MEMOIRS

OF THE

American Museum of Natural History.

VOL. IX, PART IV.

IV.—THE CONARD FISSURE, A PLEISTOCENE BONE DEPOSIT IN NORTHERN ARKANSAS: WITH DESCRIPTIONS OF TWO NEW GENERA AND TWENTY NEW SPECIES OF MAMMALS.

BY BARNUM BROWN.

February, 1908.

(*Continued from 3d page of cover.*)

Vol. XI. Anthropology (not yet completed).

**Jesup North Pacific Expedition, Vol. VII.*

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PART II.—The Chuckchee: Religion. By W. Bogoras. Pp. 277–536, pll. xxxii–xxxiv, and 301 text figures. 1907.

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**Jesup North Pacific Expedition, Vol. X.*

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Jesup North Pacific Expedition.

Ethnographical Album of the North Pacific Coasts of America and Asia. Part 1, pp. 1–5, pll. 1–28. August, 1900. Sold by subscription, price, $6.00.

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AMERICAN MUSEUM JOURNAL.

The 'Journal' is a popular record of the progress of the American Museum of Natural History, issued monthly, from October to May inclusive. Price, $1.00 a year. Volumes I–VI, 1900–1906.

For sale at the Museum.

*Published by E. J. Brill, Leiden, Holland. Not on sale at the Museum. American Agent, G. E. Strechert, 129 West 20th Street, New York City.

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By Barnum Brown.

Plates XIV–XXV.

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Discovery and Exploration of the Fissure.

Throughout the southern extension of the Ozark uplift in northern Arkansas the rocks composing these hills are furrowed by fissures and honey-combed with caves. Although densely wooded there is little soil on the hillsides, and, where found, it is usually a red residual clay.

During the last few years zinc has been discovered in this region and miners have prospected the greater part of it. Several caves have thus been opened in Newton County, some of which are very extensive, but so far as learned none has been found containing bones.

In April, 1903, Mr. Waldo Conard excavated in several fissures on his farm in hopes of finding a lead mine, which, according to local tradition, was located there. No lead was found, but in one of the fissures he discovered a veritable bone mine. Some of these bones were forwarded by Dr. R. R. Teller, partner of Mr. Conard, with an invitation to investigate the locality, to Professor Frederick W. Putnam, at that time Curator of Anthropology of the American Museum. This material was turned over to Professor H. F. Osborn, Curator of Vertebrate Palæontology, to whom I am indebted for the privilege of exploration and description. I wish here to acknowledge my indebtedness to Dr. W. D. Matthew for preliminary lists and studies, as well as assistance in critical determinations.

The fissure is a mile north of the Buffalo River, four miles west of Willcockson and fifteen miles south of Harrison, near the northern line of Newton County, Arkansas. It is situated near the crest of a hill on its southern slope, at an elevation of 1030 feet. The hill is estimated to be about one hundred feet higher than the wagon road at its base, where the elevation was taken last year.

The writer visited the locality in the fall of 1903 and secured about three hundred jaws and many disassociated limb bones and vertebræ from the dump. During the season of 1904 it was again visited and a large collection was secured comprising several thousand jaws, skulls, limb bones and vertebræ. The old prospect hole was deepened and a new hole sunk beside and opening into it, making an opening twenty-five feet deep, seven feet wide and about twelve feet long.

The old hole was by chance sunk in an angle of the fissure, which was most favorable to the accumulation and preservation of fossils. This angle probably lay in the course of material drifting down the hillside during rainstorms but was free from running water at other times, as shown by the walls. The wall is smooth with perpendicular striations, the top projecting out over the bottom at least four feet, as though cut in under. The partially disintegrated limestone composing it is ramified by numerous passages that were undoubtedly weasel lairs (Fig. 1). From one passage alone twelve weasel skulls and many jaws were taken, while the passage itself was choked with bones of small animals and

birds. On either side of the angle the walls are thickly encrusted with stalactites.

On the surface, as seen in Fig. 2, there is very little evidence of a fissure ever having been there, just a slight depression at the point first excavated and a similar depression one hundred feet down the hillside. Ledges of rock protrude through the underbrush, while the intervening spaces are filled with rounded angular blocks of limestone with loam filling the cracks, but at this point the mountain cap has the appearance of a solid mass. There is no indication of the confines of the fissure except the solid wall on the north and north-

Fig. 1. Angle of fissure showing Wessel holes.

east and the angle between, where the first opening was made. This probably represents the beginning of the fissure, which extended down the hillside diagonally southwest to the depression just noted. The south wall was not defined in the last excavation, owing to the thinning out of the bones in that direction and because of the necessity of heavy blasting to remove the large stones that were cemented together with stalagmite.

In putting down the old prospect hole, Mr. Conard found that the bones, clay and blocks of limestone were loosely packed together, with very little cementing substance. In the excavation carried on by us, however, it was quite different.

On the surface there were sixteen inches of black loam and vegetable mold mixed with small pieces of loose limestone. Below this capping for about four feet the limestone drip has formed a nearly solid bed of stalagmite attached to the wall and spreading out, cementing the fallen blocks into a solid mass that could be penetrated only by blasting. From this point to as deep as the excavation was carried the material filling the body of the fissure was composed of blocks of limestone of varying sizes, red clay, bones and chert cemented by stalactitic drip.

The stalactite covering the north wall, as represented in the model repro-

Fig. 2. Mountain side with windlass on fissure.

duced in the American Museum (Plate XXV), presents a splendid sight. Beginning about four feet from the surface there is a solid mass of stalactite formed in concentric layers resembling a series of hemispheres fastened to the wall. Descending from this mass is a drapery of beautiful thin-ribboned stalactites, which, with one edge attached to the wall, form a series of pockets varying from half an inch to four inches across, and from six to eight inches deep, extending from the capping to the bottom of the excavation, about twenty feet. Some of these ribbons present a rounded face, having nodes at regular intervals which have been formed by the arrested drip.

No bones were found on the surface. The first one noted was a *Mylohyus*

skull found below the heavy bed of stalactite, about six feet from the surface. From this point downward, however, bones were more numerous, until in the bottom of the old prospect hole they became an inextricable mass of bones, clay and breccia, cemented with carbonate of zinc and stalagmite (Plate XXV). The ribboned stalactite pockets were filled with thousands of small bones, pieces of stone and clay, which were extracted from the pockets and washed in a pool near by (Fig. 3). The bones preserved in the collection represent only a small fraction of the number entombed in the fissure, for all were more or less soft and extremely friable when found, and for every one preserved,

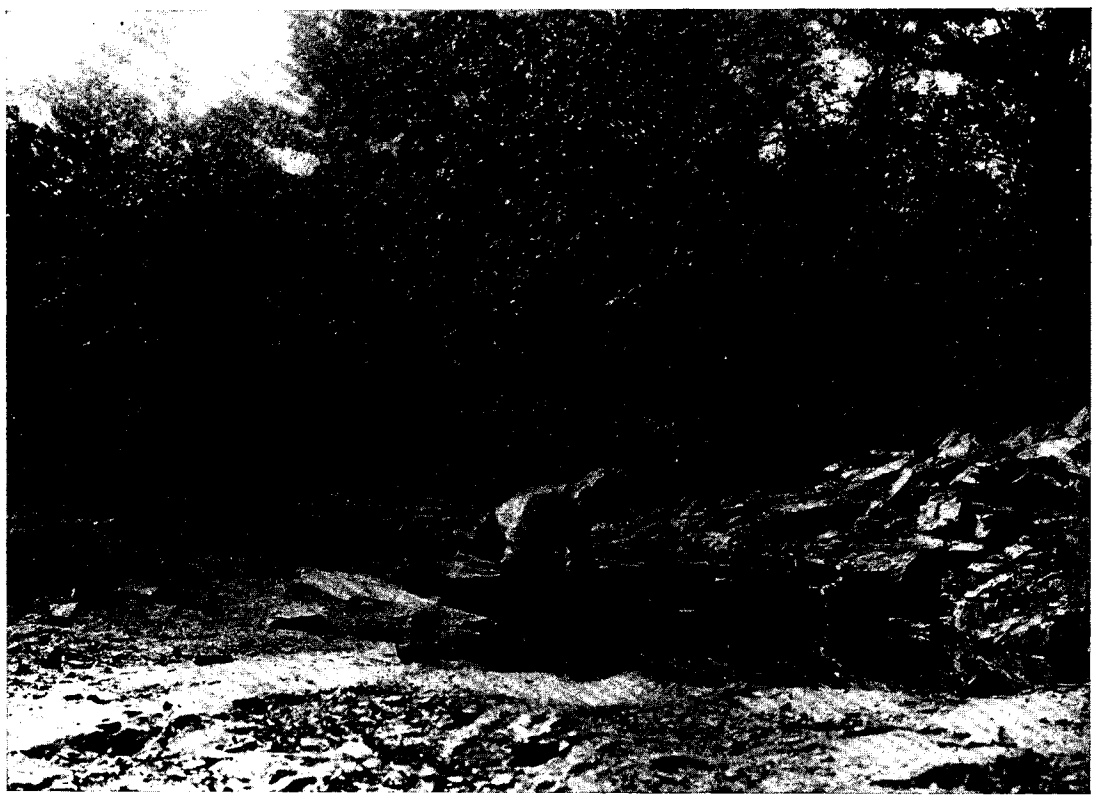

Fig. 3. Washing dirt through sieve for bones.

dozens were broken in extracting. Only the most prolific clays were scooped from the pockets and weasel lairs and washed, while the heavier material was hurriedly searched and thrown over the dump. The only preparation necessary was to wash off the clay and soak the bones in a solution of gum arabic to harden them, after which they came out as white as though recently macerated. All traces of organic matter had disappeared, leaving the bones a kaolin-like material. Very few bones were found associated; sometimes a limb or part of a vertebral column, and, at one point, fragments of several bones where an entire skeleton of a sabre-toothed tiger had lain. Owing to their extreme

friability the bones had not been able to resist the weight of incumbent rocks and were often broken and sometimes splintered. In the body of the fissure, fragments were usually found close together, but where they lay close to the stalactite-covered wall and had been broken, as in the case of the sabre-tooth skeleton, many fragments had sifted down these pockets.

Geological History.

The mountains of this region were elevated in open folds, in which the general horizontal position of the rocks was retained. The individual beds, however, show considerable movement.

According to Broadhead:[1] "It thus seems that the uplifting began just before the close of the Lower Carboniferous period and continued until after its close, and there may still have lingered a slight force into the succeeding Upper Carboniferous."

The disturbances which gave the present topography to this section, however, were certainly later than the Coal Measures, and probably during Tertiary times. These disturbances produced principally fractures and fissures in the Lower Carboniferous rocks.

The vertical markings observed in the angle of the fissure (also seen on the north and east wall after the stalactite was removed) resemble slickensides produced by faulting during an upthrust movement.

But during and since Quaternary times, with which we are at present concerned, there is no evidence of change in the topography of the country other than that caused by erosion, which has been slow.

The fissure was probably opened toward the close of the Tertiary — otherwise, we should have found Pliocene or other Tertiary mammals in it.

It is important to note that this region lies about 2°, or 150 miles, directly south of the most southern extension of Pleistocene glaciation.

Introduction and Deposition of Organic Remains.

Although the material filling the fissure is a heterogeneous mass of fallen blocks, clay, breccia and bones, there is no evidence of a sudden extermination of the fauna and a later accumulation by flood — the explanation given for the association of the Port Kennedy Cave fossils.

The clay throughout is uniformly of the same nature, that is, residuum, left from the slow disintegration of limestone. It is entirely free from bedding planes or vegetal remains. From careful investigation of the material as worked out, it seems certain that the inorganic matter was filled in gradually and that while the fissure was still open the stalactite ribbons were formed on the walls

[1] Geological History of the Ozark Uplift, Am. Geol. (3), 1889, p. 12.

by the deposition of carbonated waters from a spring which found an opening at this point. As the material filled in the body of the fissure the large blocks were kept away from the walls by the stalactite ribbons, thus leaving open spaces which were filled in with bones and clay by a sifting process, as the animals that inhabited it traveled back and forth along the face of the fissure.

The greatest number of bones was found in these stalactite pockets and in the weasel holes, where they were an inextricable mass of almost solid bones lightly coated with stalactite drip. Further away from the wall bones were less numerous.

Careful search was made for stone implements, and close attention was given to the bone fragments to determine if they could possibly have been broken by prehistoric man for marrow or used for implements as often found in caves. No worn or polished splinters, however, were found, and so far all evidence excludes man from having taken any part in this great accumulation of material.

Owing to the great number of bones bearing the tooth-marks of rodents and carnivores, and the predominance of some types, certain conditions must have existed during the lifetime of the animals entombed there, and from the abundance of large carnivore bones, it seems probable that some part of the fissure allowed easy access. Cats and bears probably inhabited a part of it, dragging in peccaries and deer, the remains of which are so numerous. The evidence of the weasels is placed beyond theory by the many remains found in their runways, where they lived, in the angle of the fissure. These weasel holes were found from near the top to the bottom of the excavation, and in them were discovered the greatest quantity of mice, rabbit and wood-rat remains, the natural food of the weasel. Shrew and mice bones are most abundant, and from the condition of the skulls (which are represented only by jaws and palates) it is probable that they were introduced largely by owls, which may have lived on the ledges of the fissure. Wood-rats probably inhabited some part of the fissure, for their remains are abundant. The well-known proclivity of the wood-rat may well account for the introduction of odd bones and teeth, as, for example, a horse tooth, jaws of the raccoon and other fragments.

When the last excavation was carried on care was taken to preserve records of position, but this was found to be impracticable, for many of the stalactite pockets were only partly filled, consequently detached material would still rattle down several feet before lodging. For this reason no dependence could be put on the position of bones in determining the relative age of different fossils. Without exception specimens of common species were found as abundantly at the top of the "ossuary" as at the very bottom, and *vice versa*.

It is worthy of note, however, that the aberrant musk-ox material was found near the bottom, about twenty feet from the surface, and the highest point at which any sabre-tooth bones were found was ten feet from the surface. *Mylohyus* and *Ursus*, on the other hand, were numerous from top to bottom.

When the fissure had filled up with fallen material to a point near the source of the carbonated water which formed the stalactites, the water flowed out over the mass, cementing the whole in a solid body and forming the heavy capping which filled the upper part of the fissure, thus sealing up this great storehouse.

This interesting record throws light on the distribution of many forms during the period when the great ice sheet covered the northern part of the United States, their subsequent migration and, in some instances, extinction.

The perfect state of preservation and, in most cases, the abundance of material representing the different species permit nearly as accurate specific determination as in a series of recent bones and eliminate, in a measure, the confusion of sexual characters, individual variation and change due to age. In all cases this material has been closely compared with the large series of recent skulls and skeletons in the American Museum.

List[1] of Species from the Conard Fissure.

In the following list of species I have studied the mammals carefully, but the birds, batrachians and reptiles have been given very little attention. Only those species readily identifiable have been determined, and among the birds there are probably several species not here recognized.

Mammals.		No. of Specimens.
* *Blarina brevicauda ozarkensis* subsp. nov.	An extinct Short-tailed Shrew	700
Sorex personatus,	Common Shrew	100
* *Sorex personatus fossidens* subsp. nov.,	An extinct Common Shrew	1
Sorex obscurus,	A species of Shrew	15
Sorex fumeus,	A species of Shrew	1
* *Microsorex minutus* sp. nov.	An extinct species of Shrew	6
Scalopus aquaticus,	Common Mole	1
* *Vespertilio fuscus grandis* subsp. nov.	An extinct Large Brown Bat	150
Myotis subulatus	Little Brown Bat	20
* *Mephitis mephitica newtonensis* subsp. nov.,	An extinct Common Skunk	5
Spilogale interrupta?	Little Striped Skunk	1
** *Brachyprotoma pristina* gen. et sp. nov.	An extinct genus of Skunk	5
* *Brachyprotoma spelæa* sp. nov.	An extinct species of this genus	1
Mustela pennanti,	Fisher Martin	7
Putorius vison,	Mink	35
* *Putorius cicognanii angustidens* sp. nov.	An extinct species of Weasel	41
* *Putorius gracilis* sp. nov..	An extinct species of Weasel	1
Canis occidentalis?	Gray Wolf	8
Vulpes fulvus?	Red Fox	2
Urocyon sp. indet.,	Gray Fox	1
Procyon lotor,	Raccoon	5

[1] In this and the following lists of species a single asterisk (*) signifies that the species is extinct; two asterisks (**) that the genus is extinct.

	Mammals.	No. of Specimens.
Ursus americanus,	Black Bear	110
* *Lynx compressus* sp. nov.	An extinct Lynx	2
Lynx ruffus?	Bay Lynx	2
Felis cougar,	Puma,	2
* *Felis longicrus,*	An extinct Cat	2
** *Smilodontopsis troglodytes* gen. et sp. nov.,	An extinct genus and species of Sabre-tooth Tiger. Fragmentary skeleton	
* *Smilodontopsis conardi* sp. nov.,	An extinct genus and species of Sabre-tooth Tiger	15
Erethizon dorsatus,	Canada Porcupine	3
Marmota monax,	Woodchuck	5
Sciurus hudsonicus,	Red Squirrel	6
* *Tamias nasutus* sp. nov.,	An extinct species of Chipmunk	30
Spermophilus tridecemlineatus,	Striped Gopher	45
* *Geomys parvidens* sp. nov.,	An extinct species of Pocket Gopher	35
Castor canadensis,	Beaver	1
Peromyscus sp.	White-footed Mouse	1500
* *Reithrodontomys simplicidens* sp. nov.	An extinct species of Harvest Mouse	5
* *Neotoma ozarkensis* sp. nov.	An extinct species of Wood Rat	234
* *Fiber annectens* sp. nov.	An extinct species of Muskrat	1
Microtus austerus,	Meadow Mouse	200
Lepus floridanus,	Cotton-tail Rabbit	300
Lepus americanus,	Varying Hare	200
* *Lepus giganteus* sp. nov.	An extinct species of Varying Hare	1
* *Equus scotti*?	An extinct species of Horse	1
** *Mylohyus* sp. *a,*	An extinct genus and species of Peccary	200
* *Mylohyus* sp. *b,*	" " " " " " "	
* *Mylohyus* sp. *c,*	" " " " " " "	
Cervus canadensis,	Wapiti Deer	5
Odocoileus hemionus,	Mule Deer	5
Odocoileus virginianus,	White-tailed Deer	12
** *Symbos australis* sp. nov.	An extinct genus and species allied to the Musk-ox	6

Amphibians and Reptiles.

Bufo? sp.	Toad	5
Rana sp.	Frog	115
Rana? sp. *a,*	Frog	1
Amblystoma? sp.	Salamander.	
Lacertian sp.	Lizard	11
Crotalus sp.	Rattlesnake	4
Ophidian sps.	Snakes	1000

Birds.

Seven species recognized.

FOSSIL REMAINS FOUND IN THE PORT KENNEDY CAVE, CHESTER COUNTY, PENNSYLVANIA.[1]

Mammals.

	No. of Specimens.
Erethizon dorsatus Linn.	7
* *Sciurus calicinus* Cope	3
Castor canadensis Linn.	1
Zapus hudsonius Zimm.	2
Hesperomys	2
* *Anaptogonia hiatidens* Cope	6
** *Sycium cloacinum* Cope	2
* *Microtus diluvianus* Cope	1
* " *speothen* Cope	4
* " *dideltus* Cope	8
* " *involutus* Cope	2
Lepus sylvaticus Bachm	56
* *Lagomys palatinus* Cope	2
** *Megalonyx wheatleyi* Cope	88
* " *tortulus* Cope	5
* " *loxodon* Cope	1
* " *scalper* Cope	1
** *Mylodon harlani* Owen	1
* *Blarina simplicidens* Cope	1
Scalops ?	1
Vespertilio	6
* *Ursus haplodon* Cope	25
" *americanus* Pallus	8
* *Canis priscolatrans* Cope	9
Undetermined	1
* *Vulpes latidentatus* Cope	1
" *cinereoargentatus*	2
* *Mustela diluviana* Cope	4
Gulo luscus Linn.	4
** *Osmotherium spelæum* Cope	1
** *Brachyprotoma* (=*Mephitis*) *fossidens* Cope	8
* " " *leptops* Cope	10
* " " *obtusatus* Cope	2
* *Mephitis orthostichus* Cope	1
" undetermined	34
** *Pelycictis lobulatus* Cope	1
* *Lutra rhoadsii* Cope	1
Taxidea americana, Bodd	1
** *Smilodontopsis* (=*Machairodus*) *gracilis* Cope	9
* *Smilodontopsis* (=*Smilodon*) *mercerii* Cope	2
* *Felis* (=*Uncia*) *inexpectata* Cope	3
" *eyra* Desm.	2
* *Lynx calcaratus* Cope	4
** *Mastodon americanus* Leidy	20
* *Tapirus haysii* Leidy	36
* *Equus fraternus* Leidy	9
* " " *pectinatus* Cope	
* *Bos*	3
** *Mylohyus tetragonus* Cope	3
* " *pennsylvanicus* Leidy	
* " *nasutus* Leidy	3
* " undetermined	11
** *Teleopternus orientalis* Cope	3
Odocoileus (=*Cariacus*), undetermined	4
* " " *lævicornis* Cope	3
Mammal undetermined	2

Total 56 species.

