SUMMARY OF NORTH AMERICAN PLEISTOCENE MAMMALIAN LOCAL FAUNAS

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INTRODUCTION

THE ages of various Pleistocene faunas have plagued geologists since the first recognition of glacial and interglacial intervals. The chief handicap in assigning Pleistocene faunas to different ages is the lack of faunas from the glaciated regions of North America which could provide controls for dating faunas from the nonglaciated regions. Faunas are unknown from tills, and only a few fossils are known from outwash gravel and sand or from interglacial deposits in the glaciated regions. With the exception of post-Sangamon deposits, no vertebrate fauna represented by more than a few specimens has been recovered from glaciated areas. Molluscan faunas, however, are known from Sangamon and Wisconsin deposits (Baker, 1920).

All the rich Pleistocene local faunas of North America have been recovered from areas outside of the glaciated region. There is, however, no direct stratigraphic correlation between most of the fossiliferous deposits in the nonglaciated region and the glacial deposits on which Pleistocene chronology is based. This does not mean that a direct correlation cannot be worked out. Such correlations will be made by the co-operative work of all specialists in Pleistocene geology.

The terms fauna and local fauna are often confused. The term fauna has many uses; "Pleistocene fauna," for example, includes all animal life of that time span. It can also be restricted to the Pleistocene fauna of a continent, country, or state. The term can be applied generally to the animal life of the different Pleistocene ages. It is unwise, however, to name a fauna after a time interval, since future work may change the age reference.

Local faunas, commonly named after a geographic locality, consist of an association of identifiable remains of animal life of the same age which have been collected in a restricted geographical area. Local faunal names should never be assigned to an isolated specimen. Only one of the Pleistocene local faunas is now well enough known over a wide geographical area, and with sufficiently precise stratigraphic control, to be considered as a contemporaneous fauna. This is the Cudahy fauna which occurs in the base of the Pearlette ash and in the immediately underlying silt and silty clay. This fauna is known from Nebraska, Kansas, Oklahoma, and Texas.

Many local faunas, as well as isolated finds of vertebrate remains, have been reported from North America. Hay gives a compilation of these (1923, 1924, and 1927). Homer (1933) and Colbert (1937) have given good summaries of the Pleistocene fossil record in North America. A brief discussion of the problems encountered in age assignment of local faunas and use of provincial age and stage terms as applied to the Pleistocene follows. An explanation is given of the stratigraphic assignment of the local faunas in Table I.

DIFFERENT CONCEPTS OF THE PLEISTOCENE

Zeuner (1950, p. 126) wrote, "the concept of Pleistocene time has developed along three almost independent lines." I list and briefly discuss these three different concepts here, since few students outside of the field of vertebrate paleontology are aware of these problems.

Typology—Lyell (1833) named certain units of Cenozoic rocks Older Pliocene and Newer Pliocene. He later (1839) applied the name Pliocene to what he previously called "Older Pliocene" and the name Pleistocene to the "Newer Pliocene." Calabrian and Villafranchian fossiliferous beds are present in the type section of Lyell's Pliocene. But these same beds, or their equivalents, occur in the base of Lyell's type section of his Pleistocene ("Newer Pliocene"). Some workers have considered the entire section at the type locality of Lyell's "Older Pliocene" as belonging in the Pliocene. Therefore, based on typology, the Pliocene has been considered by some workers to include the Calabrian and Villafranchian formations and their equivalents. The type localities of the Pliocene and Pleistocene are discussed by Gignoux (1913 and 1943), Movius (1949), and Stirton (1951). Vertebrate faunas from the Villafranchian deposits or equivalent deposits have been assigned to both Upper Pliocene and Lower Pleistocene by different workers who have failed to make clear that such age assignments were based upon Lyell's type sections.

At the 18th International Geological Congress in London in 1948, the Pliocene-Pleistocene Boundary Commission recommended to the Congress that "in order to eliminate existing ambiguities, the Lower Pleistocene should include as its basal member in the type-area the Calabrian formation (marine) together with its terrestrial (continental) equivalent the Villafranchian." The Commission also noted "that according to evidence given this usage would place the boundary at the horizon of the first indication of climatic deterioration in the Italian Neogene succession" (see King, W. B. R., *et al.*, 1950, p. 6). This does not solve the problems in dating Pleistocene deposits and faunas throughout the world, but it does give a type section for the Pleistocene with which one may try to correlate.

Climatic criterion—Most students of earth science and vertebrate zoology in North America consider the terms Pleistocene, Ice Age, "Great Ice Age," or "Glacial epoch" as synonyms. In the teaching of historical geology the Pleistocene is distinguished from the rest of the Cenozoic by the evidence of glaciation. Flint (1947), Migliorini (1950), Osborn (1910), van der Vlerk (1950), and various textbooks of historical geology all consider that the above terms are synonymous and that the Pleistocene begins with the first climatic deterioration (marked cooling) at the end of the Pliocene.

