44. SCOTT, 1940, Trans. Amer. Phil. Soc., new ser., vol. 28, pt. 4, p. 687.

GENOTYPE: *Limnenetes platyceps* Douglass.

CHARACTERS

SKULL: Small size; basal length ((96)) mm., width 65.5 mm., approximately equal in size to examples of *Oreonetes*, distinctly larger than those of *Bathysgenys*; sagittal crest light and low, with posterior downward slope, then upward to supraoccipital wings, more prominent than in *Oreonetes*; brain case well inflated, broader than in *Oreonetes*; nasals short and broad (in contrast to the long and narrow ones in *Oreonetes*); frontals broad (wider than in *Oreonetes*); supraorbital foramen similar to that of *Oreonetes*; orbit closed³; zygomatic arch moderately light, but heavier and with more depth posteriorly than in *Oreonetes*; infraorbital foramen above P⁴; lacrimal fossa small and shallow (large and deep in *Oreonetes*); occipital condyles moderately large (larger than those of *Oreonetes*); paroccipital process suggests being slightly more robust than in *Oreonetes*; auditory bulla well inflated, somewhat oblong in outline (anteroposteriorly), noticeable posterior external hyoid pit; postglenoid process moderately light, external border with inward and downward slope of approximately 45 degrees; glenoid surface longer (anteroposteri-

orly) than in *Oreonetes*; posterior palate extending to anterior lobe of M³.

MANDIBLE: Approximately equal to those of *Oreonetes anceps*; postsymphysis below posterior portion of P₃. (Known from referred incomplete mandible only.)

DENTITION: Slightly more hypsodont than in examples of *Oreonetes*; external styles of superior molars prominent, slightly more so than in *Oreonetes*. (Superior dentition known only from P³-M³.)

LIMBS: Medium size; moderately robust; approximate length of those of *Miniochoerus* (*Paraminiochoerus*) *gracilis*. (Known only from questionably referred examples, see discussion, p. 463.)

MEASUREMENTS: Tables 8 and 9 (pp. 455 and 456).

ILLUSTRATIONS: Figure 12.

DISCUSSION

The skull of *Limnenetes* is readily distinguished from that of *Oreonetes* by the smaller and shallower lacrimal fossa and the slightly more hypsodont teeth. The present writers, however, have failed to note characters that would indicate that *Oreonetes* and *Limnenetes* are representatives of two separate subfamilies. The relationship of *Limnenetes* to the *Leptauchenia-Cyclopidius* group also has not been demonstrated (see discussion, p. 453).

Hay⁴ placed the genus under the Dichobuniidae, while Thorpe⁵ rightly considered the genus under the Merycoidodontidae, but suggested that it may represent a forerunner of the "*Limnenetes-Leptauchenia-Cyclopidius* Tribe."

¹ 1924, Ann. Carnegie Mus., vol. 15, nos. 2-3, p. 373.

² 1937, Mem. Peabody Mus., vol. 3, pt. 4, p. 43.

³ See discussion, p. 457.

⁴ 1930, Publ. Carnegie Inst. Washington, no. 390, vol. 2, p. 755.

⁵ 1937, p. 44.

Simpson¹ included the genus under the subfamily Leptaucheninae. (For a discussion of the position of *Limnenetes*, see p. 453.)

DISTRIBUTION

Remains of *Limnenetes* are rare and are known only from the middle part of the Chadron formation of Montana. (See geologic distribution chart, p. 382.)

SUMMARY OF SPECIES AND TYPES

One species and one questionably referred

form of *Limnenetes* from two Oligocene (Chadron) localities are here recorded:

1. *L. platyceps* Douglass, from Gallatin County, Montana; referred remains from Beaverhead County, Montana. (Chadron.)

HOLOTYPE: Partial skull, C.M. 701. Figure 12.

1a. ?*L.*, spec. undet., from Beaverhead County, Montana.

EXAMPLE: Partial skull and partial mandible, C.M. 1086. Figure 12.

DETAILED LISTS OF TYPES, REFERRED SPECIMENS, AND SYNONYMY

LIMNENETES

TOTAL AVAILABLE SPECIMENS: 5

1. *Limnenetes platyceps* Douglass

From the middle part of the Chadron formation, Gallatin County, Montana; referred and tentatively referred from Beaverhead County, Montana

Limnenetes platyceps DOUGLASS, 1901, Trans. Amer. Phil. Soc., ser. 2, vol. 20, p. 260, pl. 9, figs. 5-6. LOOMIS, 1924, Ann. Carnegie Mus., vol. 15, p. 371, pl. 52, figs. 1-3, pl. 53, figs. 2-7, pl. 54, fig. 1 (in part). THORPE, 1937, Mem. Peabody Mus., vol. 3, pt. 4, p. 44, pl. 1, figs. 9-11. SCOTT, 1940, Trans. Amer. Phil. Soc., new ser., vol. 28, pt. 4, p. 690, pl. 73, figs. 1, 1a, 1c.²

CHARACTERS

SKULL: Small, somewhat more robust than examples of *Oreonetes anceps*, approaching size of smaller examples of *Mimiochoerus* (*Paramimiochoerus*) *gracilis*; hyoid groove on bulla absent (present in *O. anceps*); distance from posterior border of M³ to postglenoid process greater than in *O. anceps*.

MANDIBLE: Approximate size of those of *O. anceps*, smaller than in example of ?*L.* spec. undet.

DENTITION: Length of series slightly less than in *O. anceps*; premolars moderately large. (See discussion under listings, p. 463.)

LIMBS: Larger and more robust than in examples of *Bathysgenys alpha*, approximately

equal in length but somewhat heavier than in examples of *M. (P.) gracilis*. (Known from tentatively referred specimens only, see discussion, p. 463.)

MEASUREMENTS: Tables 8 and 9 (pp. 455 and 456).

ILLUSTRATIONS: Figure 12.

DISCUSSION

The holotype of *Limnenetes platyceps* exhibits inflated auditory bullae (see discussion, p. 457) which are longer (anteroposteriorly) than wide (transversely). The bulla lacks the hyoid groove that is present in the example of *Oreonetes anceps* and in those of the Merycoidodontidae³ from faunal zones "B" and "C" of the Brule formation. The absence of the hyoid groove in *L. platyceps* gives the bulla an outline similar to examples of the Merycoidodontinae from "Zone D" of the Brule. The completely inflated bulla indicates an advanced stage of development.⁴

The holotype of *L. platyceps* exhibits a well-worn and poorly preserved dentition; to supplement the characters, Loomis⁵ used as a basis two specimens, C.M. 303 and 1086, which he considered referable to this species. Recently, however, additional preparation on the anterior portion of skull, C.M. 303, exposed a large and deep lacrimal fossa similar to examples of *O.*

³The basis of a forthcoming report by the present writers.

⁴See p. 384 for discussion; also Schultz and Falkenbach, 1950, pp. 96-97; *idem*, 1954, p. 155.

⁵1924, p. 371.

¹1945, Bull. Amer. Mus. Nat. Hist., vol. 85, p. 149.

²Explanation of plates on page 744 states 1c.

anceps, to which species the specimen is here referred (p. 458). Also, the infraorbital foramen of the skull is above P^3 , while in *O. anceps* it is above P^4 . The second specimen mentioned by Loomis, C.M. 1086, is an immature partial skull and mandible with molars that are definitely larger than those of either *O. anceps* or *Limninetes platyceps* (see table 8, p. 455), and here considered under ?*L.*, spec. undet. (p. 464). Thorpe¹ considered both of these examples as "plesiotypes" of *L. platyceps*, and presumably drew his conclusions from the holotype and the two specimens in question. Scott² also agreed

with Thorpe and Loomis and considered the two specimens as plesiotypes.

The tentatively referred limb elements, C.M. 1184, from "McCarty's Mountain" actually were not found associated with a dentition. Examples of both *Oreonetes anceps* and *Limninetes platyceps* also have been reported from the same locality which indicates the possibility that the limbs in question may belong to either species, or even to an unknown form. Loomis, Thorpe, and Scott all referred the limb elements to *L. platyceps*.

Four specimens are here recorded:

HOLOTYPE

Partial skull with P^3 - M^3 (all br. with exception of P^4). ($w_{\frac{1}{2}}^{++}$)

C.M. 701

From Chadron formation, Thompson Creek, near Three Forks, Gallatin County, Montana; collected by Earl Douglass, 1899

Figured by Douglass, 1902, pl. 9, figs. 5-6; Loomis, 1924, pl. 52, figs. 1-2; Thorpe, 1937, pl. 1, figs. 9-11; Scott, 1940, pl. 73, figs. 1, 1a, 1e

This report, figure 12

REFERRED FROM (A) GALLATIN AND (B) BEAVERHEAD COUNTIES, MONTANA, AND TENTATIVELY REFERRED FROM (C) BEAVERHEAD COUNTY, MONTANA

A. FROM TYPE AREA, THOMPSON CREEK, GALLATIN COUNTY, MONTANA

MAXILLA

Partial right maxilla with P^4 - M^3 . ($M+$)

A.M. 9729

Figure 12

The P^4 of the above specimen has an accessory cusp or column on the anterior surface close to the external border, which may represent the anterior intermediate crest.

B. FROM BEAVERHEAD COUNTY, MONTANA

MANDIBLE

Partial mandible with I_1 - M_3 . ($M+$)

C.M. 1118

From "Bed U," McCarty's Mountain, 1903

Figured by Loomis, 1924, pl. 54, fig. 1 (in part); Thorpe, 1937, pl. 2, fig. 2

This report, figure 12

Both Loomis and Thorpe referred the above specimen to *Oreonetes anceps*. The dentition is less brachyodont than in examples of that form.

C. TENTATIVELY REFERRED³ FROM BEAVERHEAD COUNTY, MONTANA

SKELETAL ELEMENTS

Humerus, partial radius, partial ulna, 2 partial femora, 2 tibiae (1 partial), pes elements, and partial pelvis.

C.M. 1184

From South of McCarty's Mountain; collected by Earl Douglass, 1902

Figured by Loomis, 1924, pl. 52, fig. 3; pl. 53, figs. 2-7

This report, figure 12

¹ 1937, p. 44.

² 1940, p. 687, states, "Douglass' [presumably Thorpe's] plesiotypes."

³ See above discussion.

