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A PLIOCENE VERTEBRATE FAUNA
FROM
ELLIS COUNTY, OKLAHOMA

By

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Norman

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A Pliocene Vertebrate Fauna from Ellis County, Oklahoma

DAVID B. KITTS

ABSTRACT

A mammalian fauna from the Ogallala group is described. The Arnett locality is ten miles west of Arnett, Ellis County, Oklahoma, in the NE $\frac{1}{4}$ sec. 15, T. 28 N., R. 26 W. The specimens were collected from a layer of fine clayey sand three feet thick. The fauna includes *Osteoborus validus*, *Aelurodon* cf. *mortifer*, *Albanosmilus?* sp., *Serridentinus* sp., *Aphelops* sp., *Pliohippus* sp., *Neohipparion occidentale*, and *Prosthenops* sp. The Arnett fauna is of late Clarendonian or early Hemphillian age and closely resembles the fauna from the nearby Higgins locality in Lipscomb County, Texas.

Introduction

The Arnett locality is on the L. H. Adair ranch, 10 miles west of Arnett, Ellis County, Oklahoma. Excavations extend for several hundred feet along the east wall of a canyon which drains south into the valley of the South Canadian River, and are located in the NE $\frac{1}{4}$ sec. 15, T. 28 N., R. 26 W. Parties from Northwestern State College, Alva, Oklahoma, and from the Frick laboratory in New York City have obtained collections from the locality. The major portion of the collection described in this paper was collected by field parties from the University of Oklahoma composed largely of personnel of the Works Progress Administration and under the direction of the late J. Willis Stovall. I visited the locality during the summers of 1955 and 1956 and obtained a small collection.

I wish to express my gratitude to Dr. R. A. Stirton, Dr. Ronald E. Savage, and Mr. Richard Tedford of the University of California with whom I discussed many of the systematic problems involving the material described in this paper. I should like to thank Dr. B. E. Schultz who allowed me to examine specimens in the collection of the University of Nebraska State Museum. The plates were prepared by Mr. Irwin Gold.

THE FOLLOWING ABBREVIATIONS ARE USED:

- O. U. S. M., the J. Willis Stovall Museum of Science and History, University of Oklahoma
- A. M. N. H., The American Museum of Natural History
- U. C. M. P., University of California Museum of Paleontology
- U. S. N. M., United States National Museum

Measurements are given in millimeters unless otherwise noted

ABBREVIATIONS USED IN THE TABLES ARE:

- N, number of measurements included
 OR, observed range
 M, mean
 L, maximum length
 W, maximum width

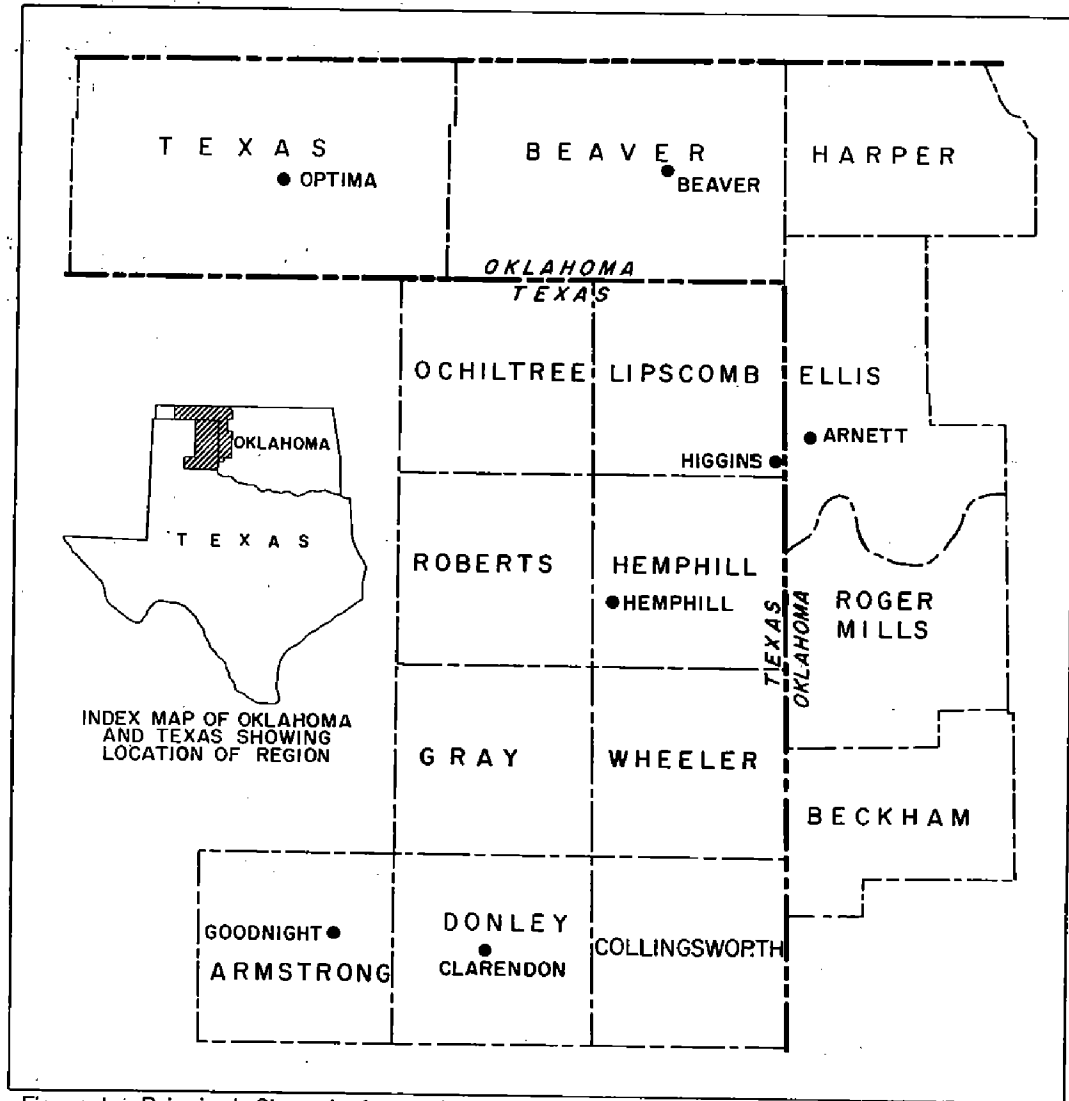


Figure 1. Principal Clarendonian and Hemphillian vertebrate localities in Oklahoma and Texas panhandle.

Geology

The beds which crop out in the Arnett quarry are continuous with beds covering the northeastern part of the Texas panhandle. It has been customary in recent years to apply the name "Ogallala formation" to these beds. The Ogallala was described by Darton (1899) from localities in southwestern Nebraska. Elias (in Stirton, 1936, p. 178) applied the name in a greatly extended sense. He stated: "In this paper, however, the term Ogallala is applied to the whole thickness of late Tertiary, predominantly arenaceous beds, which overlie the Arikaree of the North Platte valley and are found to range in age from the uppermost Miocene to the Middle and possibly the Upper Pliocene. These beds mantle the High Plains from South Dakota in the North to Texas in the south."