THE POTTER CREEK CAVE, SHASTA COUNTY, CALIFORNIA.[2]

Mammals.

** *Arctotherium simum* Cope.
* *Ursus* nov. sp.
* *Felis* nov. sp.
" near *hippolestes* Merriam.
Lynx fasciatus Rafin.
* " " nov. subsp. (?)
Urocyon townsendi Merriam.
Vulpes cascadenis Merriam.
* *Canis indianensis* Leidy.
* *Taxidea* sp. nov. (?)
Bassariscus raptor Baird.
Mephitis occidentalis Baird.

[1] Cope and Mercer, Journ. Acad. Nat. Sci. Phila. (2), Vol. XI, 1897–1901, pp. 193–289.

[2] Sinclair, University of California Publications, Vol. II, No. 1, 1904, pp. 1–27, and Vol. IV, No. 7, 1905, pp. 14–5161.

Mammals.

* *Spilogale* sp. nov.
Putorius arizonensis Mearns.
Arctomys sp.
Sciurus hudsonicus albolimbatus Allen.
Sciuropterus klamathensis Merriam.
Spermophilus douglasi Richardson-
Eutamias senex (?) Allen.
Callospermophilus chrysodeirus Merriam.
Lepus californicus Gray.
" *klamathensis* Merriam.
" near *auduboni* Baird.
" sp.
* *Teonoma spelæa* Sinclair.
Neotoma fuscipes Baird.
Microtus californicus Peale.
* *Thomomys microdon* Sinclair.
" *leucodon* Merriam.
" *monticola* Allen.
* *Aplodontia major fossilis* Sinclair.
Scapanus californicus (?) Ayres.
Antrozous pallidus pacificus Merriam.
** *Platygonus* (?) sp.
Odocoileus sp. *a.*
" sp. *b.*
Haplocerus montanus Ord.
** *Euceratherium collinum* Furlong & Sinclair.
Bison sp.
** *Camelid.*
** *Nothrotherium shastense* Sinclair.
** *Megalonyx wheatleyi* (?) Cope.
* " *jeffersonii* (?) Harlan.
* " sp. nov.
* " sp.
** *Mastodon americanus* Leidy.
* *Elephas primigenius* Blumb.
* *Equus occidentalis* Leidy.
* " *pacificus* Leidy.

Reptiles.

Crotalus sp.

Fishes.

Mylopharodon conocephalus Baird & Girard.
Ptychocheilus (?) *grandis* (?) Ayres.
Acipenser medirostris (?) Ayres.

Comparison of the Cave Faunas.

By comparing the faunas of these three best known American caves some interesting facts are brought out regarding the age, distribution, migration and extinction of many forms during the Quaternary Period.

In the Port Kennedy deposit there is a total of thirty-six genera and forty-seven species of mammals of which ten genera and thirty-eight species are extinct. Of these remains the greater number of specimens belong to sloths, tapirs and peccaries, by which, reasoning from the habits of their modern representatives, it is inferred that the climate was mild, during their lifetime. The predominance of so many extinct genera and species indicates an early part of the Mid-Pleistocene Period. These bones show no signs of gnawing or wear. It is contended that this ensemble of neotropical and nearctic forms lived contemporaneously and were suddenly exterminated and washed in together. The stratified condition of the deposit, which contains an accumulation of vegetable material, worn and unworn stones, probably represents a redeposit of later date.

The Potter Creek Cave of California was a later deposit, in which thirty-

seven genera and forty-nine species of mammals are preserved. Of these, seven genera and twenty-two species are considered extinct. This fauna is still rich in the earlier large Pleistocene forms, such as the *Megalonyx, Nothrotherium, Mastodon* and Elephant, but there is a large per cent. of living genera and species. The high Cordilleran barrier probably modified the climate of this region from that of the colder central plains, preserving species of southern migrants long after they had become extinct in the plains country. In addition to the species listed there are many birds, a tortoise and two species of molluscs. The fish and molluscs are believed to have been carried there by birds. The age of this deposit is considered by Sinclair as older than the Glacial Period in California. It is probably earlier than the Wisconsin stage in the east.

In the Conard Fissure of Arkansas we find a wonderful assemblage of mammals representing thirty-seven genera and fifty-one species, of which four genera and twenty-four species are considered extinct. The topographical condition of the country at the time of their entombment was probably similar to that of the Port Kennedy region, consisting of glades and forest-covered hills. In this fauna the sabre-tooth tiger (*Smilodontopsis*) is the only representative of the earlier extinct Pleistocene forms. There is a notable absence of *Megalonyx, Mylodon,* Tapir, Mammoth and Mastodon, and although this is negative evidence that they did not exist at that time, the large amount of material and variety of genera and species strengthen this evidence. Moreover, twenty genera and seven species that were contemporaneous with those forms in the Port Kennedy Deposit are also found in the Arkansas fissure. Such forms as the extinct genus of musk-ox *Symbos,* also found in Alaska, the Wapiti deer and many small boreal rodents and carnivores now existing far north of this region attest the more severe climate at that time. It is to the burrowing animals having a fixed habitation, whose lives are passed in the most uniform conditions, that we must look for criteria of the climatic conditions, and these are nearly all boreal types. This signifies a crowding southward of northern forms before the advance of one of the great ice sheets.

This "ossuary" is probably richer in individual specimens than any so far discovered in North America, which is accounted for by the fact that the fissure long remained open and was inhabited in late Pleistocene times by many carnivorous animals.

Species now Living in Vicinity of Conard Fissure.

In response to my request, Dr. C. Hart Merriam has furnished the following list of species now living near the boundary between Missouri and Arkansas, which represents most of the genera found in the fissure. In several cases the genera and species are not now known to occur in the Ozarks, in which case species are given that are found nearest to the region.

Blarina brevicauda,
" *carolinensis*,
" *parva*,
Sorex personatus (Indiana),
Microsorex hoyi (Wisconsin),
Scalopus aquaticus aëreus,
Vespertilio fuscus,
Myotis velifer,
" *subulatus*,
" *lucifugus*,
Mephitis mesomelas,
Spilogale interrupta? (no specimens),
Mustela americana (Michigan),
Putorius noveboracensis (Mich. and Ind.),
Vulpes fulvus,
Urocyon cinereoargenteus ocythous,
Procyon lotor,
Ursus americanus,
Lynx ruffus,
Felis cougar,
Erethizon dorsatus (Michigan),
Marmota monax,
Sciurus ludovicianus,
" *carolinensis*,
Tamais striatus,
Spermophilus tridecemlineatus,
Geomys breviceps (on the south),
" *bursarius* (on the north),
Neotoma floridana baileyi,
Peromyscus leucopus,
" *michiganensis*,
" *bellus*,
Reithrodontomys dychei,
" *intermedius aurantius*,
Fiber zibethicus,
Microtus pinetorum nemoralis,
" *austerus* (a little northwest),
Lepus floridanus alacer,
" *aquaticus*.

Description of Fossils.

INSECTIVORA.

The remains of shrews are nearly as abundant in the fissure as are those of small rodents. A species of the genus *Blarina* is especially numerous. Few bones of the skeleton are present, but there are many jaws and skulls. In all this material the brain-cases of skulls are missing. This is the usual condition of skulls where the animals have been eaten by owls, in which case the palates are always regurgitated. It seems probable that weasels were also responsible for the introduction of some of the material, for members of the shrew family, which are so noxious to most carnivores, often form a considerable part of the weasel's diet.

Blarina brevicauda ozarkensis subsp. nov.

Plate XV.

Type.— The anterior half of a skull, No. 11794.

Paratype.— Lower jaw, No. 11793.

Specific characters.— Fourth incisor compressed antero-posteriorly; last unicuspid reduced. Angle on lower border of mandible absent or faint; last lower molar reduced.

Skull.— Large and massive; interorbital region wider than that of typical *B. brevicauda*; anterior border of nares thickened; posterior palatine foramina wider than in *B. brevicauda*; first three incisors as in recent specimens; fourth incisor and canine compressed antero-posteriorly; last unicuspid reduced and rarely visible from the outside. Molariform teeth as in recent *B. brevicauda*.

Mandible.— Shows a very slight angle on the lower border in some, but is entirely lacking in most specimens; styliniform angular process longer and more acuminate than in recent species; teeth

deeply emarginate in unworn series; heel of last molar reduced and smaller than in *B. brevicauda*. Points of teeth in skulls and mandibles are pigmented; usually a dark chestnut brown but in a few specimens yellowish.

Measurements.

	mm.
Length of lower jaw	1.5
Interorbital width of skull	.6

About one hundred and fifty skulls and four hundred lower jaws are referred to this species. Slight differences of constant character throughout the series distinguish the fossils from any described living species. The species was closely related to *B. brevicauda* and the characters pointed out are considered of subspecific value.

B. simplicidens Cope,[1] a fossil species described from the "Port Kennedy Bone Deposit," differs from the Arkansas fossils and living species in having a more simple last lower molar, in which the heel is entirely wanting; also in the absence of an angle on the lower border of the jaw as figured.

Geographical Distribution.— Northern Arkansas during Mid-Pleistocene period.

Sorex personatus *G. St. Hilaire.*

PLATE XIV.

Skull.— Smaller than those referred to *S. obscurus*; teeth not as heavy, and nasals somewhat narrower; first and second, and third and fourth unicuspids in pairs, crowded and unequal; fifth unicuspid smaller than in typical recent specimens of this species; molariform teeth similar in shape and size to recent specimens, but last molar slightly smaller.

Mandibles.— Slender and slightly smaller than a series of recent specimens, but teeth apparently identical in form and size.

This species is represented by five anterior parts of skulls and seventy lower jaws that are referred to it, No. 11775.

The pigmentation of the teeth is less marked than in recent specimens; otherwise they agree well.

Geographical Distribution.— New England to Alaska and south, in high mountains, to Tennessee and North Carolina.

Sorex personatus fossidens subsp. nov.

PLATE XIV.

Type.— An anterior half of a skull, No. 12400.

Specific characters.— Palate narrow and arched; unicuspids gradually reduced to last, which is small.

Skull.— Smaller than *S. personatus*; rostrum slender but not as attenuate; palate more highly arched and dental series approach each other more closely than in *S. personatus*. Teeth not as deeply

[1] Journ. Acad. of Nat. Sci. Phila. (2), Vol. XI, p. 219.

emarginate on the outside; unicuspids decrease uniformly; last unicuspid reduced, barely visible from outside and smaller than in *S. personatus*.

This species is represented by the single type specimen, in which the last three unicuspids and first three molariform teeth of one side, and last four unicuspids and first molariform teeth on the opposite side are preserved.

Geographical Distribution.— Northern Arkansas during Mid-Pleistocene period.

Sorex obscurus? *Merriam.*

PLATE XIV.

Skull.— About the size of recent specimens; nasals not quite as broad; third unicuspid smaller than fourth; molariform teeth, as in recent specimens, but with the inner cusp of the last molar not as prominent.

Mandibles.— Lower jaws as in recent specimens.

The material referred to this species consists of the anterior portion of a skull in which all the molariform teeth and three posterior unicuspids are preserved on one side; some fragmentary palates, and ten lower jaws, No. 11777.

This material is not typical of *S. obscurus*, but approaches nearest in general characters.

Geographical Distribution.— British Columbia, and mountains of western Washington, Idaho, Montana, Utah and Colorado.

Sorex fumeus? *Miller.*

Skull.— Large; rostrum shorter than *S. richardsoni*, and pinched in laterally; infraorbital canal large; opening of lachrymal canal over middle of m^1; dental series much shorter; unicuspids reduced and very small, the last one minute; molariform teeth as in *S. richardsoni* but more deeply excavated posteriorly; last molar similar in form but much smaller than *S. richardsoni*.

Measurements.

	mm.
Length of molariform	4.1
Greatest width across dental series	5
Across anterior interorbital region	4

A single skull, No. 11776, containing two unicuspids on one side with complete molar series of both sides, is referred to this species.

Unfortunately I have not been able to compare it with recent material. The identification is based on the description of the species in Dr. Merriam's 'Synopsis of the American Shrews,' but this specimen does not seem at all typical of the species.

The skull is at once distinguished from the other species noted in this paper by its very large size and dentition.

Geographical Distribution.— Eastern United States, Nova Scotia, New Brunswick, west to Ontario and the Great Lakes.

Microsorex *Coues.*

The genus *Microsorex* has been known heretofore by only three species all of which occupy the Boreal zone and adjacent part of Transition zone from Minnesota to New Brunswick and Nova Scotia.

Microsorex minutus sp. nov.

PLATE XIV.

Type.— A palate, No. 11774.

Specific characters.— Skull robust; teeth massive; i^4 elongated and narrow. Molars wider than long.

Skull.— More robust than *M. hoyi*; nasals wider and heavier, extending farther forward; anterior nares large with thickened borders. The depression below the external nares is deeper, giving the appearance of an inflated narial opening.

Comparing the palate with that of *M. hoyi* the dental series is slightly longer and much wider; teeth more massive; i^1 wider at median constriction, anterior face of cusp rounded, lacking the internal notch; i^2 and i^3 similar to *M. hoyi*, but inner ridge and secondary cusp not as prominent; i^4 elongated transversely and reduced even more antero-posteriorly than in *M. hoyi*, a minute wedge, internal slightly wider than the external face and barely visible from the outside; the last unicuspid is not visible from the outside, ovate in form with greater transverse than antero-posterior diameter. In m^1 and m^2 the transverse is wider than the antero-posterior measurement, valleys deeper and closer to median line, so that internal cusps are wider at base than in *M. hoyi*; last molar similar in form but larger than in *M. hoyi*. In the single specimen of *M. hoyi* preserved in the Museum collection the interpterygoid space is narrowed posteriorly while in *M. minutus* it is of the same width throughout.

Five mandibles are referred to this species. The first incisor reaches posteriorly completely under the third lateral tooth. The teeth are heavier than in *M. hoyi*, but not different in form.

Measurements.

	mm.
Length of upper dental series	6.6
Width " " " "	4.2

This species is represented by the type specimen and five referred jaws. In the palate the entire dental series are preserved complete on both sides. Of the dorsal surface of the skull only the anterior part of the nasals is preserved.

Geographical Distribution.— Northern Arkansas during Mid-Pleistocene period.

Scalopus aquaticus (*Linnæus*).

PLATE XV.

This species is represented by a single lower jaw, No. 12429, in which the molars are preserved. The jaw is that of a large individual. The peculiarities pointed out below seem to be quite within the limits of normal variation. It differs from recent specimens in the Museum collection in the position of the mental foramen, which opens immediately under the first functional premolar.

In recent skulls it is never farther forward than under p_2 and is usually between p_1 and m_3. The teeth are unworn and strongly cuspidate; anterior cusplets inclined forward, while in recent specimens they are more perpendicular.

The median tubercles at right angles to the column and midway between the crown and root of teeth are present on both the anterior and posterior internal cusps of m_2 and m_3 and on the posterior internal cusp of m_1. They are quite as prominent as on *Parascalops breweri*.

I suspect that these tubercles wear off early in recent specimens by the attrition of food particles, for they are never prominent in a large series of specimens in the American Museum collection.

Measurements.	mm.
Length of molars	7.8

Geographical Distribution.— East of Rocky Mountains and great plains, and northward to Minnesota, Wisconsin and Massachusetts.

CHIROPTERA.

Two genera and species of this order are represented by many skulls and limb bones. Their presence indicates that a part of the fissure at least was closed in with dark recesses that furnished a suitable habitation for bats.

Vespertilio fuscus grandis subsp. nov.

PLATE XV.

Type.— A fragmentary skull, No. 11795.

Specific characters.— Skull large; proëncephalic region deeply excavated. Teeth massive.

Skull.— Larger than typical recent *V. fuscus*; superorbital ridge stronger and more pronounced; proëncephalic region deeply excavated; zygomatic arch wider than in recent specimens and maxillary portion apparently more spreading; teeth similar in form but more massive; basal cingula more pronounced; upper canine proportionally larger at base with posterior cutting edge extending farther backward.

Mandible.— Similar to living *V. fuscus*, with deeper masseteric fossa and larger condyle; anterior internal basal cusp of second premolar larger than in living forms.

Measurements.	mm.
Width of skull at antorbital constriction	4.5
Width of zygoma at posterior edge of orbital floor	21.5
Length of upper molar series	6.4
Length of lower jaw	15

Eighteen anterior halves of skulls, ninety-five mandibles and many limb bones represent this species. The brain-case is broken away in all specimens.

The similarity in dentition and general proportions clearly establishes the relation of this form to the living *V. fuscus*, but the characters pointed out above

are uniform throughout the series and of sufficient value on which to base a subspecies. This species is probably the direct ancestor of the living *V. fuscus*.

Geographical Distribution.— Northern Arkansas during Mid-Pleistocene period.

Myiotis subulatus? (Say).

PLATE XV.

Skull.— Same size as recent *M. subulatus*, but with abrupt high forehead and rather short rostrum; premolars crowded, as often seen in recent specimens of this species; dentition similar in size and form.

Mandible.— Same as in recent *M. subulatus*.

Measurements.	mm.
Length of molar series and canine	6
Width of skull at interorbital constriction	4
Length of mandible without teeth	10.6

The anterior parts of three skulls with partial dentitions and seventeen mandibles, No. 11779, are referred to this species. The material may represent a new species, but is not adequate for characterization.

Geographical Distribution.— North America east of Rocky Mountains.

CARNIVORA.

Mephitis mephitica newtonensis subsp. nov.

PLATE XVI.

This species is represented by two lower jaws, the right anterior side of a skull, in which p^2 is preserved, and two separate teeth, p^3 and m^1.

Type.— A lower jaw, No. 12428.

Specific Characters.— Coronoid process extensive and low. Teeth massive.

Comparing this species with northern *M. mephitica*, the posterior angular portion of the mandible is better developed; masseteric fossa more extensive; coronoid process wider antero-posteriorly and not as high. The anterior teeth are massive; fourth premolar high and strongly recurved with a well developed anterior cusp; carnassial robust, with high upturned heel. The two cusps and connecting ridge forming it contract more rapidly toward the apex, making it narrower transversely with enclosed cup deeper than in *M. mephitica*; anterior trenchant cusp shorter antero-posteriorly and more robust. The last molar in another jaw referred to this species is much larger than in *M. mephitica* of the same size, but the crown is too much worn to give character.

In the fragment of skull referred to this species the third premolar is much larger and higher than any in a large series of *M. mephitica*, with which it was compared. The apex of the cone is over the center of the base of the tooth and strongly recurved. An anterior cusp is indicated and the posterior cusp and cingulum are strongly developed. The alveolus of the canine is large and circular. In the upper molar referred to this species the transverse measurement is greater and the antero-posterior measurement less than in recent *M. mephitica*.

Measurements.	mm.
Length of mandible	42
" of sectorial	9.6

Geographical Distribution.— Northern Arkansas during Mid-Pleistocene period.

Spilogale interrupta? (Rafinesque).

Two upper teeth, No. 12427, represent this genus and are referred to this species. The outer posterior projecting heel of m^1 is strongly developed and the internal cingulum moderately so. Premolar 4 as in recent specimens of this species.

Geographical Distribution.— Kansas, Oklahoma and Texas.

Brachyprotoma gen. nov.

Generic characters.— Face short and broad with reduced post-orbital process. Antorbital foramen smaller than in living genera. Dentition $i\frac{3}{3}$, $c\frac{1}{1}$, $p\frac{3}{3}$, $m\frac{1}{2}$ as in *Conepatus*. Upper molar elongated transversely, lacking posterior projecting outer heel. Canine large. Mandible with abrupt deep symphysis; premolars greatly crowded, overlapping; sectorial, with trenchant basin-shaped heel, metaconid small but distinct.

Type.— *Brachyprotoma pristina* sp. nov.

