

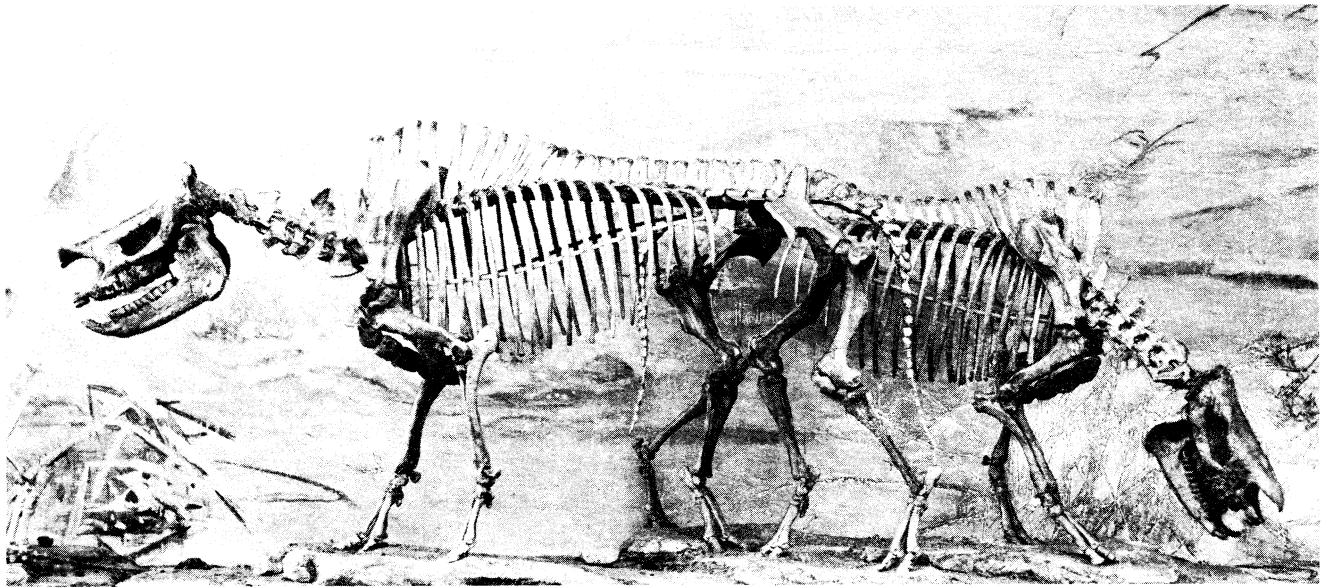
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A New Species of *Menoceras* from the
Marsland Formation of Nebraska





Frontispiece.—Mounted skeletons of *Menoceras falckenbachi*, new species, from the lower portion of the Marsland Formation (Middle Miocene), Hemingford Group, U.N.S.M. Coll. Loc. Mo-114, 9½ miles north of Bridgeport, Morrill County, Nebraska. Skeletons of male, U.N.S.M. 1241, holotype skull, on left, and of female, U.N.S.M. 1238, paratype skull, on right are exhibited in the University of Nebraska State Museum. X 1/19.

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ABSTRACT

A New Species of *Menoceras* from the Marsland Formation of Nebraska

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Further study indicates that the *Menoceras* remains collected from the "Bridgeport Quarries" (lower portion of the Marsland Formation, Middle Miocene, of the Hemingford Group) are of a new species.

In 1962, these diceratherine remains were considered to be a geologic variety of *Diceratherium niobrarense* (Stecher, Schultz, and Tanner). However, later (Tanner, 1969) a generic distinction was revived, separating the *Menoceras* Troxell from *Diceratherium* Marsh. *Diceratherium niobrarense* was then placed in synonymy with *Menoceras arikareense* (Barbour).

The new species is an intermediate between *Menoceras arikareense* (Barbour) from the Harrison Formation and *Menoceras marslandensis* Tanner, from the upper portion of the Marsland Formation.