There have been objections to applying the name "Ogallala" in this greatly extended sense. In recent years there has been a growing tendency to include all of these beds in the "Ogallala group" (see Wood, et al., 1941), a term which is essentially synonymous with the "Ogallala formation" of Elias.

The name "Panhandle beds" was proposed by Gidley (1903) for the Tertiary sediments younger than the "Clarendonian beds" in the Texas panhandle. Matthew in an unpublished manuscript quoted in Sellards, Adkins and Plummer (1932) redefined this unit as a formation to include all of the strata of the Staked Plains above the Cretaceous and Triassic formations and below the recent surface deposits, and consequently to include deposits of Pleistocene age in this area. The name was used in this sense by Sellards, Adkins and Plummer. Neither the name "Panhandle beds" nor "Panhandle formation" is in current use.

Reed and Longnecker (1932) applied the name "Hemphill beds" to the "lower Pliocene" of Hemphill County, Texas, which borders Ellis County, Oklahoma, on the west. Wood et al. (1941) suggested that these beds might be definable as a member of the Ogallala. It is certain that these beds have never been sufficiently defined lithologically to warrant elevating them formally to member status. Until such time as these beds are so defined, I should prefer to refer to them simply as an undifferentiated part of the Ogallala group.

The Arnett locality is only five miles northeast of the Higgins locality in Lipscomb County, Texas, the fauna of which was described by Hesse (1940) and determined by him to be of late Clarendonian or early Hemphillian age. The Arnett fauna and the Higgins fauna are probably nearly equivalent in age and both of these faunas show marked resemblances to elements of the Snake Creek fauna of Nebraska. The age and correlation of the Arnett fauna is considered in more detail in the last section of this paper.

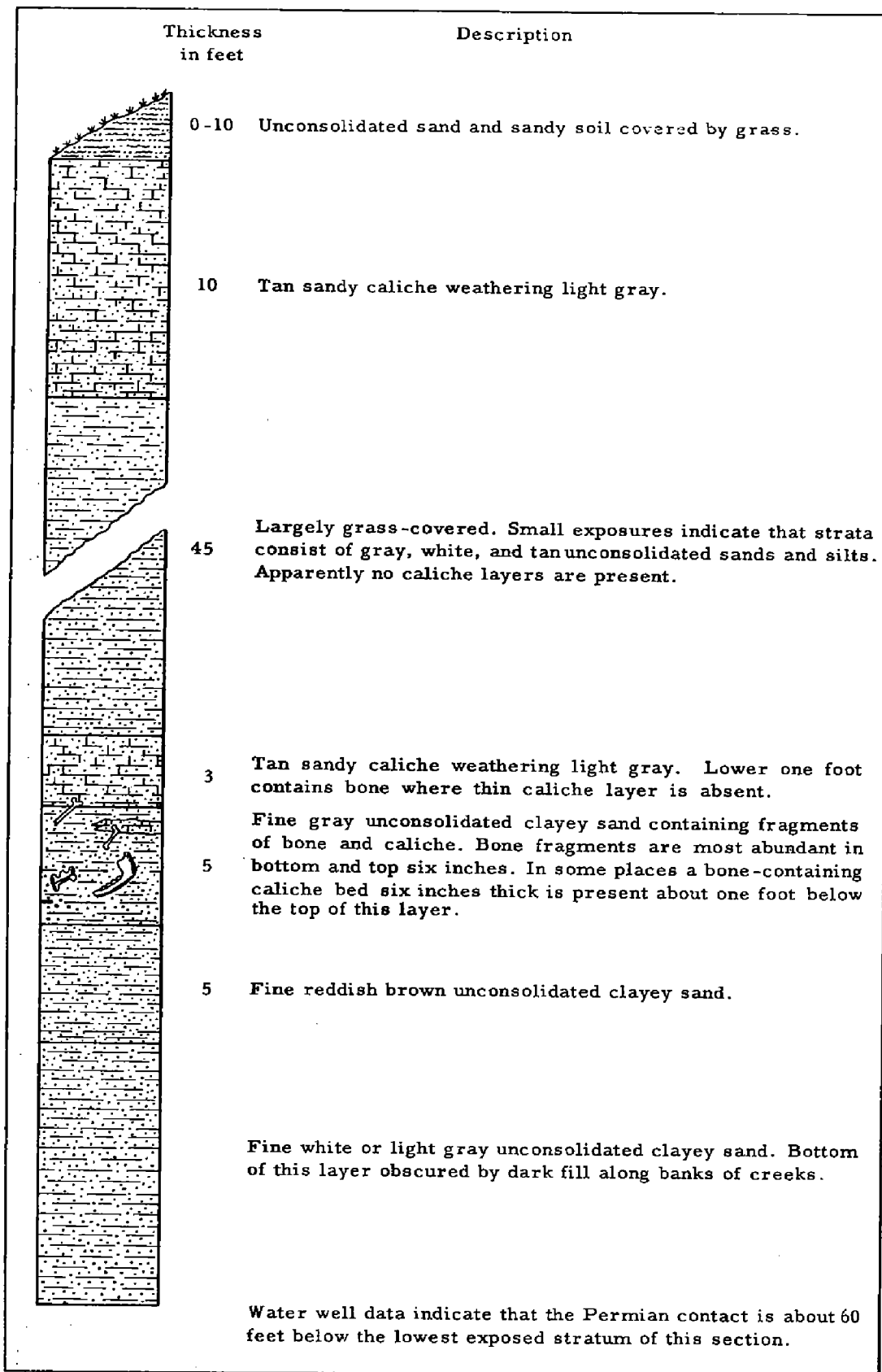


Figure 2. Columnar section of the Ogallala group at the Arnett locality.

GEOLOGIC SECTION

The section at Arnett consists of unconsolidated fine clayey and silty sands, and layers of calcareous "caliche" or "mortar beds" which contain large amounts of fine sand. There are no coarse channel sands or gravels exposed in the area, the coarsest material being a few well rounded caliche fragments of pebble size contained in the sands. The sands were presumably deposited in lakes or upon flood plains. The caliches are probably of secondary origin.

The fossils are sparsely distributed in a bed of fine clayey, silty sand about three feet in thickness. The bones are well mineralized and are hard. All of the specimens are fragmentary and the broken edges are sharp. No articulated specimens were found. After the soft parts had decomposed the bones were apparently broken and scattered, perhaps by carnivores and scavengers. It is possible that the bones were transported a short distance and deposited in ponds or playa lakes.

Deposits which accumulated in the manner suggested above would certainly not contain the remains of a representative sample of the fauna living in the area at the time. Mastodonts and large carnivores are by far the most abundant faunal elements preserved, a fact which suggests that the carnivores were preying upon the mastodonts or, particularly in the case of the hyaenoid dogs, feeding upon the carcasses of mastodonts which had died on the flood plain.

There is a striking scarcity of limb bones in the collection, which may be at least partly the result of selective collecting.

