AMERICAN JOURNAL OF SCIENCE

SEPTEMBER 1936

SUCCESSION OF NORTH AMERICAN CONTINENTAL PLIOCENE MAMMALIAN FAUNAS.

(Contribution from the University of California Museum of Paleontology.)

R. A. STIRTON.

ABSTRACT.

The Pliocene mammalian faunas of North America show three recognizable ages which intergrade through several intermediate faunas. A brief summary of the evidence for these ages is presented with the ranges of the genera (exclusive of the proboscidians) in the epoch. The faunas are listed alphabetically with citations to the pertinent literature.

In treating the various fossil assemblages in this paper, the term "fauna" is used to designate one or more identifiable fossils from given quarries, localities, or stratigraphic levels. Assemblages of fossils from different localities are herein recognized as one fauna when the genera and species are identical. Many of the faunas listed are undoubtedly identical but until they are better known, it seems advisable to list them separately. It is desirable that the term "fauna" should not necessarily be identified with the name of the stratigraphic unit in which the fossils occur. It is intended that these faunal names, taken from a suitable geographic name, should be names of convenience of reference only, and should at present have no standing in stratigraphic nomenclature.

It is believed that our evidence is too incomplete at present for close correlation (Lower, Middle and Upper ages of an epoch) between the eastern and western hemispheres. Until the time relationships between the New and Old World faunas are satisfactorily adjusted, it seems advisable for convenient usage to refer to the three faunal ages described in this paper as Lower, Middle and Upper Pliocene.

CONTENTS.

INTRODUCTION.

The Pliocene mammalian faunas of North America show three recognizable ages[1] which intergrade through several intermediate faunas. Until recently, these ages have not been recognized. As late as 1930, the Blanco and San Joaquin (= Upper Etchegoin) faunas were placed in the Middle Pliocene while the other faunas referable to the epoch were called Lower Pliocene or late Pliocene. It was thought that no Upper Pliocene faunas had been found with the possible exception of the Curtis Ranch fauna found in the San Pedro Valley of Arizona. Some authorities believe that only two Pliocene ages can be recognized. During the past seven years, the writer has spent most of his time collecting and studying North American Pliocene faunas and this report is a summary of the broader conclusions divided into:

1. A brief summary of the evidence for the recognition of Lower, Middle and Upper Pliocene mammalian faunal ages from North America;
2. And a list of the Pliocene faunas and the ranges of the genera (exclusive of the Proboscidea) in the epoch.

Any correlation based on incomplete faunal records must be tentative. As additional evidence appears, some of the geological ranges of genera may be extended. Thus, while some of the genera listed in this paper may seem to be characteristic of certain ages of the epoch, it is always possible that some species lived longer, yet have not been discovered. This listing of faunas and descriptions of their localities is designed to facilitate research on the Pliocene faunas. Detailed descriptions of some of these faunas will appear in forthcoming papers.

DIVISION OF THE FAUNAS.

Lower Pliocene.

The Lower Pliocene is indicated by the appearance of several new genera that have evolved from certain species of Upper Miocene genera. The most distinctive of these are *Pliohippus*, *Hipparion*, *Neohipparion*, *Nannippus*, and *Eucastor*. *Osteoborus* and *Ischyrosmilus* apparently make their first appearance at this time but we do not know their Upper Mio-

[1] Essentially as defined by Buckman at the behest of the Council of the Geological Society.

cene predecessors. All of these genera, except *Eucastor*, carry on into the Middle and some (*Nannippus, Neohipparion, Ischyrosmilus* and *?Pliohippus*) into the Upper Pliocene. The faunas in which they occur, then, may be identified as belonging to the Lower Pliocene not only by the progressive stage of the fauna as a whole but by the presence of several genera that carry over from Upper Miocene. These Upper Miocene-Lower Pliocene genera are *Aelurodon*, *Amphicyon*, *Hypohippus*, *Procamelus*, *Alticamelus*, *Merycodus* and certain genera of the family Oreodontidae. With the beginning of the Middle Pliocene, these genera are gradually replaced by more advanced or different genera and species.

Middle Pliocene.

Many new genera appear in the Middle Pliocene. *Dipoides* and *Capromeryx* seem to be the direct descendants of Lower Pliocene species of *Eucastor* and ? *Merycodus*. The horse teeth are higher crowned and the species are distinct for the most part from those in the Lower Pliocene. Genera of other mammals coming into the record for the first time and of uncertain ancestry are *Agriotherium* (Syn. *Hyaenarctos*), *Plesiogulo*, *Machairodus*, *Sphenophalos* and *Ilingoceros*. Ground sloths reached North America with the beginning of the Middle Pliocene but generic determination cannot be made from most of the specimens. Several mammalian genera appear to have died out or evolved into other genera at the close of the Middle Pliocene; some of these are *Dipoides*, *Osteoborus*, *Agriotherium*, *Plesiogulo* and *Calippus*,[2] also the rhinoceroses which had been so abundantly represented since the Eocene disappeared in North America at this time.

Upper Pliocene.

While the Lower Pliocene faunas intergrade almost imperceptibly with those in the Middle Pliocene, there is less evidence for an intergradation between Middle and Upper Pliocene faunas. There is good evidence now that *Equus*[3] is a descendant of an advanced species of *Calippus* and that advanced species like *Neohipparion gidleyi* and *Nannippus phlegon* are

[2] Given generic rank by Stirton, 1935B.
[3] Stirton: 1935B.

derived from Middle Pliocene species of *Neohipparion* and *Nannipus*. *Megatylopus* carries on into the Upper Pliocene but species of the genus are not sufficiently known to be of much correlative value. *Ischyrosmilus*, though not represented from Middle Pliocene faunas, has advanced considerably over the Lower Pliocene species. Some of the most characteristic Upper Pliocene genera appearing for the first time are *Glyptotherium*, *Mimomys*, *Borophagus*,[4] *Equus* and *Platygonus*. There seems, then, to be as much of a faunal break between the Middle and Upper Pliocene as there is between the Upper Pliocene and Pleistocene, although there are genera that carry over each of these arbitrary boundaries.

USE OF FAUNAL NAMES.

In treating the various fossil assemblages in this paper, the term "fauna" is used to designate one or more identifiable fossils from given quarries, localities or stratigraphic levels. Assemblages of fossils from different localities are herein recognized as one fauna when the genera and species are identical. In this connection, it should be noted that there are at least six widely separated localities in Donley County, Texas, where fossils of the Clarendon fauna have been found. Many of the faunas listed here are undoubtedly identical; but until the faunas are better known, it seems advisable to list them separately. It is desirable that the term "fauna" should not necessarily be identified with the name of the stratigraphic unit in which the fossils occur. It is intended that these faunal names (taken from a suitable geographic name) should be names of convenience of reference only, and should have no present standing in stratigraphic nomenclature.

Some of the names that have been used interchangeably for formations and faunas are, of course, retained because of their direct associations and relations; i.e., John Day formation and John Day fauna—Chanac formation and Chanac fauna. On the other hand, in the Ogallala formation (Hesse, 1935), there are a number of faunas ranging at least from Lower to Upper Pliocene that cannot be referred to under one faunal name. Furthermore, in the *Biorbia fossilia* zone (Elias, 1935) of this formation, there are at least five distinct vertebrate faunas.

[4] *Hyaenognathus* = *Borophagus*. See Stirton and VanderHoof, 1933.

Thus a fauna may occur in one or more formations, or it may be found in one or more layers or zones within a formation. But in a region where rapid deposition has presumably taken place, there may be no evolutionary or migrational change in a fauna while several hundred feet of sediment is being laid down.

It appears that the terrestrial fossil mammals of the Pliocene offer poor evidence for the accurate zoning of the formation in which they occur. Many of the fossil assemblages are found in stream channel deposits that cannot be traced laterally or very far along the old stream course. Stream channel deposits frequently are difficult to interpret because of the mixing of faunas which may occur. Often a stream may cut through one or more older formations or deposits and pick up fossils only to redeposit them with the remains of the species living in the area at the time. Matthew (1924, pp. 62-63) called attention to conditions like this in the Snake Creek fauna of Nebraska. In the summer of 1934, I had the opportunity to collect for two hours in the "Pits south of Pliohippus Draw" in the Snake Creek area. In that short time, I found horse teeth ranging from *Merychippus primus* (Middle Miocene) to extremely advanced species of *Neohipparion*, as well as teeth of *Castor* cf. *californicus*, an Upper Pliocene beaver. It is interesting to note in this connection that the *Merychippus primus* teeth did not seem to be any more water worn than those of the later horses. The only way that the age of such fossils can be determined is by comparison with faunas of other areas where no mixture in the fossil assemblages has taken place. The age of the deposit can usually be recognized by the most advanced species found.

Designation of a vertebrate fauna from one or more localities by some catch phrase involving the use of the name of the most common genus is a confusing procedure. Bone deposits of equivalent age and representing the same fauna may be subsequently found in which other genera are more characteristic, and it is unthinkable to establish faunal facies on the incomplete material that now represents our late Tertiary mammalian faunas. Also confusing is the use of the so-called "index" fossil which may eventually turn up in other deposits of different age. Locality numbers or letters are sometimes used to designate faunas, but it is felt that this may result in a characterless array of numbers subject to considerable duplications by other workers.

By applying faunal names, as I have done in this paper, I hope to avoid confusion in the handling of my evidence, especially the fossil evidence, from isolated areas where the geological relations are obscure. Until the stratigraphic evidence becomes clear, it would seem better to consider the fossil assemblages in their biological rather than their geological aspects. Stratigraphic relations are, so far as possible, kept in mind so that eventually the faunas can be used in the correlation of stratigraphic units.

In following this plan, and by presenting exact locality data, it is hoped to avoid such meaningless names as "Loup Fork" and "Republican River."

CORRELATION WITH OLD WORLD FAUNAS.

After much investigation of the described Eurasiatic faunas, the information on their stratigraphic positions and the ineffectual attempts to tie in these land-laid deposits with the marine type sections, I find now that only a tentative correlation can be made with the ages discussed here. Two important points, however, have arisen for consideration.

(1) Can homotaxis and synchrony, as used in the broad sense by Matthew in his "Climate and Evolution," be applied to the Lower, Middle and Upper faunal ages of a Tertiary epoch[5]?

(2) Are there two faunal ages in the Old World Hipparion faunas, especially in southeastern Europe, that have not been fully recognized and separated?

A comparison of the list of recent mammals that occur in the Holarctic region indicates that much intermigration has taken place without any appreciable evolutionary change. I refer to such genera as *Canis*, *Felis*, *Ursus*, *Mustela*, *Castor*, *Lepus*, *Ovis*, *Cervus*, etc. If, then, we recognize that the Old

[5] To quote from Matthew (1913, p. 290), "These considerations [Correlation of homotaxial ages of a phylum] have some bearing on the correlation of the Tertiary horizons in Europe and the United States; but so much of our mammalian fauna is derived from dispersal centers more or less equidistant from these two regions that no serious error can ensue from neglecting them." . . . . .

World *Hipparion*[6] arose from an advanced species of *Merychippus* in North America, as did the American *Neohipparion* and *Pliohippus*, should the earliest appearance of that genus in Eurasia represent a later stage than *H. mohavense* in North America on the principle of homotaxis? It is also quite possible that an advanced species of *Merychippus* may have reached northern Asia in late Miocene time.

The La Grive Saint Alban[7] and equivalent European faunas seem to be represented in America by the Barstow, Lower Snake Creek, etc. But the exact relationship of the numerous so-called Pontian and Sarmatian faunas is not well known. Pilgrim (1930, pp. 147-149) gives an excellent résumé of this complex situation and refers to the faunas as Sarmato-Pontian. Faunas like the Sebastopol (Borissiak, 1915), Polgradi (Kormos, 1911) and Salonique (Arambourg and Piveteau, 1929) seem to be more primitive than many of the other Hipparion faunas from the Old World and may prove to be the equivalents of those listed here as Lower Pliocene. It is also likely that faunal mixtures like those in North America also occur in the Old World (Eppelsheim, Pikermi, etc.).

On the whole, I believe that our evidence is too incomplete at present for close correlation (Lower, Middle, and Upper ages of an epoch) between the two hemispheres. About the best that can be done at present is to state that our Lower and Middle Pliocene faunas are equivalent to those ranging from the Sebastopol to the Montpellier in Europe. Until the relationships of the Old World faunas with which we are compelled to correlate are thoroughly revised, it seems advisable for convenient usage to refer to the three ages described in this paper as Lower, Middle and Upper Pliocene.

[6] In reply to one of my recent statements (Teilhard and Stirton, 1934, p. 282) that certain teeth mentioned by Pilgrim from the Chinji may or may not represent an Asiatic *Merychippus*, Dr. E. H. Colbert has informed me that he is positive that there is no *Merychippus* in the Chiji. Colbert (1935) derives the Old World Hipparions from *Nannippus gratum* (Leidy), a view which in my opinion is not supported by the present evidence. Evidence for the placing of *N. gratum* in the genus *Nannippus* instead of *Hipparion* is supported by a series of skulls, limb bones and isolated teeth in our Pliocene collection.