A New Species of *Menoceras* from the Marsland Formation of Nebraska

INTRODUCTION

This study was made using a large collection of rhinoceros remains from sediments considered to be near the base of the Marsland Formation of the Hemingfordian Group (Stecher, Schultz, and Tanner, 1962, p. 101) of northwestern Nebraska. The rhinoceros skeletal parts are from quarries which have been previously recorded as the "Bridgeport Quarries." (See Schultz and Stout, 1941, pp. 20, 27, and 43.) These U.N.S.M.² collecting localities are located 8½ to 9½ miles north of Bridgeport, Nebraska, and have been assigned the following collecting locality numbers: Mo-113, Mo-114, Mo-115, Mo-116, and Mo-118 (Schultz and Stout, 1961, p. 8, Fig. 3; Stecher, Schultz, and Tanner, 1962, p. 101; and Tanner, 1969, p. 401). These quarries have yielded the *Menoceras* skeletal remains considered in this paper; however, most of the specimens are recorded as being collected from U.N.S.M. Coll. Loc. Mo-113 and Mo-114.

These quarries were first discovered in 1932 and were subsequently worked for several years (Stecher, Schultz, and Tanner, 1962, p. 101). A very large rhinoceros collection was assembled for the University of Nebraska State Museum. The *Menoceras*, which constitutes the major genus in this collection, is considered specifically different from other diceratheres of the Miocene (Tanner, 1969).

¹ Coordinator of Systematic Collections, University of Nebraska State Museum, and Assistant Professor of Geology.

² U.N.S.M., University of Nebraska State Museum.

As a part of the revision of the phylogenetic scheme for *Diceratherium* and *Menoceras*, a chart showing the two lineages was prepared by Tanner (1969, Fig. 1). At that time (p. 402) it was indicated that an exact specific allocation for *Menoceras*, from the "Bridgeport Quarries," was uncertain. However, further study of these fossil rhinoceros remains from the lower portion of the Hemingford Group presents evidence which justifies the naming of a new species.

SYSTEMATIC DESCRIPTION

Class: MAMMALIA
 Order: PERISSODACTYLA
 Family: RHINOCEROTIDAE

Menoceras falkenbachi, new species³

Holotype.—Figs. 1-2 and Table 1, male skull of the composite skeleton U.N.S.M. 1241. The right and left maxillaries were damaged and have been restored by using detached premaxillaries found in the quarries. (The paratype U.N.S.M. 62050 upper dentition P¹-M² for this species is shown in Fig. 3 and Table 1.) The left zygomatic is partially restored; the right zygomatic arch is missing. The right glenoid process and both tympanic processes are missing.

³ The specific name is in honor of the late Charles Falkenbach. Charles Falkenbach and Morris F. Skinner of the Frick Laboratories, American Museum of Natural History, New York, did considerable research on Miocene rhinoceroses and both have contributed much information to the writer regarding this group.



Fig. 1—*Menoceras falckenbachi*, new species, holotype, U.N.S.M. 1241, lateral view. X $\frac{1}{3}$.