Mammalian "index fossils"—As previously stated, the lack of vertebrate faunas from the earlier Pleistocene deposits of the glaciated regions of the Northern Hemisphere was a great handicap in interpreting the Pleistocene fossiliferous nonglacial deposits to the south. Osborn's *Age of Mammals* (1910) had an important influence on later work, both in Europe and North America. Osborn considered *Elephas columbi*(?), *Elephas imperator*, *Mastodon americanus*, *Equus complicatus* and *Equus occidentalis*(?), as characteristic of the first interglacial fauna. Although Osborn (1910, p. 373) considered the Pleistocene as synonymous with the Ice Age, his faunal lists were accepted in Europe and North America. He considered the Hay Springs fauna of Nebraska as Aftonian and the Blanco fauna of Texas as Pliocene. Those accepting Osborn's faunal list taught that the Pleistocene began with the first appearance of the modern horse, *Elephas* = *Mammuthus* and *Bison*. This was accepted in part by some European workers, whereas others contended that *Equus*, *Elephas*, and *Bos* occurred in the Upper Pliocene Villafranchian deposits. It was later recognized that both the genus *Plesippus* from the Blanco fauna of Texas and *Equus stenonis* from the Villafranchian faunas of Europe were zebrine horses (see Boule, 1900; McGrew, 1944).

Some workers consider the zebrine horses as generically distinct from the true horse, *Equus* (*sensu stricto*), and others consider the difference as only subgeneric. As recently as 1941, all faunas in North America that contained the zebrine horse *Plesippus* and the little three-toed horse *Nannippus* were assigned a late Pliocene age. None of the known faunas containing these two horses has been found to contain *Equus* (*sensu stricto*), *Mammuthus*, or *Bison* (see Wood, *et al*., 1941). Though most of the vertebrate paleontologists in North America have taught that the Pleistocene is synonymous with the Ice Age, they have until recently considered all Pleistocene faunas that contained such fossils as *Stegomastodon*, *Plesippus*, and *Nannippus* as belonging in the Upper Pliocene. Thus the use of "index mammalian fossils" assigned some of the Pleistocene faunas to an earlier age.

The large mammals of the early Pleistocene faunas of North America are chiefly holdovers from the late Pliocene. In recent years it has been shown that some of the local faunas once considered as late Pliocene in age (such as the Coso Mountains, Blanco and Hagerman: Gazin, 1936; Hibbard, 1941; Wood, *et al*., 1941), because of the presence of *Plesippus* and *Nannippus*, are actually early *Pleistocene* (Schultz, 1937; McGrew, 1944; Meade, 1945; Hibbard 1956a).

Colbert (1942, pp. 1510-1515), gives a good brief summary of previous methods of dating early Pleistocene mammalian faunas: "Those mammals particularly diagnostic of the beginning of the Pleistocene in North America are the modern horse, *Equus*, the mammoth, *Archidiskodon* [= *Mammuthus*], and cattle, *Bison*. To these three types there may be added the modern camelids, as exemplified in the New World by *Camelops*. Of the foregoing enumerated forms, the first and last were autochthonous and their first appearance marks the actual beginning of Pleistocene times in the North American region."

Today these statements need modification. *Equus* (*s. s.*) is unknown in North America before the late Kansan. The date of immigration of *Mammuthus* into North America is uncertain, but apparently is Aftonian or earlier. (A large collection of vertebrates from below the Pearlette ash in the Seymour formation of Texas shows the mammoth had arrived there by late Kansan time. It could hardly have crossed the Bering Straits land bridge during a glacial age.) *Bison* is known only from later Pleistocene deposits.

Correlation with the type area—The establishment of a type area for the Pleistocene does not solve the problems of the Pliocene-Pleistocene boundary in North America. There are various means by which correlations of deposits and faunas with the type area may be attempted, such as fossil mammals, marine invertebrates, and the evidence of climatic change. The use of these three methods may not give the same results. The first evidence of a marked cooling of climate in North America seems to be the most reliable method to use for correlation with the type area in Italy, and hence for marking the beginning of the Pleistocene in North America. Evidence from Carbon-14 dating has shown that the later phases of the last glaciation were synchronous in Europe and North America, and it may be assumed that the other glaciations were also synchronous.

Correlation of Faunas

A control is needed to assign Pleistocene local faunas from the nonglaciated regions to given ages. Most of these faunas in North America come from widely scattered areas. Since an entire vertebrate fauna and the time and geographical ranges of its members cannot be completely known, it is difficult and even impossible at times to correlate local faunas that are chiefly known by different components. Stratigraphic controls do not exist in the nonglaciated regions since the Pleistocene deposits are not continuous.

Provincial Time Scales

Because of the lack of stratigraphic and faunal control on many of the fossil-bearing deposits in North America and the difficulty in correlating continental deposits with the European type sections, provincial stage and age names have been applied in North America. An example of such application is typified by the term Blancan.

Wood, *et al*. (1941) defined the Blancan age (Upper Pliocene) as the time range of *Borophagus, Ceratomeryx, Ischyrosmilus* and *Plesippus*, the last appearance of *Anancus = Stegomastodon*, *Lutravus*, *Megatylopus = Gigantocamelus?, Nannippus* and ?*Neohipparion*.

Borophagus, Ceratomeryx, Ischyrosmilus, Plesippus, Nannippus, Stegomastodon, Lutravus and *Gigantocamelus* are now also known from early Pleistocene faunas such as the Blanco, Hagerman and Coso Mountains and have been shown to be of early Pleistocene age (Schultz, 1937;McGrew, 1944; Meade, 1945; Savage, 1955; Hibbard, 1956a). The Blancan provincial age of Wood, *et al*. (1941) by definition includes both late Pliocene and early Pleistocene faunas. At the present time the term Blancan is used for those faunas containing *Plesippus* and *Nannippus*, regardless of their Pliocene or Pleistocene age. The time-term Blancan should not be confused with the Blanco local fauna, which is one of the many faunas included in this provincial age.