Among the interesting material in this collection are fragments that indicate an extinct genus of skunk. It is closely related to *Mephitis* and shows many more characters in common with it than with the genus *Conepatus*, notwithstanding the fact that the dental formula of the latter is the same.

The transverse elongation of the upper molar and reduction of the metaconid in the lower carnassial are characters that show this genus to have been more closely related to the weasels than are any of the living skunks.

Geographical Distribution.— Known to have inhabited Pennsylvania and northern Arkansas during the Pleistocene period.

Cope described four species of fossil skunks from the "Port Kennedy Bone Deposit" [1] referring all to the genus *Mephitis*. The more complete material from the Arkansas Fissure shows that three of these species belong to this new genus. In general features the jaws are similarly constructed, with deep symphysis, premolars crowded, overlapping, metaconid greatly reduced. Their differences are best shown in the accompanying measurements.

Brachyprotoma fossidens (Cope).

Mephitis fossidens COPE, *loc. cit.*

No. 1.

	mm.
Length of inferior sectorial	11
Depth of mandibular ramus at m_1	6

[1] Journ. Acad. of Nat. Sci. Phila., Vol. XI, 1897–1898, p. 232.

	mm.
No. 2.	
Length of m_1	11
Length from m_1 to condyle	26
Length from m_1 to angle	23.5
Depth of ramus at m_1	7.5
No. 3, with Canine.	
Length of dental series	31
Length of true molars and pm_1	21
Length of m_1	11.5
Depth of ramus at m_1	8

Brachyprotoma leptops (Cope).

Mephitis leptops Cope, loc. cit.

	mm.
No. 1.	
Length of dental series, including canine	25
Length of premolar series	7
Length of sectorial	10
Depth of ramus at pm_2	7
" " " " m_1, posterior root	7
No. 2.	
Depth of ramus at m_1	6

Brachyprotoma obtusatus (Cope).

Mephitis obtusatus Cope.

	mm.
Length of dental series, including canine	15.5
Length of premolar series	6.5
Length of sectorial	6
Length of ramus from symphysis to condyle	28
Length of basis of coronoid	9
Depth of ramus at pm_2	6
Depth of ramus at m_1, posterior root.	4.5

Brachyprotoma pristina sp. nov.

Plate XVI.

Type.— Half of a skull, No. 12426.

Specific characters.— Facial angle oblique; orbit elongate; external auditory meatus reduced; mandible short and robust; coronoid process vertical; carnassial massive.

Skull.— The anterior border of the nasals has been gnawed away by rodents, but the free border of the premaxillæ is preserved for a short distance above the alveoli, giving the outline of the external nares which are abrupt as in *Spilogale* and *Mephitis*; anterior border of the orbit elongated, overhanging the infraorbital foramen which is reduced and slit-like. Apparently the facial angle was greater in this form than in *Spilogale* or *Mephitis*. Auditory bullæ inflated more than in *Mephitis* or *Conepatus*, but not as much as in *Spilogale*. External auditory meatus reduced, half the size of *S. interrupta*. The periotic region is not inflated, while the prominent mastoid process extends considerably beyond the external meatus but does not flare outward as in *Mephitis*. Paroccipital process large at base with extensive muscular attachment as in *Conepatus*. The condyles do not project far

from the skull, but present an articular surface for the atlas wider than in *Spilogale*. The anterior palatine foramina are placed well forward and rounded. The palatines, projecting back to the pterygoids, are broad and arch below leaving a very narrow incision at the beginning of the posterior nares. Posterior nares not nearly as wide as the distance between the anterior margin and the molar teeth. The foramen which opens from immediately behind the cribriform plate into the orbital cavity is much larger than in living genera. Optic foramen similar to *Spilogale*. Sphenoidal fissure relatively large and rounded without indication of septum separating it from foramen rotundum. Foramen ovale for transmission of the third division of the trigeminal, including the inferior dental nerve, is proportionately smaller than in living genera. Foramen lacerum jugulare, or posterius, large, while the condyloid foramen close to it is smaller than in *Spilogale*. Carotid foramen large and far forward, close to eustachian canal as in *Conepatus*.

Teeth.— All anterior teeth are missing, but the alveoli are preserved. The third incisor was close to the canine, leaving a shorter diastema than in any living species of skunk. The alveolus of the canine is very large for a skull of this size and elongated antero-posteriorly; p^3 of No. 11772 is barely separated from the canine and much longer than wide without anterior cingulum or projecting heel; p^4 is proportioned as in *S. interrupta* with, however, a more reduced internal cusp which is not as high and is placed farther forward, while the separating valley is much shallower; anterior basal cusp wanting; m_1 has only a slightly greater crown area than the last premolar, median constriction slight and internal posterior heel reduced; the external posterior heel entirely wanting. A wide space separates the inner surfaces of the last premolar and molar.

Mandible —Three mandibular rami, No. 11773, are referred to this species. Although neither was associated with the skull, they fit it perfectly. Jaw massive and short, with symphysis extensive and abrupt, catlike; it is shallowest at the posterior root of the first molar and gradually deepens forward to the symphysis; lower border slightly curved. Ascending ramus high, vertical and more sharply pointed than in living skunks. Masseteric fossa deep and extensive. The inferior dental foramen is large and there are several small mental foramina.

Teeth.— The incisors and canines are missing in all specimens. The alveolus of the canine shows this tooth to have been large, corresponding to the canine of the upper jaw. The premolars are much crowded, oblique to the series, overlapping and increase in size rapidly from front to back; first two premolars narrow, elongated obliquely and nearly as wide externally as internally; p_3 is more than twice the size of p_2 and p_4 is more than twice the size of p_3, of triangular form, with anterior basal cusp and a slight posterior cingulum. M_1 is strongly developed and differs from living skunks in the greatly reduced internal middle cusp, or metacone. The apex of the external middle cusp divides the tooth equally antero-posteriorly. The length of this tooth is greater than all the premolars, equalling their length plus half the diameter of the canine. The last molar is minute, much smaller proportionally than in *Spilogale*, simple, circular, single rooted, with a central depression and irregularly raised margin.

Owing to the crowding of the premolars, the dental series are curved more than in living skunks. This overlapping of lower premolars and increased depth at symphysis of jaw is due to the shortening of the mandible in order to compensate for the reduction of the upper dentition.

Measurements.	mm.
Length of skull from condyle to anterior border of premaxillary, No. 11772,	46
Outside measurement across upper molars, No. 12426,	20.5
Length of upper molar series, No. 12426,	12
Length of m^1 (antero-posteriorly), No. 11772,	3.7
Greatest diameter transversely	5.7
Length of lower jaw, No. 11773,	30.5
Length of lower sectorial, No. 11773,	7.4
Depth of jaw at posterior root of m_1	5.8
Length of premolar series,	6.5

Comparing these measurements with those of the Port Kennedy fossils it is seen at once that this species is much smaller than *B. fossidens*, or *B. leptops*, and needs only to be compared with *B. obtusatus*, from which it differs in proportions, having a much larger sectorial. The ascending ramus is vertical, while in *B. obtusatus* it is oblique.

This species, which is the type of the genus, is founded on the anterior half of a skull which extends from the postorbital constriction forward and has the last premolar and molar preserved on each side. A fragmentary skull, No. 11772, and three lower jaws, No. 11773, are considered paratypes.

Brachyprotoma spelæa sp. nov.

PLATE XVI.

Type.— A lower jaw, No. 12399.

Specific characters.— Mandible slender, coronoid process oblique, carnassial narrow transversely and elongate antero-posteriorly.

Measurements.	mm.
Length of mandibular ramus	26.6
Length of sectorial	7
Depth of jaw at posterior root of p_1	4

A single mandibular ramus, No. 12399, represents this species. The jaw is nearly of the same length as *B. pristina*, but much more delicate and not as massive. It is proportionately shallower at posterior root of m_1. The ascending ramus is delicate and slopes obliquely as described in *B. obtusatus*, but the masseteric fossa is shallower than in any described species, while in *B. obtusatus* it is said to be deeper than in *B. fossidens* or *B. leptops*. The anterior teeth, p_2 and p_3, are similar to those in *B. pristina*, but the sectorial is proportionately longer, equal almost to the combined length of the premolars and alveolus of canine; heel of sectorial proportionately higher.

Mustela pennanti *Erxleben.*

Four lower jaws, the left anterior portion of a skull and two separate teeth, a lower sectorial and an upper carnassial, No. 11765, are referred to this species. Three of the jaws and the skull fragment are of young individuals having functional milk dentition, but with permanent series partly erupted. The fourth jaw is that of an adult, in which nearly all the teeth are broken.

This material differs in some respects from recent *M. pennanti*, but these differences are probably due to individual variation. The specimens are of animals much larger than *M. americana*. The right lower jaw of the adult is slightly shorter than in *M. pennanti*, and the fourth premolar is much smaller, lacking the anterior cingulum, with posterior cingulum greatly reduced. The sectorial is more slender and shorter, but agrees in structural character, except

that the anterior cusp is shorter. The posterior heel is the same as in *M. pennanti* and not as in *M. diluviana*, as described by Cope.[1] The second lower molar is similar to that of *M. pennanti*.

The upper dentition is shorter than in the single specimen of the recent species used for comparison, but this difference is probably because the permanent teeth are not erupted. The molar is the only tooth perfectly freed; it is similar in pattern, but smaller, and the inner anterior curved ridge is not as strongly developed.

Measurements.	mm.
Length of molar series of adult jaw	38.3
Length of lower jaw of nearly adult specimen	65
Length of sectorial of nearly adult specimen	12.8
Length of permanent upper dentition not yet erupted	32.5

Geographical Distribution.— North America north of 35° in forest-covered country.

Putorius vison (*Schreber*).

PLATE XVII.

Seven skulls and twenty-eight separate jaws of this species were taken from the runways in the angle of the fissure.

By comparing this material with a large series of recent skulls individual differences are found in nearly every specimen, but the amount of sexual and individual variation among a large number of recent skulls is greater than the sum total of individual differences between the fossil and recent forms.

In size and general proportion the skulls are similar to a series of recent skulls. Some differences are seen in the dentition but they are not constant. The internal cusp of the last upper premolar in the fossil form usually is not as strongly developed as in recent specimens, and in several skulls and separate teeth this cusp is divided into two minute cones. In the series of recent skulls at hand one skull shows this feature. The upper molar shows considerable variation in form and size. The narial space separating the pterygoids tends to be less in the fossil forms; otherwise there are no marked differences.

In only five lower jaws are the last molars preserved. They show a greater range of variation in size than the living forms in jaws of the same size. Both the largest and the smallest second lower molars are found among the fossils. In other respects the fossil jaws are similar to those of the living species.

Measurements.	mm.
The longest skull measures	66
The shortest skull measures	56

Geographical Distribution.— Eastern North America, through Canada to the Arctic Sea; westward north of Gulf States to the Pacific coast.

[1] *Loc. cit.*, p. 229.

Putorius cicognanii angustidens subsp. nov.

PLATE XVII.

Type.— Skull and jaws, No. 12432, ♀.
Specific characters.— Skull small; p^2 reduced, m^1 with slight median constriction.

Seven complete skulls, four having jaws attached, six parts of skulls and thirty-four separate lower jaws represent this species. The skulls and jaws in series bring out more sharply the characters which separate this species from *Putorius cicognanii.*

Judging from the size, texture and form of skulls, as compared with living series, there are eight skulls of males and five skulls of females.

In size and general structure this species may be compared most closely with *P. cicognanii,* from which, however, it differs in well-marked characters. The skulls average slightly smaller; upper molar narrower antero-posteriorly, and the postorbital constriction and process are well marked.

The female skulls are small, narrow and as in *P. cicognanii,* with, however, a marked postorbital constriction and a well developed postorbital process. The zygomata is bowed outward slightly in skull No. 12435, the only specimen in which it is complete. The brain-case is elongated and flattened vertically and not as cylindrical as in *P. cicognanii.* The audital bullæ are small, narrow and subcylindric, but shorter by one millimeter than in *P. cicognanii* of the same size. The bullæ are almost continuous anteriorly, but not inflated as much posteriorly as in the recent species, a feature which gives the skull less vertical depth at this point.

The postglenoid surface is extensive, as in *P. cicognanii,* but the space separating the pterygoids is much narrower.

There is a marked reduction in p^2, which is much smaller than in *P. cicognanii.* The upper molar shows only a slight median constriction and the outer and inner moieties are nearly equal in antero-posterior measurement. This tooth varies slightly in different skulls, some of the males showing a wider internal moiety, but the median constriction is always slight.

The male skulls are considerably larger and heavier than the female, and the brain-cases are slightly more inflated.

The following measurements are taken from normal skulls not having diseased sinuses.

Measurements.	mm.
Length of male skull	43
Length of female skull, type No. 12432	38
Width of male skull at postorbital constriction	9.5
Width of female skull at postorbital constriction, No. 12432	7
Width of male skull back of zygomata	2
Width of female skull back of zygomata, No. 12432	17

Geographical Distribution.— Northern Arkansas during Mid-Pleistocene period.

Putorius gracilis sp. nov.

PLATE XVII.

Type.— A complete skull, No. 12431.

Specific characters.— Skull attenuate; postorbital constriction narrow.

Skull.— Small, narrow and elongated, presenting the most extreme phase of long drawn out, slender skull among weasels. The postorbital constriction is as well marked as in the female skulls of *P. angustidens,* and the postorbital process is strongly developed, though not to the extent seen in *P. longicauda.*

The brain-case is uniformly inflated and subcylindrical. In profile it is slightly arched. The audital bullæ are narrower and longer than in *P. angustidens,* subcylindric and almost continuous anteriorly. The space separating the pterygoids is very narrow. The teeth are similar in pattern to those of *P. angustidens,* but the series are more nearly parallel.

The measurements show clearly the proportions separating this species from *P. angustidens.*

Measurements.	mm.
Extreme length of skull	42
Width of brain-case back of zygoma	17
Width of postorbital constriction	7.5

This species is represented by the type specimen only.

Geographical Distribution.— Northern Arkansas during Mid-Pleistocene.

Canis occidentalis ? *Richardson.*

Remains of this genus are not common in the Arkansas fissure. The material is very fragmentary and not associated. It consists of a lower mandibular ramus without teeth, No. 11761; the posterior part of a brain-case that has all the broken edges and protuberances gnawed away by rodents; two astragali and a lower molar, m_2, No. 11762, and a few fragmentary bones.

The fragments are those of an adult of a large species of *Canis* that cannot be distinguished from the living species *C. occidentalis.*

Geographical Distribution.— Western North America, Pacific Coast to Nebraska, and from Canada to Mexico.

Vulpes fulvus ? *Desmarest.*

Foxes are rare in this fissure material and are represented by only a few determinate fragments. A lower premolar, p_4, an upper molar, m^1, and a metatarsal, No. 11764, are referred to this species. The teeth are of pattern and proportions similar to the living species, but are slightly smaller. The metatarsal is considerably shorter, although not as heavy as in *Urocyon.* These specimens are apparently of old individuals.

Geographical Distribution.— Canadian boundary to Georgia, westward to the Great Plains.

Urocyon ? sp. indet.

A single tooth, m^2, No. 11763, is provisionally referred to this genus, although not typical of any described species.

Tooth.— General form not as distinctly triangular as in recent specimens. The principal cones are all low and the outer ones not greatly expanded antero-posteriorly; a wide cingulum surrounds the outer moiety of the tooth, and the median constriction is wide.

Compared with *U. scotti* it is of the same general contour but slightly larger.

Procyon lotor (*Linnæus*).

PLATE XVIII.

In the collection there is a nearly complete lower jaw, No. 12430, containing also all the dentition but i_2 and p_1 and four separate teeth, p^4, m^2 and two m_2, No. 11760.

The jaw is typical of recent specimens of this species, and structurally the teeth are the same, although some differences are marked in comparison with recent specimens. The canine of the fossil is broader antero-posteriorly at base than specimens with which it is compared. Two parallel grooves on the posterior face constrict the intervening surface into a cutting blade; the last two premolars are massive, of slightly greater dimensions at base and more deeply cupped posteriorly. The first molar is elongated antero-posteriorly more than in recent jaws of the same size, while the postero-internal cone is not as strongly developed, which gives a narrower transverse diameter to the fossil. The upper teeth are large but similar to recent specimens. Notwithstanding these differences the material does not seem to warrant separation as a new species.

Measurements.	mm.
Length of jaw condyle to symphysis	80
Width of canine antero-posteriorly	7

Geographical Distribution.— Eastern America from Canada to western Georgia and west to the Rocky Mountains north of Texas.

Ursus americanus *Pallas.*

Of the larger mammals one of the most characteristic and abundant forms is a species of bear, the remains of which are represented in the collection by a nearly complete basal portion of a skull, forty separate teeth, two lower jaws, parts of four palates and a premaxillary, besides a nearly complete fore limb, humerus, ulna and other fragmentary limb bones, carpals, tarsals and phalanges.

This material represents many individuals of different sizes, and it is quite possible that we have here the remains of two species, but unfortunately the teeth cannot be associated with each other except in one or two cases and they cannot be definitely placed with either skull or limb fragments; consequently I have provisionally identified them with the nearest living species. In comparing the material I have grouped the teeth and will point out differences from recent specimens of this species.

Skull.— Base of skull No. 11749 is large, intermediate in size between *U. horribilis* and *U. americanus*; condyles large but not as wide as in *U. horribilis*; paroccipital process long and slender; mastoid process long but not directed forward as much as in *U. americanus*, and of about the same size; bulla large and arched, and tympanic region nearly as extensive as in *U. horribilis*; external auditory meatus larger than in recent specimens of this species.

Only the lower border of the brain-case is preserved. This is highly arched and equal in width to that of a medium-sized *U. horribilis*.

Teeth.— In general of *U. americanus* style as opposed to *U. horribilis* and unlike those of *Arctotherium* or *U. haplodon*. Canines normal; the anterior premolars variable as in recent specimens; p_4 constantly larger than in recent specimens, and the internal or protocone more anterior in position, nearly opposite the emargination between the two external cones, a character noted in *U. haplodon*; m^1 normal, cones of permanent teeth sharp as in deciduous teeth and possibly compressed more transversely; m^2 is of the same size as in recent specimens, but differs in the relatively larger heel. In recent specimens of this species in the Museum collection the heel is formed by a sudden contraction posterior to ectocone; protocone and ectocone subequal and of nearly the same size.

In the four fossil teeth, m^2, preserved, the ectocone is decidedly smaller than the protocone, and posteriorly the border merges gradually into the large heel, resembling more nearly in form *U. horribilis*.

Of the second inferior molars four are preserved, which vary a great deal in size, but are of the normal form.

Two last lower molars are preserved, one considerably larger than the other. In both the crown is only slightly longer than wide. The grinding surface is concave and tuberculated as in recent specimens. The last lower molar is usually longer than wide in recent specimens.

A lower jaw without teeth is of the same proportions as that of a large black bear.

A nearly complete fore limb, preserved in position and encased in a block of calcite drip, is exhibited in the model of this fissure in the Museum. It agrees in size and form with recent specimens.

Many disassociated limb bones, carpals, tarsals and phalanges are referred to this species.

The upper part of a humerus of a young individual, in which the greater part of the shaft is preserved, is about the size of a large specimen of *U. floridanus*. The deltoid ridge extends far down the shaft of the fossil humerus, as in this species. An ulna, which is probably associated with this humerus, shows a very much larger articular surface for the radius than in recent specimens.

This material represents a large species intermediate in size between the black and grizzly bear, and it may represent a new species, as some characters pointed out in the teeth would indicate, but as I am unable to associate a complete dental series or character of skull with teeth, it seems advisable to refer it to *Ursus americanus*, with which it more nearly agrees.

Measurements.	mm.
Width of skull, No. 11748, across mastoids	140
Width across condyles	59
Between mastoid process and postglenoid process	46

	mm.
Greatest transverse diameter of brain-case	98
Length of largest p^4	14
Width	10
Length of m^2	26.5
Width of heel anteriorly	12

Geographical Distribution.— Forest-covered parts of North America.

Lynx compressus sp. nov.

PLATE XVIII.

Type.— Fragment of a skull, No. 11802.

Specific characters.— Carnassial elongated antero-posteriorly and compressed; protocone well developed.

The type specimen of this species contains the two premolars and the alveolus of the canine. Both teeth are inclined backward more than in described species; p^3 has no anterior basal cusp or cingulum, the anterior face rising evenly from base to apex of principal cone, which is relatively shorter than in *L. canadensis* or *L. ruffus*.