2. ?*Limnenetes*, species undetermined

From the middle part of the Chadron formation,
Beaverhead County, Montana

DESCRIPTION¹

SKULL: Larger than type of *Limnenetes platyceps*; malar similar to mentioned species; occipital condyles approximately equal to those of *L. platyceps*; bulla (crushed) somewhat elongated anteroposteriorly, noticeable hyoid pit (lacking hyoidal groove), similar to that of *L. platyceps*.

MANDIBLE: Heavier than in examples of *L. platyceps*; postsymphysis below dP_3 ; inferior border indicating sharp downward curve posteriorly in area below M_3 .

DENTITION: M_1^1 and M_2^2 more hypsodont

and decidedly larger than those of *L. platyceps*.

LIMBS: Unknown.

MEASUREMENTS: Table 8 (p. 455).

ILLUSTRATIONS: Figure 12.

DISCUSSION

Loomis, Thorpe, and Scott all referred this specimen to *L. platyceps* (see references and discussion, p. 462). The M_1^1 - M_2^2 are the only mature teeth present and are noticeably larger than in examples of *Oreonetes anceps* or *Limnenetes platyceps*. This example undoubtedly represents a new species or perhaps a new genus, which, however, cannot satisfactorily be established on so incomplete and immature a specimen.²

EXAMPLE

Partial skull with dP^1 - M^2 and partial
mandible with dP_2 - M_2 . (i)

C.M. 1086

From Chadron formation, "upper layer
of exposure Z," Big Hole River, S. of
McCarty's Mountain; collected by
Earl Douglass, 1903
Figure 12

III. *BATHYGENYS* DOUGLASS

Bathxygenys DOUGLASS, 1901, Trans. Amer. Phil. Soc., ser. 2, vol. 20, p. 256. THORPE, 1937, Mem. Peabody Mus., vol. 3, pt. 4, p. 41. SCOTT, 1940, Trans. Amer. Phil. Soc., new ser., vol. 28, pt. 4, p. 711.

GENOTYPE: *Bathxygenys alpha* Douglass.

CHARACTERS

SKULL: Very small (smallest known oreodont skull); sagittal crest low but prominent; brain case well inflated; frontals moderately broad; supraorbital foramen with anterior groove near midline of skull; malar shallow below orbit.

MANDIBLE: Moderately light; ramus moderately deep; increasing rapidly in depth posteriorly; ascending ramus wide anteroposteriorly.

DENTITION: Brachyodont; premolars not crowded; external styles of superior molars prominent.

LIMBS: Small and light (smallest and lightest of any oreodonts so far reported).

¹ Based on immature specimen.

² M_1^1 and M_2^2 are more hypsodont than in other forms of the *Oreonetinae* and approach early *leptauchenids* in this respect.

MEASUREMENTS: Table 8 (p. 455).

ILLUSTRATIONS: Figure 12.

DISCUSSION

The genus *Bathxygenys* was founded by Douglass on ramal fragments. There is now in the Frick Laboratory collections the first known associated skull, mandible, and limb elements, F.A.M. 45334. Many of the foregoing characters are based on this referred specimen, which, however, lacks the following: important portions of the orbit (? open or closed), bulla (? small or inflated; if small, the genus does not belong to the *Oreonetinae*), and the occipital region (? fan-shaped or with supraoccipital wings produced posteriorly).

The characters of *Bathxygenys* which Thorpe³ used were based primarily on the maxilla, A.M. 9671, figured by Matthew⁴ (not this genus, see p. 465). Thorpe reported: "In the absence of the skull, however, we cannot be certain of the exact position of this genus and species or whether it is independent, or synonymous with one of the better known lower Oligocene forms.

³ 1937, p. 42.

⁴ 1903, Bull. Amer. Mus. Nat. Hist., vol. 19, art. 6, p. 220, fig. 4.

For the present, I regard it as a dwarf form, perhaps more or less localized in Montana, and with affinities in the *Limnenetes-Eporeodon* phylum." The present writers agree with Thorpe that the position of the genus is questionable, but doubt its connection with *Eporeodon*. Even though a skull is now available, it is too incomplete to indicate close affinities to any other form.

DISTRIBUTION

Remains of *Bathygenys* are known from the

Chadron formation of Montana and Wyoming. (See geologic distribution chart, p. 382.)

SUMMARY OF SPECIES AND TYPE

One species of *Bathygenys* from two Oligocene (Chadron) deposits are here recorded:

1. *Bathygenys alpha* Douglass, from Jefferson County, Montana; referred remains from Natrona County, Wyoming. (Chadron.)

HOLOTYPE: Partial right ramus, C.M. 708. Figure 12.

DETAILED LIST OF TYPE, REFERRED SPECIMENS, AND SYNONYMY

III. BATHYGENYS

TOTAL AVAILABLE SPECIMENS: 6

1. *Bathygenys alpha* Douglass

From the middle part of the Chadron formation, Jefferson County, Montana; referred remains from Natrona County, Wyoming

Bathygenys alpha DOUGLASS, 1901, Trans. Amer. Phil. Soc., ser. 2, vol. 20, p. 256, pl. 9, figs. 7-8A. MATTHEW, 1903, Bull. Amer. Mus. Nat. Hist., vol. 19, art. 6, p. 220, fig. 14 (not this genus and species). THORPE, 1937, Mem. Peabody Mus., vol. 3, pt. 4, p. 41, figs. 18-20 (not this genus and species). SCOTT, 1940, Trans. Amer. Phil. Soc., new ser., vol. 28, pt. 4, p. 711, pl. 73, figs. 3-4.

CHARACTERS

SKULL: Very small. (See generic characters.)

MANDIBLE: Postsymphysis from below posterior portion of P_3 to anterior portion of P_4 , symphysis long and narrow, mental foramen double on both sides.

DENTITION: Exceptionally small and light; three lower incisors present (see following discussion).

LIMBS: Smaller and lighter than in the tentatively referred examples of *Limnenetes platyceps*. (Known only from partial elements.)

MEASUREMENTS: Table 8 (p. 455).

ILLUSTRATIONS: Figure 12.

DISCUSSION

In a discussion of *Bathygenys alpha*, Matthew¹ stated: "We have three specimens re-

ferred to this genus and species: parts of two upper jaws [A.M. 9671-9672] and one lower jaw [A.M. 9673]. I identify these with Mr. Douglass' species in spite of wide distinctions in the drawing of the teeth and of his cotype specimen [C.M. 708A]. These, if correctly drawn, could barely be *Oreodon* teeth; they are fully as narrow and trenchant as those of *Leptomeryx*. As, however, he compares the teeth to those of *Merycochoerus*, which are short and wide and crowded, I assume that the error is in the drawing, especially as the other drawings of the type and cotype agree well with the description and with our specimens." The present writers have not been able to locate the three specimens mentioned by Matthew. The missing ramus, A.M. 9763, no doubt agrees with the type, but the writers question the figured maxilla, A.M. 9761, which is also missing. From the illustration it does not seem possible that it represents an oreodont.

Thorpe² accepted the maxilla figured by Matthew as referable to this genus and species, and also agreed with Matthew's description, especially that M^1 and M^2 have protocones considerably wider than the hypocone, and that M^3 possesses a hypocone almost as wide as the protocone. These particular characters do not agree with those of oreodonts in general, or with those noted in the here-referred skull, F.A.M. 45334. Matthew's maxilla is most likely referable to the cervids.

Douglass³ included the following in the description of the holotype, C.M. 708: "This

¹ 1903, p. 220, fig. 14 (not this genus and species).

² 1937, p. 41, fig. 20.

³ 1901, p. 257.

shows anteriorly a transversely narrow broken surface, nearly in the middle of which is the canine alveolus, but no hint of the incisors. It is very doubtful if there was the full number. If there was they must have been exceedingly small or placed anterior to the canine." The anterior surface is broken and narrow, as noted by Douglass, but it is probable that all three incisors were present in the complete ramus, as

is the case in the referred specimen, F:A.M. 45334 (fig. 12). Thorpe¹ in reference to the incisors stated: "Undoubtedly they were small, and I believe they were not reduced in number."

The symphysis of the holotype ramus extends farther posteriorly than in the referred F:A.M. specimen. The type also has a greater depth of the ramus in the area below P₄.

Six specimens are here recorded:

HOLOTYPE

Partial right ramus with /C(alv.)-P₄ (P₁ rt. and P₂ alv.). (w)

C.M. 708

From Chadron formation, Pipestone Springs, Jefferson County, Montana; collected by Earl Douglass, 1899

Figured by Douglass, 1902, pl. 9, fig. 7; Thorpe, 1937, fig. 18; Scott, 1940, pl. 73, fig. 3

This report, figure 12

The P₃ of the type has a posterior intermediate cusp in the same position as a posterior intermediate crest that appears on P₃ of C.M. 708A.

REFERRED FROM (A) JEFFERSON COUNTY, MONTANA; AND (B) NATRONA COUNTY, WYOMING

A. FROM PIPESTONE SPRINGS, JEFFERSON COUNTY, MONTANA

MAXILLA

Partial right maxilla with M¹-M² A.M. 9672

3 MANDIBULAR RAMI

Partial ramus with P₄-M₂ 9673

The above two specimens and the "referred" maxilla, A.M. 9671, could not be located by the writers (see discussion, p. 465).

Partial right ramus with P₂(br.)-M₁ (w) C.M. 708A

Figured by Douglass, 1902, figs. 8-8A; Thorpe, 1937, fig. 19; Scott, 1940, pl. 73, fig. 4²; this report, figure 12.

The P₃ of the above specimen has an anterior intermediate crest.

Partial right ramus with M₁(br.)-M₂. (w) F:A.M. 45335

B. FROM BATES HOLE, NATRONA COUNTY, WYOMING

SKULL, MANDIBLE, AND SKELETAL ELEMENTS

Partial skull with P³-M³, mandible with I₁-P₁ rt. and P₂-M₃, 2 partial femora, partial tibia, partial pelvis, vertebrae, and fragments. Figure 12. (w†) F:A.M. 45334

The dentition of the above specimen shows the following: P₃ with posterior portion larger than anterior; P₄ with intermediate crest interrupted by an anterior lateral bar, with crest extending beyond to groove on anterior border; and M¹-M² with slightly wider protocones than hypocones.

¹ 1937, p. 41.

² Explanation of plate shows illustration as "Fig. 3A," but caption indicates "Fig. 4."