Savage (1951, p. 289) defined the Irvingtonian provincial age as including those Pleistocene faunas that are post-Blancan in age and lack *Bison*. At this time he also named and defined the Raneholabrean provincial age, which includes the faunas that are post-Irvingtonian and are "denoted by their possession of the remains of *Bison* and by the presence of many mammalian species, particularly in the Carnivora and Rodentia, which are inseparable from Recent inhabitants of the same area."

Provincial age and stage names based on certain vertebrate associations found in different rock units are useful in dividing the Pleistocene into time and rock units in North America where direct stratigraphic correlations cannot be made with the glaciated section. In many parts of North America, in the nonglaciated areas, the Pleistocene deposits and their contained faunas either have not been studied in detail or are so poorly known that it is still impossible at the present time to assign the fossils to a given age of the Pleistocene.

Stratigraphic Control in Southwestern Kansas

I have attempted to work out a stratigraphic succession of Pleistocene local faunas for a local area in the nonglaciated region of North America and to correlate these faunas with the events recorded in the glaciated region. This area is in the Meade Basin in southwestern Kansas where more than 400 feet of Pleistocene deposits are known. In this area and in the adjoining part of northwestern Oklahoma the Pleistocene deposits are underlain by more than 500 feet of Pliocene deposits. This area of deposition is unusual in that the two older Pleistocene formations occur as widespread sheet deposits on the underlying Pliocene. The two younger Pleistocene formations are not sheet deposits but abandoned valley fillings, terraces, or sinkhole deposits. A stratigraphic succession of local faunas has been recovered from these sediments. Some of the faunas consist of associated mollusks and lower vertebrates as well as mammals. This area provides a stratigraphic and faunal control for the Pleistocene local faunas by the underlying Upper Pliocene Rexroad formation and its contained local faunas, and by its recent fauna. This stratigraphic succession of Pleistocene faunas records, in part, the faunal movement, first appearance, and extinction of animal life with evidence of climatic changes in that region during the Pleistocene. These faunas can be tentatively correlated with the events in the glaciated region on the assumption that there were only four major continental glaciations and three major interglacial intervals in North America. On the basis of the correlation of these formations and their faunas in the Meade Basin with the events in the glaciated region, it is possible to extend a tentative age assignment to other known faunas, which in some cases lack a stratigraphic and faunal control in their local area.

Climatic Interpretation of Local Faunas

A local fauna must be carefully studied before assigning it to a glacial or an interglacial age. In the analysis of a fauna it is assumed, unless there is evidence to the contrary, that extinct animals had similar environmental requirements to those of their close living relatives. It is necessary to work with the entire fauna. In no case has it been found that the interpretations of the molluscan, fish, amphibian, reptilian or avian faunas associated with the mammalian fauna are antagonistic. They have been found to be complementary and have aided greatly the interpretation of past climatic and environmental conditions.

Some vertebrate collections cannot be considered as a unit fauna; they are assemblages consisting of both glacial and interglacial elements. One such is the well-known Cumberland Cave fauna of Maryland (Gidley and Gazin, 1938, pp. 10-63). The presence of a crocodile or an alligator with the remains of a boreal lemming, *Synaptomys* (*Mictomys*), indicates the mixture of an interglacial with a glacial fauna.

Pleistocene Local Faunas

I have reviewed all of the well-known Pleistocene faunas of North America. From this study I have attempted to compile a stratigraphic list of faunal occurrences using only those local faunas which I believe to have sufficient stratigraphic and faunal control to allow a tentative stage and age assignment prior to the Wisconsin.

I do not expect all workers to agree with the tentative age assignment of some faunas. Further study of the Pleistocene will provide much-needed information concerning the ages of North American Pleistocene faunas.

A great number of isolated finds of extinct mammals in North America occur in deposits of Wisconsin age, and especially in the drift area where their remains have been recovered chiefly from bog deposits. A number of these mammals have been lumped together under Wisconsin and have been assigned number 10, to indicate their occurrence in North America during Wisconsin time. For example, the remains of the American mastodon have been taken from hundreds of Wisconsin deposits in North America. It is impossible to list here all geographical occurrences of the American mastodon and those of other large mammals known chiefly from isolated finds.

The number preceding the faunal names is used in the tentative stratigraphic list of genera and species and to indicate bibliographic references to the faunas.

Wisconsin Local Faunas

1. Burnet Cave, New Mexico
2. Carpinteria, California
3. Cherokee Cave, Missouri
4. Craighead Caverns, Tennessee
5. Frankstown Cave, Pennsylvania
6. Gypsum Cave, Nevada
7. Hawver Cave, California
8. Jones Ranch, Kansas
9. McKittrick, California
10. North America
11. Papago Springs Cave, Arizona
12. Potter Creek Cave, California
13. Rampart Cave, Arizona
14. Rancho La Brea, California
15. Samwel Cave, California
16. San Josecito Cave, Mexico
17. Utah Cave, Utah
18. Ventana Cave, Arizona

Sangamon Local Faunas

19. Cragin Quarry, Kansas
20. Jinglebob, Kansas
21. Rezabek, Kansas

Illinoian Local Faunas

22. Berends, Oklahoma

Yarmouth Local Faunas

23. Borchers, Kansas

Kansan Local Faunas

24. Arkalon, Kansas
25. Cudahy (Fauna), Kansas, Nebraska, Oklahoma, Texas
26. Holloman, Oklahoma
27. Seger, Kansas

Aftonian Local Faunas

28. Blanco, Texas
29. Broadwater-Lisco, Nebraska
30. Coso Mountains, California
31. Deer Park, Kansas
32. Hagerman, Idaho
33. Sanders, Kansas

Transitional Nebraskan-Aftonian Local Faunas

34. Dixon, Kansas

Nebraskan Local Faunas

35. Unnamed assemblage from Angell member, Kansas
36. Sand Draw, Nebraska

SYSTEMATIC LIST OF PLEISTOCENE MAMMALS

Table I lists the Pleistocene mammals of North America by orders and shows their stratigraphic occurrence in the more reliably dated local faunas. Numbers refer to the list of faunas previously given, and to references.