At some places a thin calcareous layer overlies the bone containing sand, and itself contains bone. Where the thin layer of caliche is absent, the base of the massive caliche layer contains bone, which is in some instances surrounded by a thin layer of unconsolidated sand. These facts strongly suggest that the caliche is of secondary origin.

Description of the Fauna

Order Carnivora

Family Canidae

Genus *Osteoborus* Stirton and VanderHoof, 1933

Osteoborus validus (Matthew and Cook), 1909

A fragment of a mandibular ramus containing the alveoli of I₁, I₂, I₃ and P₁; the roots of the canine, P₄ and M₁ and incomplete P₂ and P₃ (O. U. S. M., No. 40-4-S52) is so similar to the material from Higgins assigned to *Osteoborus validus* by Hesse that the two forms may be considered conspecific.

OSTEOBORUS VALIDUS

The ramus is truly remarkable for its robustness. The symphyseal surface extends backward to a point below P_3 . The area of the surface is at least three times as great as it is in a recent gray wolf. A large mental foramen is located at about the mid-height of the ramus below P_2 , while another, smaller foramen is located at the same height below a point between P_3 and P_4 .

The incisor alveoli are oriented with their long axes horizontal, that is, parallel to the long axis of the mandibular ramus, and consequently the incisors must have projected straight forward. The alveolus of I_1 is located in a ventral position well below the dorsal border of the symphysis. The I_2 alveolus is larger than that of I_1 and is located in a more dorsal position, its dorsal border being level with the dorsal border of the symphysis. The alveolus of I_3 opens close to what must have been the inferior border of the alveolus of the canine. The canine is badly broken but its preserved root clearly testifies to its large size. There is a short space between the canine and the nearly round alveolus of the single rooted P_1 .

P_2 was double-rooted and was so close to P_1 that the alveoli of the two teeth are confluent dorsally. The long axis of P_2 is not quite parallel to the long axes of the other cheek teeth. P_3 is the best preserved tooth in the series, but even it is so badly worn and broken that little can be determined about its original structure. There is a trace of a posterior accessory cusp. There is no evidence of an anterior accessory cusp, but in view of the state of wear of the specimen this is not conclusive evidence of its absence in the unworn tooth.

All that remains of P_4 and M_1 are the roots and badly broken crowns. P_4 was a large, robust tooth and slightly overlapped M_1 laterally. M_1 was very long and the root at least is rather narrow. The tooth row begins to curve a little at M_1 so that this tooth is oriented with its long axis at a slight angle to the long axis of the anterior cheek teeth.

The type specimen of *Canis haydeni* Leidy (1858) consists of a mandibular fragment with well worn P_4 - M_1 and the alveoli of M_2 and M_3 (U. S. N. M. No. 124). Scott (in Scott and Osborn, 1890) referred a lower jaw fragment containing P_2 and P_3 , broken M_1 and the alveoli of the other cheek teeth to this species, changing the generic reference to *Aelurodon*. In this specimen the anterior cheek teeth are relatively rather small and are not in the least crowded.

In 1909 Matthew and Cook designated a specimen from the Snake Creek beds (A. M. N. H. No. 14147) as the type of a new "mutation" of the species, *Aelurodon haydeni validus*. This specimen differs from the

OSTEOBORUS VALIDUS

one described by Scott in that the alveoli for P₂ and P₃ were set somewhat obliquely in the jaw. It is of course impossible to guess the orientation of these teeth in the type specimen since everything anterior of P₄ is missing. Stirton and VanderHoof (1933, p. 179) stated, "*Aelurodon haydeni validus* Matthew and Cook is almost certainly not an *Aelurodon* because of the greatly shortened premolar space with its transversely set alveoli."

VanderHoof and Gregory in their revision of the genus *Aelurodon* (1940, p. 146) recognized *A. haydeni* as a valid species. They stated, "The type specimen shows distinctly the stepped posterior borders of the third and fourth premolars, indicating affinities with other *Aelurodons*. The species is the largest known at present." They referred two other specimens to the species. These specimens will be discussed in the next section of this paper.

Hesse referred *A. h. validus* to *Osteoborus*, even though he stated that the teeth are not set transversely in the jaw. The transverse orientation of these teeth, however, was the only character by which Matthew distinguished his Snake Creek specimen and the specimens referred to *Aelurodon haydeni*. The anterior premolars of the Higgins specimens are, however, crowded, and appear to me to be slightly transverse in their orientation.

I have referred the specimen from Arnett to *Osteoborus validus* because of its near structural identity to the Higgins specimens and because the anterior premolars are slightly transversely oriented in the jaw. I suspect, however, that when more material pertaining to this species becomes available it will be revealed that the crowding of the anterior premolars is an extremely variable character, as it is for example in *Osteoborus cynoides* (see Matthew and Stirton 1930).

Table 1. Measurements of the teeth of specimens of *Osteoborus validus*

		<i>Osteoborus validus</i> from Higgins U. C. M. P. No. 31517	<i>Osteoborus validus</i> from Arnett O. U. S. M. No. 40-4-S52	<i>Aelurodon haydeni validus</i> from Snake Creek A. M. N. H. No. 14147
P ₂	L	12.0		
	W	7.8		
P ₃	L	15.3	15.6	
	W	9.3		
P ₄	L	25.6	22.6	22.0
	W	14.4		*8.0
M ₁	L	37.6	38.8	36.0
	W	16.8		15.2

*This measurement is surely in error. Actually about 13.0.

Genus *Aelurodon* Leidy, 1858
Aelurodon cf. *mortifer* (Cook) 1914

Three nearly complete mandibular rami and two mandibular fragments from Arnett (O. U. S. M. Nos. 40-4-S26, 40-4-S28, 40-4-S29, 40-4-S31 and 40-4-S39) are apparently very close to *Tephrocyon mortifer* Cook (1914). Unfortunately there are no measurements accompanying the original description, but judging from the figures the type specimen must be very nearly the same size as the specimens described here, and judging from the figures and description, nearly identical in structure.

The mandibular ramus differs from that of *Canis* in that it is relatively much deeper and thicker. The inferior border is moderately convex through much of its length. Between a point beneath M_1 and the angular process it rises very sharply, much more sharply than in *Canis*. The angular process is, consequently, only a little lower than the superior border of the ramus. The coronoid process is relatively higher and narrower than in *Canis*, with a convex anterior border and a concave posterior border. The mandibular notch is less deep and the condyle is not so posteriorly offset from the main body of the coronoid process as in *Canis*. The ramus does not vary greatly in thickness although it is slightly thicker across a point marked by the posterior end of M_1 than elsewhere. The tooth row is curved.

In O. U. S. M. No. 40-4-S31 a very worn left I_3 is preserved along with the alveoli of I_1 and I_2 . The alveoli are arranged in much the same way as they are in the specimen of *Osteoborus validus* described above, that is with the alveolus of I_2 well dorsal to that of I_1 and I_3 .

It is probable that P_1 was present in most or all individuals because either the tooth or its alveolus is present in the four specimens (S29, 39, 31, 28) in which the anterior portion of the mandible is preserved. The tooth is small and is single rooted. There is, even in this small tooth, clear indication of a relatively large anterior cusp, a low accessory cusp posterior to it, and an even smaller posterior cingular accessory cusp.