EXPLANATION OF TEXT FIGURES

FIG. 1. Lateral and dorsal views of skulls: *Miniochoerus battlecreekensis*, new species, holotype, F:A.M. 45001, from "Zone A" of Brule formation, Shannon County, South Dakota (see ramus, fig. 2); *M. starkensis*, new species, holotype, F:A.M. 45497, from "Zone B," Stark County, North Dakota (see ramus, fig. 2); *M. nicholsae*, new species, holotype, F:A.M. 49585 (combination of both sides), from "Zone C," Harding County, South Dakota; *M. cheyennensis*, new species, holotype, A.M. 9797, from "Zone D," Shannon County, South Dakota. $\times \frac{1}{2}$. T, holotype.

FIG. 2. Ventral views of skulls (same as fig. 1). Inferior dentitions and mandibular rami: *Miniochoerus battlecreekensis*, new species, holotype, F:A.M. 45001 (M_1 restored from opposite side), from "Zone A" of Brule formation, Shannon County, South Dakota (see skull, fig. 1); *M. starkensis*, new species, holotype, F:A.M. 45497 (combination of both sides), from "Zone B," Stark County, North Dakota (see skull, fig. 1); *M. nicholsae*, new species, referred, A.M. 1322, from "Zone C," South Dakota; *M. cheyennensis*, new species, tentatively referred, F:A.M. 49516 (P_2 from opposite side), from "Zone D," Shannon County, South Dakota. $\times \frac{1}{2}$.

FIG. 3. Lateral and dorsal views of skulls: *Miniochoerus* (*Paraminiochoerus*) *gracilis* (Leidy) (lateral view only), holotype, A.N.S.P. 10692, from "Zone A" of Brule formation, South Dakota, and referred, F:A.M. 45363, from "Zone A," Niobrara County, Wyoming (see ramus, fig. 4); *M. (P.) affinis* (Leidy), referred, F:A.M. 44977, from "Zone A," Shannon County, South Dakota (see ramus, fig. 4), and A.M. 6404 (combination of both sides; holotype of "*Merycoidodon coloradoensis*"), from "Zone A," Logan County, Colorado (see ramus, fig. 4); *M. (P.) helprini*, new species, holotype, F:A.M. 49501 (combination of both sides), from "Zone B," Sioux County, Nebraska; *M. (P.) ottensi*, new species, holotype, U.N.S.M. 28336 (combination of both sides), from "Zone C," Sioux County, Nebraska (see ramus, fig. 4). $\times \frac{1}{2}$. IF, infraorbital foramen; MA, external auditory meatus; NF, nasal-frontal contact; PG, postglenoid process; PP, paroccipital process; SOF, supraorbital foramen.

FIG. 4. Ventral views of skulls (same as fig. 3). Examples of occipital regions: *Miniochoerus* (*Paraminiochoerus*) *affinis* (Leidy), referred, F:A.M. 44977, from "Zone A" of Brule formation, Shannon County, South Dakota (see other views,

fig. 3); *Merycoidodon culbertsonii* Leidy, referred, F:A.M. 45155, from "Zone A," Pennington County, South Dakota. $\times \frac{1}{2}$. APF, anterior palatine foramen; B, auditory bulla; FO, foramen ovale; MA, external auditory meatus; PP, paroccipital process; PPF, posterior palatine foramen; PPR, posterior palatine projection; PS, post symphysis; Z, depression for tympanohyal; 5, lacerated foramina; 7, condylar foramen.

Superior dentitions: *M. (P.) affinis* (Leidy), referred, F:A.M. 44977 (same information as above). $\times 1$. ac, Anterior crest; act, anterior crescent; af, anterior fossette; aic, anterior intermediate crest; al, anterior lobe; ats, anterior style; mc, median crest; mds, median style; pc, posterior crest; pcp, primary cusp; pct, posterior crescent; pf, posterior fossette; pl, posterior lobe; pts, posterior style (dental nomenclature primarily after Loomis). *Merycoidodon culbertsonii* Leidy, referred, F:A.M. 45155 (same information as above). $\times 1$. hy, Hypocone; me, metacone; ml, metaconule; ms, mesostyle; mts, metastyle; pa, paracone; pr, protocone; ps, parastyle (primarily after Osborn and Thorpe).

Inferior dentitions and mandibular rami: *M. (P.) gracilis* (Leidy), referred, F:A.M. 45353, from "Zone A" of Brule formation, Niobrara County, Wyoming (see skull, fig. 3); *M. (P.) affinis* (Leidy), referred, F:A.M. 44977, from "Zone A," Shannon County, South Dakota (see skull, fig. 3), and A.M. 6404, from "Zone A," Logan County, Colorado (see skull, fig. 3); *M. (P.) helprini*, new species, referred, F:A.M. 45346, from "Zone B," Shannon County, South Dakota; *M. (P.) ottensi*, new species, holotype, U.N.S.M. 28336 (I_2 from opposite side), from "Zone C," Sioux County, Nebraska (see skull, fig. 3). $\times \frac{1}{2}$.

FIG. 5. Lateral, dorsal, and ventral views of skulls: *Platychoerus platycephalus* (Thorpe), referred, F:A.M. 45338 (bulla from opposite side), from "Zone A" of Brule formation, Niobrara County, Wyoming (see ramus, fig. 6); *P. heartensis*, new species, holotype, F:A.M. 45467 (lacrimal fossa and P^1 - P^3 from opposite side), from "Zone B," Stark County, North Dakota; *P. hattcreekensis*, new species, holotype, F:A.M. 45463 (combination of both sides), from "Zone C," Sioux County, Nebraska, and referred, F:A.M. 49560 (superior dentition only), from "Zone C," Shannon County, South Dakota. $\times \frac{1}{2}$.

FIG. 6. Inferior dentitions and mandibular rami: *Platychoerus platycephalus* (Thorpe), referred, F:A.M. 45338 (process from opposite side), from

"Zone A" of Brule formation, Niobrara County, Wyoming (see skull, fig. 5); *P. heartensis*, new species, referred, F:A.M. 49545 (incisors from opposite side), from "Zone B," Sioux County, Nebraska; *P. hatcreekensis*, new species, referred, F:A.M. 45464A, from "Zone C," Sioux County, Nebraska.

Lateral views of skulls: *Stenopsochoerus sternbergi*, new species, holotype, F:A.M. 44980 (C/ from opposite side), from "Zone A" of Brule formation, Niobrara County, Wyoming (see ramus, fig. 7); *S. joderensis*, new species, holotype, F:A.M. 45483 (combination of both sides), from "Zone B," Sioux County, Nebraska (see ramus, fig. 7); *S. berardae*, new species, holotype, F:A.M. 49617 (combination of both sides), from "Zone C," Harding County, South Dakota (see ramus, fig. 7); *Parastenopsochoerus conversensis*, new species, holotype, F:A.M. 45011, from "Zone A," Converse County, Wyoming. $\times \frac{1}{2}$.

FIG. 7. Dorsal and ventral views of skulls (same as fig. 6). M³'s of *Stenopsochoerus berardae*, new species, referred, F:A.M. 49618A and 49618B, from "Zone C," of Brule formation, Fall River County, South Dakota.

Inferior dentitions and mandibular rami: *S. sternbergi*, new species, holotype, F:A.M. 44980 (P₃-P₄ from opposite side), from "Zone A" of Brule formation, Niobrara County, Wyoming (see skull, fig. 6); *S. joderensis*, new species, holotype, F:A.M. 45483 (combination of both sides), from "Zone B," Sioux County, Nebraska (see skull, fig. 6); *S. berardae*, new species, holotype, F:A.M. 49617, from "Zone C," Harding County, South Dakota (see skull, fig. 6). $\times \frac{1}{2}$.

FIG. 8. Lateral, dorsal, and ventral views of skulls: *Stenopsochoerus* (*Pseudostenopsochoerus*) *chadronensis*, new species, holotype, F:A.M. 45489 (combination of both sides), from Chadron formation, Niobrara County, Wyoming (see ramus, fig. 9); *S. (P.) douglasensis*, new species, holotype, F:A.M. 45492 (C/ combination of both sides), from "Zone A" of Brule formation, Converse County, Wyoming (see ramus, fig. 9); *S. (P.) reideri*, new species, holotype, F:A.M. 49620 (dentition combination of both sides), from Chadron formation, Niobrara County, Wyoming (see ramus, fig. 9). $\times \frac{1}{2}$.

FIG. 9. Inferior dentition and mandibular rami: *Stenopsochoerus* (*Pseudostenopsochoerus*) *chadronensis*, new species, holotype, F:A.M. 45489 (I₂ from opposite side), from Chadron formation, Niobrara County, Wyoming (see skull, fig. 8); *S. (P.) douglasensis*, new species, holotype,

F:A.M. 45492 (C and M₃ combination of both sides), from "Zone A" of Brule formation, Converse County, Wyoming (see skull, fig. 8); *S. (P.) reideri*, new species, holotype, F:A.M. 49620 (dentition combination of both sides), from Chadron formation, Niobrara County, Wyoming (see skull, fig. 8).

Comparison of skeletal elements: A, *Miniochoerus battlecreekensis*, new species; B, *M. nicholsae*, new species (see fig. 11); C, *M. (Paraminiochoerus) gracilis* (Leidy); D, *M. (P.) affinis* (Leidy); E, *M. (P.) helprini*, new species; F, *M. (P.) ottensi*, new species; G, *Platychoerus platycephalus* (Thorpe); H, *P. heartensis*, new species; I, *P. hatcreekensis*, new species; J, *Stenopsochoerus sternbergi*, new species; K, *S. berardae*, new species; L, *S. (Pseudostenopsochoerus) chadronensis*, new species; M, *S. (P.) douglasensis*, new species. $\times \frac{1}{2}$.

FIG. 10. Comparison of skeletal elements, same as fig. 9. $\times \frac{1}{2}$.

FIG. 11. Comparison of skeletal elements, same as fig. 9. $\times \frac{1}{2}$.

FIG. 12. Lateral, dorsal and ventral views of skulls: *Oreonetes anceps* (Douglass), holotype, C.M. 745 (lateral and ventral views only), and referred, C.M. 1052 (combination of both sides), from Chadron formation, Beaverhead County, Montana, C.M. 303 (P₁-P₄ from opposite side, lateral view only), and A.M. 9728 (combination of both sides, ventral view only), both from Chadron formation, Gallatin County, Montana; *Limnenetes platyceps* Douglass, holotype, C.M. 701, from Chadron formation, Gallatin County, Montana; *Bathygenys alpha* Douglass, referred, F:A.M. 45334, from Chadron formation, Natrona County, Wyoming (dorsal view only). $\times \frac{1}{2}$.