TABLE I

TENTATIVE STRATIGRAPHIC POSITION OF NORTH AMERICAN PLEISTOCENE MAMMALS

	Nebr.	Tr.	Aft.	Kan.	Yar.	Ill.	Sang.	Wisc.
Order Insectivora (Shrews and Moles)								
* *Sorex taylori* Hibbard—Taylor's shrew					23			
* *Sorex dixonensis* Hibbard—Dixon shrew		34						
* *Sorex leahyi* Hibbard—Leahy's shrew		34						
* *Sorex sandersi* Hibbard—Sanders' shrew			33					
* *Sorex cudahyensis* Hibbard—Cudahy shrew				25				
Sorex cinereus Kerr—Masked shrew				25		22	21, 20	8, 16
* *Sorex frankstounensis* Peterson—Peterson's shrew								5
Sorex cf. *trowbridgii* Baird—Trowbridge's shrew								2
Sorex saussurei Merriam—Saussure's shrew								16
Sorex cf. *ornatus* Merriam—Ornate shrew								2, 9, 14
* *Sorex (Neosorex) lacustris* (Hibbard)—Water shrew				25				
* *Microsorex pratensis* Hibbard—Plains pigmy shrew				25				
* *Blarina gidleyi* Gazin—Gidley's shorttail shrew			32					
* *Blarina fossilis* Hibbard—Fossil shorttail shrew							21	
Blarina brevicauda (Say)—Shorttail shrew						22	20	5
Cryptotis mexicana (Coues)—Mexican least shrew								16
Notiosorex crawfordi (Coues)—Desert shrew								14
Scapanus latimanus (Bachman)—California mole								12
Parascalops breweri (Bachman)—Hairytail mole								5
Order Primates (Man)								
Homo sapiens Linnaeus—Man								10
Order Chiroptera (Bats)								
Myotis cf. *velifer* (Allen)—Cave bat								11
Myotis cf. *evotis* (Allen)—Long-eared Myotis								11
Myotis cf. *thysanodes* Miller—Fringed Myotis								11
* *Corynorhinus tetralophodon* Handley—Big-eared bat								16
Corynorhinus cf. *rafinesquii* (Lesson)—Western big-eared bat								11
Antrozous pallidus (Le Conte)—Pallid bat								9, 11, 12
Tadarida cf. *mexicana* (Saussure)—Mexican freetail bat								11
Order Edentata (Sloths, Armadillos and Glyptodons)								
† *Nothrotherium shastense* Sinclair—Shasta ground sloth								6, 7, 12, 13, 14, 15, 18
† *Megalonyx leptostomus* Cope—Cope's ground sloth			28					
† *Megalonyx jeffersoni* (Desmarest)—Jefferson's ground sloth				26				9, 14
† *Paramylodon harlani* (Owen)—Harlan's ground sloth				26			20, 21	7, 9, 14
* *Dasypus bellus* (Simpson)—Beautiful armadillo								3
† *Glyptotherium texanum* Osborn—Texas glyptodon			28					
† *Xenoglyptodon fredericensis* Meade—Frederick glyptodon				26				
Order Rodentia (Squirrels, Rats and Mice)								
* *Aplodontia fossilis* Sinclair—Fossil aplodontia								12, 15
† *Paenemarmota barbouri* Hibbard & Schultz—Giant woodchuck			28, 29					
Marmota monax (Linnaeus)—Woodchuck								3
Marmota flaviventris (Audubon & Bachman)—Yellow-belly marmot								1, 11, 12, 13

Abbreviations: Nebr., Nebraskan; Tr., Transition between Nebraskan and Aftonian; Aft., Aftonian; Kan., Kansan; Yar., Yarmouth; Ill., Illinoian; Sang., Sangamon; Wisc., Wisconsin.

* Species extinct.

† Genus extinct.