[7] Called Upper Miocene by those who consider the first appearance of *Hipparion* in the Old World as representing the beginning of the Pliocene.

Lower Pliocene Generic Faunal Lists[8]

	Crocker Springs	Esmeralda	Upr. Pawnee Creek	Burge	Ironside	Ellensburg	Orinda-Siesta	Mint Cañon	Ricardo	Oakdale	Chanac	Big Spring Cañon	Oak Creek	Little White River	Upr. Santa Fe	Beaver	Clarendon	Alturas	Pine Creek	Devil's Gulch (=Ainsworth)	Valentine
Meterix		x																			
Metechinus		x		?																	
Mystipterus		x																			
Hypolagus		x																			
Sylvilagus		?																			
Mylagaulus		x		x								x					x				
Epigaulus																				?	
Eucastor		x		x			x					x		x		x					
Perognathoides		x																			
Diprionomys																				x	
Peromyscus		?																			
Macrognathomys		x																			
Leptarctus																					x
Bassariscus																x					
Aelurodon		x		x					x			x		x	L				x		
Cynodesmus				x																	
?Vulpes (=Leptocyon)				x														x			
Osteoborus	x								x								?				
Ischyrocyon												x		x			?				
Amphicyon (=Pliocyon)				x													x				x
Hadrocyon									x												?
Cynarctos																	x				
Mustela									?												
Pseudaelurus		?																			?
Machairodus																	?				
Ischyrosmilus									x			x								L	?
Teleoceras			L	x								x			x		x		x	x	x
Peraceras									?												

Lower Pliocene Generic Faunal Lists[8]—(Concluded)

	Crocker Springs	Esmeralda	Upr. Pawnee Creek	Burge	Ironside	Ellensburg	Orinda-Siesta	Mint Cañon	Ricardo	Oakdale	Chanac	Big Spring Cañon	Oak Creek	Little White River	Upr. Santa Fe	Beaver	Clarendon	Alturas	Pine Creek	Devil's Gulch (=Ainsworth)	Valentine
Aphelops			L						x	x				x							
Hypohippus		x		x					?			x					x			x	x
Parahippus								L													
Merychippus[9]				x								x		x							
Hipparion					x	?	x	x	x		x										
Neohipparion		x	x	x								x		x	x	x	x	x		x	x
Nannippus				x			x	L			x	x		x		x	x				x
Pliohippus		x		x				x	x	x	x	x	x	x			x			x	x
Calippus											?					x	x				
Prosthennops		x		x			x	?				x		x							
Metoreodon				?								?								x	?
Merycochoerus									?												
Miolabis								L													
Alticamelus		?	L	x													x	x			
Megatylopus												?									x
Pliauchenia												x			L						x
Procamelus		x		x					x			x		x						?	?
Synthetoceras																	x				
Drepanomeryx							?L														
Blastomeryx				x								x		x			?			?L	
Dromomeryx				x																?L	
Merycodus				x				?	x			x	?	x			?			?L	
Capromeryx																			L		
Sphenophalos							?L		x												

[8] In the following tables three symbols are used. x = relatively certain generic determinations; ? = questionable generic determinations; L = locality of specimen or specimens questionable. Not all of the records in these lists have been published, and not all of the generic determinations are mine, especially of the rodents.

The tabulation of the faunas listed is approximately correct. Frequently additional evidence necessitates minor changes in their arrangement.

[9] The evidence for the presence of *Merychippus* in the Lower Pliocene faunas seems conclusive.

Middle Pliocene Generic Faunal Lists

	Higgins	Alachua	Ashley River	Jacalitos	Kern River	Rattlesnake	Pinole	Long Island	Wray (=Beecher Is.)	Feldt Ranch	Goodnight	Hemphill	Optima	Keams Cañon	Lacualtipan	Tehuichila	Mount Eden	Etchegoin	Edson	Rhinoceros Hill	Rome	Thousand Creek	Upr. Snake Creek
Scalopus																							?
Ground sloth ..						x	x					x					x						x
Hypolagus						?	?			?				?									
Liodontia																						x	
Mylagaulus ...										x		x	x						x			x	x
Sciurus																							?
Citellus																						x	
Otospermophilus						x																	
Marmota																						x	
Dipoides						x				x											x	x	x
Castor																					x		x
Cupidinimus ..																						x	
Diprionomys ..																						x	
Thomomys																							?
Peromyscus ...																						?	
Leptarctus		?																					
Bassariscus ...										x													
?Vulpes (=Leptocyon)												x					x						
Canis						?																?	
Osteoborus ...	x						?		x			x	x						x	x			x
Araeocyon						x																	
Amphicyon (=Pliocyon)..						?																	?
Agriotherium ..		x										x	x				x						x
Indarctos						x																	
Plionarctos ...																	x						
Pliogale																						x	
Cernictis							x																
Eomellivora ...					x																		

Middle Pliocene Generic Faunal Lists—(Concluded)

	Higgins	Alachua	Ashley River	Jacalitos	Kern River	Rattlesnake	Pinole	Long Island	Wray (=Beecher Is.)	Feldt Ranch	Goodnight	Hemphill	Optima	Keams Cañon	Lacualtipan	Tehuichila	Mount Eden	Etchegoin	Edson	Rhinoceros Hill	Rome	Thousand Creek	Upr. Snake Creek
Lutravus						x																x	
Sthenictis																							?
Plesiogulo												x	?				x		x				
Taxidea												x	x									x	
Felis										?													
Adelphailurus..																				x		?	
Machairodus ..	x							L	x			x	x										x
Teleoceras	x	x				x	x	x		x		x	x									x	x
Aphelops	x	x							x			x							x				x
Paraphelops ...									x										x				x
Hypohippus ...																							L
Hipparion		?				x							?										?
Neohipparion ..	x	x		x		x			x	x	x	x	x			x			x	x		x	x
Nannippus		x	x					L			x	x			x	x			x	x			x
Pliohippus	x			x	x	x	x	x	x	?	x	x	x				x	x	x	x		x	x
Calippus										x	x	x	x				x						
Prosthennops ..		?				x			x	x		x	x				x		x			x	x
Platygonus						?																	
Altimeryx (see Frick 1929) ..												?							?				
Alticamelus ...						x																	
Procamelus ...																							L
Pliauchenia ...												x					?		x	x			
Megatylopus ..		x				?						x		x			?		x	x			x
?Drepanomeryx					?				?			?											L
Blastomeryx ..																							L
Capromeryx ...									?			x	x				?			x			x
Sphenophalos ..						x	?		?												x	x	
Ilingoceros						?																x	
Neotragoceras .																							x

Upper Pliocene Generic Faunal Lists

	Blanco	San Timoteo	Lawler Ranch	Coso Mountains	San Joaquin	Benson	Pittsburg	Tehama	Hagerman	Buttonwillow	Asphalto	Froman Ferry	Curtis Ranch
Blarina									x				
Simonycteris													x
Ground sloth	x	x						x	x				
Glyptotherium	x												
Hypolagus									x				
Alilepus									?				
Lepus						?							x
Citellus						x							x
Castor					x				x				
Perognathus						x							x
Cupidinimus						x							
Dipidomys						x							x
Geomys						x							x
Cratogeomys						x							
Thomomys									x				
Onychomys						x							x
Eligmodontia						?							
Neotoma						x							
Sigmodon						x							x
Mimomys				x					x	x			
Neofiber													x
Canis								x					
Borophagus	x			x			x	x			x		
Canimartes	x												
Lutravus									x				
Lutra									x				
Felis									x				
Ischyrosmilus											x	x	

Upper Pliocene Generic Faunal Lists—(Concluded)

	Blanco	San Timoteo	Lawler Ranch	Coso Mountains	San Joaquin	Benson	Pittsburg	Tehama	Hagerman	Buttonwillow	Asphalto	Froman Ferry	Curtis Ranch
Machairodus									?				
Neohipparion	?		x										
Nannippus	x					x							
Pliohippus	?												
Equus (= Plesippus)	x	x		x	x			x	x		x	x	x
Platygonus	x				?			?	x				
Megatylopus	x								?				
Cervus					x				?				
Odocoileus					x			?					
Ceratomeryx									x				

TENTATIVE CORRELATION

	ARIZONA	CALIFORNIA	COLORADO	FLORIDA	HONDURAS	IDAHO	KANSAS	MEXICO
UPPER	Curtis Ranch Benson	**Tehama** Buttonwillow San Joaquin **Pittsburg** Coso Mountains Lawler Ranch San Timoteo				Grand View Froman **Ferry** Hagerman		Tequixquiac
MIDDLE		**Etchegoin** **Mount Eden** **Jacalitos** **Pinole** Kern River	Wray (=Beecher Island)	**Alachua**	Tapasuma (*age not established*)		Rhinoceros Hill Edson Long Island	Tehuichila Lacualtipan
LOWER		**Alturas** **Chanac** Oakdale **Ricardo** **Mint Canyon** Columbia **Orinda-Siesta**	Upper Pawnee Creek (*age not established*)				*There is evidence of Lower Pliocene faunas here* *i.e. Eucastor*	

NOTE: The allocation of the faunas in the major divisions is in agreement with the evidence; but the chronologic arrangement of the faunas within each division is only approximate. Established formational names that are also used as faunal names appear in boldface.

CHART OF FAUNAS

NEBRASKA		NEW MEXICO	NEVADA	OKLAHOMA	OREGON	SOUTH DAKOTA	TEXAS	WASHINGTON
							Blanco	
Feldt Ranch			**Thousand Creek** Panaca	Optima	Rome Harper **Rattlesnake**		Hemphill Goodnight Higgins	
—Valentine—	Upper Snake Creek (*faunas mixed*)							
Pine Creek (*age not certainly known*) Devil's Gulch (*age not established*) Burge		Upper (*age not* Santa *certainly* *known*) Fe	**Esmeralda**	Beaver	Ironside	Big Spring Cañon Little White River Oak Creek	Clarendon	**Ellensburg**

ALPHABETICAL LIST OF FAUNAS WITH CITATIONS TO LITERATURE.

Ainsworth (See Devil's Gulch).

Alachua, Middle Pliocene.

Leidy (1884; 1885; 1886A-B; 1887; 1889; 1890A-B). Dall and Harris (1892). Leidy and Lucas (1896). Osborn (1904, pp. 313-314; 1909, p. 80; 1910, pp. 346-348; 1918, pp. 28-29, 191-193). Gidley (1907, pp. 902, 905). Matthew (1909, pp. 115-118; 1924A, pp. 173, 175; 1932A, p. 418). Sellards (1915; 1916). Hay (1916; 1923, pp. 375-381). Merriam (1917, p. 439). Frick (1926A, pp. 75, 84-85). Simpson (1929; 1930).

Fossil material found in Gilchrist, Alachua, Levy, Marion, Citrus and Polk Counties, Florida (see Simpson, 1930).

FORMATIONS: Alachua clay and Bone Valley gravel.

Alturas, Lower Pliocene.

Chaney (1925, pp. 32, 45). Russell (1928). Dorf (1930, p. 23). La Motte (1935). Stirton (1935C- in La Motte).

Localities along the Pit River in Warm Spring Valley, about eight to ten miles southwest of Alturas, Modoc County, California.

FORMATION: Alturas, new formation (see La Motte, 1935). The age of this incomplete and fragmentary fauna is uncertain. It is probably near to a transition between Lower and Middle Pliocene. Identifiable genera are ?*Vulpes, Alticamelus* and *Neohipparion.*

Ashley River, Pliocene, possibly = Alachua.

Leidy (1853; 1860). Cope (1889, pp. 448-449). Gidley (1907, p. 884). Osborn (1918, pp. 31, 200). Hay (1923, p. 363).

"The principal locality is at Ashley [South Carolina], in a bluff about thirty feet high, having at its base a Pliocene limestone composed of marine shells while the Post-Pliocene layer is a shallow river formation consisting of yellow sands with bands of ferruginous clay four feet in thickness. The Ashley River is chiefly mid-Pleistocene. The type of *H[ipparion] venustum* may have washed in by the erosion of Pliocene sands and mingled with true Pleistocene remains." Osborn (1918, p. 200). Marine vertebrates of Upper Eocene and Upper Miocene age have likewise been obtained by dredging in the Ashley River.

FORMATION: Ashley River.

Beaver, Lower Pliocene.

Stirton (1935A, pp. 437-438, 451). Hesse (1935B, pp. 81, 97-99).

Jewett Bennett Ranch, nine and one-half miles east and three south of Beaver City, Beaver County, Oklahoma. The locality is on the line between section 34 of T 4 and section 3 of T 3 on R 25 E.

FORMATION: Ogallala *sensu* Elias.

A report on the geology, paleobotany and paleontology is in preparation by M. K. Elias, R. W. Chaney and Curtis J. Hesse.

References to the Ogallala formation in this paper are based on the following description and discussion by Dr. Maxim K. Elias (personal communication).