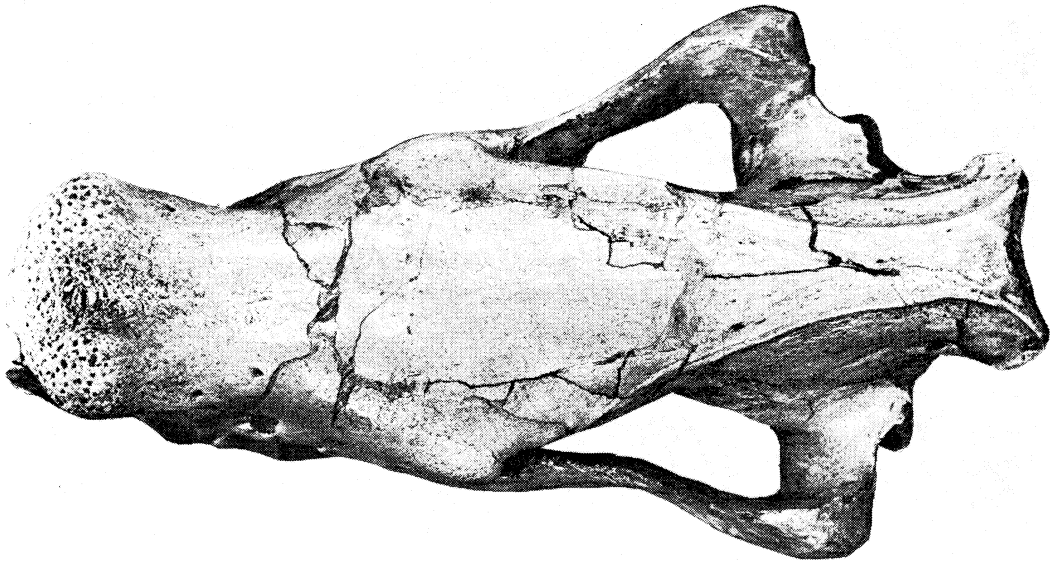


Fig. 2—*Menoceras falckenbachi*, new species, holotype, U.N.S.M. 1241, dorsal view. X $\frac{1}{3}$.

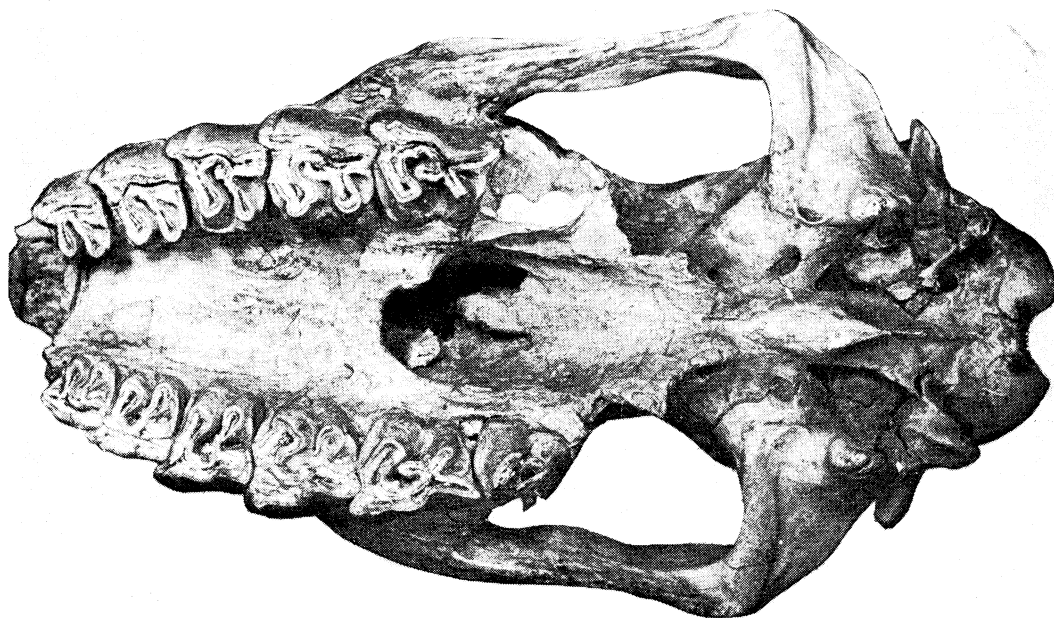


Fig. 3—*Menoceras falkenbachi*, new species, paratype, U.N.S.M. 62050, palatal view. X $\frac{1}{3}$.

Paratype.—Skulls, female, U.N.S.M. 1238 and U.N.S.M. 62050 (Fig. 3).

Type Locality.—SW. $\frac{1}{4}$, NW. $\frac{1}{4}$, sec. 10, T. 21 N., R. 50 W. Located 8½ to 9½ miles north of Bridgeport, Morrill County, Nebraska. (Elevation 4160 feet U.S.G.S., 7½ min. Quad., Angora SE.)

Stratigraphic Occurrence.—From the lower part of the Marsland Formation.