TABLE I—*Continued*

	Nebr.	Tr.	Aft.	Kan.	Yar.	Ill.	Sang.	Wisc.
Order Rodentia (Squirrels, Rats and Mice) (*Cont.*)								
* *Cynomys meadensis* Hibbard—Meade prairie dog			31					
Cynomys ludovicianus (Ord)—Blacktail prairie dog								1, 8, 18
* *Citellus cragini* Hibbard—Cragin's ground squirrel					23			
* *Citellus meadensis* Hibbard—Meade ground squirrel					23			
Citellus richardsonii (Sabine)—Richardson's ground squirrel								8
Citellus variegatus (Erxleben)—Rock squirrel								1, 14
Citellus beecheyi (Richardson)—California ground squirrel								12, 15
Citellus lateralis (Say)—Golden-mantled squirrel								12, 15, 18
Eutamias sp.—Western chipmunk								2, 12
Sciurus griseus Ord—Western gray squirrel								15
Tamiasciurus douglasii (Bachman)—Chickaree								12, 15
Glaucomys sabrinus (Shaw)—Northern flying squirrel								12, 15
* *Thomomys gidleyi* Wilson—Gidley's pocket gopher			32					
* *Thomomys microdon* Sinclair—Sinclair's pocket gopher								12, 15
Thomomys bottae (Eydoux & Gervais)—Valley pocket gopher								1, 2, 9, 12, 14, 15
Thomomys talpoides (Richardson)—Northern pocket gopher								10
Thomomys umbrinus (Richardson)—Pigmy pocket gopher								1
* *Geomys tobinensis* (Hibbard)—Tobin pocket gopher			33	25				
* *Geomys quinni* McGrew—Quinn's pocket gopher	36		31					
Geomys sp.—Eastern pocket gopher					23	22	20, 21	8
Cratogeomys castanops (Baird)—Mexican pocket gopher								1
* *Perognathus pearlettensis* Hibbard—Pearlette pocket mouse			33		23			
Perognathus cf. *inornatus* Merriam—Mexican pocket mouse								9
* *Perognathus gidleyi* Hibbard—Gidley's pocket mouse					23			
Perognathus hispidus Baird—Hispid pocket mouse							21	
Perognathus californicus Merriam—California pocket mouse								14
† *Prodipodomys* sp.—Kangaroo rat			33					
Dipodomys nr. *ingens* (Merriam)—Giant kangaroo rat								9
Dipodomys ordii Woodhouse—Ord's kangaroo rat							20	1
Dipodomys agilis Gambel—Pacific kangaroo rat								14
† *Etadonomys tiheni* Hibbard—Tihen's pocket mouse					23			
Liomys sp.—Mexican pocket mouse								16
† *Paradipoides stovalli* Rinker & Hibbard—Stovall's beaver						22		
† *Procastoroides sweeti* Barbour & Schultz—Sweet's beaver	36		29, 31					
† *Castoroides ohioensis* Foster—Ohio giant beaver								10
† *Castoroides* sp.—Giant beaver				24		22	21	
* *Castor accessor?* Hay—Hay's beaver			32					
Castor canadensis Kuhl—Canada beaver								3, 15
* *Oryzomys fossilis* Hibbard—Fossil rice rat							20	
* *Sigmodon* cf. *intermedius* Hibbard—Intermediate cotton rat			33					

TABLE I—*Continued*

	Nebr.	Tr.	Aft.	Kan.	Yar.	Ill.	Sang.	Wisc.
Order Rodentia (Squirrels, Rats and Mice) (*Cont.*)								
* *Sigmodon hilli* Hibbard—Hill's cotton rat					23			
† *Cudahyomys moorei* Hibbard—Moore's mouse				25				
* *Reithrodontomys pratincola* Hibbard—Grassland harvest mouse					23			
Reithrodontomys cf. *montanus* (Baird)—Plains harvest mouse							20	
Reithrodontomys megalotis (Baird)—Western harvest mouse								14, 16
* *Peromyscus imperfectus* Dice—Dice's deer mouse								14
Peromyscus cf. *californicus* (Gambel)—California mouse								9
* *Peromyscus cragini* Hibbard—Cragin's white-footed mouse				25				
* *Peromyscus cochrani* Hibbard—Cochran's white-footed mouse							20	
Peromyscus maniculatus (Wagner)—Deer mouse								5, 15
Neotoma lepida Thomas—Desert woodrat								1, 9
Neotoma mexicana Baird—Mexican woodrat								1
Neotoma cinerea (Ord)—Bushytail woodrat								1, 12, 15
† *Bensonomys meadensis* Hibbard—Meade-Benson mouse			33					
* *Onychomys fossilis* Hibbard—Fossil grasshopper mouse					23			
* *Onychomys jinglebobensis* Hibbard—Jinglebob grasshopper mouse							20	
Onychomys leucogaster (Wied-Neuwied)—Northern grasshopper mouse								8
Onychomys torridus (Coues)—Southwestern grasshopper mouse								14
† *Mimomys* (*Cosomys*) *primus* (Wilson)—Wilson's vole			30, 32					
† *Pliophenacomys meadensis* (Hibbard)—Meade vole		34	33					
Phenacomys sp.—Boreal grassland vole				25				
Clethrionomys gapperi (Vigors)—Boreal redback vole								5
† *Pliopotamys meadensis* Hibbard—Meade amphibious vole	36	34	31					
† *Pliopotamys minor* (Wilson)—Idaho amphibious vole			32					
* *Ondatra kansasensis* Hibbard—Kansas muskrat				25				
Ondatra zibethicus (Linnaeus)—Muskrat							20, 21	
† *Pliolemmus antiquus* Hibbard—Ancient vole		34	31, 33					
* *Neofiber leonardi* Hibbard—Leonard's water rat							21	
* *Pedomys llanensis* (Hibbard)—Upland vole				25				
Pedomys ochrogaster (Wagner)—Prairie vole						22	20, 21	8
* *Pitymys meadensis* Hibbard—Meade shrub vole				25				
Microtus pennsylvanicus (Ord)—Meadow vole						22	20, 21	5, 8
Microtus californicus (Peale)—California vole								2, 9, 12, 14, 15
Microtus longicaudus (Merriam)—Longtail vole								1
Microtus mexicanus (Saussure)—Mexican vole								1
* *Microtus paroperarius* Hibbard—Tundra vole				25				
* *Synaptomys rinkeri* Hibbard—Rinker's bog lemming		34						
* *Synaptomys australis* Simpson—Simpson's bog lemming							20	
Synaptomys cooperi Baird—Southern bog lemming								5, 16
* *Synaptomys landesi* Hibbard—Landes' bog lemming					23			
Synaptomys borealis (Richardson)—Northern bog lemming				25				
* *Zapus sandersi* Hibbard—Sanders' jumping mouse			33					
* *Zapus burti* Hibbard—Burt's jumping mouse					23			
* *Zapus adamsi* Hibbard—Adams' jumping mouse							20	
Zapus hudsonius (Zimmermann)—Meadow jumping mouse								5
Erethizon dorsatum (Linnaeus)—Porcupine								3, 5, 15