P_2 is much larger than P_1 and is double-rooted. The roots, however, are so close together that they are nearly fused. There is a large broad-based cusp located slightly anterior of a point midway between the anterior and posterior borders, a prominent but much smaller and lower posterior accessory cusp, and a still smaller posterior cingular accessory cusp. There is no anterior accessory cusp.

P_3 is essentially like P_2 . It is, however, slightly larger and its roots are more widely separated.

The main cusp of P_4 has the appearance of being pitched backward. The crest of this tooth is located about halfway between the anterior and

AELURODON MORTIFER

posterior borders of the tooth. The accessory cusp is crowded close behind the main cusp. A posterior cusp, as in P_2 and P_3 is apparently formed of the upturned cingulum. In one specimen (S28) there is a small cusp close to the base of P_4 at the anterior end of the tooth and just internal of the ridge which forms the anterior border of the main cusp.

M_1 is a robust tooth with a prominent metaconid. The talonid is a little narrower than the anterior portion of the tooth. The entoconid and the hypoconid are prominent and of about equal size. The equal height of the entoconid and hypoconid is cited by VanderHoof and Gregory (1940) as characteristic of *Tephrocyon mortifer* and *Aelurodon haydeni*. In *Aelurodon taxoides*, which is about the same size as these forms, the hypoconid is larger.

M_2 is of typical canid structure. It narrows somewhat posteriorly. In no specimen is M_3 preserved.

The well worn dentitions reveal that the principal wear has been upon the crowns of the teeth. Even the carnassials show little lateral wear.

Two maxillary fragments, one containing P^2 - M^2 (40-1-S22) and the other containing P^3 - M^2 and the alveoli of P^1 and P^2 (40-1-S40) may, I think, be reasonably associated with the lower jaw material assigned to *Aelurodon mortifer*. The upper dentitions occlude quite well with some of the lower dentitions. The teeth are considerably smaller than those in a skull of *Osteoborus validus* from Higgins described by Johnston (1939):

The alveolus of the canine indicates that this tooth was more robust than the lower canine. The alveolus of the single-rooted P^1 is located so close to the alveolus of the canine that they are narrowly confluent antero-laterally.

P^2 is double-rooted. The point of the broad-based main cusp is located somewhat anterior of a point midway between the anterior and posterior borders of the tooth. At the anterior edge of the tooth is a small cusp which rises just above the cingulum. Just posterior of the main cusp is a small accessory cusp, and, at the posterior edge of the tooth, the merest trace of a cusp rising from the cingulum.

P^3 differs from P^2 only in being of larger size. P^4 is a relatively large and robust tooth. Both the protocone and the parastyle are more prominent than in *Osteoborus cynoides*, and of about the same relative size as those in other species of *Aelurodon*. M^1 and M^2 are robust teeth of typically canid character. The internal portions of both of these teeth are deflected posteriorly.

VanderHoof and Gregory in their revision of the genus *Aelurodon* (1940, p. 144) state: "*Osteoborus* differs from *Aelurodon* in the shortening of the jaw and muzzle with corresponding reduction in size of the

anterior premolars, as well as the loss on these teeth of the stepped cusps, resulting in a nearly central position of the low main cusp." If relative size of P_3 and P_4 can be used as a measure of anterior premolar reduction, examination of specimens referred by these authors to *Aelurodon* and specimens which they tacitly refer to *Osteoborus* by excluding them from *Aelurodon*, will reveal that this character alone is not sufficient to distinguish the two genera. The anterior premolar reduction in *Tephrocyon mortifer* Cook, referred by VanderHoof and Gregory to *Aelurodon haydeni*, and in some specimens referred to *Aelurodon taxoides* is at least as marked as in specimens which have been referred to *Osteoborus*; for example, the type specimen of *O. ricardoensis* (see table 2). In species referred to *Aelurodon* the accessory cusps are well-developed, while in those referred to *Osteoborus* these cusps are weak or absent.

Osteoborus diabloensis (Richey 1938), except for its smaller size, is similar to the Arnett material described above. The anterior premolars are relatively small in comparison to P_4 , but they are well spaced and show well developed accessory cusps.

This evidence seems to suggest that in the genus *Aelurodon* there was a tendency toward reduction of anterior premolars without the loss of accessory cusps and without the crowding seen in *Osteoborus*. In the species assigned to *Aelurodon* by VanderHoof and Gregory a gradation from Miocene and earliest Pliocene forms with relatively large anterior premolars to later Pliocene forms with reduced anterior premolars is evident. *Tephrocyon mortifer* and *Osteoborus diabloensis* perhaps represent the culmination of this trend.

VanderHoof and Gregory tentatively referred *Tephrocyon mortifer* Cook (1914) to *Aelurodon haydeni*. They state that although the type specimen is about the size of *Aelurodon taxoides* it differs in having an entoconid equal in size to the hypoconid. A further marked difference is the greater relative premolar size in most specimens which have been referred to *A. taxoides*. Since I have referred some of the canids in the Arnett fauna to *A. haydeni* and some to *A. mortifer* the question of their synonymy is important in the present context.

The five specimens which I have referred to *Aelurodon* comprise a remarkably homogeneous group. The specimen which I have referred to *Osteoborus validus* differs very markedly from these in having larger teeth and a more massive jaw. As far as can be told from the material at hand the specimens are otherwise similar. If we consider the six specimens as a group the size distribution is strongly bimodal. It is possible that the large specimen represents an extreme individual variant, but I think that this is unlikely. In the Higgins fauna no specimens similar to the ones I

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have assigned to *A. mortifer* are present, but *O. validus* is represented. In the Higgins fauna there is a second canid, *Osteoborus cynoides*, which has not been found at Arnett. This form is distinctive and there is little probability that the individual specimens referred by Hesse to this species

Table 2. Measurements of the teeth
of *Aelurodon* cf. *mortifer* from Arnett
and two species of *Osteoborus*

		<i>Aelurodon</i> cf. <i>mortifer</i> from Arnett			<i>Osteoborus</i> <i>diabolensis</i>	<i>Osteoborus</i> <i>diabloensis</i>	<i>Osteoborus</i> <i>ricardoensis</i>
		N	OR	M	U. C. M. P. U. C. M. P.	U. C. M. P.	L. C. M.
					No. 33476	No. 34640	No. 6
C	L	1		14.0			
C	W	1		11.6			
P ₁	L	2	5.0-5.7	5.35	3.3		
	W	2	4.4-4.8	4.60			
P ₂	L	3	9.1-9.9	9.60	8.6		9.5
	W	3	5.7-6.3	6.23	5.1		6.8
P ₃	L	4	10.8-12.5	11.70	10.2	9.8	12.9
	W	4	6.5-8.5	7.40	6.0	6.8	8.9
P ₄	L	6	18.0-21.1	19.22	16.7	14.9	20.5
	W	6	11.1-12.3	11.47	9.1	10.2	12.9
M ₁	L	6	31.9-36.0	33.72	26.0	25.8	34.0
	W	6	13.5-14.4	13.73	10.4	11.5	14.5
M ₂	L	2	15.0-15.9	15.45		12.6	16.0
	W	2	10.0-10.7	10.35		9.1	11.8

are conspecific with those referred to *O. validus*. It is probable, I think, that two species are present in each fauna, the smaller canid niche being filled by different species in each fauna.