"The Ogallala is a lithologic unit originally studied and designated by Darton in the North Platte valley between Ogallala and Scotts Bluff (Darton, U. S. Geol. Surv., Prof. Paper 17, 1903). The age of this unit as indicated by the faunas and floras (herbaceous seeds) is from uppermost Miocene to Middle and possibly Upper Pliocene.

"At Scotts Bluff the Ogallala overlies unconformably the Lower Miocene Arikaree sands of Darton whereas north of the North Platte River and south of Agate Springs is the Middle Miocene Sheep Creek formation of Matthew and Cook. The Sheep Creek corresponds to the hiatus between the Arikaree and the Ogallala deposits along the North Platte river.

"The area of Sheep Creek outcrops is mapped as Arikaree on the geologic map of Nebraska published by Darton (ibid., pl. 9), also the sandy beds at Valentine, Nebraska, which overlie the loess-like beds (probably Brule). These lower beds were mapped by Darton as 'Chadron formation.' Neither of these latter correlations by Darton can be accepted. The

Sheep Creek differs from the Arikaree lithologically and belongs to a later sedimentary cycle. The arenaceous Tertiary exposed at Valentine clearly corresponds lithologically and paleontologically to the original Ogallala of the North Platte valley or to the Ogallala formation as here accepted.

"It seems desirable at this time to designate a type section for the Ogallala formation, since Darton did not define the exact type section. He did state, however, that the 'type locality [is] near Ogallala station in western Nebraska' (Darton, U. S. Geol. Surv. Folio no. 212, Syracuse-Lakin, Kansas, 1920). I propose then, as the type section of the Ogallala formation, the exposures in the canyon two miles east and one-half mile north of the town of Ogallala on the Feldt Ranch; SE ¼ Sec. 33, T. 14 N., R. 38 W. in Keith County, Nebraska. This is, also, the type locality of the Feldt Ranch Middle Pliocene fauna [Hesse, 1935B]. The following reasons are given for this selection:

1. The section in this canyon is more completely exposed than any within the radius of a few miles of the town of Ogallala.
2. The outcropping section is very fossiliferous and contains both vertebrates and seeds of herbs.
3. The section is 100′ thick and the fossil seeds indicate that it belongs entirely within the *Biorbia* zone of Elias.

"If future work, then, shows that it is desirable to restrict the term Ogallala to narrower limits, the name may be applied to the *Biorbia* zone. In this paper, however, the term Ogallala is applied to the whole thickness of the 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 Upper Pliocene. These beds mantle the High Plains from South Dakota in the north to New Mexico and Texas in the south."

Benson, Upper Pliocene.

Gidley (1922; 1926). Hay (1927, pp. 10, 54, 78, 80, 136). Wood (1935, pp. 145-148, 155-156).

About two miles south of Benson west of the state road on the west side of San Pedro Valley, Cochise County, Arizona.

FORMATION: Called Benson beds by Wood (1935). The fauna is characterized by the presence of *Nannippus phlegon.*

Beecher Island (See Wray).

Big Spring Cañon, Lower Pliocene.

Matthew and Gidley (1904, pp. 243, 261-263, 265-267; 1906, pp. 135-136, 140-142, 144-145, 148-151). Gidley (1907, p. 926). Osborn (1918, pp. 25, 182-183). Stirton (1935A, p. 439).

Cañon near the Ed Ross Ranch house, about fifteen miles southwest of Martin, Bennett County, South Dakota.

FORMATION: Ogallala *sensu* Elias.

Collections housed in the American Museum of Natural History in New York and the Museum of Paleontology at the University of California. The collection at California has not been described and a detailed comparison with closely related assemblages from Nebraska and South Dakota have not been completed.

Bone Valley (See Alachua).

Blanco, Upper Pliocene.

Cummins (1890; 1891; 1892, pp. 143, 170-171; 1893, pp. 200-201). Cope (1892A-G; 1893, pp. 47-74). Matthew (1899, p. 75; 1909, p. 120; 1924B-C; 1925; 1926, pp. 162-165). Gidley (1901; 1903A; 1903C, pp. 624-627; 1907, pp. 911-912, 919-921). Osborn (1909, pp. 82-83; 1918, pp. 30, 167-170). Merriam (1911, pp. 216-219; 1917, pp. 434-435). Hay (1923, pp. 1-2). Frick (1926A, p. 93). Matthew and Stirton (1930A, *Felis hillanus* Cope, a synonym of *Borophagus diversidens* Cope, p. 173; 1930B, pp. 359, 366-367). Sellards, Adkins and Plummer (1932, pp. 765-766, 774-775). Stirton and VanderHoof (1933, pp. 175-176, 180, Fig. 2). Hesse (1935B, pp. 82, 97-99).

Crawfish Creek, near Mount Blanco, Crosby County, Texas.

FORMATION: Ogallala *sensu* Elias; Blanco of Texas Geological Survey.

Burge, Lower Pliocene.

Stirton and McGrew (1935). McGrew (1935).

Three localities reported, two on Snake River and one on Gordon Creek, Cherry County, Nebraska.

FORMATION: Ogallala *sensu* Elias.

Barbour (1914B) referred to the section on Snake River near Burge as the Snake River stage and mastodon beds. The Burge quarry is now being thoroughly excavated by one of Childs Frick's collecting parties.

Buttonwillow, Upper Pliocene.

Hesse (1934). Barbat and Galloway (1934, p. 496).

"Crites" No. 1 well, Buttonwillow Gas Field, Kern County, California.

FORMATION: San Joaquin clay.

A pair of lower jaws of *Mimomys primus* (Wilson) were found 3174 feet below the surface of the ground. Barbat and Galloway call this the San Joaquin Clay "B" zone which they correlate with the Günz or first glacial period. They say that it is stratigraphically above the San Joaquin Clay "C" zone which contains the San Joaquin (= Upper Etchegoin) vertebrate fauna.

Cedar Mountain (See Esmeralda).

Chanac, Lower Pliocene.

Merriam (1915A; 1915C, pp. 52, 54; 1916C; 1917, p. 426). Osborn (1918, pp. 25, 138-140, 189). Hoots (1930). Stock (1935).

Along Comanche Creek, Tejon Hills, Kern County, California.

FORMATION: Chanac.

Evidence now indicates that the Chanac fauna is older than the Jacalitos and Etchegoin and approximately the equivalent of the Ricardo, though some large *Pliohippus* teeth in the fauna (comparable to *P. nobilis* Osborn) are usually associated with Middle Pliocene faunas. Dr. Chester Stock has not finished his study on additional material collected in the Chanac quarries.

Clarendon, Lower Pliocene.

Cummins (1893, pp. 203-204). Cope (1893, pp. 18-40). Matthew (1899, pp. 65-74; 1902; 1932A, p. 418). Gidley (1903C, pp. 632-634; 1907, pp. 912-915). Osborn (1918, pp. 26, 138, 156-158). Frick (1926A, p. 54, in foot note considers *Dinocyon gidleyi* Matthew as a species of *Amphicyon*). Matthew and Stirton (1930B, pp. 359, 366-367). Stirton

(1932A). Sellards, Adkins and Plummer (1932, pp. 765, 774). Hesse (1935B, pp. 82, 97-99).

The Clarendon fauna has been collected from various localities north and northeast of Clarendon in blocks C-7, C-3, C-8 and E, Donley County, Texas.

FORMATION: Ogallala *sensu* Elias; Panhandle of Texas Geological Survey.

Mr. Will Chamberlain has recently collected much valuable material from the Clarendon for the West Texas State Teachers College.

Collins, ?Middle Pliocene.

Elias (1931, p. 153). Hesse (1935B, p. 97).

In Collins Draw SE ¼, Sec. 27, T 12 S, R 41 W, Wallace County, Kansas.

FORMATION: Ogallala *sensu* Elias.

Columbia, Lower Pliocene.

Chaney (1925, p. 33). Louderback (1933). Merriam and Stock (1933).

Two *Hipparion* teeth and a fragmentary camel jaw were found in gravels and sands of the Springfield shafts Nos. 2 and 3, located one and one-half miles southwest of Columbia, below the leaf-bearing tuffs at Table Mountain, Tuolumne County, California.

FORMATION: Not described.

Coso Mountains, Upper Pliocene.

Wilson (1932). Stock (1932).

The fauna was found on the flanks of Coso Mountains at the eastern edge of Owens Valley, nine and one-half miles east of Olancha, Inyo County, California.

FORMATION: Not described.

Crocker Springs, ?Lower Pliocene or Upper Miocene.

VanderHoof (1931). Barbat and Weymouth (1931). VanderHoof and Stirton (1933, p. 177).

Crocker Springs Creek, near Crocker Springs, on the northeast side of the Temblor Range, 13 miles northwest of Taft, and near the west line of Kern County, California.

FORMATION: ?Santa Margarita.

The vertebrate evidence for correlation of Crocker Springs is not conclusive.

Curtis Ranch, Upper Pliocene or Pleistocene.

Gidley (1922; 1926). Hay (1927, pp. 10, 54, 80, 136). Stirton (1931). Wood (1935, pp. 107, 155-159).

Small area of badlands about three miles east of Curtis Ranch which is on the State road about fourteen miles northwest of Tombstone and an equal distance southeast of Benson by road. San Pedro Valley, Cochise County, Arizona. Curtis has been used for a Jurassic formation in southeastern Utah.

FORMATION: ?

Devil's Gulch, ?Lower Pliocene.

Barbour (1913; 1914A). Barbour and Cook (1915; 1917A). Osborn (1918, pp. 29, 209-210). Frick (1929, p. 107). Matthew (1932A, pp. 436-437, pls. 76-79). Wood (1935, pp. 178-197).

Fifteen miles north of Ainsworth in Devil's Gulch, Brown County, Nebraska.

FORMATION: Ogallala *sensu* Elias.

Apparently more than one fauna occurs in Devil's Gulch. A large collection from this cañon is in the Frick laboratories.

Eden (See Mount Eden).

Edson, Middle Pliocene.

Martin (1928). Adams and Martin (1929). Hall (1930A). Elias (1931, pp. 161-162). Stirton and VanderHoof (1933, p. 177). Hibbard (1934, pp. 243-255). Hesse (1935B, p. 97).

Fifteen miles south of Edson, Abram Marshall Ranch, Sherman County, Kansas.

FORMATION: Ogallala *sensu* Elias; "Edson beds" of Martin.

Ellensburg, Lower Pliocene.

Merriam (1915B, pp. 6-8). Merriam and Buwalda (1917, pp. 255-256). Osborn (1918, pp. 27, 175-176). Chaney (1925, pp. 30, 46).

Near North Yakima, Kittitas County, Washington. Exact locality not recorded.

FORMATION: Ellensburg.

The only genus and species is *Hipparion condoni* Merriam. The fossil plants probably occur at a lower level.

Esmeralda, Lower Pliocene.

Turner (1900A-B). Lucas (1900). Knowlton (1900). Merriam (1913C; 1916A, exclusive of locality 2027). Buwalda (1914). Osborn (1918, pp. 21, 27, 208-209). Chaney (1925, p. 35). Stock (1926). Berry (1927). Matthew (1929). Hall (1929; 1930B-C). Stirton (1929; 1932B; 1935A, pp. 431-437). Wood (1935, pp. 92-96).

Pliocene mammalian remains from the Fish Lake Valley and Cedar Mountain areas, Esmeralda and Nye Counties, Nevada.

FORMATION: Esmeralda.

The known species that have been found in each of these areas are identical and since they are contained within one formation the old name Esmeralda is used. Cedar Mountain is likely to be confusing since two faunas[10] occur in the Cedar Mountain area. Esmeralda is also used for the fossil flora from that formation.

Etchegoin, ?Middle Pliocene.

Merriam (1915E, pp. 220-222; 1917, pp. 424-425). Clark (1915, pp. 434-435). Nomland (1916A; 1916B, p. 204; 1917, pp. 217, 223-224). Osborn (1918, pp. 30, 165-166). Dickerson (1922, pp. 557-559). Matthew and Stirton (1930B, p. 359). Gester and Galloway (1933, pp.1173-1174).

Glycimeris coalingensis zone or *Pliohippus coalingensis* zone in the Etchegoin sands, North Coalinga hills, Kern County, California.

FORMATION: Etchegoin sands.

The isolated teeth representing this fauna were formerly referred to the Lower Etchegoin. At that time, the *Pecten coalingensis* zone was included in the Etchegoin formation. But Gester and Galloway (1933) and Barbat and Galloway

[10] *Stewart Spring* was suggested as a faunal name for the Middle Miocene fauna from U. C. loc. 2027 (Teilhard and Stirton, 1934, p. 285) in the Cedar Mountain area. This fauna is possibly equivalent in age to the Virgin Valley).

(1934) have shown that the *P. coalingensis* zone is in the San Joaquin clay instead of the Etchegoin sands. Therefore Upper Etchegoin = San Joaquin.

Feldt Ranch, Middle Pliocene.

Hibbard (1933). Hesse (1935A; 1935B). Stirton (1935A, p. 444).

A fauna from the upper part of the type section of the Ogallala formation on the Feldt Ranch, two miles east and one-half mile north of the town of Ogallala, Keith County, Nebraska.

FORMATION: Ogallala.