TABLE I—*Continued*

	Nebr.	Tr.	Aft.	Kan.	Yar.	Ill.	Sang.	Wisc.
Order Carnivora (Wolves, Bears, Raccoons and Cats)								
* *Canis andersoni* Merriam—Anderson's coyote								14
* *Canis petrolei* Stock—Petrol coyote								14
* *Canis caneloensis* Skinner—Canelo coyote								11
Canis cf. *latrans* Say—Coyote	36							
Canis latrans Say—Coyote								1, 9, 14, 18
Canis lupus Linnaeus—Gray wolf								1, 9, 11, 14
† *Aenocyon dirus* (Leidy)—Terrible wolf								2, 5, 9, 12, 14, 18
† *Aenocyon milleri* Merriam—Miller's wolf								14
Vulpes fulva (Desmarest)—Red fox								1, 12
Vulpes macrotis Merriam—Large-eared kit fox								9, 18
Vulpes velox (Say)—Kit fox								1
Urocyon cinereoargenteus (Schreber)—Gray fox								2, 11, 14, 16
† *Borophagus diversidens* Cope—Cope's bone-eating dog			28					
† *Borophagus solus* (Stock)—Stock's bone-eating dog			30					
† *Arctodus haplodon* (Cope)—Cope's short-faced bear								5
† *Arctodus simus* (Cope)—Short-faced bear							20	9, 12, 14
* *Tremarctos mexicanus* Stock—Mexican spectacled bear								16
* *Ursus optimus* Schultz—Schultz's grizzly bear								9, 14
Ursus (*Euarctos*) *americanus* Pallas—Black bear								3, 5, 11, 15, 16
* *Bassariscus sonoitensis* Skinner—Sonoita ringtail cat								11
Bassariscus astutus (Lichtenstein)—Ringtail cat								1, 12, 13
Procyon lotor (Linnaeus)—Raccoon								3
† *Canimartes cumminsii* Cope—Cummins's mustelid			28					
† *Canimartes? idahoensis* Gazin—Extinct mustelid			32					
† *Canimartes? cookii* Gazin—Extinct mustelid			32					
† *Trigonictis kansasensis* Hibbard—Kansas grison	36							
Mustela frenata Lichtenstein—Longtail weasel								9, 12, 14, 15
Mustela nigripes (Audubon & Bachman)—Black-footed ferret								1
Taxidea taxus (Schreber)—Badger								1, 2, 8, 9, 11, 14, 18
Spilogale interrupta (Rafinesque)—Southern spotted skunk							20	
Spilogale gracilis Merriam—Southwestern spotted skunk								2, 9, 11, 14
Mephitis mephitis (Schreber)—Striped skunk								2, 5, 8, 9, 11, 12, 14, 15
Conepatus mesoleucus (Lichtenstein)—Hognose skunk								1
* *Lutra piscinaria* Leidy—Fish otter			29, 32					
* *Felis lacustris* Gazin—Lake cat			32					
* *Felis daggetti* Merriam—Daggett's cat								9, 14
* *Felis bituminosa* Merriam and Stock—Black cat								14
Felis concolor Linnaeus—Puma							19	1, 14
* *Panthera palaeoonca* Meade—Extinct jaguar			28					
* *Panthera atrox* (Leidy)—The fierce jaguar							19	9, 10, 14, 18
Panthera onca (Linnaeus)—Jaguar								4
Lynx rufus (Schreber)—Bobcat								1, 9, 12, 14
† *Smilodon californicus* Bovard—Sabre-tooth cat								9, 14
† *Smilodon* sp.—Sabre-tooth cat	36							