The carnassial is the characteristic tooth of this species and is unlike described *Lynx*, resembling *F. eyra* except that it is narrower transversely at the anterior end. It is elongated antero-posteriorly, narrow and strongly compressed transversely; the antero-internal cone is better developed and higher than in described species and separated from the antero-external cone by a deep incision. The paracone is more slender than in *L. canadensis* or *L. ruffus* and relatively not as high; the antero-external cone is narrow transversely at its base, with apex subdivided into a smaller preanterior cone which is in line antero-posteriorly with the paracone. In recent species this preanterior cone is situated on the external side; the posterior shearing ledge in *L. compressus* is elongated antero-posteriorly and does not bend outward posteriorly as in *L. ruffus* or *L. canadensis*.

A lower jaw, No. 11803, is referred to this species. It is much smaller and the dental series much shorter than in *L. canadensis*, *L. ruffus* or *L. calcaratus* Cope.

Compared with *L. calcaratus* the mandible of *L. compressus* is slenderer; dentition neither as massive nor as long; diastema longer; anterior basal cone of p_3 less strongly developed; anterior cutting lobe of m_1 is longer and the posterior basal cone is more reduced, scarcely apparent. The sectorial is longer in *L. calcaratus* than in *L. compressus* or *L. ruffus*.

Measurements.	mm.
Length of carnassial, No. 11802,	14
Width of carnassial anteriorly, No. 11802,	6
Length of two upper premolars, No. 11802,	23
Length of lower jaw, No. 11803, condyle to symphysis,	75
Length of molar series,	26.5

Geographical Distribution.— Known only from Arkansas Mid-Pleistocene period.

Lynx ruffus? (*Güldenstædt*).

PLATE XVIII.

The right anterior portion of a skull, No. 11801, and a lower jaw, No. 11800, are referred to this species.

The canine of the skull fragment is not peculiar, but p^3 lacks the anterior basal cusp, as in *L. compressus* and sometimes in *L. ruffus*; the anterior portion of the carnassial, all that is preserved of this tooth, is typical of *L. ruffus* and entirely unlike *L. compressus*; the anterior cusp is wide at base with apex internal. Preanterior basal cusp on the outer border as in recent *L. ruffus*. The internal anterior cone is broken.

The lower jaw is complete forward to alveolus of canine, and agrees well with recent specimens of this species.

Measurements.	mm.
Length of lower jaw condyle to alveolus of canine	77
Length of molar series	30

Geographical Distribution.— Central North America from southern Georgia to Maine.

Felis cougar (?) *Kerr.*

PLATES XIX AND XXIII.

This species is represented by the anterior half of a lower jaw, No. 12398, which contains all the teeth.

The canine is small and erect, with the characteristic form of this species. Diastema normal. Molariform teeth massive with relatively large anterior and posterior basal lobes in premolars; m_1 equally divided at base.

The dental series equals in length that of a large adult recent specimen, and appear slightly more massive though not equal to *F. pearsoni* of Patagonia.

The lower border of the jaw has been eaten away by rodents. A single large mental foramen opens just below the anterior root of p_2.

The distal end of a humerus, No. 11788, is referred to this species. The supinator ridge and part of the external condyle have been gnawed away, but remaining portions agree in measurements with recent specimens. The internal condyle instead of having the long diameter nearly vertical, as in recent specimens, is oblique, the upper end placed farther forward, which causes the entepicondylar foramen to look outwards.

Measurements.	mm.
Length of molar series	49
Greatest diameter of canine	12
Least diameter of canine	9
Width of humerus across condyles	50
Diameter of shaft 100 mm. above trochlea antero-posteriorly	25
Diameter of shaft 100 mm. above trochlea transversely	20

Geographical Distribution.— Eastern United States.

Felis longicrus sp. nov.

PLATES XVIII AND XXIII.

Type.— An upper sectorial, No. 11787.

The type specimen of this species was at first referred to *F. inexpectata*, but when compared with the type specimen of the latter species distinct specific differences were immediately apparent. M^1 is slightly more massive and of distinctly different proportions. The protocone is relatively larger than indicated in the broken type specimen of *F. inexpectata* and placed farther forward, although not as well developed as in *F. onca*. This tooth is narrower transversely at this point than in *F. inexpectata*. The paracone is larger than in *F. inexpectata*, and the metacone projects farther backward at a more obtuse angle, its cutting edge nearly parallel with the base of the tooth.

A separate premolar, p^3, (Plate XVIII) is referred to this species. It agrees well with the Port Kennedy fossil and closely resembles that of *F. onca* but with principal cusp relatively higher.

The proximal end of a referred humerus is of about the size of that of a mature female of *F. leo*. Another specimen, the distal end of a humerus (Plate XXIII), also referred here, is distinctly feline and unlike that of the "saber-tooth." It is about the size of *F. leo* with entepicondylar foramen small and higher above the trochlea than in *Smilodontopsis*; inner trochlea vertical as in modern *Felis*.

A referred ulna (Plate XXIII) is nearly complete except for the styloid process and is as large as in an adult *F. leo* and considerably longer.

Several phalanges, metacarpals, an ectocuneiform, and a radius without epiphyses are also referred here. The ectocuneiform is distinctly feline and is deeper proximo-distally and narrower transversely than in *Smilodontopsis*.

Measurements.	mm.
Length of m^1 antero-posteriorly	27
Width of m^1 anterior end	13
Length of p_3 antero-posteriorly	19.3
Extreme transverse width of humerus across condyles	6.3
Length of ulna, styloid process missing	290

Numerous fragmentary remains from the Conard Fissure indicate a cat intermediate in size between *F. inexpectata* Cope and *F. atrox* Leidy and closely related to the former.

Geographical Distribution. — Northern Arkansas during Mid-Pleistocene period.

MACHAIRODONTINÆ.

Remains of Saber-tooths have been found in the Pleistocene deposits of the Americas at various times and places; in South America two nearly complete skeletons of *Smilodon* were found in the Pampean formation not far from Buenos Aires.

On account of the striking development of the upper canines and the general similarity in structure of the carnassials, European writers have grouped all the American species under the Old World genus *Machairodus*, notwithstanding the fundamental difference in the relative development of parts in the dental series and disregarding the skeletal differences as well.

It has been pointed out by Cope and Gervais that the South American genus *Smilodon* is distinct from *Machairodus* in the following characters: (1) in the absence of entepicondylar foramen; (2) in the coössification of the post-tympanic to the postglenoid process of the skull.

Other fundamental differences are seen in the teeth, as the rudimentary or suppressed p_3, which in *Machairodus* is well developed, and the nearly equal tripartite division of the upper carnassial in *Machairodus*.

The structure of the manus is quite different in the two genera. The unciform in *Smilodon* is greatly enlarged, thus increasing the length of the fourth digit, the metacarpals of which terminate distally on the same plane as mc. III. Metacarpals short, straight and flat dorsally. Mc. I short with little lateral movement. The proximal end of the proximal phalanx of the pollex shows two large facets of nearly equal size, giving a powerful digit but of less lateral movement than in modern Felidæ. *Machairodus* apparently approaches this type of pollex, judging from Gaudry's [1] illustrations of *M. cultridens*. But the manus is longer and distinctly more feline in structure, having a greater arch. The unciform is reduced.

Before considering the North American forms it will be necessary to describe some important material from the Arkansas fissure.

In this collection the remains of two species of "Saber-tooths" are numerous, and, although the material is fragmentary, it is sufficient to determine the generic separation from *Machairodus* and *Smilodon*. For this genus the name *Smilodontopsis* is proposed.

Smilodontopsis gen. nov.

Generic characters.— So far as known the characters are as follows:

Dentition.— $1\frac{3}{3}$, $c\frac{1}{1}$, $p\frac{2}{2}$, $m\frac{1}{1}$. P^4 with three roots, protocone present or absent.

Lumbar vertebræ with weak anapophyses; spines short, straight, and heavy. Manus short; metacarpals with flat dorsal surfaces, as in *Smilodon*. Pes with five digits; metatarsals longer than in *Smilodon*, and shaft nearly round. Humerus with entepicondylar foramen.

Type.— *Smilodontopsis troglodytes* sp. nov.

Smilodontopsis troglodytes sp. nov.

PLATE XIX.

This species is founded on associated fragments of a skeleton, No. 11786, which was found about twelve feet from the surface. Part of the specimen was destroyed by helpers before it was recognized. The portions saved consist of a point of the upper canine, an upper sectorial and an upper incisor; three vertebræ, distal end of humerus, distal ends of radius and ulna and olecranon process of ulna, several carpals, tarsals, metacarpals and phalanges.

[1] Animaux Fossiles et Géologie de L' Attique, Plate XVI.

The incisor[1] has a strongly recurved crown, the posterior face of which is excavated with sharp crenulated lateral cutting borders. On its external border near the base of the crown is a small tubercle.

The point of the canine, of which 38 mm. is preserved, is compressed transversely and crenulated on both edges. From comparisons of many "saber-tooth" cats it seems probable that the presence or absence of these crenulations of the canine is a matter of wear.

The sectorial is characterized by the absence of a protocone and the presence of a well developed metacone, which is relatively greater than in *Trucifelis fatalis*, the type of which is now in the American Museum. The external face of the metacone has a slight median depression but is not as strongly marked as in the following species; paracone not highly convex on the external face, as in *Dinobastis serus*, the inner face is nearly straight without sign of tubercle. This cone is relatively better developed than in *S. conardi*. Anterior cone large and high; preanterior cone a well developed tubercle but not as large as in *Trucifelis fatalis*, although the tooth is much longer antero-posteriorly.

The distal end of the humerus is as large as that of *Felis leo* and about as wide across the condyles as in *Machairodus cultridens*; entepicondylar foramen large and lower border of foramen much lower on shaft than in *M. cultridens*; capitellum reflexed on anterior face of shaft more than in *M. cultridens* or *F. leo*. The supinator ridge is gnawed away, but remaining portions of base resemble that of *Smilodon*.

The distal ends of ulna and radius resemble those of *M. cultridens* and are about half the size of those of *Smilodon*. Olecranon process of ulna as in *M. cultridens*.

Of the carpals the scapho-lunare, unciform and cuneiform are preserved. The unciform is reduced. It is smaller than in *Machairodus* but of the same form; and unlike *Smilodon*. The scapho-lunare is different from either of these genera in the greatly reduced facet for the magnum, which shows a stage of development intermediate between *Smilodon* and *Machairodus*.

The distal ends of three metacarpals and metatarsals are preserved. They are relatively of the same length as in *Smilodon*. Several phalanges are preserved, the proximal rows are strongly decurved and m. I shows a large internal proximal facet as in *Felis*. Middle phalanges as in *Felis*. Ungual phalanges graded in size as in *Felis*; proximal process under the articular facet of unguals as in *Smilodon*.

The three lumbar vertebræ preserved are characterized by weak anapophyses which do not approach the development seen in *Smilodon*. Spines erect and short; centra flattened, much wider transversely than deep, ventral surface sharply keeled; transverse processes take origin above the middle centrum and curve forward.

The vertebral column indicated by these lumbars is a marked departure from that of *Smilodon* and is more feline in its structure.

Measurements.

	mm.
Length of sectorial, m^1	37.5
Length of metacone, m^1	16
Height of preanterior cone, anterior face m^1	8.5
Width of humerus across condyles	86
Height of lower border of entepicondylar foramen above distal border of trochlea	44
Transverse measurement of ulna and radius	73

Smilodontopsis conardi sp. nov.[1]

PLATE XIX.

Type.— A complete upper carnassial, greater part of crown of the upper canine and a lower canine, No. 11790.

The carnassial equal in size to that of *S. troglodytes,* and the posterior cutting blade or metacone is of the same size and development but its exterior face bears a deep median depression which divides it into two nearly equal parts; paracone large as in *S. troglodytes*; anterior cone large and preanterior basal cone rudimentary, considerably smaller and not as high as in *S. troglodytes*; protocone a small but distinct tubercle. Another anterior half of an upper carnassial, and probably the mate, as it is of the opposite side, shows the same characters. Upper canine large, with the external more convex than the internal border. In cross-section the anterior cutting edge is internal to the median line; the anterior is more convex than the posterior edge and both are crenulated. Only 100 mm. of the crown is preserved, but enough to show this to have been one of the most extreme phases of development in these last representatives of the "Saber-tooths."

The lower canine is small, probably slightly larger than incisors; crown strongly recurved, posterior face excavated and oblique without basal cones, and external crenulated edge posterior in position to the internal edge.

Several bones and teeth, Nos. 11792 and 11785, are referred to this species and are considered cotypes. Two fragmentary lower jaws, No. 11785, a pair, are exhibited in the model. The anterior and posterior parts of both are lost, but the premolars and molars are preserved.

P_3 is single-rooted and oval in outline, with the internal face flattened; the middle cone is oblique and strongly inclined backwards and inwards; the apex of cone above the base of crown, inside measurement, is equal to the transverse measurement of the tooth at this point; there is a distinct anterior basal cone about half the size of the posterior basal cone. Two other separate teeth, p_3, show the same characters.

The fourth premolar is large and the crown strongly inclined posteriorly; the principal cusp occupies about half the length of the tooth; there is a well-developed posterior lobe and cingular heel-lobe; the anterior basal lobe is larger than the posterior heel-lobe with apex directed forward. The lower carnassial, m_1, resembles closely that of *S.* (*Machærodus*) *gracilis* Cope.[2] The posterior cutting blade, or metacone, is nearly twice the length of the anterior, or paracone; there is a rudimentary posterior heel, which is separated at its apex from the posterior edge of the metacone by a slight notch; the anterior base of paracone is swollen with a slight notch separating it from the crown. The external base is quite convex, so that in profile and crown view the blades form a V.

Several disassociated fragmentary limb bones, carpals, metacarpals and a part of associated pes are referred to this species, although they may pertain to *Smilodontopsis troglodytes* equally well.

Three unciforms are preserved which closely resemble those of *S. troglodytes.* Three metacarpals, one mc. II and two mc. V, show this to have been a short-footed form resembling *Smilodon.* The metacarpals are shorter and shafts rounder; phalanges as in *S. troglodytes.*

The shaft of a tibia is larger than in *F. leo*; distal end not as wide and internal malleolus shorter.

The associated pes consists of calcaneum, astragalus, navicular, ectocuneiform and four metatarsals.

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[1] I take pleasure in dedicating this species to Mr. Waldo Conard, who discovered the fissure and subsequently aided me in the excavation. These were the specimens sent to the Museum by his partner, Dr. R. R. Teller, of Arkansas City, Oklahoma.

[2] *Loc. cit.*, p. 240.

The pes resembles *Smilodon* more closely than modern Felidæ, but the metatarsals are not as spreading; shorter, and shafts rounded. The astragalus is relatively shorter than in *Felis*. This shortening is accomplished by a deflection of the head and a greater arch in the external trochlea, which is flatter than in *Felis*. This throws the greatest diameter of the head nearly horizontal.

The astragalar facets of the calcaneum are considerably anterior to the middle of the shaft, which thus increases the leverage of the plantar muscle passing over its tuberosity.

The navicular is nearly quadrate in outline and deeply excavated for the head of the astragalus; its anterior face is about half the vertical diameter of the ectocuneiform; facet for mesocuneiform relatively large, and that of the entocuneiform small.

The ectocuneiform is wider transversely but not as deep vertically as in *Felis*. The facet for articulation of the second metatarsal extends above the middle of the vertical diameter, thus indicating a shortening of the vertical diameter of the mesocuneiform.

These characters pointed out in the pes indicate a more plantigrade type of foot than in the true Felidæ.

Smilodontopsis (*Machærodus*) *gracilis* and *S. merceri* Cope,[1] from the Port Kennedy Bone Deposit, were closely related species; both smaller than *S. troglodytes* and *S. conardi*. Cope first described these as species of *Smilodon*, but subsequently found the entepicondylar foramen present in *S. gracilis*, which determined it as generically distinct. In his uncorrected manuscript he still retains *Smilodon merceri*, but says that ultimately it may be found to belong to the genus *Machairodus* when the remaining parts of skull and teeth are obtained.

Dinobastis Cope[2] is an apparently well established genus, characterized in upper sectorial by absence of both protocone and internal root; metacone 1.5 greater length than paracone; anterior edge of canine turns inward at base of crown, as in *Smilodontopsis*.

Dinobastis (*Machærodus*) *ischyrus* Merriam [3] probably belongs to this genus, as indicated by the nearly equal size of paraconid and metaconid in m_1, and the erect position of p_4 without posterior basal heel. This correlation was suggested by Dr. Merriam.

Trucefelis fatalis Leidy. This genus was founded on an upper sectorial from the petroleum beds of Hardin County, Texas. The specimen was associated with *Megalonyx validens*, mastodon, and *Equus complicatus*. Protocone and internal root present. The paracone is relatively better developed than among any described species of either *Smilodon* or *Smilodontopsis*, while the metacone is absolutely and relatively weaker. The relative proportion of parts in this highly specialized tooth is of generic value and readily separates it from other described Pleistocene genera.

The posterior half of a skull was found later in the same beds and referred by Cope to *Smilodon fatalis*. This specimen shows a development of the tympanic region similar to that of *Smilodon*, but as teeth from the same beds are generically distinguishable from *Smilodon*, the reference does not seem warranted from our present knowledge of the group.

From the above descriptions it is seen that the Pleistocene "Saber-tooths" of North America should be separated from those of Europe and South America. They are represented by three distinct genera — *Trucefelis*, *Dinobastis* and *Smilodontopsis* — which were widely distributed over the United States. The latter genus was probably the last of these highly specialized forms to disappear during the latter part of the Pleistocene period.

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[1] Journ. Acad. Nat. Sci. of Phila. (2), Vol. XI, 1899, pp. 239–247.

[2] American Naturalist, 1893, p. 896; Journ. Acad. Nat. Sci. of Phila. (2), Vol. IX, 1884–5, p. 454.

[3] University of California Publications, Vol. IV, 1905, No. 9, pp. 171–175.

GLIRES.

Erethizon dorsatus (*Linnæus*).

PLATE XX.

The dentigerous portion of a skull containing complete molar series, No. 12422, and two separate lower teeth, No. 12423, of this species are preserved.

Skull.— That of a large mature animal, equal in size to the largest of a series of twenty recent skulls. Teeth very large, but of exactly similar pattern.

Measurements.	mm.
Length of molar series	28.5
Length of diastema	30

Geographical Distribution.— Canada west to Saskatchewan Plains, south to central Maine and northern New Hampshire, and west of Connecticut River nearly to border of Massachusetts. Formerly it extended along the Alleghanies through Pennsylvania into Virginia and possibly to Kentucky.

Marmota monax (*Linnæus*).

This species is represented by a nearly complete though badly crushed skull, No. 12421, an upper milk dentition and fragmentary palate, a lower jaw having the incisor and premolar preserved, and two separate lower teeth.

Skull.— Longer than the largest skull of recent specimens of *M. monax* in the Museum Collection, but the increased length may in part be due to crushing. For this reason measurements cannot be relied on. Structurally the skull and teeth are in every respect similar to recent specimens of this species.

The incisor of the lower jaw is slender; and the premolar differs slightly from recent specimens in having a wider space separating the anterior and posterior external cones; alveoli of molars very large.

The upper milk dentition is typically that of *M. monax*.

Geographical Distribution.—From New York to Georgia, west to the Dakotas.

Sciurus hudsonicus *Erxleben.*

PLATE XX.

A nearly complete skull, No. 11806, and five lower jaws, No. 11807, represent this species.

Skull.— Small and light with faint lateral ridges; brain-case strongly arched and wider across parietals than in most recent skulls of this species in the Museum collection: depressed between the orbits with the highest point of arch between the postorbital processes; postorbital processes delicate but strong; lachrymal long and narrow, extending beyond the jugal; bullæ normally inflated.

Teeth.— Only the incisors and first molar on each side are preserved; m^1 is worn and of the same pattern as in recent skulls. The alveoli of the molar series are longer than in recent skulls with which they were compared, but I can see no characters in the material preserved to separate it from the recent species.

In two of the lower jaws the molars are preserved; all are much worn. They do not differ from recent specimens in position of cones, and in this respect differ from *S. calycinus* Cope [1] of Port Kennedy Pleistocene.

Measurements.	mm.
Length of skull, condyle to incisors inclusive	40.5
Length of skull, occiput to premaxillary included	42
Width of skull at postorbital constriction	14.4
Width of skull across parietals	20
Length of lower jaw, condyle to incisors	30.5
Depth of lower jaw at p_4	8

Geographical Distribution.— Boreal North America, Labrador, west to Rocky Mountains and Alaska.

Tamias nasutus sp. nov.

PLATE XX.

Type.— A skull, No. 11797.