"The collection described by Hesse (1935B) is pre-eminently the Ogallala fauna, since it was obtained at the type locality"—Maxim K. Elias (personal communication).

Froman Ferry, ?Upper Pliocene.

Merriam (1917, pp. 431-432; 1918). Hay (1927, p. 267).

Specimens found on the Snake River about two miles northwest of Froman Ferry, which is 7 or 8 miles southwest of Caldwell Canyon, Sec. 7, T 23 N, R 4 W, upper 75-100 feet of section, Canyon County, Idaho.

FORMATION: Idaho.

The correlation of *Ischyrosmilus idahoensis* (Merriam) and *Equus idahoensis* Merriam with the Hagerman and Grand View faunas has not been established.

Goodnight,[11] Middle Pliocene.

Cummins (1893, pp. 201-203). Cope (1893, pp. 40-46, pl. 12). Matthew (1899, p. 75). Gidley (1901, pp. 125-126; 1903C, pp. 628-632; 1907, pp. 915-919). Osborn (1918, pp. 26, 158, 184-187). Matthew and Stirton (1930B, pp. 359, 364-366). Sellards, Adkins and Plummer (1932, pp. 765-766).

[11] The locality mentioned briefly by Cummins (1892, p. 149) is probably the type locality of *Neophipparion eurystyle* (Cope). He says: "At the falls of Palo Duro canyon, south of Amarillo, the Tertiary beds are about one hundred and forty feet thick. Near the top there is often a bed of white arenaceous hardened clay, being sometimes more lime than clay, generally overlying a white argillaceous sand containing masses of stalactitic structure and fossil vertebrates. In this bed, on the south side of the canyon, opposite the falls were found the teeth of a fossil horse and mastodon and other fragments of the skeleton. This sand bed varies in thickness from a few inches to fifteen feet." Other teeth referable to *N. eurystyle* were found with the Goodnight fauna in Mulberry Cañon.

Mulberry Cañon, Goodnight Ranch, Armstrong County, Texas. The exact locality has not been recorded.

FORMATION: Ogallala *sensu* Elias; Panhandle of the Texas Geological Survey.

Grand View, ?Upper Pliocene.

Wilson (1933).

"On the west side of the Snake River approximately thirteen miles northwest of the town of Grand View," Owyhee County, Idaho.

FORMATION: ?Idaho.

Hagerman, Upper Pliocene.

Gidley (1930; 1931). Gazin (1933A-B; 1934A-B; 1935A-B). Wilson (1933). Stirton (1935A, pp. 446-447).

Across the Snake River from Hagerman, Twin Falls County, Idaho.

FORMATION: ?Idaho (called Hagerman lake beds).

Harper, Middle Pliocene.

Furlong (1931).

"Several miles northeast of Harper in loosely consolidated sands, gravels and ash overlying a thin sheet of basalt." Malheur County, Oregon.

FORMATION: ?Payette.

Hemphill, Middle Pliocene.

Matthew and Stirton (1930A-B). Burt (1931). Matthew (1932A). Reed and Longnecker (1932). Sellards, Adkins and Plummer (1932, pp. 766, 775). Stirton and Vander-Hoof (1933, pp. 175-177). Hesse (1935B, pp. 82, 97; 1935C, p. 308).

Coffee Ranch nine miles northeast of Miami, Hemphill County, Texas.

FORMATION: Ogallala *sensu* Elias; Hemphill beds of Reed and Longnecker.

Fauna not fully described. Part but not all of the Reed and Longnecker localities have fossils referable to the Hemphill fauna. Mr. Childs Frick has recently obtained a large collection from the Coffee Ranch quarry. Additional material is being collected by the West Texas State Teachers College.

Higgins, Early Middle Pliocene.

Burt (1931, p. 262). Matthew (1932A, pp. 424, 431, 435-436, pls. 68-75). Reed and Longnecker (1932, p. 67). Sellards, Adkins and Plummer (1932, p. 776, Loc. 24). Hesse (1935B, p. 97; 1935C, *Capromeryx texanus* Hesse is temporarily assigned to the Higgins fauna).

Two quarries on the Sebits Ranch about two miles south of Higgins, Lipscomb County, Texas.

FORMATION: Ogallala *sensu* Elias.

Ironside, ?Lower Pliocene.

Merriam (1916D). Osborn (1918, p. 190).

Three-fourths of a mile southwest of Ironside Postoffice, Malheur County, Oregon.

FORMATION: Not certainly known; it has been referred to the Idaho.

Jacalitos, Middle Pliocene.

Arnold (1909). Merriam (1915B, p. 3; 1915E, pp. 216-220; 1917, p. 425 [included in Etchegoin]). Clark (1915, pp. 435-437). Nomland (1916A; 1916B, p. 204; 1917, pp. 217, 224, 226). Dickerson (1922, pp. 557-559). Gester and Galloway (1933, pp. 1173-1174).

Below Etchegoin sand, *Neohipparion molle* zone, North Coalinga hills, Kern County, California.

FORMATION: Jacalitos, considered by some authorities as part of the Etchegoin formation.

Keams Cañon, Middle or Upper Pliocene.

Frick (1929).

Near the head of Jadito Wash (east side, south of road), approximately seven miles west and two south of Keams Cañon, Navajo County, Arizona.

FORMATION: Not described.

A large collection is in the Frick laboratories.

Kern River, ?Middle Pliocene.

Anderson (1905). Stock, Patterson and Furlong (1929). Stock and Hall (1933).

Bakersfield Quadrangle, U. S. Geol. Surv. NE 1/4 of Sec. 26, T 28 S, R 28 E, Mount Diablo Base and Meridian, Kern County, California.

FORMATION: Kern River.

Dr. Chester Stock has not completed his report on this fauna.

Lacualtipan, ?Middle Pliocene.

Leidy (1883). Osborn (1918, pp. 31, 197).

Locality near Lacualtipan, Hidalgo, Mexico.

FORMATION: ?

Lawler Ranch, Upper Pliocene.

Merriam (1915B, pp. 1-2). Osborn (1918, pp. 29, 187). Dickerson (1922, pp. 553-554). Chaney (1925, pp. 34, 44).

Lawler Ranch six miles east of Petaluma, Sonoma County, California.

FORMATION: Petaluma.

Little White River, Lower Pliocene.

Leidy (1856; 1899, pp. 281, 287-289, 326-330). Cope (1889, pp. 434, 445). Gidley (1903B). Matthew (1904, pp. 103, 125-126). Matthew and Gidley (1904, pp. 243, 246-257; 1906, pp. 136-144, 145-151). Osborn (1904, pp. 312, 322; 1918, pp. 25, 130, 134, 150, 176, 179-181). Stirton (1935A, p. 430).

Pliocene faunal remains near the Rosebud Indian Agency and Mission, Todd County, South Dakota (see Osborn's map, 1918, p. 26).

FORMATION: Ogallala *sensu* Elias.

Long Island, ? Middle Pliocene.

Cope (1878; 1880B; 1887A, pp. 1004, 1006, 1075; 1887B; 1889, pp. 445-447). Matthew (1899, p. 65; 1932A, p. 423). Osborn (1904, pp. 310-314; 1910, p. 349; 1918, pp. 28, 142-143, 160-161). Merriam (1917, p. 438). Matthew and Stirton (1930B, p. 359). Hesse (1935B, pp. 96-98 in part).

Long Island quarry near Long Island, Phillips County, Kansas.

FORMATION: Ogallala *sensu* Elias.

This assemblage was formerly referred to as the Republican

River fauna and formation. The formation is now considered as Ogallala and part of the fauna which has been called the Republican River contains Upper Miocene fossils from Driftwood Creek in Nebraska, also the Long Island fossils as well as numerous isolated finds from both Kansas and Nebraska have been discussed as part of the fauna. I have referred *Teleoceras fossiger* and *Pliohippus nobilis* to the Long Island fauna and *Merychippus republicanus* to the Driftwood Creek (Upper Miocene) fauna but most of the isolated finds cannot at present be placed definitely in either of the above faunas. Some specimens of *Nannippus gratum*—(Cope, 1889, pp. 445-447) and *Eucastor*—(Stirton, 1935A, p. 439) from Northern Kansas—probably belong to a Lower Pliocene fauna. The faunas with which *Aphelops malacorhinus* Cope (1878) and *Peraceras superciliosus* Cope (1880B) were associated is not definitely known.

Lost Quarry, ?Middle Pliocene.

Hibbard (1934, pp. 239-243).

South fork of Smoky Hill River south of Wallace, NW ¼ of Sec. 1, T 15 S, R 38 W, Wallace County, Kansas.

FORMATION: Ogallala *sensu* Elias.

Mint Cañon, Lower Pliocene.

Kew (1924). Maxson (1930). Stirton (1933).

Seven miles northeast of Saugus, Los Angeles County, California.

FORMATION: Mint Cañon.

The lower part of the Mint Cañon formation may be Miocene.

Mount Eden, Middle Pliocene.

Frick (1921, pp. 335-409; 1926A, pp. 74-75, 83-84, 111-116; 1926B, p. 441; 1933, p. 516). Stock (1925, p. 21). Fraser (1931).

Localities near Mount Eden and farther south (see Frick's 1921 map, p. 282) Elsinore Quadrangle, Riverside County, California.

FORMATION: Mount Eden.

Oak Creek, Lower Pliocene.

Troxell (1916). Osborn (1918, pp. 25, 160).

Near the head of Oak Creek, east of Mission, Rosebud Indian Reservation, Todd County, South Dakota.

FORMATION: Ogallala *sensu* Elias.

Oakdale, Lower Pliocene.

VanderHoof (1933A).

Vertical bank forming north side of Tulloch ditch, elevation 200′, NW ¼ of Sec. 4, T 25 S, R 11 E, Mount Diablo Base and Meridian, Oakdale Quadrangle, Stanislaus County, California.

FORMATION: Not named (but see U. S. G. S. Water Supply paper in press).

Optima, Middle Pliocene.

Matthew and Stirton (1930B, p. 349). Hesse (1935B, p. 97; 1935C, p. 313).

On the James England Ranch, 100 yards north of Rock Island right of way, one and one-half miles southwest of Optima, Texas County, Oklahoma.

FORMATION: Ogallala *sensu* Elias.

Small collections were uncovered at this locality by University of Oklahoma and University of California parties in 1928, 1929 and 1930. Since then the quarries have been extensively excavated by one of the Frick collecting parties.

Orinda-Siesta, Lower Pliocene.

Merriam (1896; 1911, p. 232; 1913B; 1915B; 1917, p. 426). Lawson and Palache (1901, pp. 374-398). Lawson (1914). Clark (1915, p. 442). Osborn (1918, pp. 26, 188). Stock (1921A). Dickerson (1922, pp. 557-559). Stirton (1935A, pp. 438-439). Hesse (1935C, p. 313).

Miscellaneous isolated localities in Contra Costa County, California.

FORMATION: Orinda, Siesta and ?Moraga.

One specimen from the Nerola (Upper San Pablo) apparently belongs to the Orinda-Siesta fauna.

Panaca, ?Middle Pliocene.

Stock (1921B).

Near Panaca in Meadow Valley, Lincoln County, Nevada.

FORMATION: ?

This fragmentary faunal assemblage is tentatively placed in the Middle Pliocene since the *Pliohippus* remains approach in size those of *P. nobilis* from the Long Island fauna.

Upper Pawnee Creek, Lower Pliocene.

Cope (1873). Matthew (1901, p. 359). Osborn (1904, pp. 309-310, 319-322; 1918, pp. 27, 139-141, 183-184).

Sand Cañon at the head of Pawnee Creek, from upper beds, Logan County, Colorado.

FORMATION: Ogallala *sensu* Elias.

Evidence of a Lower Pliocene fauna in this area was mentioned by Matthew and the type of *Neohipparion coloradense* (Osborn) is certainly more advanced than any known species of Upper Miocene *Merychippus*. *Aphelops megalodus* (Cope) may belong with this fauna.

Pine Creek (new name), ?Lower Pliocene.

Hatcher (1894). Osborn (1904, pp. 314-316). Matthew (1904, pp. 126-127). Hesse (1935C- [the genotype of *Capromeryx* may belong to this fauna]).

". . . adjacent hills on the south side of the Niobrara River, midway between the mouths of Pine and Box Butte creeks in Sheridan County, Nebraska." (See Hatcher.)

FORMATION: Not certainly determined, Matthew (1924A, p. 113) referred to this fauna as Republican River.

Pinole, Middle Pliocene.

Merriam (1911, p. 232; 1917, p. 425). Lawson (1914). Osborn (1918, p. 29). Dickerson (1922, p. 559). Stock (1925, p. 20). Hall (1935).

Two localities are known, the first one-fourth of a mile west of Pinole Junction and the second one-fourth of a mile northeast of Rodeo, Contra Costa County, California.

FORMATION: Pinole Tuff.

Fossils from both localities seem to represent one fauna.

Pittsburg, Upper Pliocene.

Merriam (1903, pp. 283-288). Matthew and Stirton (1930A, pp. 178-180).