A specimen from the Esmeralda formation consisting of a skull, lower jaw fragment with M₂ and M₃, and skeleton was referred to *A. haydeni* by VanderHoof and Gregory. Whatever its proper systematic position, in its lower teeth this specimen is much closer to the type specimen of *Tephrocyon mortifer* and the Arnett material here considered conspecific with it, than it is to the type specimen of *A. haydeni*.

Family Felidae
Genus *Albanosmilus* Kretzoi, 1929
Albanosmilus? sp.

The machairodont material in the Arnett collection consists of a left mandibular fragment with P₄ and M₁ and the alveoli of I₁, I₂, I₃, C and P₃. Most of the flange and the posterior portion of the jaw is lacking. The species represented by this specimen is quite clearly allied to *Eusmilus whitfordi* Barbour and Cook (1915), *Ischryosmilus osborni* Merriam (1919) and "*Megantereon*" *whitfordi* (Gregory, 1942), and to several as yet undescribed specimens from the Hemphillian deposits of Nebraska.

Table 3. Measurements of the lower jaws
and dentitions of specimens of *Albanosmilus?*
from North America

	Arnett local fauna O. U. S. M. No. 36-4-S16	Big Spring Canyon local fauna (Gregory 1942) U. C. M. P. No. 32307	Ricardo local fauna (Merriam 1919) U. C. M. P. No. 19416
Anterior Side	103.0	84.7	81.0
C to post. side M ₁			
Depth symphysis	55.5	48.5+	
C-P ₃ (alveoli)	49.2	39.7	
Diastema	31.7	21.8	26.5
L alveolus P ₃	7.7	5.9	7.0
L P ₄	20.9	18.0	16.7
L M ₁	33.0	25.9	24.0

Table 4. Measurements of the
limb bones of *Albanosmilus?* from Arnett
(Measurements in centimeters)

	36-13-S1	36-13-S3	36-14-S1	36-14-S2	36-21-S3	36-23-S2	36-23-S3
	Humerus	Humerus	Radius	Radius	Femur	Tibia	Tibia
Total length	23.2	23.0	22.7	23.2	25.4	23.3	21.5

Gregory (1942) has discussed the affinities of the described specimens at some length. He referred them all to "*Megantereon*" *whitfordi*, using "*Megantereon*" in a broad sense. The North American "*Megantereon*" is apparently very close to *Machairodus jourdani* Filhol (1883) upon which Kretzoi had based the genus *Albanosmilus*. Matthew (1929) referred Filhol species to *Megantereon* while recognizing that it might prove to be generically distinct. Because the type specimen of *Albanosmilus jourdani* lacks the anterior portion of the jaw and consequently the flange, Gregory felt that he could not refer the North American specimens

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to *Albanosmilus* because of the lack of evidence of similarity of the flange structures in the two forms. Gregory pointed out that "*M.*" *whitfordi* is probably entitled to generic distinction from "*Megantereon*" but that it is more closely related to this genus than to others. Gregory now feels (personal communication) that his "*M.*" *whitfordi* might better be referred to *Albanosmilus*. I agree with him in this and I have tentatively referred the Arnett form to that genus.

The Arnett form may well be specifically distinct from other specimens of the group since it is considerably larger than any of the described specimens and smaller than the undescribed specimens from the middle Pliocene of Nebraska. I do not, however, intend to compound the confusion by designating this specimen as the type of a new species.

The felid limb bones in the Arnett collection fall into two distinct size groups. Bones which fall into the small size group I have tentatively associated with the jaw described above. These bones are typically felid in character. They are slightly longer and considerably more robust than those of a recent adult African leopard in the collection of the Stovall Museum.

Order Proboscidea Family Gomphotheriidae Genus *Serridentinus* Osborn, 1923 *Serridentinus* sp.

The proboscidian specimens constitute the most conspicuous element in the Arnett fauna not only because of their large size but because of the large number of specimens. Morphologically these specimens form a homogenous group and there is little reason to believe that more than one species is represented.

The worn molars are impossible to distinguish from those of *Gomphotherium*. Examination of the several unworn teeth, however, reveals no trace of the central conules cited by Osborn (1936) as characteristic of the unworn teeth of *Gomphotherium*. On the other hand there are very well developed crests arising from the internal cones of the upper molars and the external cones of the lower molars. This character is presumably one which serves to distinguish *Serridentinus* from *Gomphotherium*.

The material consists of a partial skull (O. U. S. M. No. 28B-1-S2), maxillary fragments (O. U. S. M. Nos. 28B-2-S1, 28B-2-S2, 28B-2-S7, 28B-2-S16), mandibular fragments (O. U. S. M. Nos. 28B-4-S5, 28B-4-S6, 28B-4-S7, 28B-4-S8, 28B-4-S9, 28B-4-S11, 28B-4-S13), and isolated lower molars (O. U. S. M. Nos. 28B-26-S17, 28B, 26-S19, 28B-26-S28).

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There are three lophs on M^2 with complete simple internal trefoils on the protoloph and metaloph. The trefoil on the tritoloph consists of a simple anterior spur and a smaller posterior spur which is deflected laterally. There are no unworn specimens of M^2 in the collection.

There are $3\frac{1}{2}$ or 4 lophs on M^3 . Complete internal trefoils are present on the protoloph and metaloph. The internal trefoil on the tritoloph consists of a prominent anterior spur and the faintest suggestion of a posterior spur. In unworn teeth the internal cones are bluntly rounded and in some cases slightly bifid. The anteroexternally and posteroexternally directed crests arise from these internal cones of the protoloph, metaloph and tritoloph. The crests are not sharply serrated, the edges consisting of a variable number of low, blunt conelets. The posterior loph or half loph consists of two conelets the most lateral of which is elongated antero-posteriorly. The external portions of the protoloph and metaloph consist of transverse ridges bearing three small conelets which disappeared after slight wear, leaving level transverse ridges. The external parts of the tritoloph and the tetartoloph consist of only two conelets. The cingulum is very obscure internally and was apparently absent externally. Among the specimens available there is some variation in the number of conelets on the external ridges, and in the form and angle of the spurs.

The only M_2 in the collection is so well worn that little can be said of its structure beyond the obvious fact that three lophs are present.

There are $4\frac{1}{2}$ lophs in M_3 with complete, simple external trefoils on the protolophid, metalophid and tritolophid. The trefoil on the tetartoloph is incomplete, consisting only of an anterior spur. The posterior half lophid consists of a variable number of small conelets. In unworn condition the internal part of the anterior four lophids consists of two closely applied blunt conelets. Internally there is a single large, bluntly rounded cone. The spurs resemble the spurs on M^3 in being edged with small, blunt conelets, but differ from the spurs of the upper tooth in being directed almost anteriorly and posteriorly.