Specific characters.— Muzzle inflated; postorbital constriction wide; p^4 small and round.

Skull.— Large; wider at postorbital constriction than *T. striatus* or subspecies; postorbital extends outward and downward, posterior border at right angles to skull; supraorbital foramen nearly enclosed in superciliary ledge; nasals terminate posteriorly on the line of fronto-premaxillary suture; jugal and lachrymal as in *T. striatus griseus*; incisive foramen elongated, ending evenly on the line of maxillo-premaxillary suture; infraorbital foramen large and round; post-dental notch large; post-palatine notch wide as in *T. striatus*. The premaxillaries and nasals expand anteriorly forming a wider muzzle than in any described species and in consequence the incisors are wider apart, touching only at the point.

Teeth.— In the type specimen p^4 is preserved on both sides and m^3 on the right side. In three palates referred to this species and considered paratypes the intermediate teeth are preserved. The premolar is smaller than any described species and of different form. It is nearly round with a slightly greater transverse diameter. The last molar is slightly larger than the type of *T. striatus griseus*, but smaller than *T. striatus* with the heel produced farther backward. The intermediate teeth of paratypes show no marked difference from *T. striatus griseus*. In the type specimen on the right side only there is a notch in the alveolus of the anterior root of p^4. In two of the separate palates this notch is larger, but in the third palate it is not present. Whether this notch lodged a minute p^3 or is the alveolus of the deciduous tooth cannot be determined.

Twenty-six lower jaws, No. 11796, are referred to this species. They are characterized by a correspondingly reduced premolar which is smaller than in *T. striatus* or subspecies. The remaining teeth are similar in form but larger than *T. striatus*. The jaw is about the same length but not as deep anteriorly.

Measurements.	mm.
Width of rostrum across anterior end of premaxillaries	7
Width of skull at postorbital constriction	12.8
Length of dental series	6
Length of lower jaw, condyle to anterior end of incisor alveolus	26
Depth of lower jaw at premolar	5

[1] Journ. Acad. Nat. Sci. of Phila. (2), Vol. XI, 1897–1901, p. 199.

The material on which this species is founded consists of a well preserved anterior half of a skull, three palates and twenty-six lower jaws.

This species differs from *T. striatus* and subspecies, to which it approaches nearest, in size and form of teeth, extremely wide muzzle and wide postorbital constriction.

Geographical Distribution.— Arkansas during Mid-Pleistocene period.

Spermophilus tridecemlineatus? (*Mitchell*).

Skull.— A fragmentary skull, No. 11799, agrees in form and measurements with this species, having a rather elongated brain-case with faint lateral ridges; postorbital processes small and delicate; frontals swollen over olfactory lobes; interorbital constriction narrow and arched transversely; process below infraorbital foramen short and stout.

Teeth.— Six halves of palates and thirty-eight lower jaws, No. 11798, are referred to this species. The penultimate premolar in all skull fragments is missing, but the alveolus is large. The pattern of preserved teeth is identical with recent specimens, but all appear slightly narrower externally, and the posterior heel of the last molar is not as strongly developed. In the lower jaws there are some features differing from recent specimens; they average slightly shorter; the premolar varies and is usually of less circumference; posteriorly the jaws are not as deep, while the base of the condylar process is wider than in recent specimens. But quite as much variation is noted in recent specimens at hand from different localities.

Measurements.	mm.
Width of skull at interorbital constriction	8.5
Width of parietals, widest part	16.6
Length of dental series	7.4

Jaws, fragmentary parts of skulls and limb bones of the striped gopher are numerous.

Geographical Distribution.— Central North America; eastern Michigan to Montana and Colorado, and central Texas north to Saskatchewan Plains in Canada, also in the prairie region of the Mississippi from Ohio to Minnesota.

Geomys parvidens sp. nov.

PLATE XXI.

Type.— A nearly complete skull, No. 11804.

Specific characters.— Skull medium sized; teeth very small.

Skull.— Medium sized; slightly larger than *G. lutescens* and about the size of a female *G. bursarius* with which it may be compared, but easily distinguished by the small molariform teeth; zygomata less spreading anteriorly than in *G. bursarius* and they do not converge as rapidly posteriorly, more nearly parallel; sagittal crest well developed. It is broken posteriorly, but is sufficiently preserved to show that it was much higher than in *G. lutescens*; rostrum long and relatively narrow; nasals flaring but not depressed anteriorly as much as in *G. bursarius* or *G. lutescens*; posteriorly the nasals contract rapidly and are narrower than in *G. lutescens*.

Teeth.— This species has delicate molariform teeth, smaller than in described species. Upper incisor as in *G. bursarius* but narrower, about the width of *G. breviceps*; in the last molar the anterior and posterior faces are nearly parallel with a slight postero-external lip, not triangular; intervening teeth similar to *G. bursarius* but smaller.

The palatine canal is closed over posteriorly before reaching the palatine-maxillary suture. In another specimen the canal is closed over posterior to the premolar.

Twenty-five lower jaws are referred to this species. They differ from *G. bursarius* in having a lighter dentition, corresponding to the skull. The jaw bone is relatively not as deep and the condyle is considerably smaller than in *G. bursarius*.

Measurements.	mm.
Length of skull	47.5
Width across zygoma, anterior end	27.8
Width across zygoma, posterior end,	26.3
Length of molar series, crown measurement	6
Width of premolar transversely	2

Unfortunately the skull was heavily encrusted with calcite drip which could be removed only in places, sufficiently, however, to determine its character, with the aid of several fragmentary skull parts.

Geographical Distribution.— Known from Pleistocene of Arkansas. Remains of this species of pocket gopher are quite common in the fissure. It probably inhabited the forest glades in considerable numbers during Pleistocene times.

Castor canadensis *Kuhl.*

Beavers may have been rare in this vicinity during Pleistocene times. The genus is represented in the collection by a single pair of upper incisors, No. 11798.

I infer from the small diameter, the length and the very open pulp cavity that the teeth are those of a young individual. They are about half the size of a recent adult specimen of this species. The enamel layer laps over one millimeter on each side of the tooth and is pigmented a light orange color.

Measurements.	mm.
Width of tooth transversely	5

Geographical Distribution.— Northeastern North America.

Peromyscus sp. indet.

Remains of this genus, the white-footed mice, are the most abundant of all the animals found in the fissure. There were literally thousands of jaws and limb bones, and they were numerous wherever bones were found.

This material in the American Museum Collection includes six anterior portions of skulls and eighteen palates, No. 11809, seven hundred lower jaws and several hundred limb bones and vertebræ. It probably represents two species, but owing to the fragmentary nature of the skulls, I hesitate to refer it. They show the following characters:

Skull.— About the size of *P. leucopus*; nasals wide expanding anteriorly; nostrils wider than *P. leucopus*; zygomata flare out abruptly anteriorly; interorbital constriction wide and flat, not beaded

on supraorbital border; incisive foramen large, one millimeter longer than palate. In one specimen the anterior palatine process of each maxillary unites with the posterior process of the premaxillary to bridge the incisive foramen, but do not unite with each other; in all other specimens they are united.

Teeth.— As in *P. leucopus* but posterior molar is smaller. The lower jaws agree in size and pattern of teeth with *P. leucopus.*

Measurements.	mm.
Width across zygoma	14
Width across interorbital	4.5
Length of incisive foramen	5.5
Length of palate	4.5
Length of dental series	4
Length of lower jaw	

Reithrodontomys simplicidens sp. nov.

PLATE XXI.

Type.— Lower jaw, No. 12397.

Specific characters.— Mandible deep. Last molar simple, nearly round, with two external cones fused.

Teeth.— Jaw of the same length as *R. dychei* but much deeper, having greater area for attachment of masseter muscle. Molar series of the same length. M_1 and m_2 are the same in pattern as in *R. dychei.* In *R. dychei* m_3, when unworn, is slightly elongated antero-posteriorly and composed of an internal and two external cones. In this species it is rounded and simple, measuring the same antero-posteriorly as transversely, and the two external cones are fused.

Measurements.	mm.
Extreme length of jaw	11.5
Depth of jaw at alveolus of m_1	3
Length of dental series	3

There are five lower jaws representing this new species of harvest mouse. Compared with living forms it is nearest *R. dychei,* but is readily distinguished by the above characters.

Geographical Distribution.— Northern Arkansas during Mid-Pleistocene period.

Neotoma ozarkensis sp. nov.

PLATE XXI.

Type.— Anterior half of skull, No. 12404.

Specific characters.— Palate and incisive foramen of equal length. External nares large.

Skull.— About the same size as *N. floridana,* with similar dentition, but readily distinguished from it in the palatal region. The incisive foramen does not reach the plane of the first molar; length of palate equals length of incisive foramen; postpalatal notch narrowly excavated and evenly rounded anteriorly, about half the width of *N. floridana.* Teeth similar to *N. floridana,* but series more nearly parallel.

The external nares were evidently large; ascending branches of premaxillæ narrow, expanding slightly where they unite with the frontal, and terminating midway between the anterior plane of the orbit and the narrowest part of the interorbital constriction, where they equal in width the posterior ends of nasals. The nasals barely reach the anterior plane of the orbit and expand anteriorly equal in

width to the largest *N. micropus*. The frontal is flat, without upturned edges, and the interorbital constriction is relatively wider than in *N. floridana*.

The lower jaws referred to this species are similar to *N. floridana* but heavier. The ridge running from the condyle to the root of the incisor on the external surface is more prominent than in *N. floridana*. Diastema longer than in *N. floridana*.

Measurements.	mm.
Interorbital constriction	6.5
Length of palate	9
Length of molar series at base	9
Width of postpalatal notch	2.5

Woodrats are abundant in the fissure and are represented in the collection by four halves of skulls, about thirty upper dentitions, two hundred lower jaws and many separate limb bones and vertebræ.

Geographical Distribution.— Northern Arkansas during Mid-Pleistocene period.

Fiber annectens sp. nov.

PLATE XXI.

Type.— Nearly complete right mandibular ramus, No. 12424.

Specific characters.— Jaw very small, the size of *Neofiber alleni*. M_1 with broad anterior loop; m_3 with antero-external column reduced.

The jaw is that of a young adult and agrees perfectly in size, shape and muscular attachments with *Neofiber alleni*. The teeth, however, are those of *Fiber* with modified characters of *Neofiber*.

Molars all double-rooted, and in general the enamel pattern is similar to *Neofiber* with more open triangles. Sulci or reentrant angles partly filled with cement showing interstices as in *Fiber*, and not solid as in *Microtus*; m_1 with broad anterior loop, rounded and recurved as in *Neofiber alleni*, but wider and not cut by reentrant angles as in living species of *Fiber*; m_3 is composed of a posterior loop, two external and two internal angles as in *Fiber*, but with antero-external column greatly reduced. In *Neofiber* this angle is not present.

The separate right upper molar does not show any features distinguishing it from *F. zibethicus* except small size.

Measurements.	mm.
Length of jaw, condyle to symphysis	30
Length of alveolus	12
Width of m_1 transversely	2.5
Length of m_1 crown antero-posteriorly	3.7

This species is represented by the single type specimen and a separate upper molar m^1, and is one of the most interesting fossils in this collection. It is the smallest *Fiber* so far described and forms an intermediate type connecting *Fiber* with *Microtus* through the subgenus *Neofiber*, representing the stage through which *Fiber* has been derived.

Geographical Distribution.— Northern Arkansas in Mid-Pleistocene period.

Microtus austerus (*Le Conte*).

PLATE XXI.

In this collection there are many skulls, jaws and limb bones of a vole which I am unable to distinguish from the species now living in the vicinity of the fissure. It is represented by twenty fragmentary skulls, one hundred and twenty lower jaws and many limb bones. Although none of the skulls has the brain-case preserved, the simple pattern of the variable teeth m^3, m_1 and m_3 agree well with recent specimens of this species. The palatines extend forward to the posterior face of m^1, and the postpalatal notch is rounded, whereas in recent skulls it is usually angular.

In comparing a large series of skulls and jaws of the genera *Microtus* (including *Neofiber*) and *Fiber*, I find that the sulci separating the columns composing the teeth of *Fiber* are partly filled with cement, always distributed in horizontal layers that are separated by pocket-like interstices. In *Neofiber*, as in all other subgenera of *Microtus*, the cement fills the sulci evenly never showing interstices. This is a generic distinction not before pointed out so far as I am aware.

Geographical Distribution.— Central part of Mississippi Valley from southern Wisconsin to southern Missouri and Fort Reno, Oklahoma, and west into eastern Nebraska and Kansas.

Lepus.

This is one of the most common genera in the collection. It is represented by jaws, fragmentary skulls, limb bones and vertebræ in great numbers. Jack rabbits, hares and cottontails are found here, but as would be expected in this forest fauna, the varying hare is most abundant while the jack rabbit is represented by a single skull fragment.

Lepus americanus? *Erxleben.*

PLATE XXI.

Skull.— A skull lacking the anterior and posterior parts but having the characteristic portions preserved equals in size the largest recent skulls of *L. americanus* in the Museum collection. The nasals are lost, but they must have been very broad for the premaxillaries are slightly wider than in recent skulls; postorbital process massive and much longer than in recent skulls, attached by a broad pedicle with a short free anterior projection subtending a large anterior notch and a much larger wide, free posterior projection subtending a larger posterior notch; arched as in recent skulls but elevated more as in *L. campestris*, which gives a greater vertical diameter to the orbit than in recent skulls. The postorbital constriction of this skull is narrow, while in the other specimen it is wide, but both agree in the postorbital process. Maxillæ highly reticulated. A separate dentary portion of a premaxilla is massive and apparently wider from incisors to incisive vacuity than in recent specimens of *L. americanus*, resembling *L. campestris*.

In all other characteristic features, zygomatic arch, teeth and palate, the fossils agree in general with recent specimens, although they may represent an extinct subspecies.

The lower jaws agree perfectly with recent specimens of this species.

Measurements.	mm.
Length of skull, parietals to base of ascending branch of premaxilla	75
Length of dental series, alveolus measurement	15.8
Length of dental series, crown measurement	13
Width across zygomatic arches anteriorly	39
Width across postorbital constriction, No. 1	11
" " " " No. 2	13

Two fragmentary skulls, No. 12416, ten upper dentitions, No. 12412, eighteen lower jaws, No. 12413, and a pair of lower jaws, No. 12417, also many limb bones and vertebræ are referred to this species.

Geographical Distribution.— From New Brunswick and Nova Scotia northward to the limit of trees and westward to Alaska. Subspecies are described from eastern, central and western States and as far south as New Mexico.

Lepus giganteus sp. nov.

PLATE XXI.

Type.— Fragment of skull with two teeth, No. 12414.

Specific characters.— Skull very large. Anterior projection of zygoma to external zygomatic excavation deep. P^4 and m^1 narrow antero-posteriorly, reentrant angle crenulate, extending more than half across teeth.

This species is represented by the single type specimen. In size it rivaled *L. alleni*, for the distance from center of palate to outside of zygomatic arch is the same as in the largest *L. alleni* in the Museum collection.

The teeth, however, differ; p^4 and m^1 are as wide transversely but less antero-posteriorly, and not as robust; the reentrant angle is crenulated and passes only slightly more than half way across the tooth; anterior and posterior lobes of teeth more nearly equal in length transversely than in *L. alleni*; palate as in *L. alleni*; zygoma rises from a broad pedicle, as in *L. alleni*, but distance from the anterior projecting foot to the external zygomatic excavation is much greater than in any living species; antorbital excavations deep, as in *L. americanus*.

Measurements.	mm.
Greatest width from center of palate to outside of zygomatic arch	23
Depth of zygomatic arch	7
Transverse width of m^1	6.4
Antero-posterior width of m^1	3

Geographical Distribution.— Northern Arkansas during Mid-Pleistocene period.

Lepus floridanus? *Allen.*

PLATE XXI.

Eight upper dentitions and twenty lower jaws, No. 12418, are referred to this species and agree well with northern varieties. Considerable variation is shown in the zygomata of different specimens but all are more or less fragmentary and of uncertain age. More than one subspecies of *L. floridanus* may be represented.

The lower jaws vary a great deal in age, but can be readily distinguished from *L. americanus* from this fissure by the much smaller teeth and less depth of jaw. The jaws are longer proportionately than in southern and eastern forms of *L. floridanus* and agree with western subspecies.

Geographical Distribution.— North Carolina to Florida west to Louisiana; subspecies north to northern boundary of the United States and west to the Pacific.

Equus scotti? *Gidley.*

A single milk molar, d. p.^{3}, No. 12396, is the only specimen representing this genus. The tooth is unworn and of much greater antero-posterior than transverse diameter, which characterizes the milk dentition. The enamel folds are very simple without plications.

Coming from such a large collection it emphasizes the rarity of true plains forms in the vicinity of the fissure while it remained open. The presence of *Equus* in a fauna so comparatively recent revives the question, "Was the horse extinct in America before the arrival of Europeans?" It seems pretty well established that the horse still existed after the mammoth became extinct, and it is conceded that the mammoth was contemporaneous with early man in America. The genus *Equus* was one of the last, if not the very latest, of the early Pleistocene genera to disappear.

Measurements.	mm.
Antero-posterior diameter.	37
Transverse diameter	26

Geographical Distribution.— Southern and Central United States during Pleistocene period.

Mylohyus.

Mylohyus was a forest and glade-inhabiting peccary ranging from the Central States eastward. *Platygonus* was a type most commonly found in the plains regions. Both were southern migrants that persisted into Mid-Pleistocene times. *Mylohyus* was closely related to the modern peccaries, as indicated in the development of the teeth and limbs.

This genus has been imperfectly known from fragmentary parts of skulls and jaws containing a few teeth. Three species have been described: *M. nasutus* Leidy from Indiana; *M. pennsylvanicus* Leidy from the Hartman Cave in Pennsylvania, and *M. tetragonus* Cope from the Port Kennedy Deposit, Pennsylvania.

All are characterized by elongated facial region. The dentition of *Platygonus* is readily distinguished from that of *Mylohyus* by the molariform premolars in the latter genus. In the molar teeth of *Platygonus* the principal cones are elevated into high transversely paired cusps, separated by deep transverse valleys. The premolars have a single pair of high cusps.

In *Mylohyus* the principal cones of premolars and molars are low and

rounded and are separated by large intermediate subsidiary cones. *Mylohyus* is distinguished from *Tayassu* by having only two incisors in lower jaw; subsidiary cusps in premolars and molars larger and simple; metatarsal II relatively more reduced; metatarsals III and IV more firmly coössified.

Unfortunately the species of *Mylohyus* have been defined principally on the number and size of cusps composing the teeth, which are exceedingly variable in all peccaries both living and extinct.

In the Conard Fissure these remains were encountered everywhere throughout the excavation. Two hundred separate teeth, fragmentary skulls and nearly all parts of the skeleton are preserved, which represent two and probably three species, as indicated by three distinct types of lower jaws. Two of these may be sexual phases, although the difference between them is more marked than the sexual differences observed in a large series of recent peccaries.

Composite fore and hind limbs (Plate XXIII) have been assembled from this material and may comprise the bones of one or more species. They serve, however, to show characters in the limbs which separate this genus from *Platygonus* and *Tayassu*, as seen in the following comparisons.

Fore and hind limbs of the same length as in *Platygonus* but slenderer. Ulna-radius and carpus as in *Platygonus*. The second and fifth digits are complete as in *Tayassu*, but the metacarpals are relatively reduced. In *Platygonus* the second is represented by a short splint and the fifth by a small nodule of bone. The third and fourth metacarpals are separate, as in *Tayassu*. In *Platygonus* they are coössified. The ungual phalanges are vertical, as in *Tayassu*, whereas in *Platygonus* they are flattened dorsally.

In the tarsus the ento- and mesocuneiforms are reduced, smaller than in *Platygonus* with a correspondingly greater reduction of the second metatarsal, as indicated by the articular facet on mt. III. The fifth was apparently not represented. In *Platygonus* it is indicated by a nodule of bone. The median metatarsals are coössified as in *Platygonus*. The third is distinctly shorter than the fourth, whereas in *Platygonus* they are of equal length.

All teeth and skull fragments are typical of the genus *Mylohyus*, but so many variations are shown in corresponding teeth of different specimens, that I am unable at present to refer this material to its proper species.

Mylohyus sp. a.

PLATE XXIV.

A lower jaw, No. 11810, with attached symphysial portion of the opposite jaw agrees in dental characters with *M. tetragonus* with the exception of the canine. This tooth has only three planes, as in *Tayassu*, whereas in *M. tetragonus* it is described as having four planes in an unworn condition. The measurements, however, differ considerably. The jaw is very long and slender and displays a diastema nearly equal in length to the molar series. The canine is rather small and is separated from the incisors by a diastema of fourteen millimeters. The second pair of incisors is nearly horizontal. Ventrally the symphysis is evenly convex and is contracted to a round heel.