"... a quarry about two miles southeast of Cornwall (now Pittsburg), Contra Costa County, California."

FORMATION: Possibly Pittsburg. Type locality of *Hyaenognathus* (*Porthocyon*) *dubius* Merriam.

Rattlesnake, Middle Pliocene.

Cope (1880A; 1887A, p. 1072; 1889, pp. 434-435). Wortman (1882). Marsh (1894). Matthew (1899, pp. 70-71). Merriam (1901; 1917, p. 428). Sinclair (1906). Merriam and Sinclair (1907). Gidley (1907, pp. 898-900). Osborn (1909, p. 81; 1918, pp. 30, 164-165, 195-196). Matthew (1909, pp. 115-118; 1932A, p. 418). Merriam, Stock and Moody (1916; 1925). Thorpe (1921; 1922A-B; 1924). Chaney (1925, p. 44). Stock (1925, pp. 18-19). Merriam and Stock (1925). Frick (1926A, pp. 89-90). Matthew and Stirton (1930A, p. 183). Wilson (1934, p. 28). Stirton (1935A, pp. 442-444). Hesse (1935C, p. 313).

The localities are approximately five and one-half miles west of Dayville and are found in parts of townships 12, R 25 E, and R 26 E, Williamette Baseline and Meridian, Grant County, Oregon.

FORMATION: Rattlesnake.

Republican River (See Long Island).

Ricardo, Lower Pliocene.

Merriam (1913D; 1915C, pp. 53-56; 1915D; 1917, pp. 430-431; 1919). Osborn (1918, pp. 29, 162, 164, 193-195). Matthew (1924C, p. 752; 1932A, p. 418). Stock and Furlong (1926). Matthew and Stirton (1930A, p. 181; 1930B, p. 359). Stirton and VanderHoof (1933, pp. 178-179).

"... in excellent exposures around Ricardo Postoffice in Red Rock Cañon, between the eastern foot of the Sierras and the El Paso Range." (Merriam, 1919, p. 440). San Bernardino County, California.

FORMATION: Ricardo and possibly Puente (Stock, 1928B). There is some indication that two Pliocene faunas are represented in the Ricardo formation. A large collection of this fauna is in the Frick laboratories.

Rhinoceros Hill, Middle Pliocene.

Elias (1931, pp. 159-163). Hibbard (1934, p. 239). Hesse (1935B, p. 97; 1935C).

". . . in the SE ¼ NE ¼ Sec. 11, T 11 S, R 38 W of Wallace County." (Elias, 1931, p. 160) Kansas.
FORMATION: Ogallala *sensu* Elias.

Rome, Middle Pliocene.

Furlong (1931). Wilson (1934).

". . . along the Crooked Creek drainage, tributary to the Owyhee River, five miles southwest of Rome, Malheur County, Oregon."
FORMATION: ?Payette.

Rooks, ?Middle Pliocene.

Lane (1927). Matthew (1932A, p. 417).

Near Plainville, Rooks County, Kansas.
FORMATION: Ogallala *sensu* Elias.

San Joaquin, Upper Pliocene.

Merriam (1903, pp. 277-283; 1915E, pp. 222-232; 1915C, pp. 56-58; 1916B; 1917, p. 425). Bovard (1907). Kellogg (1911). Matthew (1924A, pp. 102-103). Nomland (1916A; 1917, p. 217). Osborn (1918, pp. 31, 170-172). Hay (1927, pp. 67, 78, 97, 199-200). Matthew and Stirton (1930A, pp. 178-180; 1930B, p. 359). Gester and Galloway (1933, pp. 1172-1173). Barbat and Galloway (1934). Stirton (1935A, pp. 445-446).

Pecten coalingensis zone or San Joaquin clay "C" zone, North Coalinga Hills, Kern County, California.
FORMATION: San Joaquin clay.

The beds in which this fauna was found were formerly considered as part of the Etchegoin formation and were called Upper Etchegoin. Recent investigation has shown that this Upper Pliocene vertebrate fauna occurs in the San Joaquin clay and not in the Etchegoin formation. It seems less confusing, then, to call it the San Joaquin fauna.

San Pedro Valley (See Benson and Curtis Ranch).

Upper Santa Fe, ?Lower Pliocene.

Cope (1875; 1877). Matthew (1909, pp. 115, 117). Frick (1929, p. 107; 1933, p. 549).

Near Santa Fe, New Mexico. Localities not recorded.

FORMATION: ?Santa Fe Marl.

Mr. Frick has not completed the study of his large collection from this area.

San Timoteo, Upper Pliocene.

Frick (1921, pp. 317-334). Hay (1927, p. 163). Stock (1925, p. 21).

San Timoteo Cañon, east of Moreno, Riverside County, California.

FORMATION: ?Mount Eden.

Siesta (See Orinda-Siesta).

Upper Snake Creek, faunas mixed, Upper Miocene-Pliocene.

Matthew and Cook (1909). Cook (1912; 1914; 1922, pp. 13-15; 1930, pp. 49-50). Sinclair (1915). Merriam (1917, pp. 435-437). Matthew (1918; 1924A; 1924C, p. 750; 1932A, p. 418; 1932B). Osborn (1918, pp. 28, 162-163). Matthew and Stirton (1930A, pp. 178-181; 1930B, pp. 359, 366-367). Stirton and VanderHoof (1933, pp. 177-178). Stirton (1935A, pp. 430-431, 439, 443-444). Wood (1935, pp. 105-107). Hesse (1935C).

Numerous localities on the Ashbrook and Kilpatrick ranches approximately eighteen miles south of Agate, Sioux County, Nebraska.

FORMATION: Not certainly determined.

In 1924 Matthew divided the Snake Creek faunas into Lower Snake Creek (Upper Miocene) and Upper Snake Creek (Lower Pliocene) and the Sheep Creek fauna from that area was called Middle Miocene. Recent collecting has shown that Lower, Middle and Upper Pliocene genera and species occur in the Snake Creek localities. Much additional information has been obtained by the Frick collecting parties who have been collecting in the Snake Creek quarries for several years.

Tapasuma, ?Upper Pliocene.

Frick (1933, p. 528).

Near Tapasuma, Western Honduras.
FORMATION: ?

Tehama, Upper Pliocene.

Russell and VanderHoof (1931). VanderHoof (1933B).

"The fossils were obtained from pale greenish clays of the Tehama formation exposed on the Black and Heavy ranches, eighteen miles (air line) west-northwest of Corning, Tehama County," California.
FORMATION: Tehama.

Tehuichila, Middle Pliocene.

Cope (1885; 1886; 1889, pp. 435-436). Freudenberg (1910, pp. 205-214; 1921). Osborn (1918, pp. 31, 141, 198-200). Frick (1926A, p. 85).

The fossils were found in white slates and clays on the Galiana property near the small village of Tehuichila, Vera Cruz, Mexico.
FORMATION: Tehuichila.

Thousand Creek, Middle Pliocene.

Merriam (1909; 1910, pp. 43-50; 1911; 1915B, pp. 3-5; 1917, p. 429). Kellogg (1910). Butterworth (1916). Dice (1917, p. 181). Osborn (1918, pp. 30, 197). Merriam and Stock (1928). Hall (1930A, pp. 149-151; 1930B, pp. 302-304). Matthew and Stirton (1930B, pp. 366-367). Furlong (1932). Matthew (1932A, p. 418). Stirton (1932C; 1935A, pp. 442-443). Wood (1935, pp. 145-148, 176-178).

East and north of Thousand Creek in Humboldt County, Nevada.
FORMATION: Thousand Creek.

Valentine, Transitional from Lower to Middle Pliocene.

Leidy (1858, p. 27; 1869, pp. 286-287). Marsh (1874, pp. 252-253). Matthew (1889, p. 70; 1909, p. 107; 1924A, pp. 103, 200; 1924C, opposite p. 746, and p. 750; 1926, p. 160; 1932A, p. 418). Matthew and Gidley (1906, pp. 151-153).

Gidley (1907, pp. 879-880, 892-895). Barbour and Cook (1917B [in part]). Osborn (1918, pp. 25, 135-136, 151-156, 178-179). Thorpe (1922C, p. 424). Matthew and Stirton (1930B, pp. 359, 366). Cook and Cook (1933, pp. 43-58). Stirton and McGrew (1935). Elias (1935, p. 31).

Fauna mostly from the calcareous sands at the top of the exposed section in the north pasture of the Niobrara Game Preserve. Other remains probably referable to this fauna were found by a University of Nebraska expedition in the upper calcareous beds in Sec. 20, R 27 W, T 33 N. This fauna evidently occurs in South Dakota and other parts of Nebraska but the fossils have not been carefully studied and revised.

FORMATION: Ogallala *sensu* Elias.

Barbour and Cook (1917B) proposed the name "Valentine beds" for a deposit near Valentine, Nebraska. At that time they stated that it was "probably a lower phase than either Snake Creek or the Devil's Gulch." The exact locality has never been recorded.[12] Leidy's name Niobrara River has already been extensively used for the fossils collected from exposures near Fort Niobrara (Leidy, 1858, pp. 1, 20-29; 1869, p. 26, second paragraph, and used throughout the paper. Matthew, 1899, pp. 65-74; 1904, p. 103. Matthew and Gidley, 1904, p. 241. Gidley, 1907 [throughout paper]. Osborn, 1909, p. 77; 1918, pp. 25, 75, 128, 147, 174, 204. Merriam, 1913A, p. 360), and many specimens representing the species named by Leidy in 1858 have been found in the *Aelurodon platyrhinus* quarry and clearly demonstrate the direct correlation of the two assemblages. Unfortunately, Niobrara River, Valentine, and to some extent Fort Niobrara as well as Nebraska have been used for both Miocene and Pliocene material from that area. But since the majority of Leidy's 1858 types came from the Upper Miocene and since the name Niobrara River was so widely used in print, it seems advisable to retain it at least as a faunal name for the Upper Miocene as listed by Stirton and McGrew (1935). In 1924A (pp.

[12] Members of the Nebraska State Museum have informed me that the material described and discussed by Barbour and Cook came from a Niobrara River faunal locality V337 (see Stirton and McGrew, 1935, pp. 126-127). My friend, Mr. F. W. Johnson of the Nebraska State Museum, told me that the type of *Prosthennops xiphodonticus* also was taken from the *Aelurodon platyrhinus* quarry (loc. V337) though it was recorded from "a mile or two west of Valentine."

103, 200) Matthew clearly showed that he considered the Valentine as belonging to the age that I here call Lower Pliocene and in his later papers (1924C, opposite p. 746, and p. 750; Matthew[13] and Stirton, 1930A, p. 178; 1930B, pp. 352-359) he refers to types from the upper levels as Valentine. Due to the wide distribution of Matthew's papers and Simpson's correlation (1933) I have followed his usage in assigning Valentine to the later fauna from the calcareous sands at the top of the section.

Wray, Middle Pliocene.

Cook (1922, pp. 3-13; 1927; 1930, pp. 44-48). Matthew (1924A, p. 103; 1932A, p. 422). Matthew and Stirton (1930A, p. 178). Stirton and VanderHoof (1933, p. 178). Cook and Cook (1933). Elias (1935, p. 31). Hesse (1935B, p. 97; 1935C, p. 308).

Near Beecher Island Postoffice and battleground, Yuma County, Colorado.

FORMATION: Ogallala *sensu* Elias.

The name Wray is slightly misleading since the town lies approximately twelve miles north of the fossil quarries. Beecher Island has been used as a faunal name for this assemblage of fossils but it is now thought best to retain the name Wray because of its priority.

Pliocene Mammals in Pleistocene Deposits.

Nannippus—Hay (1913; 1917; 1924) also see Ashley River and Alachua.

"*Protohippus*"—Hay (1924, p. 140).

Megatylopus (=*Titanotylopus*)—Barbour and Schultz (1934).

LITERATURE CITED[14]

Adams, L. A., and Martin, H. T.: A new Urodele from the Lower Pliocene of Kansas. This Journal, vol. 17, pp. 504-520, 1929.

Anderson, F. M.: A stratigraphic study in the Mount Diablo Range of California. Proc. Calif. Acad. Sci., vol. 2, pp. 187-188, 191, 1905.

[13] At this time Matthew thought that the primitive genera (Niobrara River specimens) were carry overs still existing in a later fauna, all of which he called Valentine.

[14] All faunal names given by Simpson (1930), Teilhard and Stirton (1935) and Cook and Cook (1933) are not cited.

Arambourg, C., and Piveteau, J.: Les vértebrés du Pontien de Salonique. Ann. Pal. Paris, tome 18, pp. 59-82, pls. 1-10, 1929.

Arnold, R.: Paleontology of the Coalinga District, Fresno and Kings Counties, California. Bull. U. S. Geol. Surv., no. 396, fig. 3, pl. 11, 1909.

Barbat, W. F., and Galloway, J.: San Joaquin clay, California. Bull. Am. Assoc. Petroleum Geol., vol. 18, no. 4, pp. 476-499, 1934.

————, and Weymouth, A. A.: Stratigraphy of the *Borophagus littoralis* locality, California. Univ. Calif. Publ. Dept. Geol. Sci., vol. 21, pp. 25-36, figs. 1-2, pls. 4-5, 1931.