DP_4 is three-lophed. Both available specimens are unworn. Except for its smaller size this tooth is in general like M_3 in that the spurs are anteriorly and posteriorly directed. The external portion of each lophid consists of a single cone and the internal portion consists of a bifid transverse ridge. DP_3 is in all essentials like DP_4 . There is a single two-lophed DP_2 in the collection, which is very well worn.

In our collection is the cast of the lower jaw of a juvenile, the original of which is in the museum of Northwestern State College, Alva, Oklahoma. It is remarkable that this specimen is very similar to the type specimen of *Trilophodon willistoni* (Barbour, 1914), a fact which, I be-

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lieve, is indicative of the marked homogeneity of the lower jaw characters of the mastodonts rather than of any special relationship of the two species. The only difference of any note between the two specimens is that in the type of *T. willistoni* the lingual groove is apparently relatively deeper. The fragmentary adult jaw material in the collection is similar to the juvenile specimen.

Table 5. Measurements of teeth of
Serridentinus sp. from Arnett
(Measurements in centimeters)

		N	OR	M
DP ₂	L	1		3.3
	W	1		2.4
DP ₃	L	5	7.4-8.3	7.82
	W	5	4.4-4.7	4.56
DP ₄	L	3	9.0-13.1	10.43
	W	3	5.1-6.5	5.60
M ₂	L	1		12.4
	W	1		7.2
M ₃	L	5	18.2-24.0	20.48
	W	5	8.0-9.2	8.52
M ²	L	2	9.9-12.4	11.15
	W	2	7.9-8.1	8.00
M ³	L	6	15.9-19.1	17.17
	W	6	7.8-9.5	8.82

The species of *Serridentinus* are difficult if not impossible to determine. The material referred to each named species is so meager that often there is no part in common between two such species. In no case is sufficient material available to allow any evaluation of intraspecific variability.

I might hazard one guess as to the relationships of the Arnett mastodonts. The material resembles quite closely in all comparable parts the type and paratype specimens of *Serridentinus anguirivalis* (Osborn, 1926) from the Snake Creek beds. The resemblance of the trefoil spurs is particularly striking in that the conulets on the crests of the spurs characteristic of most species of *Serridentinus*, are in these two forms absent. The paratype, an M³, is broken but the type specimen, an M², compares closely in size with M²s, from Arnett.

Order Perissodactyla

Family Equidae

Dr. R. A. Stirton has examined the horse material from Arnett. I wish gratefully to acknowledge his help.

Genus *Pliohippus* Marsh, 1874

Pliohippus sp.

There are several well worn upper molars in the collection which may be assigned to *Pliohippus*. These specimens are not sufficiently well preserved nor abundant to allow for any, even a tentative, specific determination.

Genus *Neohipparion* Gidley, 1903

Neohipparion occidentale (Leidy), 1856

The material referable to *Neohipparion* consists of an associated lower dentition with P₂-M₃ (O. U. S. M. No. 16-4-S12). Dr. Stirton (personal communication) has determined that this specimen is referable to the *occidentale* group. He feels that from the degree of hypsodonty it might be slightly younger than the Higgins specimens of *Neohipparion*. Dr. Stirton goes on to point out, however, that the Higgins specimens are all well worn so that an accurate comparison of the two samples is impossible.

Family Rhinocerotidae

Genus *Aphelops* Cope, 1873

Aphelops sp.

The rhinoceros material in the Arnett collection consists of two isolated upper premolars (O. U. S. M. Nos. 19-25-S26 and 19-25-S50) and fragments of three upper molars (O. U. S. M. Nos. 19-25-S26, 19-25-S31 and 19-25-S39).

In the upper premolars the crochet is strong, extending about half way across the prefossette. There is a well marked anticrochet which nearly touches the crochet. The valley is open internally. The upper molar specimens are sufficiently preserved to show that they are essentially the same in structure as the premolars. All of these teeth may be characterized as moderately brachyodont.

These specimens are probably assignable to *Aphelops*. They are quite similar to, but a little smaller, than the Higgins rhinoceros assigned to *Aphelops mutilus* by Matthew (1932), and to *Aphelops malichorhinus* by Hesse (1940).

Order Artiodactyla

Prostennhops sp.

The material in the Arnett collection referable to *Prostennops* consists of a maxillary fragment with parts of P², P³ and P⁴ (O. U. S. M. No. 20-2-S3), a fragment of a right mandibular ramus containing parts of M₁ and M₂ (O. U. S. M. No. 20-4-S7) and a fragment consisting of the anterior portion of the lower jaw with the alveoli of the canine and incisors preserved on both sides (O. U. S. M. No. 49-4-S1).

Judging from their relative sizes, the upper and the lower teeth are probably referable to the same species. The upper teeth are about the size of those of the type specimen of *Prostennhops ziegleri* Marsh (1871) and they exhibit the rugosity of surface characteristics of that species. The lower teeth, on the other hand are close to both *P. condoni* Marsh (1871) and *P. longirostris* Thorpe (1924) in size. The enamel of the teeth of *P. condoni*, however, is smooth, differing in this respect from the Arnett material. Because *P. ziegleri* is based on upper teeth and *P. longirostris* is based on a lower jaw, they may actually be conspecific.

The locality mentioned in the original description of *P. ziegleri* is "Grizzly Buttes, base of Uintah Mountains". This would, I presume, put it somewhere in the Bridger formation. It is almost certain that the locality is incorrect. The locality for *P. longirostris* is almost as confusing, being given as "Near John Day region, Oregon". The type specimen may well be from the Mascall formation.

Age and Correlation of the Arnett Local Fauna

Three Arnett forms have been at least tentatively referred to Snake Creek species. It is well known that the Snake Creek "fauna" is mixed, possibly including forms of from Barstovian to Hemphillian age. Until the stratigraphy within the Snake Creek beds is better understood the significance of the similarity of Arnett species to certain Snake Creek species is difficult to interpret, but this resemblance is not inconsistent with the conclusions concerning the age of the Arnett fauna reached below.

The Arnett fauna includes a number of species that are identical to or closely related to species in the nearby Higgins fauna. I believe that the Arnett fauna and the Higgins fauna are nearly equivalent in age. Hesse (1940) concluded that the Higgins fauna is of late Clarendonian or early Hemphillian age.

The species in the Higgins fauna most suggestive of Hemphillian age is *Osteoborus cynoides*. *O. cynoides* is absent from the Arnett fauna but another hyaenoid dog, here referred to *Aelurodon mortifer*, is repre-

AGE AND CORRELATION

sented by a number of specimens. *A. mortifer* is in general the least specialized of the two species in that the anterior premolars retain their accessory cusps and are not crowded. The two species, however certainly do not stand in an ancestral-descendant relationship to one another and the fauna containing the most specialized species is not necessarily the youngest.

The specimens from this fauna referred to *Aelurodon*, however, are very similar to and possibly conspecific with a form which may well be of Clarendonian age (*Tephrocyon mortifer* from the Snake Creek beds) and seem to be closely related to species of *Aelurodon* of known Clarendonian age (for example *A. taxoides*) from which it may be descended. The Arnett form is, however, somewhat more specialized than the typical Clarendonian species and possibly represents the end member of a particular phylum of hyaenoid dogs which survived only until late Clarendonian or early Hemphillian time.