Measurements.

	mm.
Length of diastema	89
Length of molar series	91
Depth of symphysis	18
Width of jaws at narrowest constriction	21

Mylohyus sp. b.

PLATE XXIV.

The symphysial portion of a pair of jaws, No. 11814, indicates another type but may be a sexual phase of the species just noted. This specimen belonged to an old individual in which the crown of the canine is nearly all worn away. The second pair of incisors is horizontal, but the diastema separating them from the canine is only seven millimeters, or half that of the last-mentioned species, while the canine has nearly twice the diameter of this species. Ventrally the symphysis is nearly flat, without any indication of keel and of little vertical depth. The ridge separating the canine from the molars has been gnawed away by rodents.

Measurements.	mm.
Depth of symphysis	16
Width of symphysis at narrowest constriction	27

Mylohyus sp. c.

PLATE XXIV.

A third distinct species is indicated by a massive symphysis, No. 11815, in which all teeth are missing. This jaw is much more robust and wider than that of either of the above-mentioned species, resembling in form that of *Platygonus leptorhynus*. The second incisor was not horizontal and was separated from the canine by a very short diastema. Canine large. Ventrally the symphysis is keeled and anteriorly it bends upward sharply, as in *Platygonus*. It is nearly twice the depth of the previously-mentioned species.

Measurements.	mm.
Depth of symphysis	27
Width of symphysis at narrowest contriction	36

Symbos *Osgood.*[1]

In this admirable paper Mr. Osgood clearly defines the status of the many different fossil forms which have been given different specific names and all loosely treated as synonyms of *Ovibos*.

In discussing a new species from the Klondike he says: "These specimens represent an animal evidently related to the existing genus *Ovibos*, but sufficiently different to rank as a separate genus, for which a name is here proposed. The species called *O. cavifrons* by Leidy is closely related and falls in the same genus. *O. maximus* of Richardson possibly belongs here also, but for the present can only be considered indeterminate. The genus *Boötherium*, in which *O. cavifrons* was included by Leidy, is recognized as distinct, with *Bos bombifrons* Harlan as the type."

In the Cope Collection, now in the American Museum, are two skulls to which I can find no published reference. One of these, No. 12699 Am. Mus. Coll., is accompanied by a letter from the collector, Mr. Charles H. Sternberg, to Professor Cope stating that he purchased this skull, which was found near Wilson, Kansas.

[1] Wilfred H. Osgood. Smithsonian Miscellaneous Collections, Vol. 48, Part 2, p. 173.

This specimen is a badly broken brain-case with condyles attached and sufficiently preserved to determine that it belongs to the genus *Symbos* (= *Scaphoceros*), as defined by Osgood. Occipital condyles large, wide and produced; foramen magnum very large; external meatus large and not deflected backward, as in *Ovibos*; frontal sinuses deep.

The other specimen, No. 12700 Am. Mus. Coll., is a brain-case bearing the label Ottumwa, Iowa. This specimen has been rolled and surfaces abraided, but sufficiently preserved to determine it as *Ovibos*. Foramen magnum small as in recent skulls; frontal sinuses not as deep as in *Symbos*; exostosis extensive, approaching close to the median line which is marked by a deep groove as in recent skull of male.

Geographical Distribution.— This genus has had a wide distribution during the Quaternary, specimens having been secured at various localities: Fort Gibson, Indian Territory; Council Bluffs, Iowa; New Madrid, Mo.; St. Louis, Mo.; Benton County, Mo.; Trumbull County, Ohio; Brook County, W. Va.; Pennsylvania; Anvik, Alaska; Bonanza Creek, near Dawson, Yukon Territory; Wilson, Kansas; and Newton County, Arkansas.

Symbos australis sp. nov.

PLATE XXII.

Type.— Three teeth, No. 11828.

Among the interesting material in this collection are three molars, three premolars, an atlas, a proximal and an ungual phalanx of a large bovine closely related to *Ovibos*. It marks the most southern limit of this genus so far discovered.

The three molars, a right upper m^2, left lower m_2 and m_3 were found associated and are considered the type. Nearby, in the same stalactite pocket, were found an ungual phalanx during 1904, and in 1905, an atlas and a proximal phalanx.

Teeth.— The teeth are hypsodont and closely resemble *O. moschatus* in structure, but are larger than *Bison bison* and lack the accessory inner columns of *Bison*; they differ from *Ovibos* in size, being much wider in proportion to length. In m^1 the median external style is strongly developed, but the anterior and posterior styles are not prominent as in *O. moschatus*; m_2 differs only in size, but m_3 differs considerably in the posterior portion, the last two external columns of which are more crescentic than in *O. moschatus*.

The m^2 and atlas were sent to Mr. Osgood for comparison with types. He says: "They evidently belong to a species different from the one on which I am working, *Symbos* (*Scaphoceros*) *tyrelli*. The tooth is somewhat smaller than in my specimen, although the difference in condition makes it difficult to get an exact comparison. The atlas is much too small to fit on the condyle of my specimen or on that of the type of *Ovibos cavifrons* Leidy, with which I compared it in Philadelphia. The type of *O. bombifrons* is also in Philadelphia, but is very different from any of the other specimens and hardly needs to be considered."

The well-worn premolars, No. 11780, are referred here. They evidently belong to this species but to a much older individual than the type specimen. They are left p^2, right p_2 and right p_4. All are too much worn to give character, but they are very wide transversely for their length antero-posteriorly as in molar teeth of this species; p^3 has three roots, the inner one reduced.

The ungual phalanx is nearly twice the size of an adult female *O. moschatus* and of quite different contour; highly arched dorsally, and convex on the outer side but not rolled inward; vertical; ventral surface not as wide proportionately as in *O. moschatus*; posterior articular surfaces for second phalanx

divided into two nearly equal parts, the inner slightly wider; in *O. moschatus* it is quite the reverse, the outer division is nearly a half wider than the inner. These lines characterize a high, arched hoof, but not nearly as spreading as in *O. moschatus*. *Alces* and *Cervus* both have straighter phalanges, *Alces* much longer with a sharp inner dorsal border, and *Cervus* with a short, straight inner border.

Two proximal phalanges were found near the ungual phalanx, one complete, the other that of a young animal lacking the proximal articular epiphysis. Both are longer than in *O. moschatus*, and the adult specimen is considerably larger; the central body of the shaft resembles that of *O. moschatus* in the symmetrically rounded outer and inner contour. In *Alces* and *Cervus* the inner is more vertical than the outer surface. The distal articular surface is of the same contour but deeper, and is reflexed on the ventral and dorsal surfaces more than in *O. moschatus*, *Cervus* or *Alces*, allowing greater vertical movement than in any of these forms.

The atlas, No. 11829, referred to this species is larger than *O. moschatus* and resembles it in general form, but with some well-marked differences. The articular surfaces for the condyles are deeper and cupped more transversely, indicating a more prominent condyle. The deeply excavated facets, which arrest the downward movement of the head by impact against the prominent basioccipital process and which are so characteristic of *O. moschatus*, are but faintly indicated in this species. Articular surface of axis slightly cupped transversely and articulation of odontoid process relatively more extensive. Unfortunately the outer borders of the transverse processes are broken away, but the remaining portions indicate that it extended backward farther than in *O. moschatus*. The foramen for the transmission of the first cervical nerve is about half the size of *O. moschatus*.

Measurements.	mm.
Length of m^2 at base	32
Length of m_2 at base	30
Length of m_3 at base	49
Width of m^2 at base	30
Width of m_2 at base	23
Width of m_3 at base	22
Width of atlas across articular surface for condyle	111
Width of atlas across articular surface for axis	107
Length of proximal phalanx	78
Length of ungual phalanx	80

Geographical Distribution.— Northern Arkansas during Mid-Pleistocene period.

Cervus canadensis? *Erxleben.*

In the collection there are two calcania and two navicular-cuboids, No. 11827, of a very large Cervid. These bones may represent a new species, but owing to lack of sufficient material for an adequate description are referred here.

The calcania are of general cervine style, but more massive, shorter and deeper than *Cervus canadensis* or *Alces*, presenting a larger astragalar facet.

The navicular-cuboids are slightly different from each other, but these differences are not more than the individual variation seen in a series of recent bones. They are both larger than *Cervus canadensis* and proportionately wider transversely, though of about the same depth; the articular facet for entocuneiform is reduced to about half the size of that in *Cervus canadensis* but larger than in *Alces*; facet for articulation with metatarsal much smaller than in *Alces* and about the same as in *C. canadensis*. In *Ovibos* specimens examined this facet is not present.

These navicular-cuboids are relatively much deeper than in *Ovibos* and are of distinctly cervine character. For this reason they are referred to *Cervus* rather than to *Symbos*, the remains of which are also found in the fissure, although the tarsus of the latter genus is not known.

Odocoileus virginianus? (*Boddaert*).

Two lower jaws are referred to this species, one that of an adult, No. 11823, in which the tooth pattern is indistinguishable from recent specimens. The jaw has been crushed greatly and deepened, so that the measurements equal those of *O. hemionus*, but the decided angular deflection of the lower border is characteristic of *O. virginianus*. Premolars narrowed anteriorly, and the posterior loop of last molar small as in *O. virginianus*. The outer basal cusps are large and the coronoid process rises obliquely as in *O. hemionus*, but the teeth are not as massive and the series not as long.

Lower jaw, No. 11782, is that of a young specimen in which three milk molars are functional and the first permanent molar has erupted. These teeth and the slender jaw agree perfectly with recent specimens of the same age.

Several phalanges, carpals and tarsals and separate teeth are referred to this species, agreeing in all respects with recent specimens.

Geographical Distribution.— Eastern North America from Ontario, Canada, and Maine to Florida, and west to the Missouri River below the Canadian boundary line.

Odocoileus hemionus? *Rafinesque.*

Two upper molars and a premolar, No. 11783, are considerably larger than those referred to *O. virginianus* and agree with recent specimens of this species. The inner basal cusps are larger than in recent teeth examined, but this character is probably individual.

The base of a large antler, No. 11784, is referred here; it is very rough and larger than in *O. virginianus*.

Several foot bones, including an astragalus, calcaneum and a number of phalanges are also referred to this species, agreeing in size with recent specimens.

Geographical Distribution.— West of the Missouri River from Fort George south to Texas, westward through Nevada to latitude of San Francisco, including North and South Dakota, Nebraska, Kansas, Texas, Colorado, Wyoming, Montana, Idaho, Nevada, California, Oregon, and Washington.

AVES.

Many bird bones were scattered through the fissure, especially in the weasel holes. They comprise nearly all parts of the skeleton with the exception of the skull. Not any of them, however, were associated.

It seems probable that many of these birds were carried into the fissure by weasels, although some of the bones represent a small species of owl that may have inhabited the ledges of the fissure.

Seven species can be distinguished by homologous or related parts, but through lack of sufficient recent skeletons for comparison, I have been able to identify only one, a turkey.

Meleagris gallopavo? *Linnæus.*

This species is represented by the proximal end of a tibia and an incomplete tarso-metatarsal. The latter bone has a large spur on the distal half of the shaft which is apparently of about the same length as in the living representatives of this species now found in northern Arkansas.

Amphibians and Reptiles.

Remains of toads, frogs, salamanders and snakes are abundant in this collection, but as very little skull or sternal material is present and none of the bones associated, I have found no way to determine them specifically.

Bufo ? sp.

Plate XXII.

A large species of toad is represented by two vertebræ, an ilium, tibio-fibula and fibulare.

Rana sp.

Plate XXII.

No less than one hundred and fifteen separate bones, comprising the greater part of the skeleton, represent a frog about the size of *R. sylvatica.*

Rana ? sp.

Plate XXII.

A sacrum, unlike that of any living batrachian with which I am familiar, indicates a form closely related to *Rana.* It consists of two firmly coössified vertebræ, the 8th and 9th, which do not in any way look pathologic, though of peculiar *Rana* resemblance. The anterior vertebra is about twice the size of the posterior, with concave perforated centrum. Its transverse process is about half the size of that of the posterior vertebra and is directed slightly backwards. Neural canal wider transversely than high. The posterior vertebra has two normal condyles for articulation with the urostyle.

This sacrum is unlike that of *Pelobates, Pipa* or *Hymenochirus,* in which the coccyx is fused with the ninth.

Amblystoma ? sp.

Plate XXII.

A medium-sized salamander, larger than any of the North American *Spelerpes,* is represented by numerous limb bones and vertebræ. Femora large with strongly developed trochanter; vertebræ amphicoelous.

Lacertian sp.

A lizard not unlike those found living in the woods near the Conard Fissure at the present time is represented by eleven jaws.

Ophidians.

Snakes were numerous in the fissure. Many no doubt lived there, attracted by the great number of frogs, while others were carried there by birds.

Vertebræ and ribs were encountered from top to bottom of the excavation. About a thousand vertebræ were preserved in the collection, and that represents but a small fraction of those run through the sieve in washing the dirt. The material probably represents several species, but only two have been recognized from the different structure of the jaws.

Crotalus sp.

PLATE IX.

This genus is represented by an articular, No. 6404, which probably represents a small species of timber rattlesnake.

SUMMARY.

From the evidence certain conclusions seem fairly well established.

First. Man may or may not have existed during this period but the absence of implements or fashioned bones precludes his aid in the accumulation of these remains.

Second. The uniform condition of the materials filling the fissure shows a gradual accumulation during a long period of time but not of sufficient duration to show a change in the fauna.

Third. The absence of bones in six other fissures nearby, above and below in direct drainage on the same hillside, shows that the bones were not washed in.

Fourth. The condition of the bones, association and predominance of certain forms indicates that this fissure was the home of several contemporaneous species which preyed on others and brought their remains into it.

Fifth. The fauna is typically that of a forest region with open glades, similar to present conditions.

Sixth. Although sufficient data have not yet been secured in America to define well marked subdivisions of the Pleistocene period a comparison of the three best known cave faunas of the United States shows that the Port Kennedy, Pennsylvania, fauna is oldest, dating back to the lower middle Pleistocene, as indicated by numerous lower Pleistocene forms and the large number of extinct

genera and species, especially extinct species of living genera. Out of a total of 36 genera and 47 identified species in the Port Kennedy fauna 10 genera and 38 species are extinct and but 9 species are now living. While the locality comes well within the area of glaciation the presence of numerous species of edentates, tapirs and peccaries shows that the climate was much more uniform than at present, a condition that probably existed previous to the glacial period or during an early interglacial time.

These fossils are in a state of preservation similar to those from the early Pleistocene beds of Europe and unlike those from the late and middle Pleistocene caves where bones appear as though recently macerated.

The Potter Creek, California, cave fauna was certainly much later than that of Port Kennedy and probably represents a late phase of the middle Pleistocene. The fauna here represented is quite as varied as that of Port Kennedy but there are many more living species. Out of a total of 37 genera and 49 species of mammals 7 genera and 22 species are known to be extinct and 22 identified species are now living. It seems probable that the Rocky Mountains on the east formed an effective barrier during their existence and shut out the cold of the central glacial-covered country giving a modified climate to the Pacific coast region thus allowing the survival of many of the older Pleistocene forms long after they had become extinct in the eastern half of the continent.

The Conard Fissure fauna is of considerably later date than either that of the Port Kennedy or the Potter Creek Cave, as shown by the total disappearance of all but two of the lower Pleistocene genera and by its closer affinity to the present living fauna. It probably marks a period at about the time of the final retreat of the great ice sheet. Out of 37 genera and 51 species 4 genera and 24 species are extinct while of the extinct species 5 are considered only subspecifically different from living species. The collection emphasizes the extreme variation in species during this period, which makes it imperative to have adequate material for reliable determinations. Apparently this period is one in which the animals that had inhabited the northern part of the United States during the preglacial or an interglacial epoch were driven southward. A few genera and several species were unable to continue their existence but the hardier descendants of many of these forms are now found far to the northward.

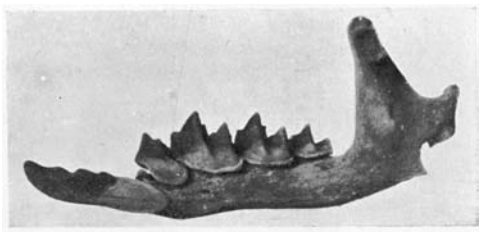
Essentially this phase marks a period of redistribution.

Errata.

Page 207, under Crotalus sp., for Plate IX read Plate XXII.
Plate XXII, lower right corner, for Cotalus, read Crotalus.
Plate showing model and matrix, for Vol. IX, read Vol. IX, Plate XXV.

Sorex personatus x $\frac{6}{1}$

Microsorex minutus x $\frac{6}{1}$



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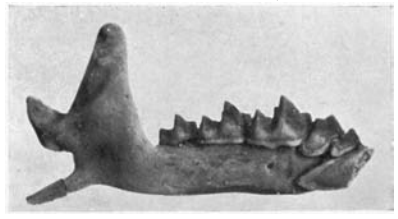

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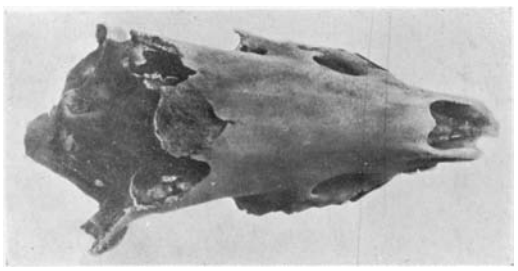

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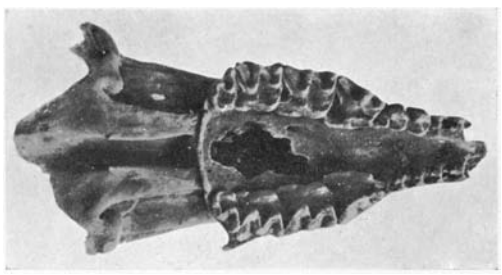

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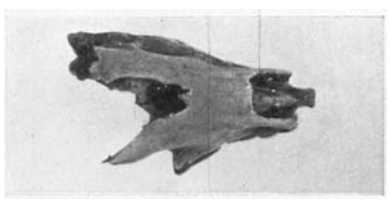
S. personatus x $\frac{6}{1}$



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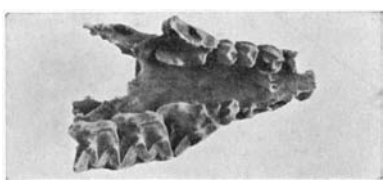

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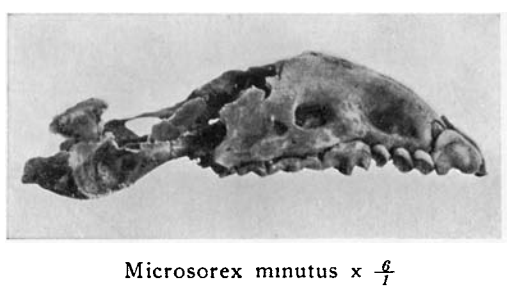

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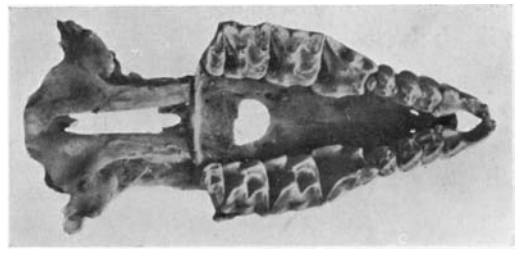
Sorex obscurus x $\frac{6}{1}$

S. obscurus x $\frac{6}{1}$



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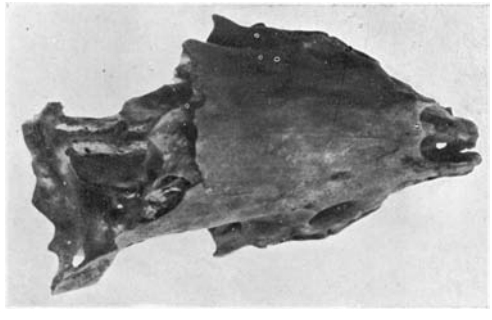