TABLE I—*Continued*

	Nebr.	Tr.	Aft.	Kan.	Yar.	Ill.	Sang.	Wisc.
Order Proboscidea (Mastodons and Mammoths)								
† *Stegomastodon mirificus* (Leidy)—Wonderful short-jawed mastodon	35, 36		28, 31	27				
† *Stegomastodon priestleyi* (Hay & Cook)—Priestley's short-jawed mastodon				26				
† *Rhynchotherium falconeri* Osborn—Falconer's mastodon			28					
† *Rhynchotherium* sp.—Mastodon			31					
† *Mammut cosoensis* (Schultz)—Coso mastodon			30					
† *Mammut americanus* (Kerr)—American mastodon								5, 9, 10, 12, 14
† *Mammuthus haroldcooki* (Hay)—Cook's mammoth				24, 26				
† *Mammuthus imperator* (Leidy)—Imperial mammoth								2, 14
† *Mammuthus columbi* (Falconer)—Columbian mammoth							20	9, 14
† *Mammuthus jeffersoni* (Osborn)—Jefferson's mammoth								10
† *Mammuthus primigenius* (Blumenbach)—Woolly mammoth								10, 12
Order Lagomorpha (Rabbits and Hares)								
† *Hypolagus* sp.—Extinct rabbit			28, 31		23			
† *Hypolagus furlongi* Gazin—Furlong's rabbit			32					
† *Hypolagus* cf. *vetus* Kellogg—The old rabbit			32					
† *Hypolagus limnetus* Gazin—Gazin's marsh rabbit			30, 32					
† *Alilepus? vagus* Gazin—Undetermined rabbit			32					
† *Nekrolagus* sp.—Dead rabbit					23			
Lepus townsendii Bachman—Townsend hare								1
Lepus americanus Erxleben—Snowshoe hare								5, 15
Lepus alleni Mearns—Antelope jackrabbit								1
Lepus cf. *californicus* Gray—Blacktail jackrabbit					23			
Lepus californicus Gray—Blacktail jackrabbit								9, 11, 14, 18
Sylvilagus floridanus (Allen)—Eastern cottontail								1, 5
Sylvilagus audubonii (Baird)—Desert cottontail								1, 9, 11, 12, 14, 15
* *Sylvilagus leonensis* Cushing—Leon cottontail								16
Sylvilagus bachmani (Waterhouse)—Brush rabbit								2, 9, 14
Order Artiodactyla (Peccaries, Camels, Deer, Pronghorns, Bison, Musk oxen, etc.)								
† *Mylohyus pennsylvanicus* (Leidy)—Pennsylvania peccary								5
† *Platygonus pearcei* Gazin—Pearce's peccary			32					
† *Platygonus bicalcaratus* Cope—Cope's peccary			28					
† *Platygonus alemanii* Duges—Aleman's peccary								11
† *Platygonus compressus* Le Conte—Le Conte's peccary								3, 8, 9, 12, 14
† *Platygonus* sp.—peccary	36		30, 31	26	23			
† *Gigantocamelus spatulus* (Cope)—Giant camel	36		28, 29	26				
† *Camelops kansanus* Leidy—Kansas camel							19	
† *Camelops hesternus* (Leidy)—Western camel								9, 14, 17
† *Camelops* sp.—camel	35, 36		28, 32					
† *Tanupolama blancoensis* Meade—Blanco long-legged llama			28					
† *Tanupolama hollomani* (Hay & Cook)—Holloman's long-legged llama				26				
† *Tanupolama stevensi* (Merriam & Stock)—Stevens's long-legged llama								9
Cervus sp.—Elk								11
† *Sangamona?* sp.—Extinct deer								1
Odocoileus virginianus (Zimmermann)—Whitetail deer								1, 5
† *Cervalces scotti* (Lydekker)—Scott's moose								5, 10
* *Rangifer? fricki* Schultz & Howard—Frick's caribou?								1

TABLE I—*Concluded*

	Nebr.	Tr.	Aft.	Kan.	Yar.	Ill.	Sang.	Wisc.
Order Artiodactyla (Peccaries, Camels, Deer, Pronghorns, Bison, Musk oxen, etc. (*Cont.*)								
Rangifer caribou (Gmelin)—Woodland caribou								10
Rangifer arcticus (Richardson)—Barren ground caribou								10
† *Capromeryx arizonensis* Skinner—Arizona four-horned pronghorn			29					
† *Breameryx minor* (Taylor)—Tar pit pronghorn								9, 14
† *Breameryx minimus* (Meade)—Least tar pit pronghorn							19	
† *Ceratomeryx prenticei* Gazin—Prentice's pronghorn			32					
† *Stockoceros onusrosagris* (Roosevelt & Burden)—Stock's pronghorn								1, 11
† *Stockoceros conklingi* (Stock)—Conkling's pronghorn								16, 18
Antilocapra americana (Ord)—Pronghorn								1, 9, 14
* *Bos bunnelli* Frick—Bunnell's yak								10
* *Bison latifrons* (Harlan)—Giant bison							20	
* *Bison geisti* Skinner & Kaisen—Geist's bison								10
* *Bison crassicornis* Richardson—Richardson's bison								10
* *Bison antiquus* Leidy—Ancient bison								1, 9, 10, 14
* *Bison alaskensis* Skinner and Kaisen—Alaska bison								10
* *Bison preoccidentalis* Skinner and Kaisen—Early western bison								10
* *Bison occidentalis* Lucas—Western bison								10
* *Saiga ricei* Frick—Rice's gazelle—Antelope								10
* *Oreamnos harringtoni* Stock—Harrington's mountain goat								13
Oreamnos americanus (Blainville)—Mountain goat								12
† *Bootherium nivicolens* Hay—Snow muskox								10
† *Bootherium sargenti* Gidley—Sargent's muskox								10
† *Symbos cavifrons* (Leidy)—Woodland muskox								10
† *Symbos tyrrelli* Osgood—Tyrrell's woodland muskox								10
* *Ovibos proximus* Bensley—Bensley's muskox								10
* *Ovibos yukonensis* Gidley—Yukon muskox								10
Ovibos moschatus (Zimmermann)—Muskox								10
† *Euceratherium collinum* Furlong & Sinclair—California shrub-ox								1, 7, 12, 15
† *Preptoceras sinclairi* Furlong—Sinclair's shrub-ox								1, 9, 15
Ovis canadensis Shaw—Bighorn sheep								1, 6
Ovis dalli Nelson—White sheep								10
Order Perissodactyla (Tapirs, Zebras, Asses, and Horses)								
* *Tapirus copei* Simpson—Cope's tapir				26				
Tapirus sp.—Tapir								14, 18
† *Nannippus phlegon* (Hay) Small three-toed horse	35		28, 31, 33	27				
† *Plesippus simplicidens* (Cope)—Plains zebra	35, 36		28, 31	27				
† *Plesippus shoshonensis* Gidley—Shoshone zebra			32					
† *Plesippus francescana* (Frick)—California zebra			30					
* *Asinus calobatus* (Troxell)—Stilt-legged ass				24				
* *Asinus conversidens* Owens—Mexican ass								1, 11, 16
* *Asinus littoralis* Hay—Mexican ass?				26				
* *Asinus francisci* Hay—Francis' ass							19	
* *Equus excelsus* Leidy—Plains horse								1
* *Equus scotti* Gidley—Scott's horse				24				
* *Equus pacificus* Leidy—Pacific horse				26				
* *Equus complicatus* Leidy—Eastern horse				26				
* *Equus niobrarensis* Hay—Niobrara horse							19	
* *Equus occidentalis* Leidy—Western horse								9, 12, 14, 15, 18
* *Equus lambei* Hay—Lambe's horse								10
* *Equus alaskae* Hay—Alaska horse								10