It is customary to regard the range of *Aelurodon* as Upper Miocene to Lower Pliocene. If reference of the Arnett specimens to *Aelurodon* is correct, then it is certain that this species represents the most or nearly the most specialized of the genus.

Osteoborus validus has been known previously only from the Higgins and Snake Creek faunas.

The specimen referred in this paper to *Albanosmilus?* sp. is larger than the closely related species *Albanosmilus? whitfordi* of Clarendonian age and smaller than closely related species from middle and upper Pliocene faunas in Nebraska. These facts at least suggest that the Arnett species may be phylogenetically and consequently temporally intermediate between the Clarendonian and Hemphillian forms.

Hesse referred several fragmentary felid specimens from Higgins to *Machairodus catocopis* Cope. Burt (1931) had mentioned these Higgins specimens in his paper on the Hemphill machairodonts. He noted that the Higgins form was quite different from *Machairodus catocopis* from Hemphill and stated that when more material became available it might be necessary to refer them to another genus. Two complete lower jaws from Arnett to be described in a separate paper, clearly show that neither they nor the closely similar Higgins specimens are referable to *Machairodus*, but are probably conspecific with Macdonald's (1947) *Pseudaelurus thinobates* of the Clarendonian Black Hawk Ranch fauna.

Owing to the lack of adequate material for comparison, no certain specific determination of the Arnett mastodonts has been possible. They appear to be fairly close to *Serridentinus anguirivalis* from the Snake Creek. Hesse did not attempt to identify the Higgins proboscidians even

REFERENCES

to genus because of the inadequacy of the material. Further collecting at the Higgins locality in the hope of obtaining more mastodont material might shed some light on the equivalence or non-equivalence of the two faunas.

It was stated in the discussion of the horses of the fauna that Dr. Stirton thought that the Arnett *Neohipparion* might have somewhat higher crowned teeth than the Higgins horses of the same genus and consequently might be somewhat younger. Dr. Stirton stated further, however, that the Higgins specimens were well worn and that for this reason a detailed comparison was impossible.

The genus *Aphelops* has a very long temporal range. The Arnett rhinoceros is consequently of little use in determining the precise age of the fauna, particularly in view of the impossibility of the specific identification.

The recorded localities of the type specimens of *Prosthennops zieglerei* and *P. longirostris*, the species which most resemble the Arnett peccary, are either too indefinite or are in error and consequently no conclusions regarding the age of these species is possible.

I believe that on the whole the evidence reviewed above indicates that the Arnett fauna is of latest Clarendonian or earliest Hemphillian age, and perhaps a little older than the nearby Higgins fauna. It is hoped that further collecting at the Arnett locality and at newly discovered localities in the immediate vicinity will allow a more precise estimation of the age.

REFERENCES

- Barbour, E. H., 1914, Mammalian fossils from Devil's Gulch: Nebr. Geol. Survey, vol. 4, pp. 177-190.
- Barbour, E. H., and Cook, H. J., 1914, A new saber-toothed cat from Nebraska. Nebr. Geol. Survey, vol. 4, pp. 235-238.
- Burt, W. H., 1931, *Machaerodus catacopis* Cope from the Pliocene of Texas. Calif., Univ., Publ., Dept. Geol. Sci., Bull., vol. 20, pp. 261-292.
- Cook, Harold James, 1914, A new canid from the Lower Pliocene of Nebraska. Nebr. Geol. Survey, vol. 7, pp. 49-50.
- Darton, N. H., 1899, Preliminary report on the geology and water resources of Nebraska west of the one hundred and third meridian. U. S. Geol. Survey, 19th Ann. Rept., Pt. 4, pp. 727-785.
- Filhol, M. H. 1883, Notes sur quelques mammifères fossiles de l'époque miocènes. Lyon, Musée, Histoire Naturelle, Archives, vol. 3, pp. 1-97.
- Gidley, J. W., 1903, The fresh-water Tertiary of northwestern Texas. American Museum expeditions of 1899-1901. Amer. Museum Nat. History, Bull., vol. 19, pp. 617-636.