Diagnosis.—Male skull U.N.S.M. 1241 larger than *Menoceras arikareense* (Barbour); see Tables 1-3 and Figs. 1-2. Smaller in nearly all dimensions than *Menoceras marslandensis*. The frontal rugosities and convexity of the holotypic skull are relatively less prominent than that of the holotype of *M. marslandensis*. The bosses at the tips are more roughened anteriorly than those of *Menoceras arikareense*, but relatively less than *Menoceras marslandensis*. The skull U.N.S.M. 62006 (Tanner, 1969, p. 402) demonstrates the male characteristics of the species as does the holotypic skull, U.N.S.M. 1241 (Fig. 1-2). The female skull, U.N.S.M. 1238, has several dimensions nearly equal to those of the type male skull, U.N.S.M. 1241, the main exception being the relative dimensions of the nasals (see Table 1).

Discussion.—Five nearly complete skulls, several partial skulls and a large quantity of associated skeletal parts have been measured and recorded.

The study of the skulls, dentition, and many skeletal elements is reported only in part. The male skull U.N.S.M. 1241, on the mounted skeleton, has been selected for the type; however, the paratype skull U.N.S.M. 62050 has a better and more complete dental series.

The holotype skull has the following characteristics which are in an intermediate stage of evolution and appear to be a connecting link between *M. arikareense* of the upper part of the Harrison and *M. marslandensis* from the middle to upper Marsland. The generic characteristics in common are: (1) saddle-shaped skull; (2) convex frontal, with slight crescent-shaped ridges on the anterior portion of the frontal; (3) rugosity on the fore portion of the nasal extended to and including the inferior surface of the nasal bone; (4) bosses on the anterior tip of the nasal which elongate and swell anteriorly. The major specific differences are the comparison of dimensions of the skulls, i.e., the length from the occipital condyle to the anterior end of the nasals. This dimension for the type skull of *M. falkenbachi*