In the compilation of the list no specimens were examined. The faunal lists were taken from the publications cited, but I have changed the names of living genera and species to accord with the *List of North American Recent Mammals* (Miller and Kellogg, 1955), except in the case of the bears where I followed Erdbrink's classification (1953). A few recent revisions of the larger extinct Pleistocene mammals (Simpson, 1941, 1945; Skinner and Kaisen, 1947) have also been followed. I have not recognized fossil subspecies.

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Discussion

The following remarks concern the tentative age assignment of certain well-known faunas. Some other faunas not listed in the chart are discussed also.

Meade (1953) considers the Blanco fauna from Texas as Nebraskan. If the sediments were laid down in a lake during a glacial time, as Evans and Meade (1945) suggest, the environmental conditions would have been favorable for an abundant molluscan and small vertebrate fauna. This statement is based on study of the late Nebraskan Sand Draw local fauna of Nebraska and that of the transitional Nebraskan-Aftonian Dixon local fauna from south-central Kansas. Both assemblages indicate richer faunas and widespread moist conditions in this region at the close of Nebraskan time. A widespread cool, moist climate during late Kansan time is shown by the Cudahy fauna, reported from the Panhandle of Texas (Johnston and Savage, 1955) to South Dakota. I have listed the Blanco fauna as Aftonian since no molluscan fauna has been recovered from these well-exposed deposits.

The Holloman fauna (Meade, 1953) from near Frederick, Oklahoma, is not strictly a local fauna, but an assemblage of vertebrates of various ages. The older members of the Holloman fauna indicate Kansan age. The basis for this age assignment is the topographic position of the deposit and the association of *Stegomastodon* and *Mammuthus*. The identification of the horses as given by Meade shows that the assemblage is post-earliest Kansan, that is, post-Blancan. The assemblage is pre-*Bison* in age and falls within the Irvingtonian provincial age. I have assigned a Kansan age to most of the mammals reported from this locality. There is some evidence of later channeling of the earlier sand and gravel (O. F. Evans, 1930). The larger well-known faunas of whose age I am uncertain are listed and followed by citation and comments.

Aftonian? local fauna

Cita Canyon, Texas (Johnston and Savage, 1955; Savage, 1955).

Late Kansan and/or Yarmouth local faunas

Curtis Ranch, Arizona (Gazin, 1942).
Grand View, Idaho (Wilson, 1933).
Port Kennedy, Pennsylvania (Cope, 1899; Hibbard, 1955a); probably Yarmouth.
Rock Creek, Texas (Troxell, 1915).

Illinoian and/or Sangamon local faunas

Conard fissure, Arkansas (Brown, 1908; and Hay, 1924). Chiefly glacial and may include later elements; probably Illinoian.

Cumberland Cave, Maryland (Gidley and Gazin, 1938). Both glacial and interglacial elements.

Hay Springs, Nebraska (Matthew, 1918; Hay, 1924). This fauna has always been assigned to an earlier age. At present there is no evidence for an age earlier than Illinoian. The muskrat, *Ondatra nebrascenisis* (Hollister), is larger and more advanced than *O. hiatidens* Cope from the Port Kennedy cave fauna and *O. kansasensis* Hibbard from the Cudahy fauna. *Microtus pennsylvanicus* (Ord) is a common element of the fauna (Hibbard, 1956b). This meadow vole is unknown from the earlier Cudahy fauna, but it appears as a common member in the Illinoian Berends fauna of Oklahoma and its equivalents in Kansas.

Kentucky assemblage, Kansas (Hibbard, 1952). Both glacial and interglacial elements. The rodents indicate Illinoian and Sangamon.

Slaton local fauna, Texas (Meade, 1952); probably Sangamon.

Don flora and fauna, Ontario, Canada (Coleman, 1894, 1901). This interglacial fauna is known chiefly from the mollusks. The vertebrate remains should be carefully restudied.

Students interested in the Pleistocene faunas of Florida are referred to the following papers: Gazin, 1950; Holmes and Simpson, 1931; Simpson, 1929.

Wisconsin local faunas

Space has prohibited listing all Wisconsin local faunas in the table. Many of these, such as the Fossil Lake (Oregon) local fauna, are in need of revision.

Students interested in the occurrence of Wisconsin man with Pleistocene vertebrates are referred to Sellards' *Early Man in America* (1952). Dr. Sellards lists at least 113 sites with bibliographic references. A number of these sites have been dated by Carbon-14. Jelinek (1957) discusses the stratigraphic occurrence of certain Wisconsin mammals in association with early man.

Faunal References

All numbers, both here and in Table I, refer to the list of local faunas.

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