Superior dentitions: *Oreonetes anceps* (Douglass), holotype, C.M. 745, referred, C.M. 1052 and A.M. 9728, all with same information as above; *O. anceps douglassi*, new subspecies, holotype, C.M. 11256, from Chadron formation, Beaverhead County, Montana; *Limnenetes platyceps* Douglass, referred, A.M. 9729, from Chadron formation, Gallatin County, Montana; ?*L. spec. undet.*, example, C.M. 1086, from Chadron formation, Beaverhead County, Montana; *Bathygenys alpha* Douglass, referred, F:A.M. 45334 (same information as above). $\times 1$.

Mandibular rami: *Oreonetes anceps* (Douglass), referred, A.M. 9728 (combination of both sides), from Chadron formation, Beaverhead County, Montana; *Limnenetes platyceps* Douglass, referred, C.M. 1118, from Chadron formation,

Beaverhead County, Montana; ?*L.* spec. undet., example, C.M. 1086 (same information as above); *Bathysenys alpha* Douglass, holotype, C.M. 708, from Chadron formation, Jefferson County, Montana, and referred, F:A.M. 45334 (same information as above). $\times \frac{1}{2}$.

Inferior dentitions: *Oreonetes anceps* (Douglass), referred, A.M. 9728; *Limnenetes platyceps* Douglass, referred, C.M. 1118; ?*L.* spec. undet., example, C. M. 1086 (combination of both sides); *Bathysenys alpha* Douglass, holotype, C.M. 708;

(all with same information as above); and *B. alpha* Douglass, referred, C. M. 708A, from Chadron formation, Jefferson County, Montana, and F:A.M. 45334 (same information as above). $\times 1$.

Skeletal elements: *Limnenetes platyceps* Douglass, tentatively referred, C. M. 1184, from Chadron formation, Beaverhead County, Montana; *Bathysenys alpha* Douglass, referred, F:A.M. 45334, from Chadron formation, Natrona County, Wyoming, $\times \frac{1}{2}$.

LIST OF SYNONYMS

The following synonyms (which are not included in the contents) are here recorded for the convenience of the reader. A formal and detailed index is planned for the final oreodont report.

Limnenetes species, Matthew, 464
coloradoensis, 405

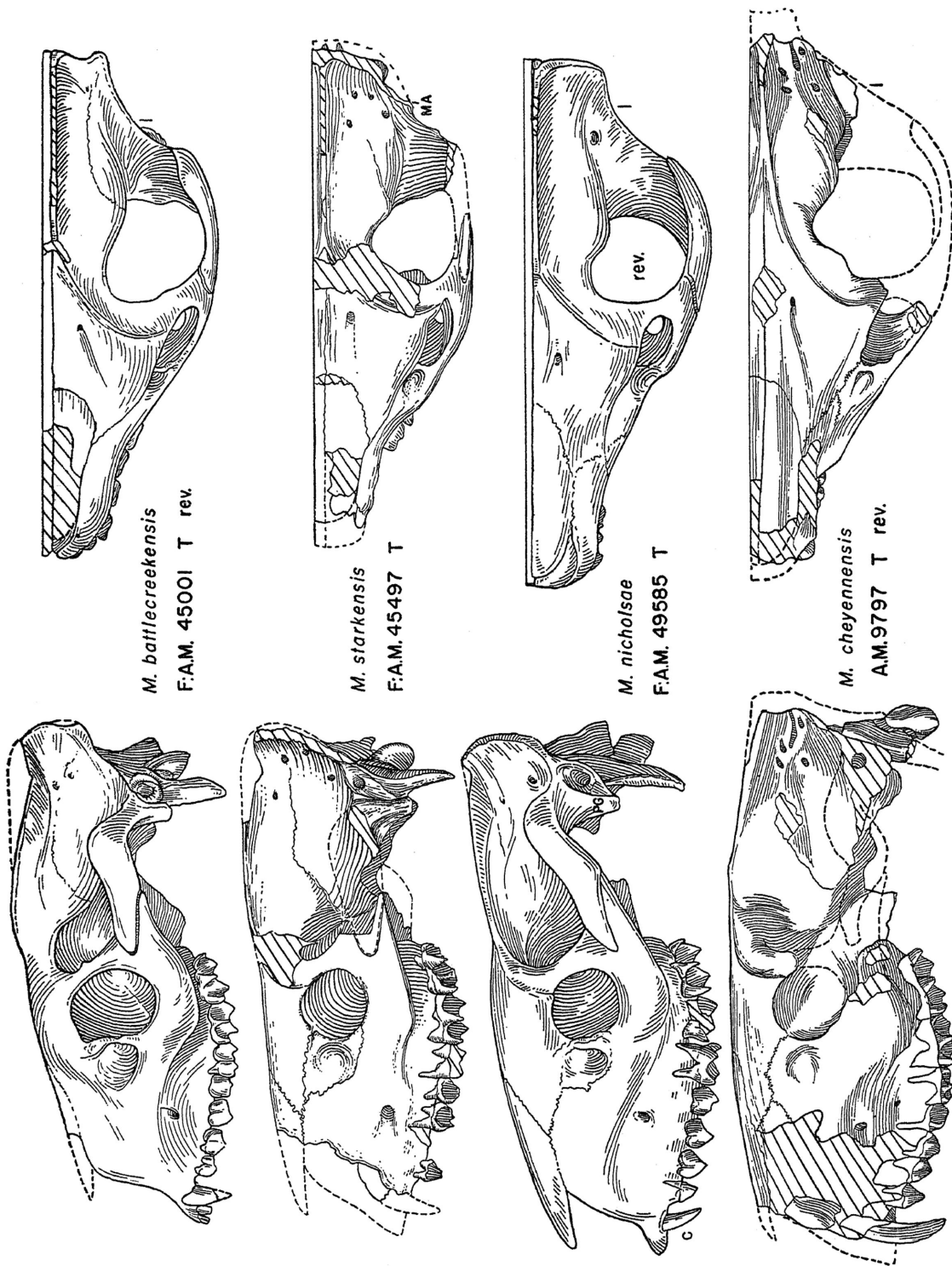


FIG. 1. *Miniochoerus*, four species, holotypes, F.A.M. 45001, 45497, and 49585, and A.M. 9797. See p. 467.) $\times \frac{1}{2}$. (See fig. 2.)

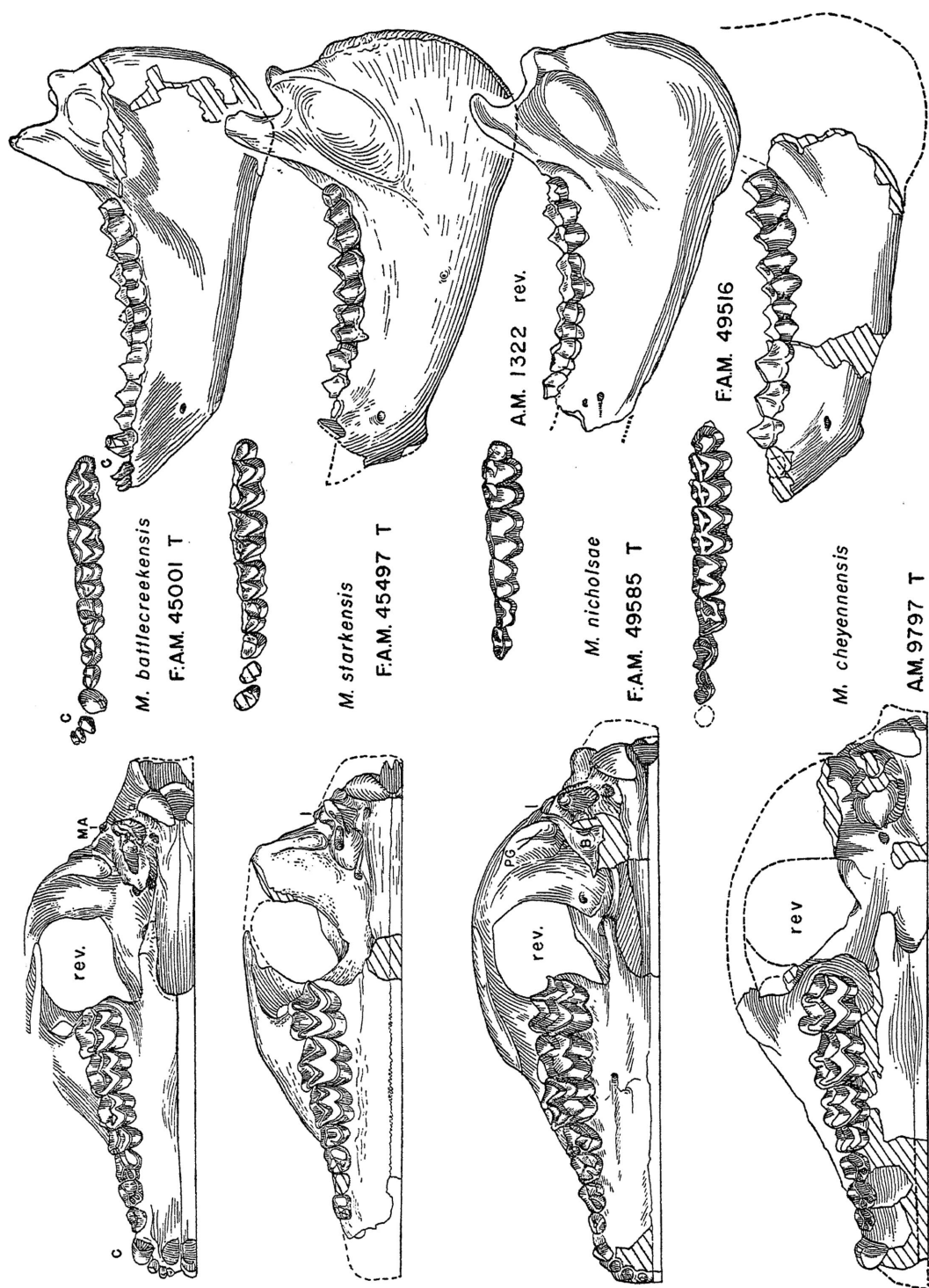


FIG. 2. *Miniochoerus*, four species, holotypes, F.A.M. 45001, 45497, and 49585, and A.M. 9797; referred, A.M. 1322, and tentatively referred, F.A.M. 49516. (See p. 467.) $\times \frac{1}{2}$. (See fig. 1.)