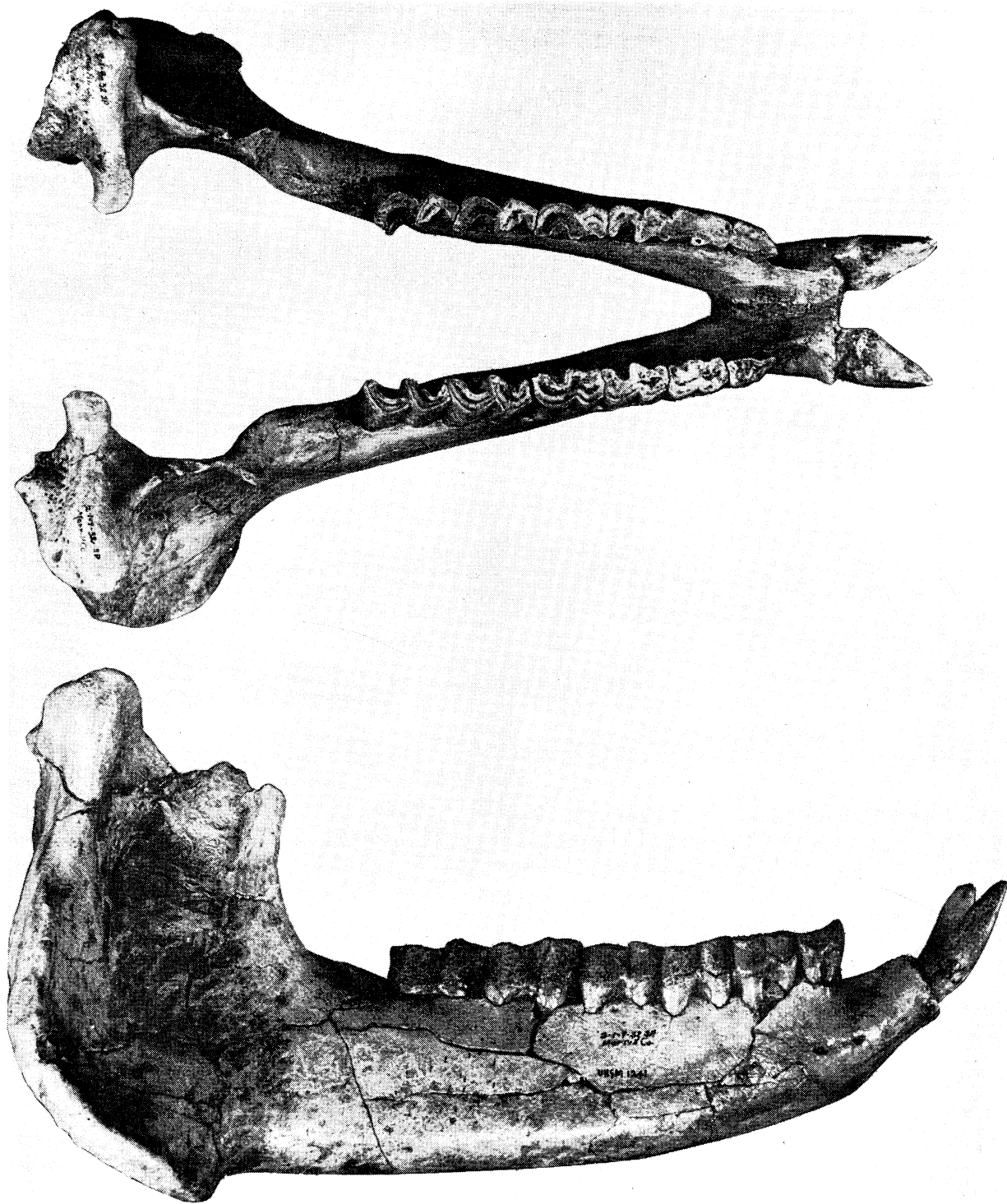


Fig. 4—*Menoceras falckenbachi*, new species, U.N.S.M. 1241. lateral view. X $\frac{2}{5}$.

TABLE 1
Dimensions (in millimeters) for three skulls
of *Menoceras falkenbachi*, new species.

SKULLS	<i>Menoceras falkenbachi</i>	<i>M. falkenbachi</i>	<i>M. falkenbachi</i>
	Holotype U.N.S.M. 1241	Paratype U.N.S.M. 1238	Paratype U.N.S.M. 62050
Occipital condyles to tip of premaxillary .....	.....	.....	.....
Occipital condyles to tips of nasals.....	444	449	433
Midpoint occipital crest to tips of nasals.....	411	412	378
Anterior margin of P ¹ to occipital condyles.....	((368))*	((382))	388
Narial notch to occipital crest.....	333	323	313
Palatal notch to foramen magnum.....	200	249	242
Palatal notch to palatal foramina.....	.....	129	138
Narial notch to tips of nasals.....	107	115	100
Zygomatic breadth (maximum).....	((245))	222	((233))
Width across palate to buccal sides M ²	((152))	142	145
Orbital breadth (between notches).....	150	.....	150
Occipital height, base condyles to crest.....	154	145	144
Occipital width (maximum).....	153	153	158
Condylar width (outer margins occ. condyles).....	92	84	88
Tooth row, P ¹ -M ³ (midline, to rear of M ³).....	.....	.....	208
Tooth row, P ² -M ³ (midline, to rear of M ³).....	.....	182	200
Premolars (midline).....	.....	.....	100
Length P ² -P ¹ (midline, to rear of P ¹).....	.....	78	85
Molars (midline, to rear of M ³).....	.....	105	111
Length P ¹ (maximum).....	.....	.....	.....
Width P ¹ (maximum).....	.....	.....	.....
Length P ² (maximum).....	26.5	23.0	22.0
Width P ² (maximum).....	40.0	30.0	30.0
Length P ³ (maximum).....	28.0	27.0	28.0
Width P ³ (maximum).....	42.5	33.0	36.0
Length P ⁴ (maximum).....	.....	28.0	36.0
Width P ⁴ (maximum).....	.....	40.0	40.0
Length M ¹ (maximum).....	34.0	34.0	37.0
Width M ¹ (maximum).....	41.0	42.0	42.0
Length M ² (maximum).....	38.5	37.0	40.0
Width M ² (maximum).....	47.5	43.0	41.0
Length M ³ (maximum).....	.....	30.0	.....
Width M ³ (maximum).....	.....	38.0	.....