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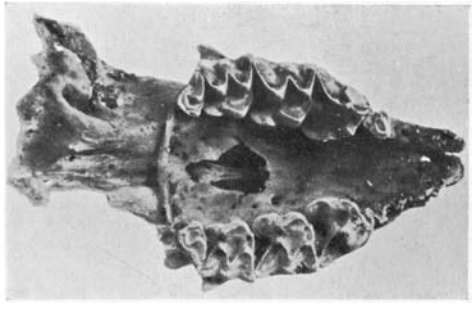
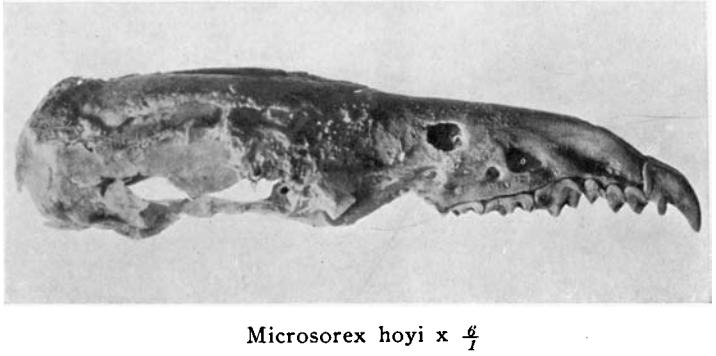
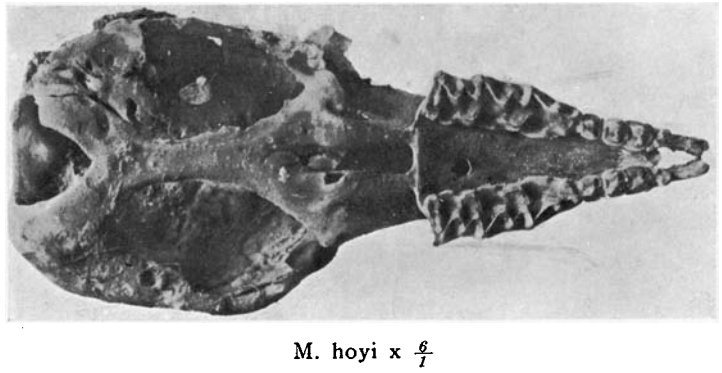


S. fumeus x $\frac{6}{1}$

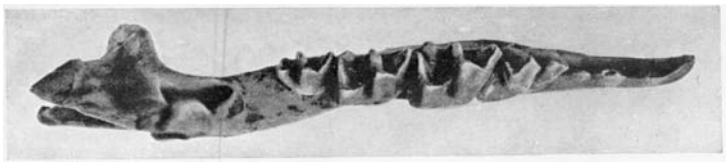


Microsorex hoyi x $\frac{6}{1}$

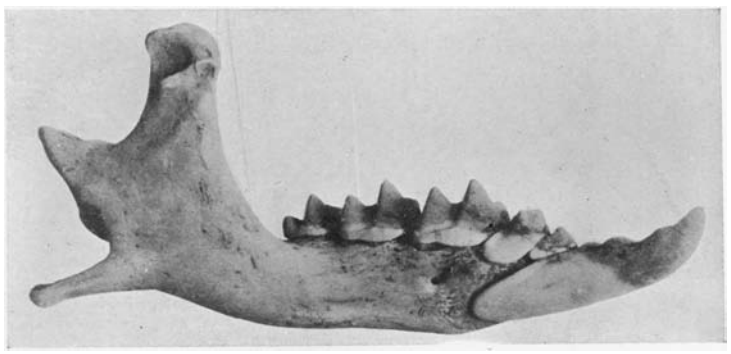


M. hoyi x $\frac{6}{1}$

CONARD FISSURE FOSSILS.



Blarina brevicauda ozarkensis x $\frac{6}{1}$



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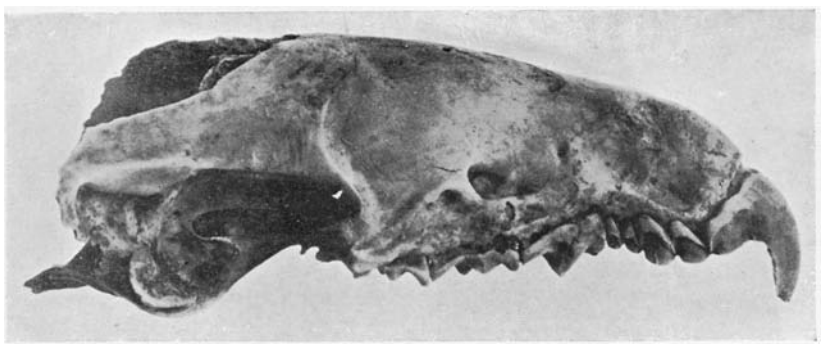

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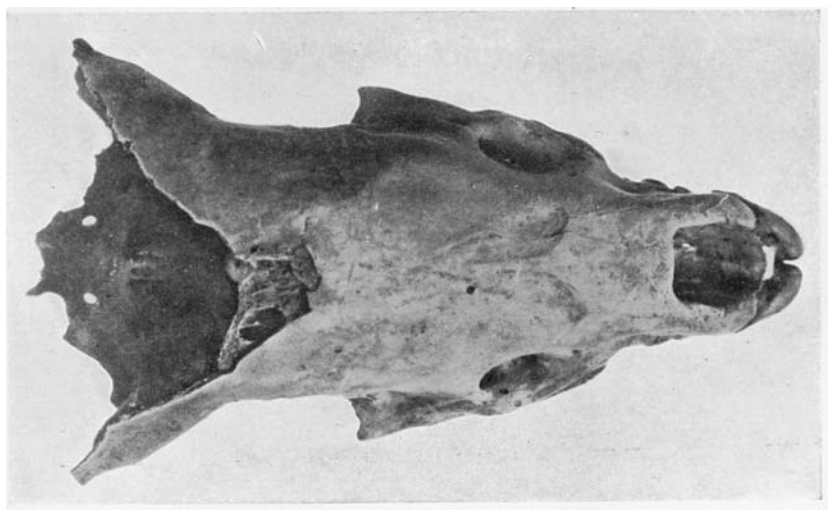

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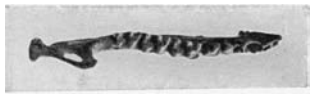
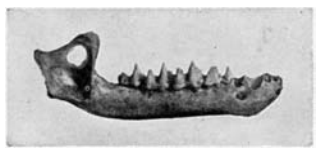


Myotis subulatus x $\frac{3}{1}$



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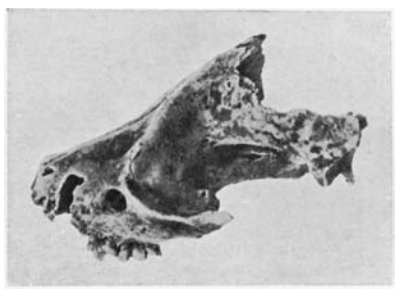
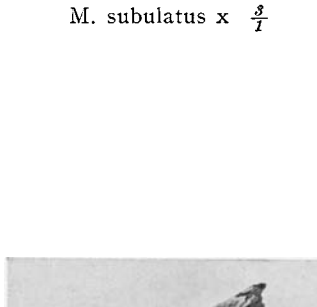


V. f. grandis x $\frac{3}{1}$

V. f. grandis x $\frac{3}{1}$

V. f. grandis x $\frac{3}{1}$



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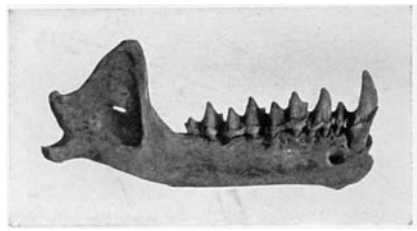
Vespertilio fuscus grandis x $\frac{3}{1}$



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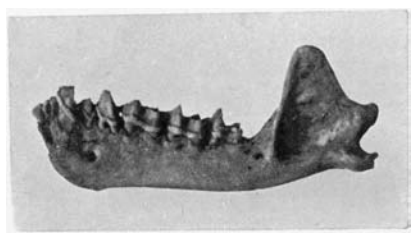

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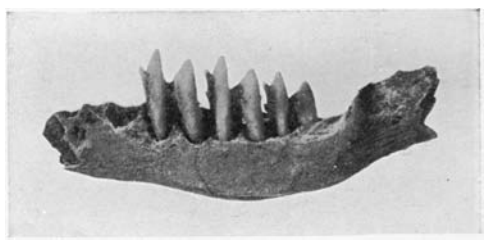
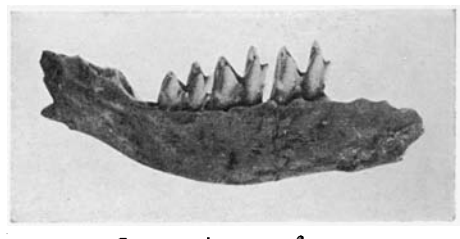
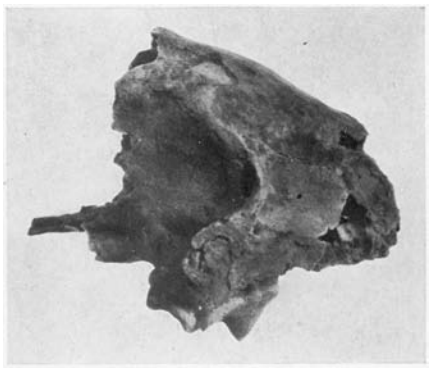


Scalopus aquaticus x $\frac{3}{1}$

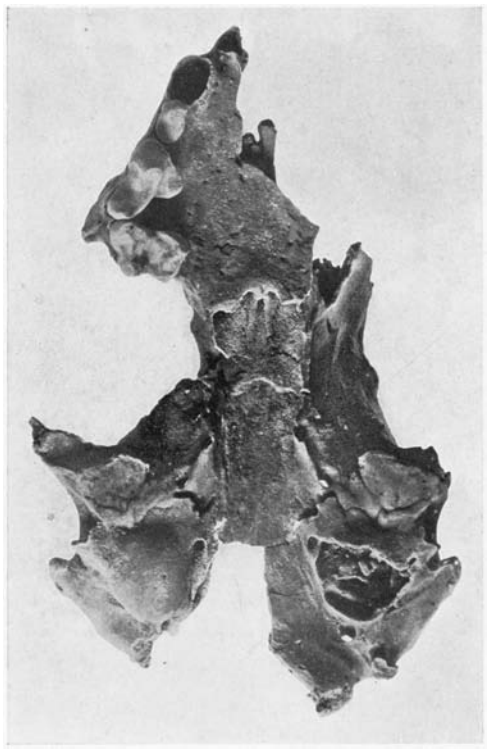


S. aquaticus x $\frac{3}{1}$

CONARD FISSURE FOSSILS.



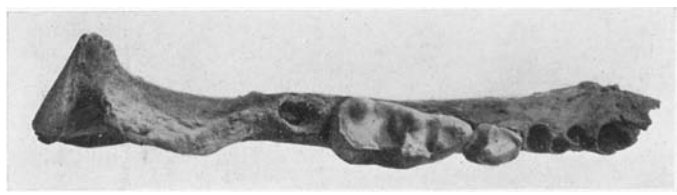
Brachyprotoma pristina x $\frac{2}{1}$



B. pristina x $\frac{2}{1}$

B. pristina x $\frac{2}{1}$

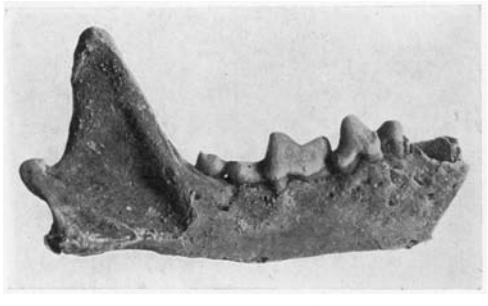
B. pristina x $\frac{2}{1}$



Mephitis mephitica newtonensis x $\frac{2}{1}$

B. pristina x $\frac{2}{1}$

B. spelaea x $\frac{2}{1}$



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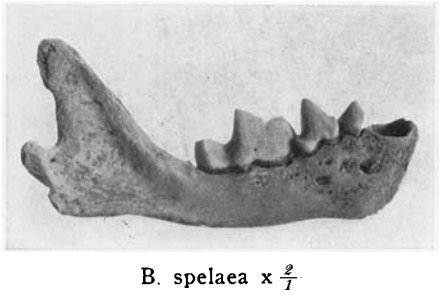
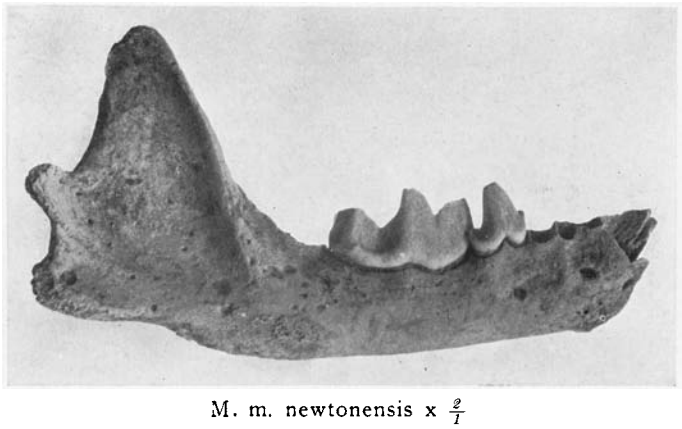
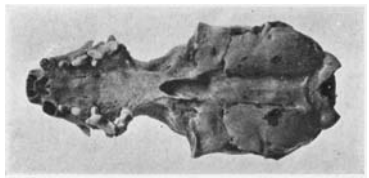