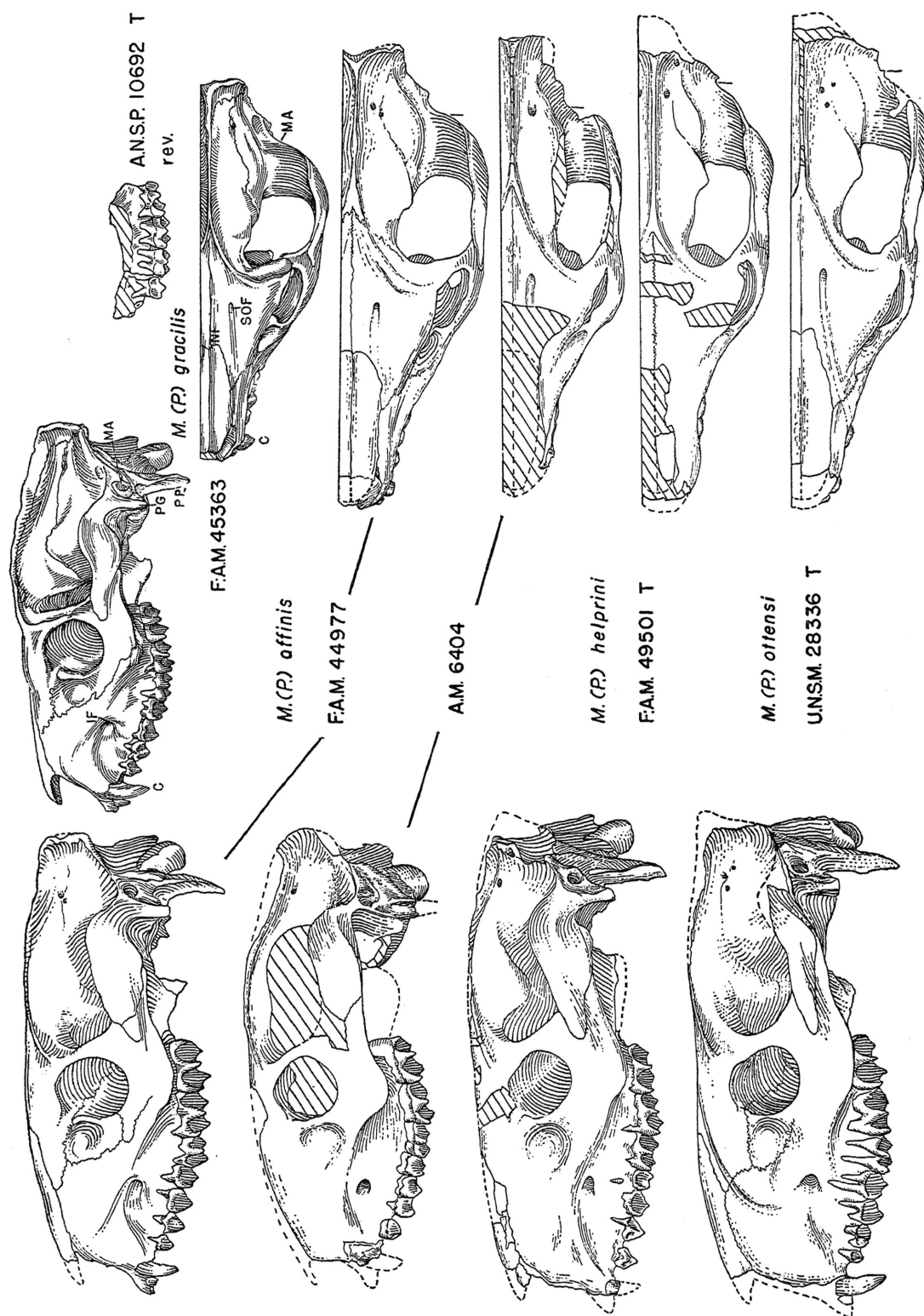


FIG. 3. *Miniochoerus* (*Paraminiochoerus*), four species, holotypes, A.N.S.P. 10692, F.A.M. 49501, and U.N.S.M. 28336, and referred, A.M. 6404, F.A.M. 45363, and 44977. (See p. 467.) $\times \frac{1}{2}$. (See fig. 4.)

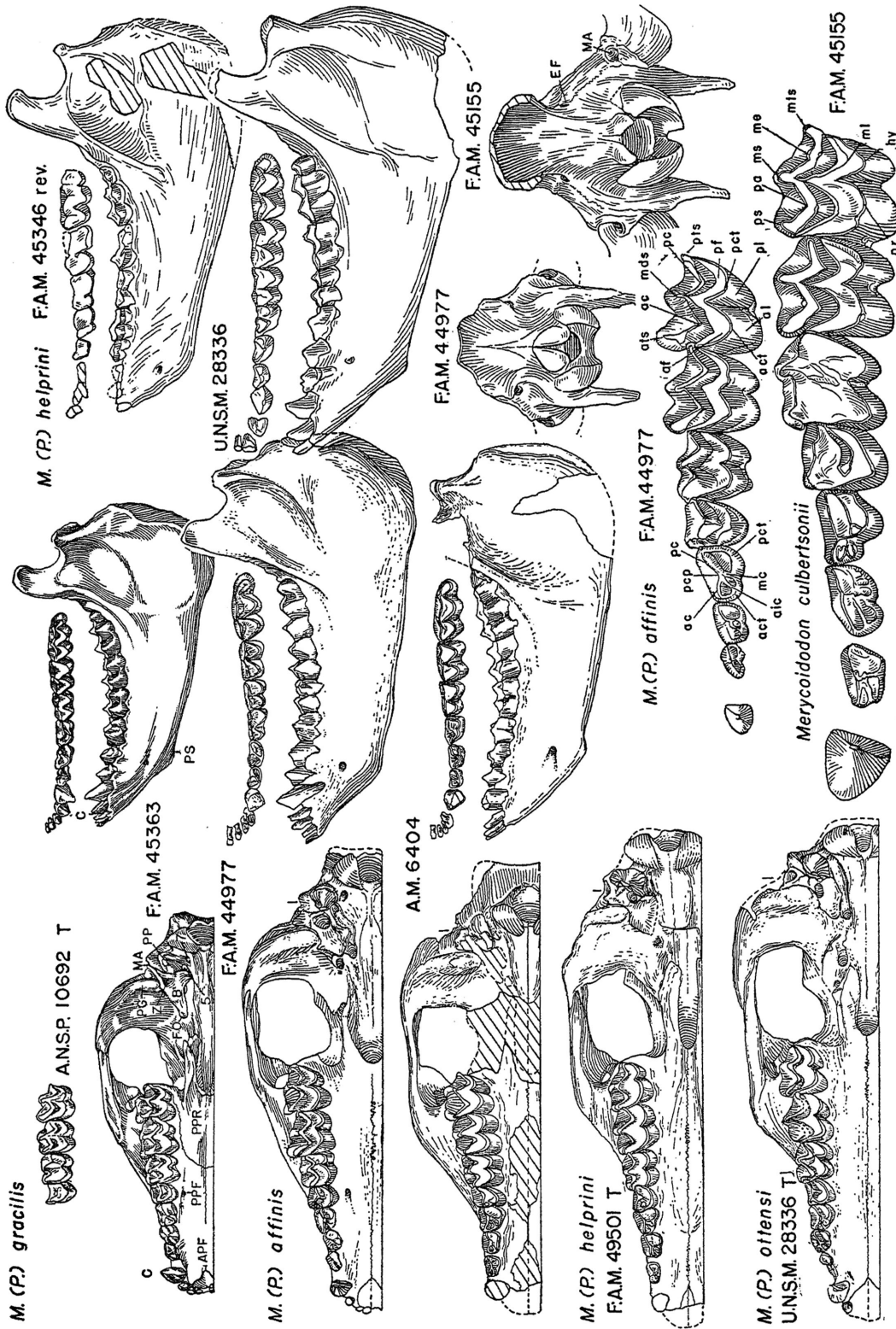


FIG. 4. *Miniochoerus* (*Paraminiochoerus*), four species, holotypes, A.N.S.P. 10692, F.A.M. 49501, and U.N.S.M. 28336, and referred, F.A.M. 45363, 44977, and 45346, and A.M. 6404; *Merycoidodon culbertsonii*, referred, F.A.M. 45155. (See p. 467.) $\times \frac{1}{2}$ (occlusal views of maxillary dentitions of 44977 and 45155, $\times 1$). (See fig. 3.)