* (()) Estimated dimensions

TABLE 1A

The following dimensions (in millimeters) were measured on the right ramus of the mandible mounted with skull U.N.S.M. 1241. The specimen was found in the same quarry but not recorded as being in articulation with the skull. The slightly worn teeth of the jaw have a subhypodont appearance. The internal and external cingula are well-developed P_2 - P_4 , but are less strong M_1 - M_3 .

Menoceras falckenbachi, new species.

Length, base of incisor to condyle.....	379.0	Width P_3	17.0
Width, across tusks	67.0	Length P_4	29.0
Lower cheek teeth P_2 - M_3	85.0	Width P_4	19.0
Lower premolars P_2 - P_4	78.0	Length M_1	31.5
Length of symphysis.....	62.0	Width M_1	21.5
Depth of jaw beneath M_1	73.0	Length M_2	35.9
Height, angle to condyle.....	195.0	Width M_2	23.5
Length P_2	21.0	Length M_3	22.5
Width P_2	47.0	Width M_3	39.9
Length P_3	25.0		

(U.N.S.M. 1241) is 444 mm., for *M. arikareense* (U.N.S.M. 1250) and *M. marslandensis* (U.N.S.M. 62003) 350 mm. and 474 mm., respectively.

The mounted skeletons, U.N.S.M. 1241 and 1238, have been previously illustrated by Schultz and Reider (1943, p. 275), also Stecher, Schultz, and Tanner (1962, p. 102), and more recently by Augusta and Burian (1966, p. 24). Professor Augusta followed the previous specific determination used by Stecher, Schultz, and Tanner (1962), *Diceratherium niobrarense*. However, this name is no longer valid and should be a rejected synonym (Tanner, 1969, p. 409). The elements for the skeleton were selected from the large collection and are not necessarily associated by articulation and are considered to be composites from several animals.

Comparison of dorsal and lateral views of the Miocene species of this group demonstrates evolution of the skulls during Arikareean and Hemingfordian times (Figs. 1-3, this paper, Figs. 5, 6, 7, and 8 in Tanner, 1969). The morphologic differences between the older form, *Menoceras arikareense* (Barbour) and *Menoceras marslandensis* Tanner have been published by Tanner (1969, p. 403-404). Comparison of characters and dimensions between *Menoceras arikareense* from the Arikaree and the new species, herein described, from the lower portion of the Hemingfordian show greater relative morphologic differences in the skulls and skeletal elements

than are present between the new species and *Menoceras marslandensis* from deposits considered to be medial to upper Marsland. (See Schultz and Stout, 1961, p. 8, for Miocene correlation of these quarries.)

SUMMARY

The two lineages of diceratheres in the Miocene sediments of Nebraska have been established, and the distinct genera of *Diceratherium* Marsh and *Menoceras* Troxell each have species which can be assigned.

The evidence from the study indicates that species succession for *Menoceras* is: *Menoceras arikareense* (Barbour) from the Harrison Formation; *Menoceras falckenbachi*, new species, from deposits from the base of the Marsland Formation; and *Menoceras marslandensis* Tanner from the sediments considered middle to upper Marsland in age. The most diagnostic of these changes are: development of a rugose, convex surface on the anterior portion of the frontal which no doubt served as a base support for a frontal horn on the males; relative strengthening of the area above the maxillae and posterior to the narial opening; the continued elevation of the nasals and occipital regions, accentuating the saddle-shaped skull; lateral expansion and heavier rugosity on the posterior portion of the zygomata. Some evidence is available, in the University of Nebraska

TABLE 2
Dimensions (in millimeters) for the skulls of
M. marslandensis and *M. arikareense*