Barbour, E. H.: Mammalian fossils from Devil's Gulch. Neb. Geol. Surv., vol. 4, pp. 177-190, 1913.

A new fossil horse, *Hypohippus matthewi.* Ibid., vol. 4, pp. 169-173, pls. 1-2, 1914A.

A new longirostral mastodon from Cherry County, Nebraska. Ibid., vol. 4, pp. 213-222, figs. 1-6, 1914B.

————, and Cook, H. J.: A new saber-toothed cat from Nebraska. Ibid., vol. 4, pp. 235-238, figs. 1-4, pl. 1, 1915.

Notes on the skull of *Metoreodon.* Ibid., vol. 7, pp. 165-172, figs. 1-8, 1917A.

Skull of *Aelurodon platyrhinus,* sp. nov. Ibid., vol. 7, pp. 173-180, figs. 1-11, 1917B.

————, and Schultz, C. B.: A new giant camel, *Titanotylopus nebrascensis,* gen. et. sp. nov., Bull. Neb. State Mus., vol. 1, no. 36, pp. 291-294, figs. 171-172, 1934.

Berry, E. W.: The flora of the Esmeralda formation in Western Nevada. Proc. U. S. Nat. Mus., vol. 72, pp. 1-15, pls. 1-2, 1927.

Borissiak, A.: Mammifères fossiles de Sebastopol, II. Mém. Com. Géol. Petrograd, N. S., Livr. 137, pp. 1-47, pls. 1-3, 1915.

Bovard, J. F.: Notes on Quaternary Felidae from California. Univ. Calif. Publ. Geol. Dept. Geol. Sci., vol. 5, pp. 156-163.

Burt, W. H.: *Machaerodus catocopis* Cope from the Pliocene of Texas. Univ. Calif. Publ. Dept. Geol. Sci., vol. 20, pp. 261-292, pls. 43-50, 1931.

Butterworth, E. M.: A new mustelid from the Thousand Creek Pliocene of Nevada. Ibid., vol. 10, pp. 21-24, fig. 1, 1916.

Buwalda, J. P.: Tertiary mammal beds of Stewart and Ione valleys in west-central Nevada. Ibid., vol. 8, pp. 335-363, pls. 32-38, 1914.

Chaney, R. W.: The Mascall flora—its distribution and climatic relation. Carn. Inst. Wash., no. 349, pt. 2, pp. 23-48, 1925.

Clark, B. L.: Fauna of the San Pablo group of middle California. Univ. Calif. Publ. Dept. Geol. Sci., vol. 8, pp. 385-572, pls. 42-71, 1915.

Colbert, E. H.: Distributional and phylogenetic studies on Indian fossil mammals. II. The correlation of the Siwaliks of India as inferred by the migrations of *Hipparion* and *Equus.* Am. Mus. Novitates, no. 797, pp. 1-15, 1935.

Cook, H. J.: Faunal lists of the Tertiary formations of Sioux County, Nebraska. Neb. Geol. Surv., vol. 7, pp. 43-45, 1912.

A new canid from the Lower Pliocene of Nebraska, *Tephrocyon mortifer.* Neb. Geol. Surv., vol. 7, pp. 49-50, 1914.

A Pliocene fauna from Yuma County, Colorado, with notes on the closely related Snake Creek beds from Nebraska. Proc. Colo. Mus. Nat. Hist., vol. 4, no. 2, pp. 3-15, 1922.

A new rhinoceros of the genus *Teleoceras* from Colorado. Ibid., vol. 7, no. 1, 1927.

New rhinoceroses from the Pliocene of Colorado and Nebraska. Ibid., vol. 9, no. 4, pp. 44-51, pls. 1-7, 1930.

————, and Cook, M. C.: Faunal lists of the Tertiary vertebrata of Nebraska and adjacent areas. Neb. Geol. Surv., no. 5, pp. 41-58, 1933.

Cope, E. D.: On some new extinct Mammalia from the Tertiary of the plains. Pal. Bull., no. 14, pp. 1-2, 1873.
On some new fossil Ungulata. Proc. Acad. Nat. Sci., Phila., vol. 27, pp. 258-261, 1875.
Report upon the extinct Vertebrata obtained in New Mexico by parties of the expedition of 1874. XIII. Fossils of the Loup Fork epoch. Geol. Surv. west of the one hundredth meridian, vol. 4, pp. 302-303, 344, pl. 69, fig. 2, pl. 77, fig. 4, 1877.
The species of *Rhinoceros* from the Loup Fork epoch. Am. Nat., vol. 12, pp. 488-489, 1878.
A new *Hippidium*. Am. Nat., vol. 15, p. 223, 1880A.
A new genus of Rhinocerontidae. Am. Nat., vol. 14, p. 540, 1880B.
Report on the coal deposits near Zacualtipan in the state of Hildago, Mexico. Proc. Am. Philos. Soc., vol. 23, pp. 146-151, figs. 1-2, 1885.
On two new species of three-toed horses from the Upper Miocene, with notes on the fauna of the Ticholeptus beds. Ibid., vol. 23, pp. 357-361, 1886.
Perissodactyla. Am. Nat., vol. 21, pp. 985-1007, 1060-1076, 1887A.
A saber-toothed tiger from the Loup Fork beds. Ibid., vol. 21, pp. 1019-1020, 1887B.
A review of the North American species of *Hippotherium*. Proc. Am. Philos. Soc., vol. 26, pp. 429-449, 458, figs. 1-4, 6-12, 16-18, 1889.
In the Texas Panhandle. Am. Geol., vol. 10, pp. 131-132, 1892A.
Report on the paleontology of the vertebrata. Geol. Surv. Texas, 3rd Ann. Rept., pp. 251-253, 1892B.
A contribution to a knowledge of the fauna of the Blanco beds of Texas. Proc. Acad. Nat. Sci., Phila., vol. 44, pp. 226-229, 1892C.
A hyaena and other Carnivora from Texas. Ibid., vol. 44, pp. 326-327, 1892D.
A contribution to the vertebrate paleontology of Texas. Proc. Am. Philos. Soc., vol. 30, pp. 123-125, 1892E.
A hyaena and other Carnivora from Texas. Am. Nat., vol. 26, pp. 1028-1029, 1892F.
The fauna of the Blanco epoch. Ibid., vol. 26, pp. 1058-1059, 1892G.
A preliminary report on the vertebrate paleontology of the Llano Estacado. Geol. Surv. Texas, 4th Ann. Rept., pp. 11-87, pls. 1-21, 1893.
Cummins, W. F.: The Permian of Texas and its overlying beds. First Ann. Rept. Geol. Surv. Texas, pp. 190-191, 1890.
Report on the geology of northwestern Texas. Second Ann. Rept. Geol. Surv. Texas, pp. 431-433, 1891.
Llano Estacado or Stake Plains. Geol. Surv. Texas, 3rd Ann. Rept., pp. 129-174, 1892.
Notes on the geology of northwestern Texas. Geol. Surv. Texas, 4th Ann. Rept., pp. 179-238, 1893.
Dall, W. H., and Harris, G. D.: Correlation papers: The Neocene of North America. Bull. U. S. Geol. Surv., no. 84 (faunal list by Leidy), p. 129 (faunal list by Cope), p. 130, 1892.
Dice, L. R.: Systematic position of several American Tertiary Lagomorphs. Univ. Calif. Publ. Dept. Geol. Sci., vol. 10, pp. 181-182, figs. 4-5, 1917.
Dickerson, R. E.: Tertiary and Quaternary history of the Petaluma, Point Reyes and Santa Rosa Quadrangles. Proc. Calif. Acad. Sci., vol. 11, pp. 527-601, pls. 17-41, 1922.
Dorf, E.: Pliocene floras of California. Carn. Inst. Wash., no. 412, pt. 1, pp. 1-112, 1930.
Elias, M. K.: The geology of Wallace County, Kansas. Bull. Univ. Kans., vol. 32, no. 7, pp. 1-254. [State Geol. Surv. Bull. no. 18], 1931.
Tertiary grasses and other prairie vegetation from high plains of North America. This Journal, vol. 29, pp. 24-33, 1935.

Fraser, D. M.: Geology of the San Jacinto Quadrangle south of San Gorgonio Pass, California. Mining in California, vol. 27, pp. 512-514, 1931.

Freudenberg, W.: Die Säugetierfauna des Pliocäns und Postpliöcans von Mexiko. I. Carnivoren. Geol. Pal. Abh. Jena, vol. 9, pp. 195-231, pls. 20-28, 1910.

Geologie von Mexico. Berlin, Borntraeger, p. 131, 1921.

Frick, C.: Extinct vertebrate faunas of the badlands of Bautista Creek and San Timoteo Cañon, Southern California. Univ. Calif. Publ. Dept. Geol. Sci., vol. 12, pp. 277-424, figs. 1-165, pls. 43-50, 1921.

The Hemicyoninae and an American Tertiary bear. Bull. Am. Mus. Nat. Hist., vol. 56, pp. 1-119, figs. 1-63, 1926A.

Prehistoric evidence. Nat. Hist., vol. 26, no. 5, p. 441 [foot note], 1926B.

History of the earth. Childs Frick Tertiary-Quaternary expeditions 1928. Ibid., vol. 29, no. 1, p. 107, 1929.

New remains of trilophodont-tetrabelodont mastodons. Bull. Am. Mus. Nat. Hist., vol. 59, pp. 505-652, figs. 1-38, 1933.

Furlong, E. L.: Distribution and description of skull remains of the Pliocene antelope *Sphenophalos* from the northern Great Basin Province. Carn. Inst. Wash., no. 418, pp. 27-36, pls. 1-5, 1931.

A new genus of otter from the Pliocene of the northern Great Basin province. Ibid., no. 418, pp. 93-103, pls. 1-2, 1932.

Gazin, C. L.: A new shrew from the Upper Pliocene of Idaho. Jour. Mamm., vol. 14, no. 2, pp. 142-144, fig. 1, 1933A.

New felids from the Upper Pliocene of Idaho. Ibid., vol. 14, no. 3, pp. 251-256, figs. 1-3, 1933B.

Upper Pliocene Mustelids from the Snake River Basin of Idaho. Ibid., vol. 15, no. 2, pp. 137-149, figs. 1-5, 1934A.

Fossil hares from the late Pliocene of Southern Idaho. Proc. U. S. Nat. Mus., vol. 83, no. 2976, pp. 111-121, figs. 1-5, 1934B.

Gravigrade sloth remains from the late Pliocene and Pleistocene of Idaho. Jour. Mamm., vol. 16, no. 1, pp. 52-60, figs. 1-7, 1935A.

A new antilocaprid from the Upper Pliocene of Idaho. Jour. Pal., vol. 9, no. 5, pp. 390-393, fig. 1, 1935B.

Gester, G. C., and Galloway, J.: Geology of Kettleman Hills oil field, California. Bull. Am. Assoc. Petroleum Geol., vol. 17, no. 10, pp. 1161-1193, figs. 1-6, 1933.

Gidley, J. W.: Tooth characters and revision of the North American species of the genus *Equus*. Bull. Am. Mus. Nat. Hist., vol. 14, pp. 123-128, 1901.

On two species of *Platygonus* from the Pliocene of Texas. Ibid., vol. 19, pp. 477-481, figs. 1-5, 1903A.

A new three-toed horse. Ibid., vol. 19, pp. 465-476, 1903B.

The fresh-water Tertiary of northwestern Texas. Amer. Mus. expeditions of 1899-1901. Ibid., vol. 19, pp. 617-635, 1903C.

Revision of the Miocene and Pliocene Equidae of North America. Ibid., vol. 23, pp. 865-934, 1907.

Preliminary report on fossil vertebrates of the San Pedro Valley, Arizona, with descriptions of new species of Rodentia and Lagomorpha. U. S. Geol. Surv., Prof. Paper, no. 131-E, pp. 119-131, pls. 34-35, 1922.

Fossil Proboscidea and Edentata of the San Pedro Valley, Arizona. Ibid., Prof. Paper, no. 140-B, pp. 83-95, pls. 32-44, 1926.

A new Pliocene horse from Idaho. Jour. Mamm., vol. 11, no. 3, pp. 300-303, pl. 18, 1930.

Continuation of the fossil horse round-up on the old Oregon trail. Explorations and Field Work Smithsonian Inst. of 1930, pp. 33-40, figs. 27-32, 1931.

Hall, E. R.: A second new genus of hedgehog from the Pliocene of Nevada. Univ. Calif. Publ. Dept. Geol. Sci., vol. 18, pp. 227-231, fig. 1, 1929.

Three new genera of Mustelidae from the later Tertiary of North America. Jour. Mamm., vol. 11, no. 2, pp. 147-151, pl. 7, 1930A.

Rodents and lagomorphs from the later Tertiary of Fish Lake Valley, Nevada. Univ. Calif. Publ. Dept. Geol. Sci., vol. 19, pp. 295-312, figs. 1-29, pl. 37, 1930B.