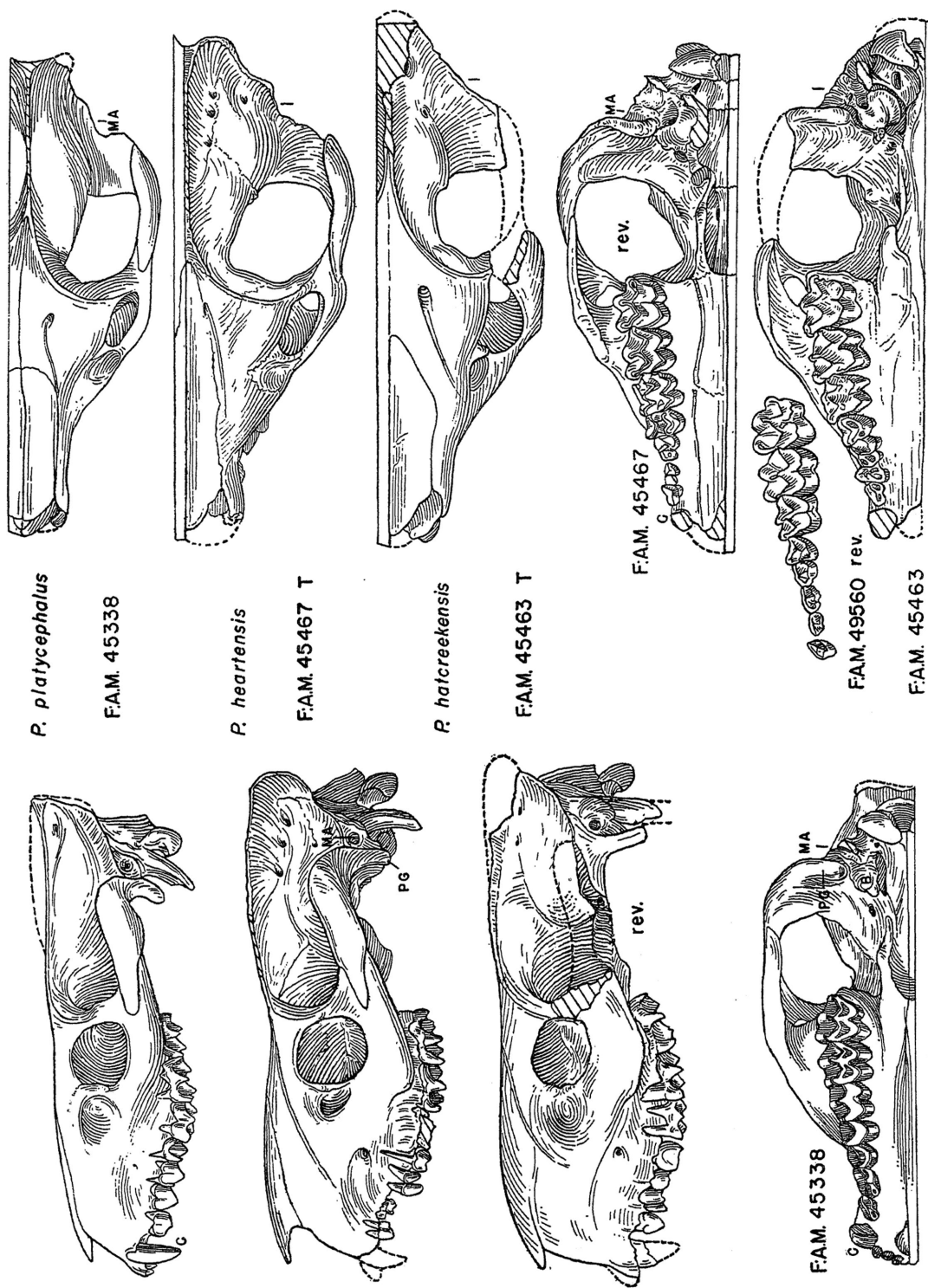


FIG. 5. *Platychoerus*, three species, holotypes, F.A.M. 45467 and 45463, and referred, F.A.M. 45338 and 49560. (See p. 467.) $\times \frac{1}{2}$. (See fig. 6.)

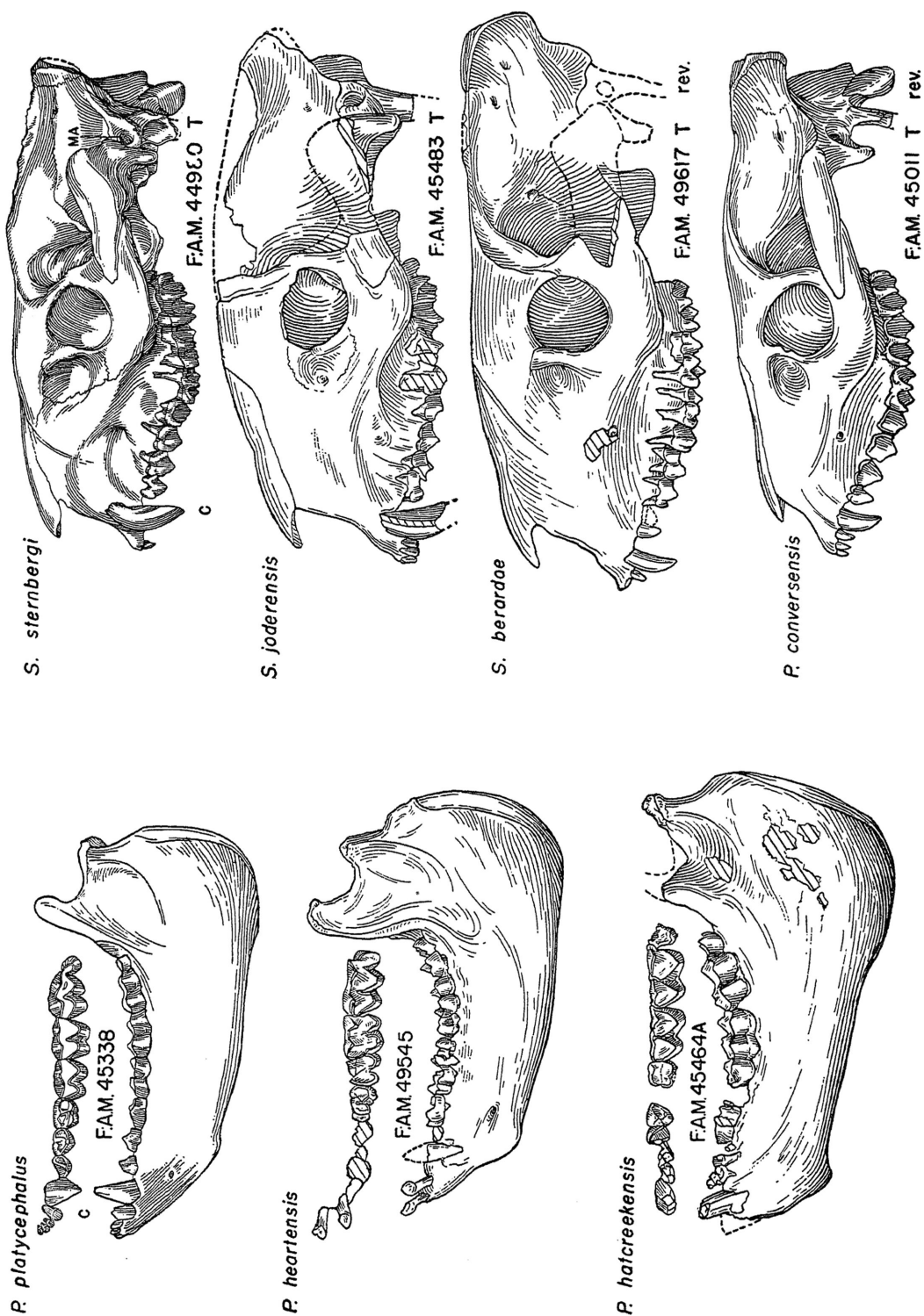


FIG. 6. *Platychoerus*, three species, referred, F.A.M. 45338, 49545, and 45464A; *Stenoposchoerus*, three species, holotypes, F.A.M. 44980, 45483, and 49617; *Parastenoposchoerus*, one species, holotype, F.A.M. 45011. (See p. 467.) $\times \frac{1}{2}$. (See fig. 7.)

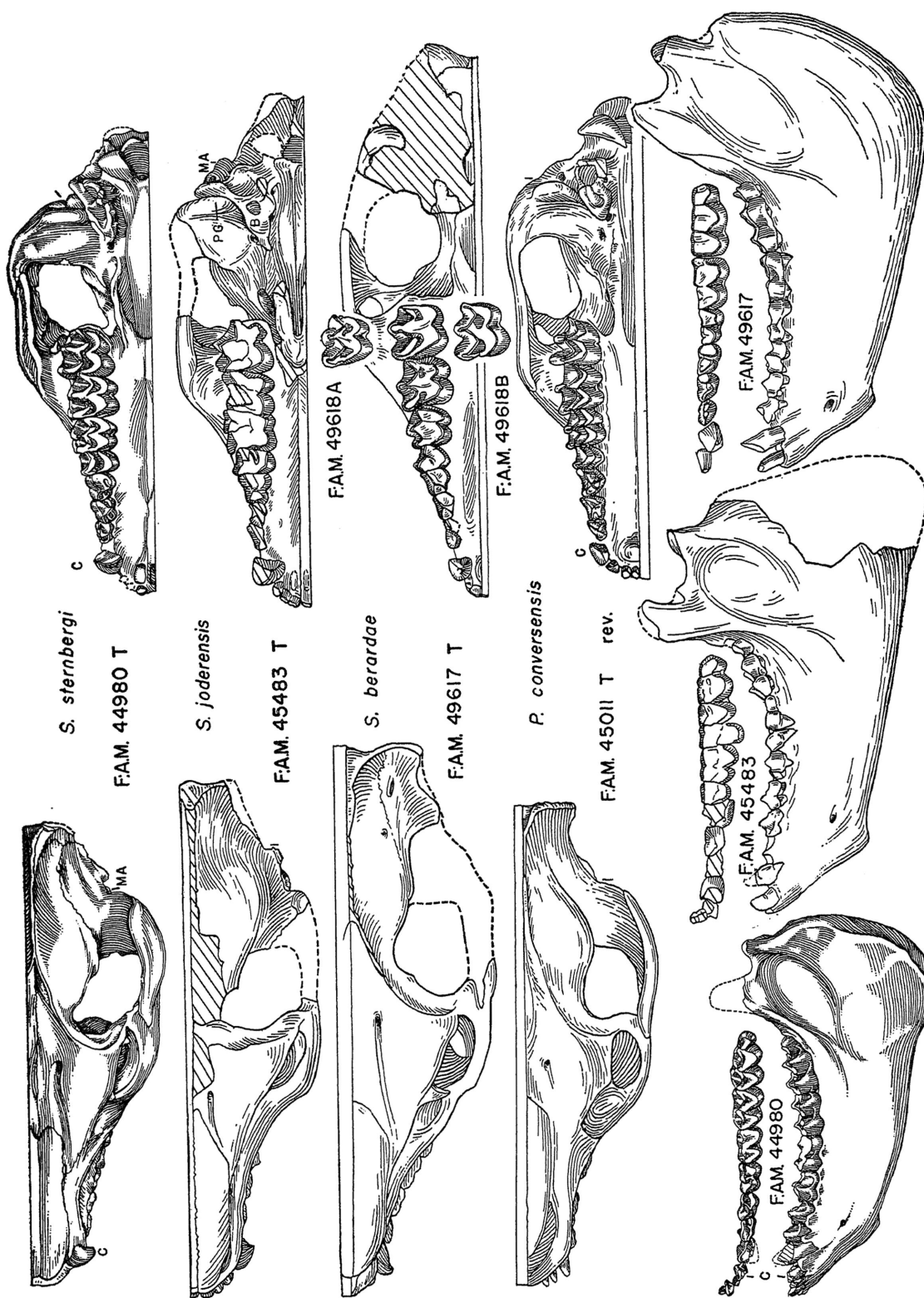


Fig. 7. *Stenopsochoerus*, three species, holotypes, F.A.M. 44980, 45483, and 49617, and referred, F.A.M. 49618A and 49618B; *Parastenopsochoerus*, one species, holotype, F.A.M. 45011. (See p. 468.) $\times \frac{1}{2}$. (See fig. 6.)