REFERENCES

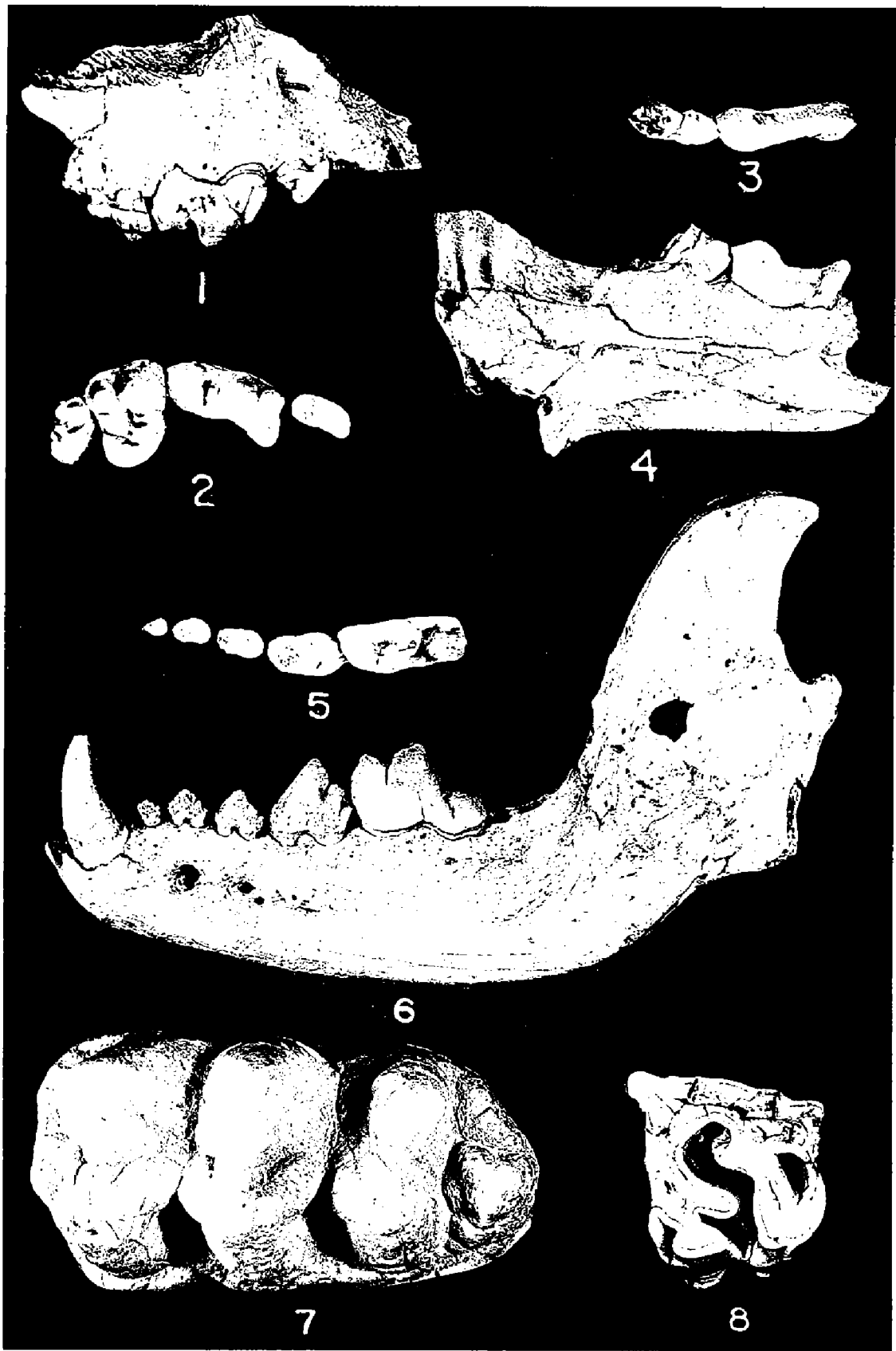
- Gregory, J. T., 1942. Pliocene vertebrates from Big Spring Canyon, South Dakota. Calif., Univ., Publ., Dept. Geol. Sci., Bull., vol. 26, pp. 307-439.
- Hesse, C. J., 1940, A Pliocene vertebrate fauna from Higgins, Lipscomb County, Texas. Texas, Univ., Publ., no. 3945, pp. 671-698.
- Johnston, C. S., 1939, A skull of *Osteoborus validus* from the early middle Pliocene of Texas. Jour. Paleontology, vol. 13, pp. 526-530.
- Kretzoi, Nikolaus, 1929, Materialien zur phylogenetischen Klassifikation der Aeluroiden. Congrès international de Zoologie, Budapest, Xe, pt. 2, pp. 1293-1355.
- Leidy, J., 1858, Notice of remains of extinct *Vertebrata*, from the valley of the Niobrara River, collected during the exploring expedition of 1857, in Nebraska, under the command of Lieut. G. K. Warren, U. S. Top. Eng., by Dr. F. V. Hayden, Acad. Nat. Sciences, Phila., 1858, pp. 20-29.
- Macdonald, J. R., 1947, The Pliocene carnivores of the Black Hawk Ranch fauna. Calif., Univ., Publ., Dept. Geol. Sciences, Bull., vol. 28, pp. 53-80.
- Marsh, O. C., 1871, Notice of some new fossil mammals and birds from the Tertiary formation. Amer. Jour. Science, vol. 102, pp. 35-44.
- Matthew, W. D., 1929, Critical observations upon Siwalik mammals. Amer. Museum Nat. History, Bull., vol. 56, pp. 437-560.
- Matthew, W. D., 1932, A review of the rhinoceros with a description of *Aphelops* material from the Pliocene of Texas: Calif., Univ., Publ., Dept. Geol. Sciences, Bull., vol. 20, pp. 411-480.
- Matthew, W. D., and Cook, H., 1909, A Pliocene fauna from western Nebraska. Amer. Museum Nat. History, Bull., vol. 26, pp. 361-414.
- Matthew, W. D., and Stirton, R. A., 1930, Osteology and affinities of *Borophagus*. Calif., Univ., Publ., Dept. Geol. Sciences, Bull., vol. 19, pp. 171-216.
- Merriam, J. C., 1919, Tertiary mammalian faunas of the Mohave Desert. Calif., Univ., Publ., Dept. Geol. Sciences, Bull., vol. 11, pp. 437-585.
- Osborn, H. F., 1926, Additional new genera and species of the mastodontoid Proboscidea. Amer. Museum Nat. History, Novitates, no. 238, pp. 1-16.
- Osborn, Henry Fairfield, 1936. Proboscidea. A monograph of the discovery, evolution, migration and extinction of the mastodonts and elephants of the world. Vol. 1—Moeritheroidea, Deinotherioidea, Mastodontoidea. New York, Amer. Museum Nat. History, pp. i-xi, 1-802.

REFERENCES

- Reed, L. C., and Longnecker, O. M., 1932, The geology of Hemphill County, Texas. Texas, Univ., Bull., no. 3231, pp. 1-98.
- Richey, K. A., 1938, *Osteoborus diabloensis*, a new dog from the Black Hawk Ranch fauna, Mt. Diablo, California. Calif., Univ., Publ., Dept. Geol. Sciences, Bull., vol. 24, pp. 303-308.
- Scott, W. B., and Osborn, H. F., 1890, Preliminary account of the fossil mammals from the White River and Loup Fork formations contained in the Museum of Comparative Zoology: Part II. Carnivora and Artiodactyla, by W. B. Scott. Perissodactyla, by Henry F. Osborn. Harvard College, Museum Comp. Zoology, Bull., vol. 20, pp. 65-100.
- Sellards, E. H., Adkins, W. S., and Plummer, F. B., 1932, The geology of Texas. Vol. I. Stratigraphy. Texas, Univ., Bull., no. 3232, pp. 1-1006.
- Stirton, R. A., 1936, Succession of North American continental Pliocene mammalian faunas. Amer. Jour. Science, vol. 232, pp. 161-206.
- Stirton, R. A., and VanderHoof, V. L., 1933, *Osteoborus*, a new genus of dogs, and its relations to *Borophagus* Cope. Calif., Univ., Publ., Dept. Geol. Sciences, Bull., vol. 23, pp. 175-182.
- Thorpe, M. R., 1924, A new species of extinct peccary from Oregon. Amer. Jour. Science, vol. 207, pp. 393-397.
- VanderHoof, V. L., and Gregory, J. T., 1940, A review of the genus *Aelurodon*. Calif., Univ., Publ., Dept. Geol. Sciences, Bull., vol. 25, pp. 143-164.
- Wood, H. E., Chaney, R. W., Clark, J., Colbert, E. H., Jepsen, G. L., Reeside, J. B., and Stock, C., 1941, Nomenclature and correlation of the North American continental Tertiary. Geol. Soc. Amer., Bull., vol. 52, pp. 1-48.

EXPLANATION OF PLATE I

- 1, 2. *Aelurodon mortifer* (Cook), O. U. S. M. No. 40-1-S40, fragment of right maxilla with P³-M². 1. Lateral view. 2. Crown view of cheek teeth. X $\frac{1}{2}$.
- 3, 4. *Albanosmilus?* sp., O. U. S. M. No. 36-4-S16, fragment of left mandibular ramus with P₄ and M₁. 3. Crown view of cheek teeth. 4. Lateral view. X $\frac{1}{2}$.
- 5, 6. *Aelurodon mortifer* (Cook), O. U. S. M. No. 40-4-S26, left ramus with P₂-M₁. 5. Crown view of cheek teeth. 6. Lateral view. X $\frac{1}{2}$.
7. *Serridentinus* sp., O. U. S. M. No. 28-B-4-S16 (part), left M³, crown view. X $\frac{1}{3}$.
8. *Aphelops* sp., O. U. S. M. No. 19-25-S50; X $\frac{1}{2}$.



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