A new genus of bat from the later Tertiary of Nevada. Ibid., vol. 19, pp. 319-320, pl. 38, 1930C.

A new mustelid genus from the Pliocene of California. Jour. Mamm., vol. 16, no. 2, pp. 137-138, figs. 1-3, 1935.

Hatcher, J. B.: On a small collection of vertebrate fossils from the Loup Fork beds of northwestern Nebraska; with notes on the geology of the region. Am. Nat., vol. 28, pp. 236-248, figs. 1-2, pls. 1-2, 1894.

Hay, O. P.: The Pleistocene mammals of Iowa. Iowa Geol. Surv., vol. 23, pp. 26, 53, 147-151, fig. 44, pl. 9, 1913.

Descriptions of some Floridian fossil vertebrates, belonging mostly to the Pleistocene. Ann. Rept. Fla. Geol. Surv., vol. 8, pp. 41-42, pl. 2, fig. 8, 1916.

On a collection of fossil vertebrates made by Dr. F. W. Cragin in the *Equus* beds of Kansas. Bull. Univ. Kans., vol. 10, pp. 42-43, pl. 1, figs. 6-7, 1917.

The Pleistocene of North America and its vertebrated animals from the states east of the Mississippi River and from the Canadian provinces east of Longitude 95°. Carn. Inst. Wash., no. 322, pp. 1-2, 363, 375-381, 1923.

The Pleistocene of the middle region of North America and its vertebrated animals. Ibid., no. 322A, pp. 139-140, 146, 164, 1924.

The Pleistocene of the western region of North America and its vertebrated animals. Ibid., no. 322B, pp. 1-346, pls. 1-12, figs. 1-19, 1927.

Hesse, C. J.: Another record of the fossil vole *Mimomys primus* (Wilson) from California. Jour. Mamm., vol. 15, no. 3, p. 246, 1934.

An immature mastodon from the Ogallala Pliocene. Ibid., vol. 16, no. 1, pp. 61-63, figs. 1-2, 1935A.

A vertebrate fauna from the type locality of the Ogallala formation. Bull. Univ. Kans., vol. 36, pp. 79-117, pls. 15-22, 1935B.

New evidence on the ancestry of *Antilocapra americana*. Jour. Mamm., vol. 16, no. 5, pp. 307-315, figs. 1-5, 1935C.

Hibbard, C. W.: A new *Bassariscus* from the Lower Pliocene of Nebraska. Bull. Univ. Kans., vol. 34, no. 5, pp. 273-278, pl. 26, 1933.

Two new genera of Felidae from the Middle Pliocene of Kansas. Trans. Kans. Acad. Sci., vol. 37, pp. 239-255, pls. 4-6, 1934.

Hoots, H. W.: Geology and oil resources along the southern border of San Joaquin Valley, California. Bull. U. S. Geol. Surv., no. 812-D, pp. 292-294, 1930.

Kellogg, L.: Rodent fauna of the late Tertiary beds at Virgin Valley and Thousand Creek, Nevada. Univ. Calif. Publ. Bull. Dept. Geol. Sci., vol. 5, pp. 421-437, figs. 1-20, 1910.

A fossil beaver from the Kettleman Hills, California. Ibid., vol. 6, pp. 401-402, fig. 1, 1911.

Kew, W. S. W.: Geology and oil resources of a part of Los Angeles and Ventura Counties, California. Bull. U. S. Geol. Surv., no. 753, p. 54, 1924.

Knowlton, F. H.: Fossil plants of the Esmeralda formation. U. S. Geol. Surv., 21st Ann. Rept., pt. 2, pp. 209-220, 1900.

Kormos, T.: Der Pliozäne knochenfund bei Polgardi, Földtani Közlöny [zeit. ungar. Geol. Ges.], vol. 41, pp. 171-189, 1911.

Lane, H. H.: A new rhinoceros from Kansas. Univ. Kans. Sci. Bull., vol. 17, pp. 297-311, pls. 22-25, 1927.

La Motte, R. S.: The Upper Cedarville flora of northwestern Nevada and adjacent California. Carn. Inst. Wash. Publ., no. 455, part 4 [in press], 1935.

Lawson, A. C.: San Francisco Folio. U. S. Geol. Surv. Folio, no. 193, p. 13, 1914.

————, and Palache, C.: The Berkeley Hills, a detail of Coast Range geology. Univ. Calif. Publ. Dept. Geol. Sci., vol. 2, pp. 349-450, pls. 10-17, 1901.

Leidy, J.: [Remarks on several fossil teeth.] Proc. Acad. Nat. Sci., Phila., vol. 6, p. 241, 1853.

Notices of some remains of extinct Mammalia, recently discovered by Dr. F. V. Hayden in the badlands of Nebraska. Ibid., vol. 8, p. 59, 1856.

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, geologist to the expedition. Ibid., vol. 10, pp. 20-29, 1858.

Description of vertebrate fossils. Holmes' Post-Pliocene fossils of South Carolina, p. 105, pl. 16, figs. 32-33A, 1860.

The extinct mammalian fauna from Dakota and Nebraska, including an account of some allied forms from other localities. Jour. Acad. Nat. Sci. Phila., vol. 7, pp. 1-472, pls. 1-30, 1869.

On remains of horses. Proc. Acad. Nat. Sci. Phila., vol. 34, pp. 290-291, fig. 1, 1882.

Vertebrate fossils from Florida. Ibid., vol. 36, pp. 118-119, 1884.

Rhinoceros and *Hippotherium* from Florida. Ibid., vol. 37, pp. 32-33, 1885.

An extinct boar from Florida. Ibid., vol. 38, pp. 37-38, 1886A.

Mastodon and llama from Florida. Ibid., vol. 38, pp. 11-12, 1886B.

Fossil bones from Florida. Ibid., vol. 39, pp. 309-310, 1887.

Description of vertebrate remains from Peace Creek, Florida. Trans. Wagner Free Inst. Sci., vol. 2, pp. 20-22, 1889.

Fossil vertebrates from Florida. Proc. Acad. Nat. Sci., Phila., vol. 42 pp. 64-65, 1890A.

Hippotherium and *Rhinoceros* from Florida. Ibid., vol. 42, pp. 182-183, 1890B.

————, and Lucas, F. A.: Fossil vertebrates from the Alachua clays of Florida. Trans. Wagner Free. Inst. Sci., vol. 4, pp. 7-61, pls. 1-19, 1896.

Louderback, G. D.: Notes on the geologic section near Columbia, California, with special reference to the occurrence of fossils in the Auriferous gravels. Carn. Inst. Wash., no. 440, pp. 12-13, 1933.

Lucas, F. A.: A new fossil cyprinoid, *Leuciscus turneri*, from the Miocene of Nevada. Proc. U. S. Nat. Mus., vol. 23, pp. 333-334, pl. 8, 1900.

Marsh, O. C.: Notice of new equine mammals from the Tertiary formation. This Journal, vol. 7, pp. 252-258, 1874.

Description of Tertiary artiodactyls. Ibid., vol. 48, pp. 273-274, 1894.

Martin, H. T.: Two new carnivores from the Pliocene of Kansas. Jour. Mamm., vol. 9, no. 3, pp. 233-236, pls. 20-21, 1928.

Matthew, W. D.: A provisional classification of the fresh-water Tertiary of the west. Bull. Am. Mus. Nat. Hist., vol. 12, pp. 65-75, 1899.

Fossil mammals of the Tertiary of northeastern Colorado. Mem. Am. Mus. Nat. Hist., vol. 1, pp. 353-447, figs. 1-34, pls. 37-39, 1901.

A skull of *Dinocyon* from the Miocene of Texas. Bull. Am. Mus. Nat. Hist., vol. 16, pp. 129-136, figs. 1-4, 1902.

A complete skeleton of *Merycodus*. Ibid., vol. 20, pp. 101-129, 1904.
Faunal lists of the Tertiary Mammalia of the west. Bull. U. S. Geol. Surv., no. 361, pp. 115-120, 1909.
Certain theoretical considerations affecting phylogeny and correlation. Bull. Geol. Soc. Amer., vol. 24, pp. 283-292, 1913.
Contributions to the Snake Creek fauna with notes upon the Pleistocene of western Nebraska. American Museum expedition of 1916. Bull. Am. Mus. Nat. Hist., vol. 38, pp. 183-229, figs. 1-20, pls. 4-10, 1918.
Third contribution to the Snake Creek fauna. Ibid., vol. 50, pp. 59-210, figs. 1-63, 1924A.
A new link in the ancestry of the horse. Am. Mus. Novitates, no. 131, pp. 1-2, 1924B.
Correlation of the Tertiary formations of the Great Plains. Bull. Geol. Soc. Am., vol. 35, pp. 743-754, 1924C.
Blanco and associated formations of northern Texas [abstract]. Ibid., vol. 36, pp. 221-222, 1925.
The evolution of the horse. A record and its interpretation. Quart. Review Biol., vol. 1, pp. 139-185, figs. 1-27, 1926.
A new and remarkable hedgehog from the later Tertiary of Nevada. Univ. Calif. Publ. Bull. Dept. Geol. Sci., vol. 18, pp. 93-102, pls. 7-8, 1929.
A review of the rhinoceroses with a description of *Aphelops* material from the Pliocene of Texas. Ibid., vol. 20, pp. 411-482, figs. 1-12, pls. 61-79, 1932A.
New fossil mammals from the Snake Creek Quarries. Am. Mus. Novitates, no. 540, pp. 1-8, figs. 1-7, 1932B.
————, and Cook, H. J.: A Pliocene fauna from western Nebraska. Bull. Am. Mus. Nat. Hist., vol. 26, pp. 361-414, figs. 1-27, 1909.
————, and Gidley, J. W.: New or little known mammals from the Miocene of South Dakota. American Museum expedition of 1903. Ibid., vol. 20, pp. 241-268, figs. 1-15, 1904.
New or little known mammals from the Miocene of South Dakota. Ibid., vol. 22, pp. 135-153, figs. 1-20, 1906.
————, and Stirton, R. A.: Osteology and affinities of *Borophagus*. Univ. Calif. Publ. Bull. Dept. Geol. Sci., vol. 19, pp. 171-216, figs. 1-2, pls. 21-34, 1930A.
Equidae from the Pliocene of Texas. Ibid., vol. 19, pp. 349-396, pls. 45-58, 1930B.
Maxson, J. H.: A Tertiary mammalian fauna from the Mint Canyon formation of Southern California. Carn. Inst. Wash., no. 404, pp. 77-112, figs. 1-18, 1930.
McGrew, P. O.: A new *Cynodesmus* from the Lower Pliocene of Nebraska with notes on the phylogeny of the dogs. Univ. Calif. Publ. Bull. Dept. Geol. Sci., vol. 23, pp. 305-312, figs. 1-4, 1935.
Merriam, J. C.: *Sigmogomphius leContei*, a new castoroid rodent from the Pliocene near Berkeley, California. Ibid., vol. 1, pp. 363-370, figs. 1-2, 1896.
A contribution to the geology of the John Day Basin. Ibid., vol. 2, pp. 310-312, 1901.
The Pliocene and Quaternary Canidae of the Great Valley of California. Ibid., vol. 3, pp. 277-290, pls. 28-30, 1903.
The occurrence of strepsicerine antelopes in the Tertiary of northwestern Nevada. Ibid., vol. 5, pp. 319-330, figs. 1-7, 1909.
Tertiary mammal beds of Virgin Valley and Thousand Creek in northwestern Nevada. Part I—Geologic history. Ibid., vol. 6, pp. 21-53, pls. 1-12, 1910.

Tertiary mammal beds of Virgin Valley and Thousand Creek in northwestern Nevada. Part II—Vertebrate faunas. Ibid., vol. 6, pp. 199-304, pls. 32-33, figs. 1-80, 1911.

Notes on the canid genus *Tephrocyon.* Ibid., vol. 7, pp. 359-372, 1913A.

Vertebrate fauna of the Orindan and Siestan beds in middle California. Ibid., vol. 7, pp. 373-385, figs. 1-9, 1913B.

New Anchitheriine horses from the Tertiary of the Great Basin area. Ibid., vol. 7, pp. 419-427, figs. 1-2, 1913C.

New Protohippine horses from Tertiary beds on the western border of the Mohave desert. Ibid., vol. 7, pp. 435-441, figs. 1-4, 1913D.

Remains of land mammals from marine Tertiary beds in the Tejon Hills, California. Ibid., vol. 8, pp. 283-288, figs. 1-7, 1915A.

New species of the *Hipparion* group from the Pacific Coast and Great Basin Provinces of North America. Ibid., vol. 9, pp. 1-8, figs. 1-5, 1915B.

New horses from the Miocene and Pliocene of California. Ibid., vol. 9, pp. 52-58, figs. 4-12, 1915C.

Extinct faunas of the Mohave Desert, their significance in a study of the origin and evolution of life in America. Pop. Sci. Monthly, vol. 86, pp. 245-264, figs. 1-7, 1915D.

Tertiary vertebrate faunas of the north Coalinga region of California, a contribution to the study of paleontologic correlation in the Great Basin and Pacific Coast province. Trans. Am. Philos. Soc. (n.s.), vol. 22, pp. 191-234, figs. 1-49, 1915E.