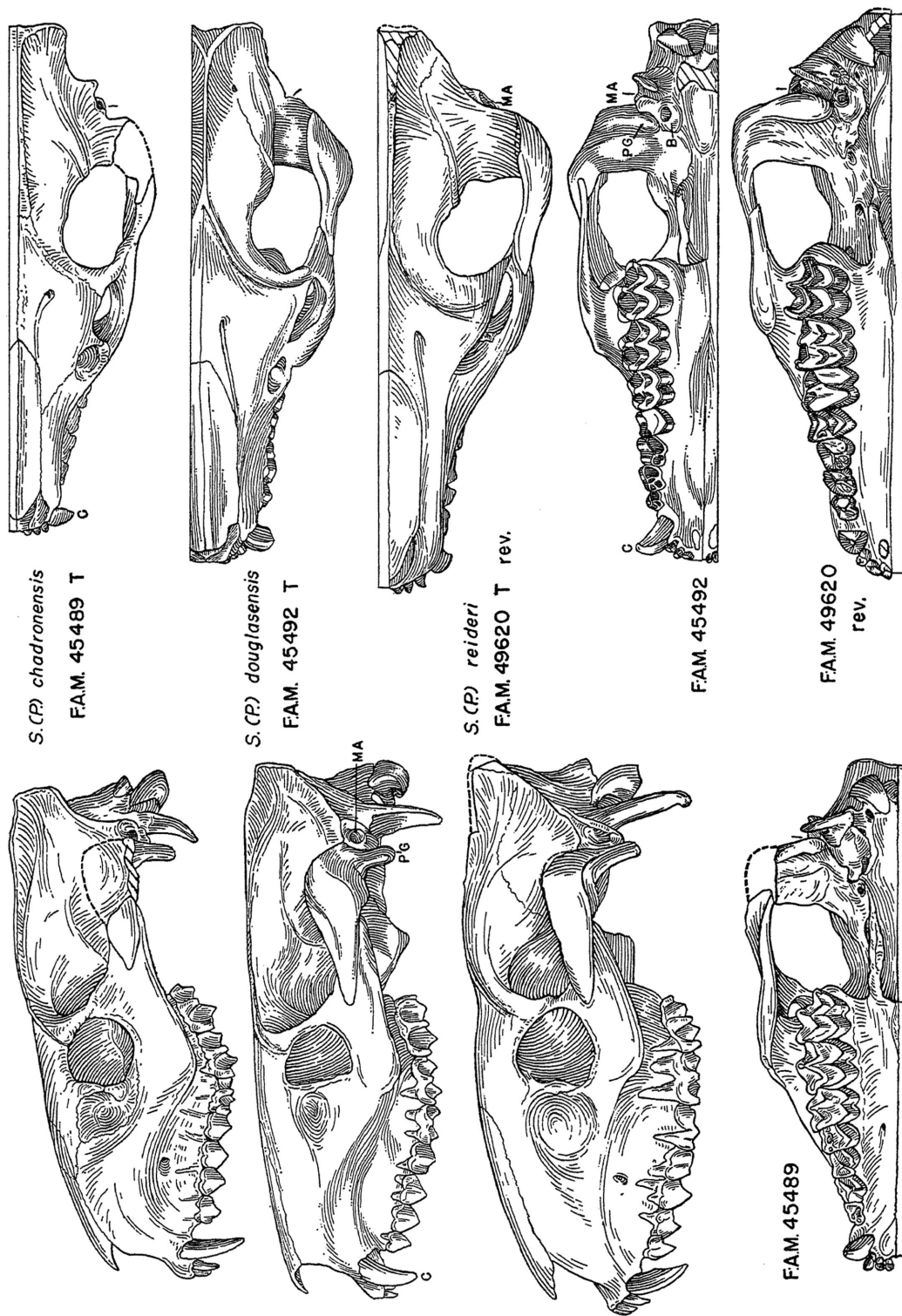


Fig. 8. *Stenopsochoerus* (*Pseudostenopsochoerus*), three species, holotypes, F.A.M. 45489, 45492, and 49620. (See p. 468.) $\times \frac{1}{2}$. (See fig. 9.)

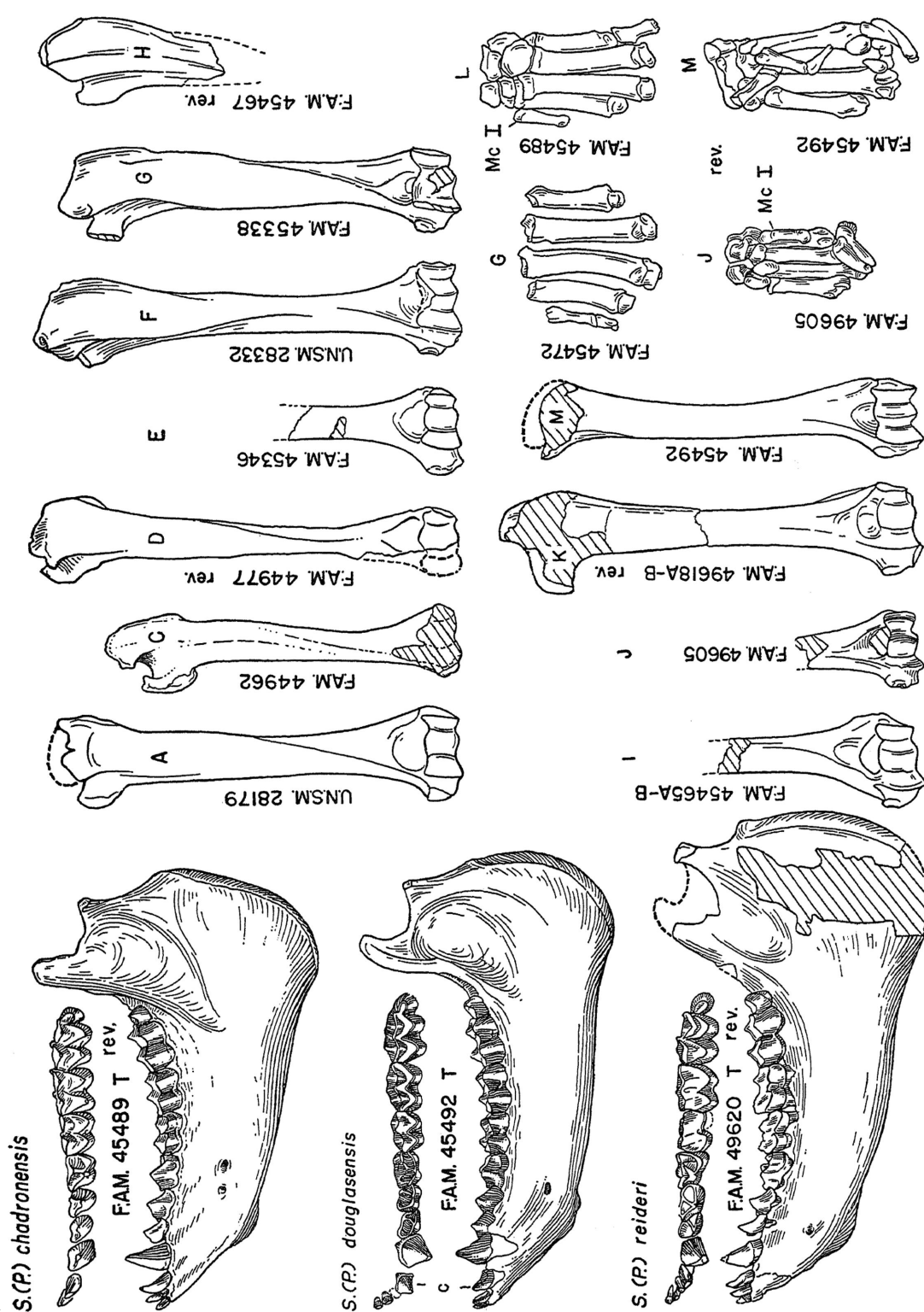


FIG. 9. *Stenopsochoerus* (*Pseudostenopsochoerus*), three species, holotypes, F.A.M. 45489, 45492, and 49620. Comparison of limb elements: A, *Miniochoerus battlecreekensis*; B, *M. nicholsae* (see fig. 11); C, *M. (Paraminiochoerus) gracilis*; D, *M. (P.) affinis*; E, *M. (P.) helpini*; F, *M. (P.) obtensi*; G, *Platychoerus platycephalus*; H, *P. heartensis*; I, *P. hatcreetensis*; J, *Stenopsochoerus sternbergi*; K, *S. berardae*; L, *S. (Pseudostenopsochoerus) chadronensis*; M, *S. (P.) douglasensis*. (See p. 467.) $\times 4$.