SKULLS	<i>M.</i> <i>marslandensis</i>	<i>M.</i> <i>arikareense</i>
	Holotype U.N.S.M. 62003	ref. U.N.S.M. 1147
Occipital condyles to tips of nasals.....	474	351
Midpoint occipital crest to tips of nasals.....	416	348
Anterior margin of P ¹ to occipital condyles.....	402	320
Narial notch to occipital crest.....	324	295
Palatal notch to foramen magnum.....	234	205
Palatal notch to palatal foramina.....	154	107
Narial notch to tips of nasals.....	164	87
Zygomatic breadth (maximum).....	250	236
Width across palate to buccal sides M ²	132	121
Orbital breadth (between notches).....	143	133
Occipital height, base condyles to crest.....	140	122
Occipital width (maximum).....	145	135
Condylar width (outer margins occ. condyles).....	.....	72
Tooth row, P ¹ -M ³ (midline, to rear of M ³).....	212	165
Tooth row, P ² -M ³ (midline, to rear of M ³).....	200	150
Premolars (midline).....	100	80
Length P ² -P ⁴ (midline, to rear of P ⁴).....	.....	63
Molars (midline, to rear of M ³).....	89	89
Length P ¹ (maximum).....	.....	13.5
Width P ¹ (maximum).....	.....	13.5
Length P ² (maximum).....	28.0	20.0
Width P ² (maximum).....	35.0	27.0
Length P ³ (maximum).....	28.0	20.0
Width P ³ (maximum).....	41.0	34.5
Length P ⁴ (maximum).....	30.0	23.0
Width P ⁴ (maximum).....	46.0	38.0
Length M ¹ (maximum).....	32.0	27.5
Width M ¹ (maximum).....	52.0	40.0
Length M ² (maximum).....	40.0	32.0
Width M ² (maximum).....	52.0	40.0
Length M ³ (maximum).....	38.0	34.5
Width M ³ (maximum).....	47.0	36.0

TABLE 3

Since the type descriptions of the skull and maxillae of *Menoceras arikareense* (Barbour) have not been presented in detail the following table of dimensions for U.N.S.M. 62008 is included.

Occipital condyles to tips of nasals.....	.....
Midpoint occipital crest to tips of nasals.....	.....
Anterior margin of P ¹ to occipital condyles.....	.....
Narial notch to occipital crest.....	.....
Palatal notch to foramen magnum.....	.....
Palatal notch to palatal foramina.....	.....
Narial notch to tips of nasals.....	.....
Zygomatic breadth (maximum).....	209.0
Width across palate to buccal sides M ²	127.4
Orbital breadth (between notches).....	115.0
Occipital height, base condyles to crest.....	116.0
Occipital width (maximum).....	126.4
Condylar width (outer margins occ. condyles).....	73.5
Tooth row, P ¹ -M ² (midline, to rear of M ²).....	178.0
Tooth row, P ² -M ² (midline, to rear of M ²).....	162.0
Premolars (midline).....	83.8
Length P ² -P ¹ (midline, to rear of P ¹).....	69.7
Molars (midline, to rear of M ³).....	93.8
Length P ¹ (maximum).....	14.5
Width P ¹ (maximum).....	15.4
Length P ² (maximum).....	21.0
Width P ² (maximum).....	26.8
Length P ³ (maximum).....	23.4
Width P ³ (maximum).....	32.8
Length P ¹ (maximum).....	23.4
Width P ¹ (maximum).....	35.5
Length M ¹ (maximum).....	33.0
Width M ¹ (maximum).....	34.8
Length M ² (maximum).....	31.8
Width M ² (maximum).....	32.6
Length M ² (maximum).....	28.0
Width M ³ (maximum).....	32.2

The tooth characteristics for *M. arikareense* are as follows: P¹ small, P² medial valley open, faint buccal cingulum, labial cingulum on protoloph only, antecrochet, slight crenulation on metaloph. P³ medial valley open, faint buccal cingulum, labial cingulum on protoloph. P⁴ same as P³ only larger, and buccal cingulum more pronounced. M¹ buccal cingulum, labial cingulum faint, antecrochet and crochet, crenulation well developed. M² same as M¹ with faint crista. M³ buccal cingulum faint, labial cingulum present crista developed. Parastyle fold P¹-M²; postfossettes P²-M².

State Museum study collection, that *Menoceras* may have lived until early Pliocene times in the Great Plains Area. However, more fossil rhinoceros material is needed to establish this conclusion. The pre-Harrison occurrence of *Menoceras* in sediments of the Great Plains Area is still in doubt. Perhaps this genus may have been a migrant, along with chalicotheres, from the old world (Skinner, 1968, p. 11).

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