A Tertiary vertebrate fauna from the Cedar Mountain region of western Nevada. Univ. Calif. Publ. Bull. Dept. Geol. Sci., vol. 9, pp. 161-198, figs. 1-48, 1916A.

Relationship of *Equus* to *Pliohippus* suggested by characters of a new species from the Pliocene of California. Ibid., vol. 9, pp. 525-534, figs. 1-18, 1916B.

Mammalian remains from the Chanac formation of the Tejon Hills, California. Ibid., vol. 10, pp. 111-127, figs. 1-21, 1916C.

Mammalian remains from a late Tertiary formation at Ironside, Oregon. Ibid., vol. 10, pp. 129-135, figs. 1-3, 1916D.

Relationships of Pliocene mammalian faunas from the Pacific Coast and Great Basin provinces of North America. Ibid., vol. 10, pp. 421-443, 1917.

New mammalia from the Idaho formation. Ibid., vol. 10, pp. 523-530, figs. 1-5, 1918.

Tertiary mammalian faunas of the Mohave Desert. Ibid., vol. 11, pp. 525-585, figs. 138-253, 1919.

————, and Buwalda, J. P.: Age of strata referred to the Ellensburg formation in the White Bluffs of the Columbia River. Ibid., vol. 10, pp. 255-266, pl. 13, 1917.

————, and Sinclair, W. J.: Tertiary faunas of the John Day region. Ibid., vol. 5, pp. 171-182, 195-198, 1907.

————, and Stock, C.: A hyaenarctid bear from the later Tertiary of the John Day Basin of Oregon. Carn. Inst. Wash., no. 346, pp. 39-44, pl. 1, 1925.

A further contribution to the mammalian fauna of the Thousand Creek Pliocene, northwestern Nevada. Ibid., no. 393, pp. 5-21, figs. 1-14, pls. 1-3, 1928.

Tertiary mammals from the Auriferous gravels near Columbia, California. Ibid., no. 440, pp. 3-6, figs. 1-2, 1933.

————, and Moody, C. L.: An American Pliocene bear. Univ. Calif. Publ. Bull. Dept. Geol. Sci., vol. 10, pp. 87-109, figs. 1-23, 1916.

The Pliocene Rattlesnake formation and fauna of eastern Oregon, with notes on the geology of the Rattlesnake and Mascall deposits. Carn. Inst. Wash., no. 347, pp. 43-92, figs. 1-45, 1925.

Nomland, J. O.: Relation of the invertebrate to the vertebrate faunal zones of the Jacalitos and Etchegoin formations in the North Coalinga region, California. Univ. Calif. Publ. Bull. Dept. Geol. Sci., vol. 9, pp. 77-88, pl. 7, 1916A.

Fauna from the Lower Pliocene at Jacalitos Creek and Waltham Canyon, Fresno County, California. Ibid., vol. 9, pp. 199-214, pls. 9-11, 1916B.

The Etchegoin Pliocene of Middle California. Ibid., vol. 10, pp. 191-254, figs. 1-2, pls. 6-12, 1917.

Osborn, H. F.: *Glyptotherium texanum*, a new glyptodont, from the Lower Pleistocene of Texas. Bull. Am. Mus. Nat. Hist., vol. 19, pp. 491-494, one plate, 1903.

New Miocene rhinoceroses with revision of known species. Ibid., vol. 20, pp. 307-326, figs. 1-21, 1904.

Cenozoic mammal horizons of western North America. Bull. U. S. Geol. Surv., no. 361, pp. 76-83, 1909.

The age of mammals. MacMillan Co., New York, pp. 1-635, figs. 1-220, 1910.

Equidae of the Oligocene, Miocene and Pliocene of North America, iconographic type revision. Mem. Am. Mus. Nat. Hist., vol. 2, pp. 1-330, figs. 1-173, pls. 1-54, 1918.

Pilgrim, G. E.: Catalogue of the Pontian Carnivora of Europe. Publ. British Mus. Nat. Hist., pp. 1-174, figs. 1-30, pls. 1-2, 1930.

Reed, L. C., and Longnecker, O. M., Jr.: The geology of Hemphill County, Texas. Univ. Texas Bull., no. 3231, pp. 1-98, figs. 1-9, 1932.

Russell, R. D., and VanderHoof, V. L.: A vertebrate fauna from a new Pliocene formation in northern California. Univ. Calif. Publ. Bull. Dept. Geol. Sci., vol. 20, pp. 11-21, figs. 1-7, 1931.

Russell, R. J.: Basin Range structure and stratigraphy of the Warner Range, northeastern California. Ibid., vol. 17, p. 412, 1928.

Sellards, E. H.: The pebble phosphates of Florida. Ann. Rept. Fla. Geol. Surv., vol. 7, pp. 72-73, 77, 81, 106-111, figs. 37-39, 44, 1915.

Fossil vertebrates from Florida: a new Miocene fauna; new Pliocene species; the Pleistocene fauna. Ann. Rept. Fla. Geol. Surv., vol. 8, pp. 92-100, pl. 11, fig. 10, pl. 12, pl. 13, figs. 7-8, 1916.

————, Adkins, W. S., and Plummer, F. B.: The geology of Texas. Stratigraphy. Univ. Texas Bull., vol. 1, no. 3232, pp. 727-776, 1932.

Simpson, G. G.: The extinct land mammals of Florida. Ann. Rept. Fla. Geol. Surv., vol. 20, pp. 248-261, 1929.

Tertiary land mammals of Florida. Bull. Am. Mus. Nat. Hist., vol. 59, pp. 149-211, figs. 1-31, 1930.

Glossary and correlation charts of North American Tertiary mammal-bearing formations. Ibid., vol. 67, pp. 79-121, figs. 1-8, 1933.

Sinclair, W. J.: Some edentate-like remains from the Mascall beds of Oregon. Univ. Calif. Publ. Bull. Dept. Geol. Sci., vol. 5, pp. 65-66, figs. 1-3, 1906.

Additions to the fauna of the Lower Pliocene Snake Creek beds (results of the Princeton University 1914 expedition to Nebraska). Proc. Am. Philos. Soc., vol. 54, pp. 73-95, figs. 1-18, 1915.

Stirton, R. A.: Artiodactyla from the fossil beds of the Fish Lake Valley, Nevada. Univ. Calif. Publ. Bull. Dept. Geol. Sci., vol. 18, pp. 291-302, figs. 1-9, 1929.

A new genus of the family Vespertilionidae from the San Pedro Pliocene of Arizona. Ibid., vol. 20, pp. 27-30, figs. 1-2, 1931.

A new genus of Artiodactyla from the Clarendon Lower Pliocene of Texas. Ibid., vol. 21, pp. 147-168, figs. 1-3, pls. 6-11, 1932A.

Correlation of the Fish Lake Valley and Cedar Mountain beds in the Esmeralda formation of Nevada. Science (n.s.), vol. 76, no. 1959, pp. 60-61, 1932B.

An association of horn-cores and upper molars of the antelope *Sphenophalos nevadanus* from the Lower Pliocene of Nevada. This Journal, vol. 24, pp. 46-51, figs. 1-3, 1932C.

A critical review of the Mint Canyon mammalian fauna and its correlative significance. Ibid., vol. 26, pp. 569-576, 1933.

A review of the Tertiary beavers. Univ. Calif. Publ. Bull. Dept. Geol. Sci., vol. 23, pp. 428-458, figs. 1-142, 1935A.

Phylogeny of North American Miocene and Pliocene Equidae [abstract]. Proc. Geol. Soc. Am. for 1934, pp. 382-383, 1935B.

The age of the vertebrate fauna [Alturas formation]. Carn. Inst. Wash., no. 455, pt. 4 [incorporated with LaMotte, 1935], 1935C.

————, and McGrew, P. O.: A preliminary notice on the Miocene and Pliocene mammalian faunas near Valentine, Nebraska. This Journal, vol. 29, pp. 125-132, 1935.

————, and VanderHoof, V. L.: *Osteoborus*, a new genus of dogs and its relations to *Borophagus* Cope. Univ. Calif. Publ. Bull. Dept. Geol. Sci., vol. 23, pp. 175-182, figs. 1-3, 1933.

Stock, C.: Note on an *Hipparion* tooth from the Siestan deposits of the Berkeley Hills, California. Univ. Calif. Publ. Bull. Dept. Geol. Sci., vol. 13, pp. 19-21, fig. 1, 1921A.

Later Cenozoic mammalian remains from the Meadow Valley region, southeastern Nevada. This Journal, vol. 2, pp. 250-264, figs. 1-12, 1921B.

Cenozoic gravigrade edentates of western North America with special reference to the Pleistocene Megalonychinae and Mylodontidae of Rancho La Brea. Carn. Inst. Wash., no. 331, pp. 18-21, 1925.

Anchitheriine horses from the Fish Lake Valley region, Nevada. Univ. Calif. Publ. Bull. Dept. Geol. Sci., vol. 16, pp. 61-68, fig. 1, pl. 11, 1926.

Canid and Proboscidean remains from the Ricardo deposits, Mohave Desert, California. Carn. Inst. Wash., no. 393, pp. 39-47, pls. 1-4, 1928A.

A tooth of *Hipparion mohavense* from the Puente formation. Ibid., no. 393, pp. 49-53, fig. 1, 1928B.

Hyaenognathus from the late Pliocene of the Coso Mountains, California. Jour. Mamm., vol. 13, no. 3, pp. 263-266, pl. 14, 1932.

Deep-well record of fossil mammal remains in California. Bull. Am. Assoc. Petroleum Geol., vol. 19, no. 7, pp. 1064-1068, figs. 1-2, 1935.

————, and Furlong, E. L.: New canid and rhinocerotid remains from the Ricardo Pliocene of the Mohave Desert, California. Univ. Calif. Publ. Bull. Dept. Geol. Sci., vol. 16, pp. 43-60, pls. 7-10, 1926.

————, and Hall, E. R.: The Asiatic genus *Eomellivora* in the Pliocene of California. Jour. Mamm., vol. 14, no. 1, pp. 63-65, pl. 4, 1933.

————, Patterson, J. W., and Furlong, E. L.: Tertiary mammalian fauna from the Kern River series, California [abstract]. Bull. Geol. Soc. Am., vol. 40, p. 260, 1929.

Teilhard de Chardin, P., and Stirton, R. A.: A correlation of some Miocene and Pliocene mammalian assemblages in North America and Asia with a discussion of the Mio-Pliocene boundary. Univ. Calif. Publ. Bull. Dept. Geol. Sci., vol. 23, pp. 277-290, 1934.

Thorpe, M. R.: Two new fossil Carnivora. This Journal, vol. 1, pp. 477-480, figs. 1-3, 1921.

A new generic name for *Pliocyon marshi*. Ibid., vol. 3, p. 97, 1922A.

Araeocyon, a probable Old World migrant. Ibid., vol. 3, pp. 371-377, 1922B.

Some Tertiary Carnivora in the Marsh collection, with description of new forms. Ibid., vol. 3, pp. 423-455, figs. 1-13, 1922C.

A new species of extinct peccary from Oregon. Ibid., vol. 7, pp. 393-397, figs. 1-4, 1924.

Troxell, E. L.: An early Pliocene one-toed horse, *Pliohippus lullianus*, sp. nov. Ibid., vol. 42, pp. 335-348, figs. 1-7, 1916.
Turner, H. W.: The Esmeralda formation. Am. Geol., vol. 25, pp. 168-170, 1900A.
The Esmeralda formation, a fresh-water lake deposit. 21st Ann. Rept. U. S. Geol. Surv., pt. 2, pp. 191-208, 1900B.
VanderHoof, V. L.: *Borophagus littoralis* from the marine Tertiary of California. Univ. Calif. Publ. Bull. Dept. Geol. Sci., vol. 21, pp. 15-24, pls. 1-3, 1931.
A skull of *Pliohippus tantalus* from the later Tertiary of the Sierran foothills of California. Ibid., vol. 23, pp. 183-194, figs. 1-5, pl. 16, 1933A.
Additions to the fauna of the Tehama Upper Pliocene of Northern California. This Journal, vol. 25, pp. 382-384, 1933B.
Wilson, R. W.: *Cosomys*, a new genus of vole from the Pliocene of California. Jour. Mamm., vol. 13, no. 2, pp. 150-154, pl. 12, 1932.
A rodent fauna from later Cenozoic beds of southwestern Idaho. Carn. Inst. Wash., no. 440, pp. 117-135, figs. 1-8, pls. 1-2, 1933.
A new species of *Dipoides* from the Pliocene of eastern Oregon. Ibid., no. 453, pp. 19-28, pl. 1, 1934.
Wood, A. E.: Evolution and relationship of the heteromyid rodents with new forms from the Tertiary of Western North America. Ann. Carn. Mus., vol. 24, pp. 73-262, figs. 1-157, 1935.
Wortman, J. L.: On the origin and development of existing horses. Kansas City Rev. Sci. and Industry, vol. 6, p. 73, 1882.

Berkeley, Calif.