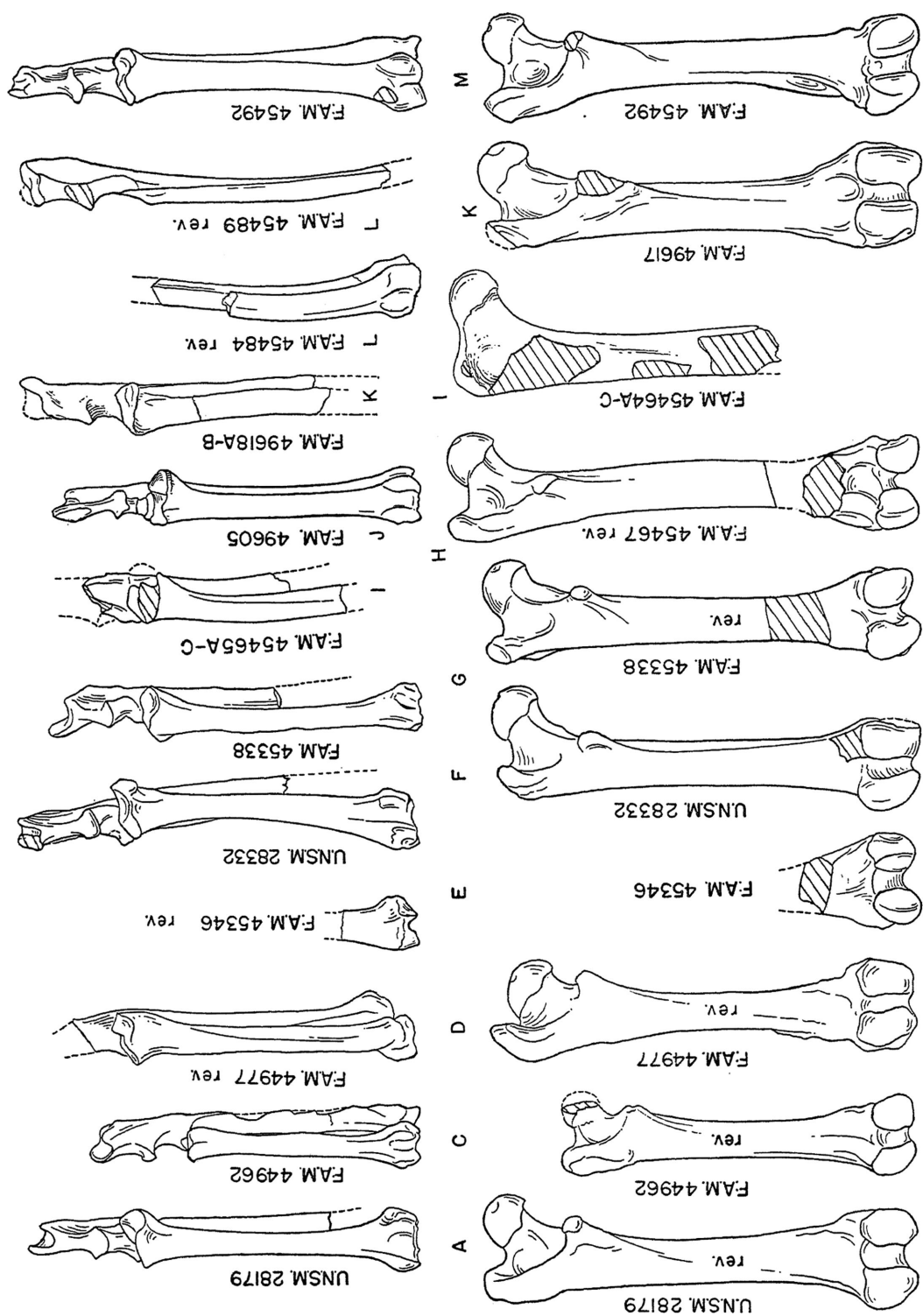


Fig. 10. See legend to figure 9 and explanation, page 468.

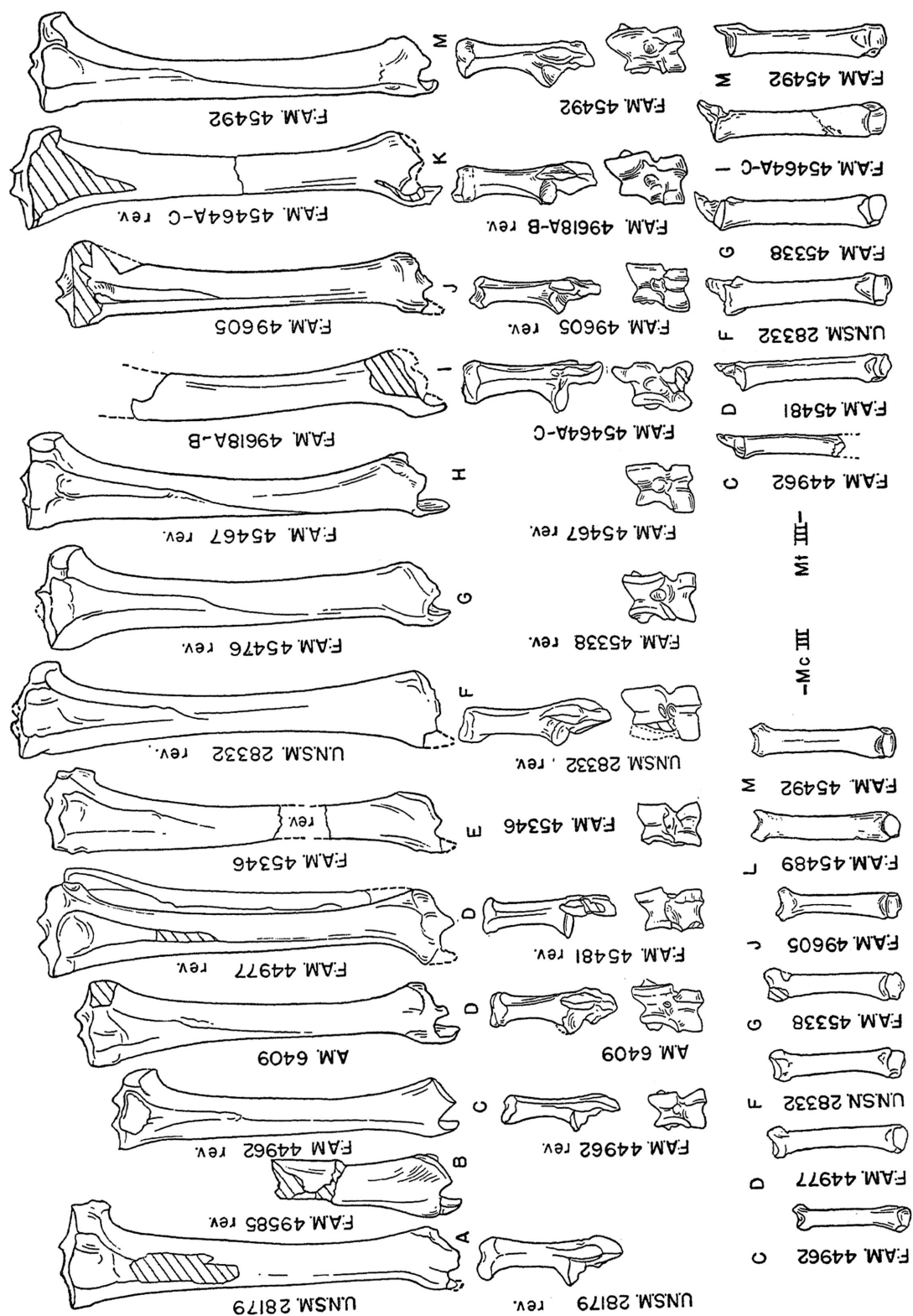


FIG. 11. See legend to figure 9 and explanation, page 468.

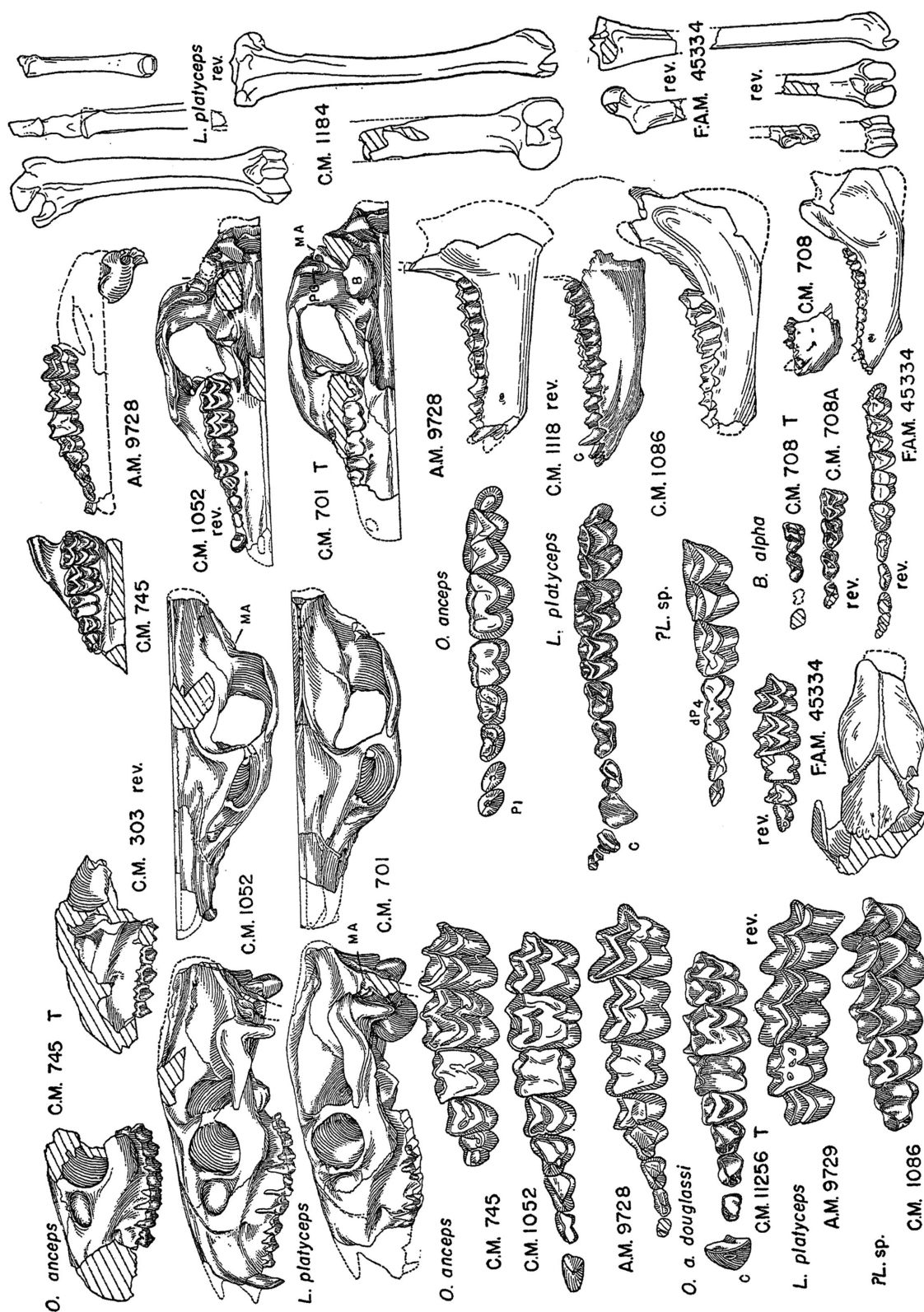


FIG. 12. *Oreonetes*, one species and one subspecies, holotypes, C.M. 745 and 11256, and referred, C.M. 303 and 1052, and A.M. 9728; *Limnetaetes*, one species and spec. undet., holotype, C.M. 701, example, C.M. 1086 (dps-M²), and referred, C.M. 1118 and 1184; *Bathygenys*, one species, holotype, C.M. 708, and referred, C.M. 708A and F.A.M. 45334. (See p. 468.) $\times 1$ and $\times \frac{1}{2}$.