B. spelaea x $\frac{2}{1}$

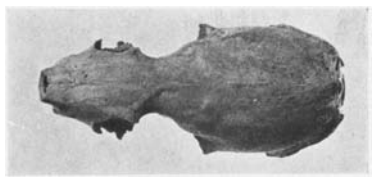


M. m. newtonensis x $\frac{2}{1}$

Putorius gracilis x $\frac{1}{1}$



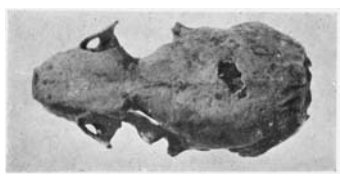
P. gracilis x $\frac{1}{1}$



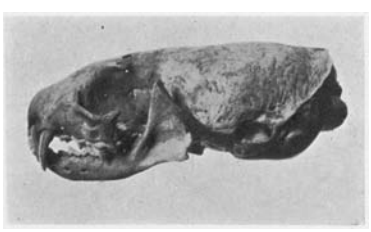
P. gracilis x $\frac{1}{1}$

Putorius cicognanii angustidens x $\frac{1}{1}$ ♀

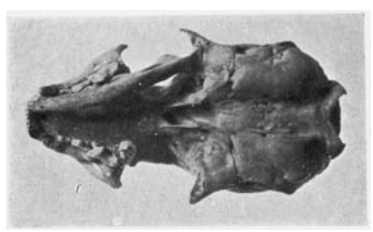
P. c. angustidens x $\frac{1}{1}$ ♀



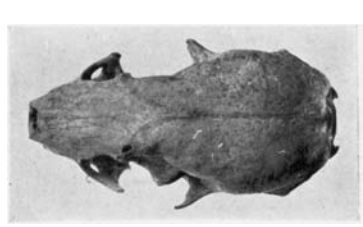
P. c. angustidens x $\frac{1}{1}$ ♀



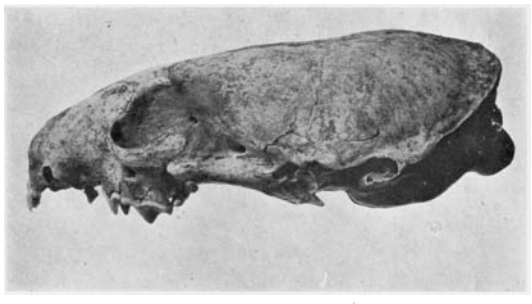
P. c. angustidens x $\frac{1}{1}$ ♂



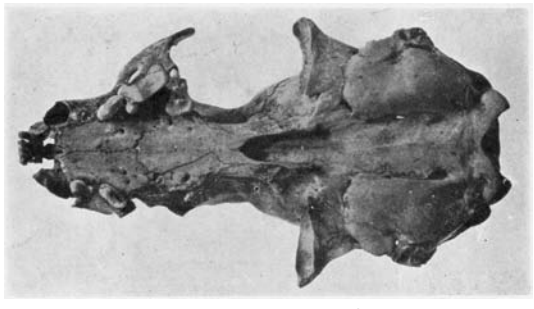
P. c. angustidens x $\frac{1}{1}$ ♂



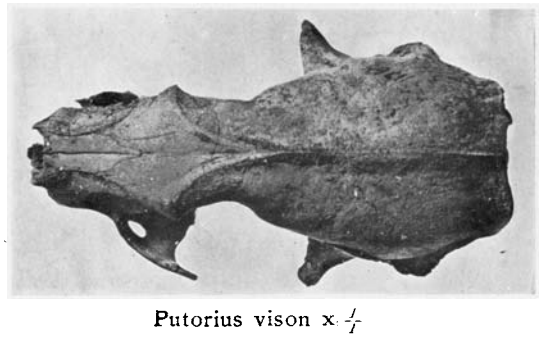
P. c. angustidens x $\frac{1}{1}$ ♂



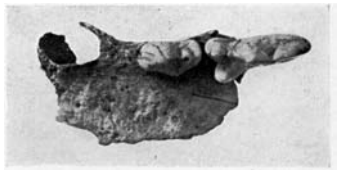
Putorius vison x $\frac{1}{1}$



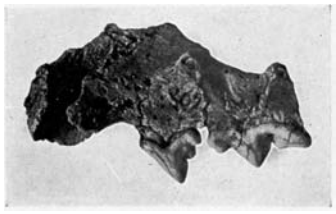
Putorius vison x $\frac{1}{1}$



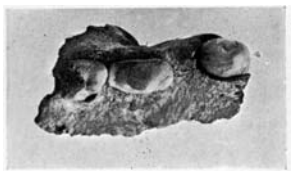
Putorius vison x $\frac{1}{1}$



Lynx compressus x $\frac{1}{1}$

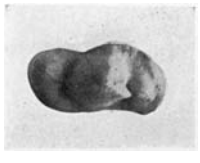


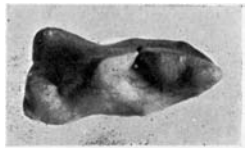
L. compressus x $\frac{1}{1}$



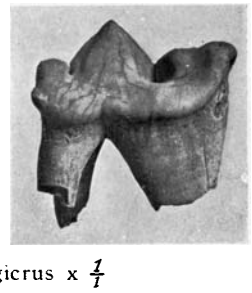
Lynx ruffus x $\frac{1}{1}$

L. ruffus x $\frac{1}{1}$

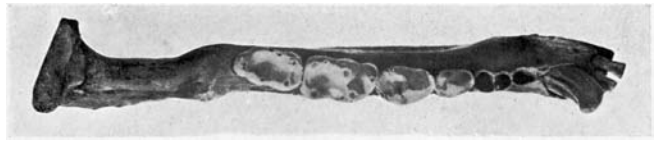




Felis longicrus x $\frac{1}{1}$

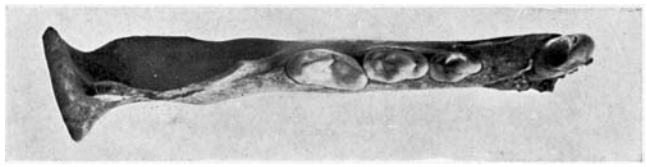


Felis longicrus x $\frac{1}{1}$



Procyon lotor x $\frac{1}{1}$

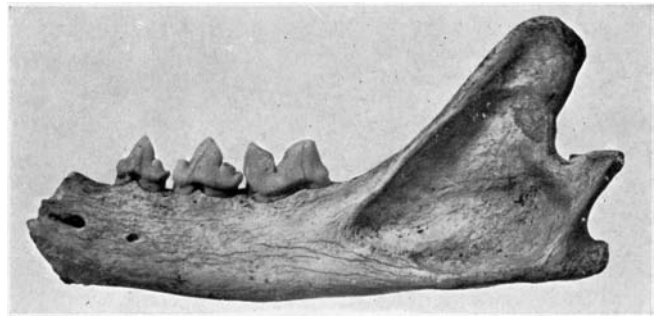
P. lotor x $\frac{1}{1}$



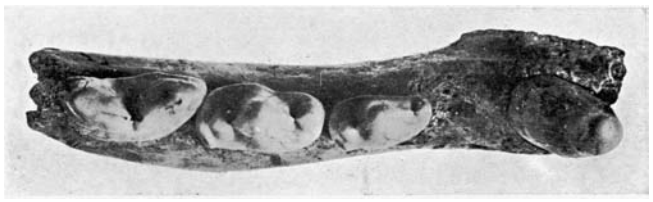
Lynx compressus x $\frac{1}{1}$

L. compressus x $\frac{1}{1}$

Lynx ruffus x $\frac{1}{1}$

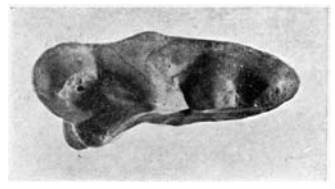


L. ruffus x $\frac{1}{1}$

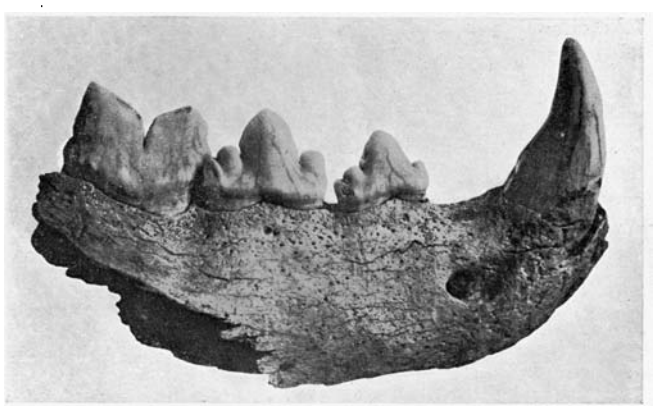


Felis cougar x $\frac{1}{1}$

Smilodontopsis troglodytes x $\frac{1}{1}$



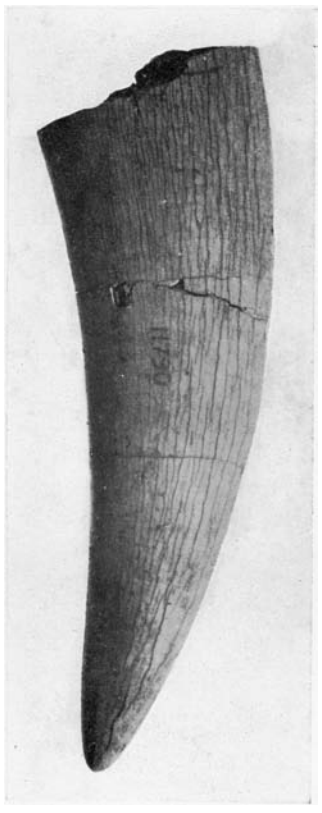
Smilodontopsis conardi x $\frac{1}{1}$



F. cougar x $\frac{1}{1}$

S. troglodytes x $\frac{1}{1}$

S. conardi x $\frac{1}{1}$



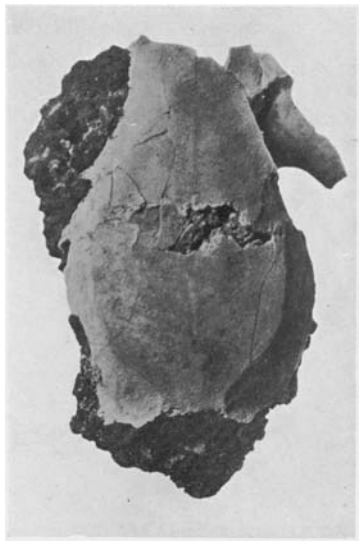
S. conardi x $\frac{1}{1}$

S. troglodytes x $\frac{1}{1}$

S. conardi x $\frac{1}{1}$

S. conardi x $\frac{1}{1}$

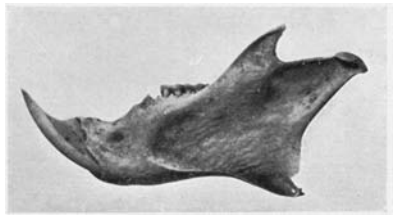
CONARD FISSURE FOSSILS.



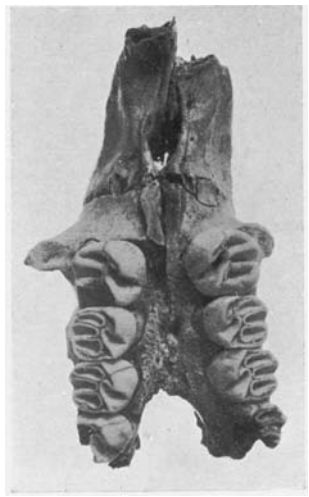
Spermophilus tridecemlineatus x $\frac{2}{1}$

S. tridecemlineatus x $\frac{2}{1}$

Sciurus hudsonicus x $\frac{3}{2}$

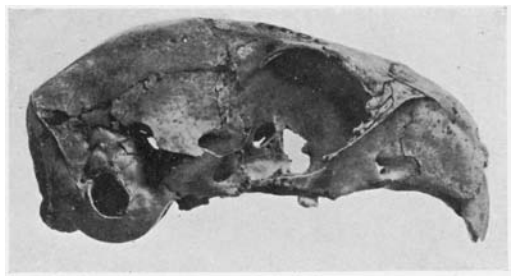


Sciurus hudsonicus x $\frac{3}{2}$

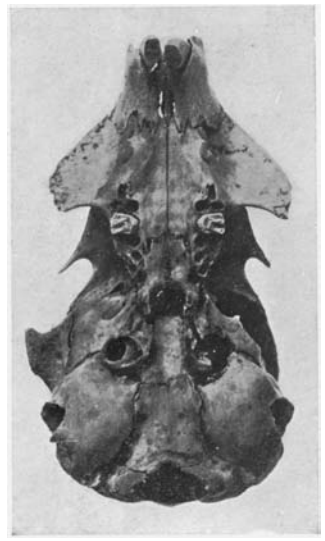


Erethizon dorsatus x $\frac{1}{1}$

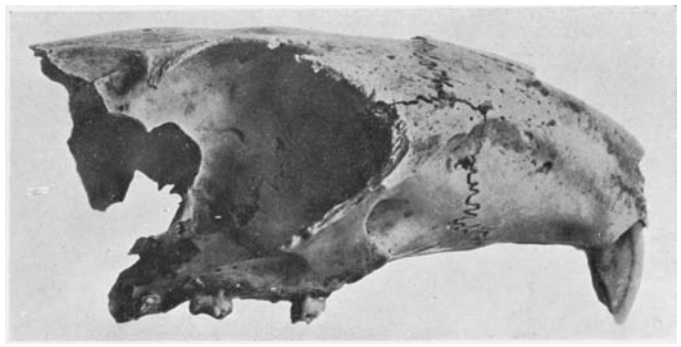
S. hudsonicus x $\frac{3}{2}$



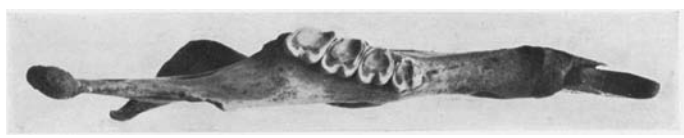
Sciurus hudsonicus x $\frac{3}{2}$



S. hudsonicus x $\frac{3}{2}$



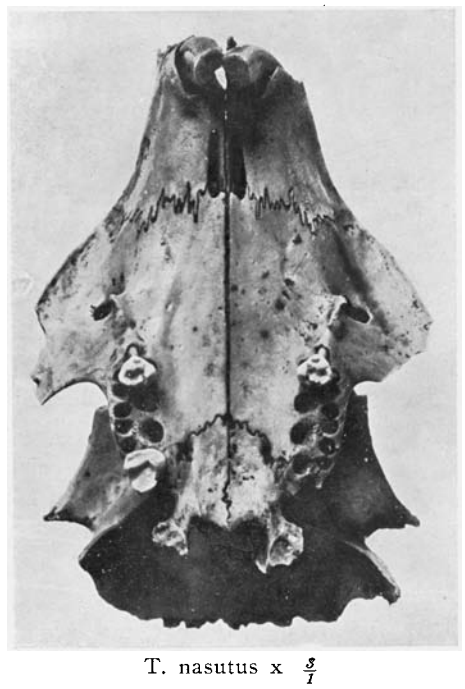
Tamias nasutus x $\frac{3}{1}$



T. nasutus x $\frac{3}{1}$

T. nasutus x $\frac{3}{1}$

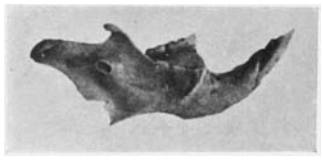
T. nasutus x $\frac{3}{1}$



T. nasutus x $\frac{3}{1}$

CONARD FISSURE FOSSILS.

Reithrodontomys simplicidens x $\frac{3}{1}$

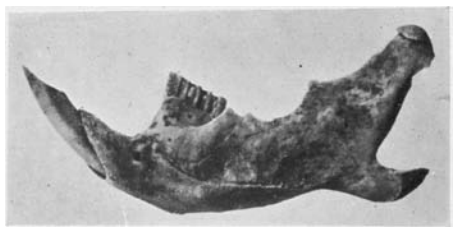


R. simplicidens x $\frac{3}{1}$

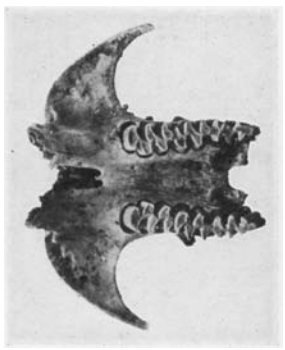
Fiber annectens x $\frac{2}{1}$

F. annectens x $\frac{2}{1}$

Microtus austerus x $\frac{3}{1}$



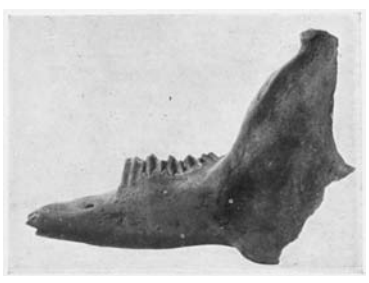
M. austerus x $\frac{3}{1}$



M. austerus x $\frac{3}{1}$

Lepus floridanus x $\frac{1}{1}$

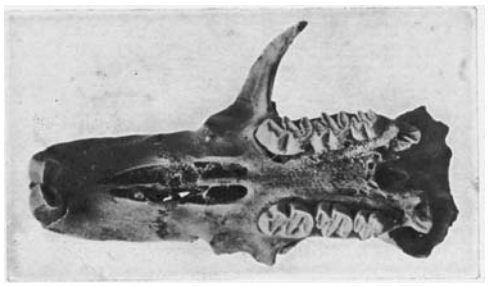
L. floridanus x $\frac{1}{1}$



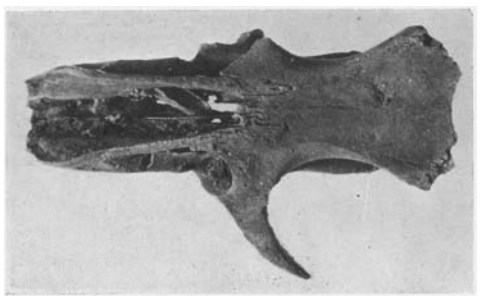
L. floridanus x $\frac{1}{1}$

Neotoma ozarkensis x $\frac{2}{1}$

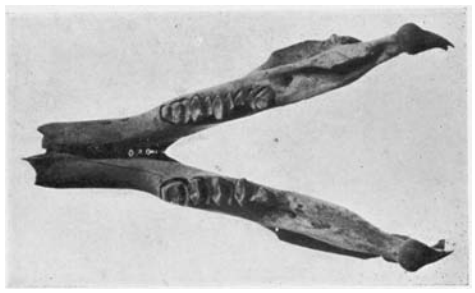
N. ozarkensis x $\frac{2}{1}$



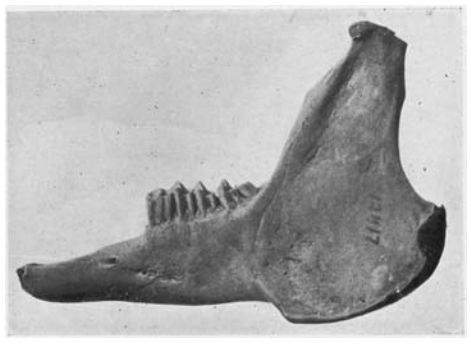
N. ozarkensis x $\frac{2}{1}$



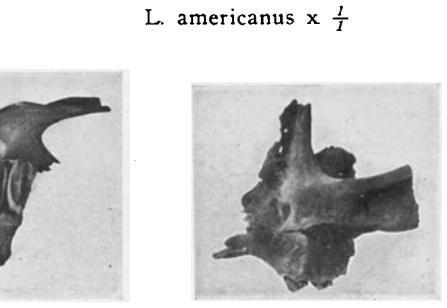
N. ozarkensis x $\frac{2}{1}$



L. americanus x $\frac{1}{1}$



L. americanus x $\frac{1}{1}$

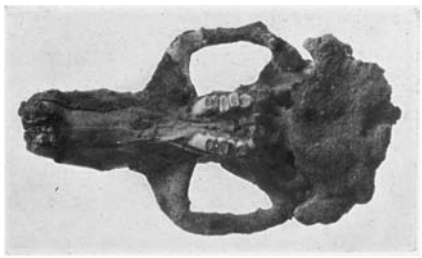


Lepus giganteus x $\frac{1}{1}$

Lepus giganteus x $\frac{1}{1}$

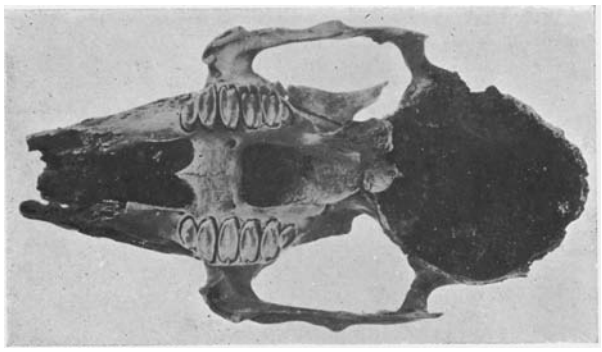
Geomys parvidens x $\frac{1}{1}$

G. parvidens x $\frac{1}{1}$

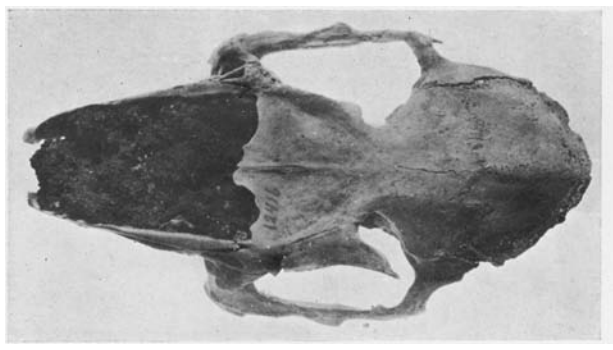


G. parvidens x $\frac{1}{1}$

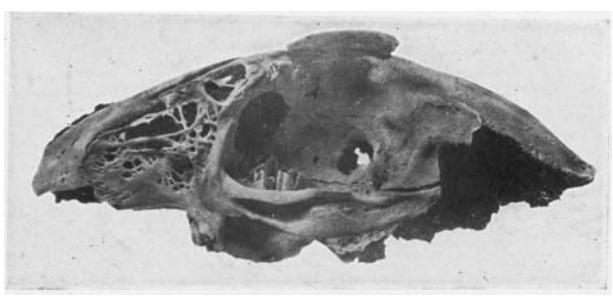
G. parvidens x $\frac{1}{1}$



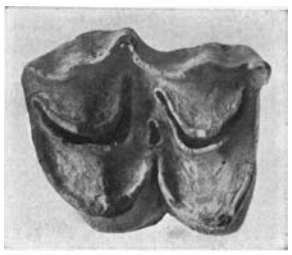
Lepus americanus x $\frac{1}{1}$



L. americanus x $\frac{1}{1}$

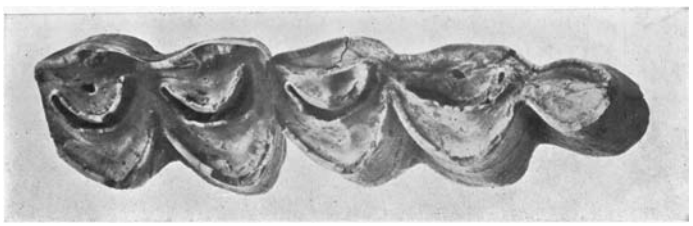


L. americanus x $\frac{1}{1}$



S. australis x $\frac{1}{1}$

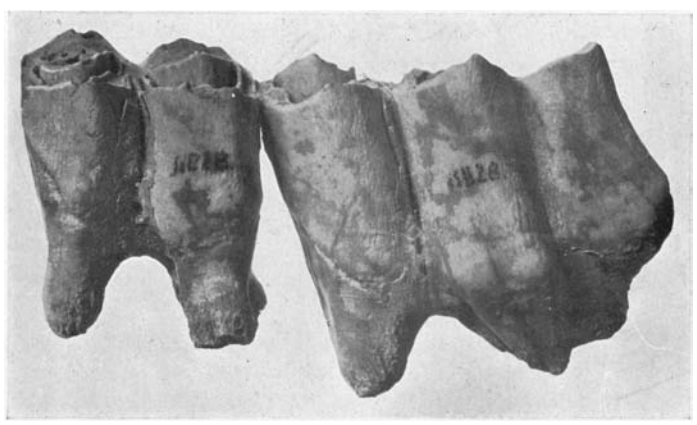
Symbos australis x $\frac{1}{1}$



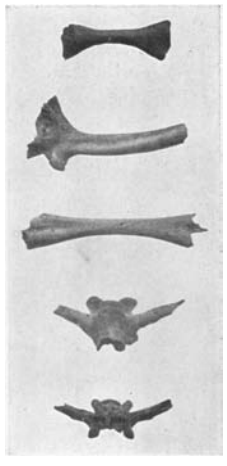
Symbos australis x $\frac{1}{1}$

S. australis x $\frac{1}{1}$

S. australis x $\frac{1}{1}$



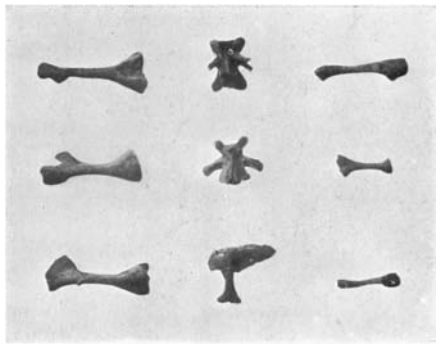
S. australis x $\frac{1}{1}$



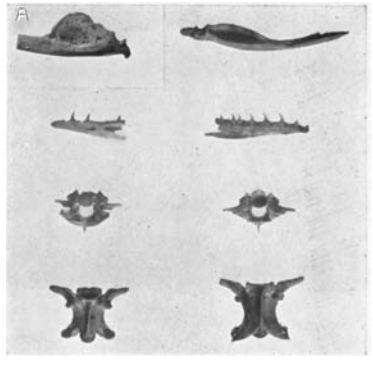
Bufo sp. ? x $\frac{1}{1}$

Rana ? sp. ? x $\frac{1}{1}$

B Rana ? sp. ? x $\frac{1}{1}$



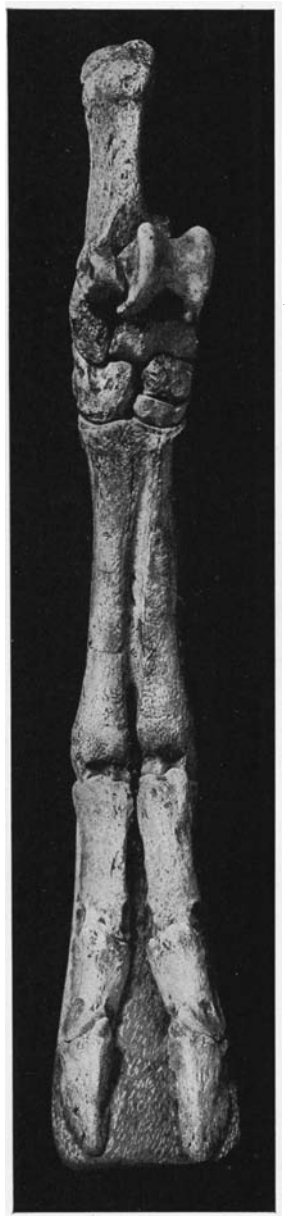
Amblystoma ? x $\frac{1}{1}$



Lacertian x $\frac{1}{1}$

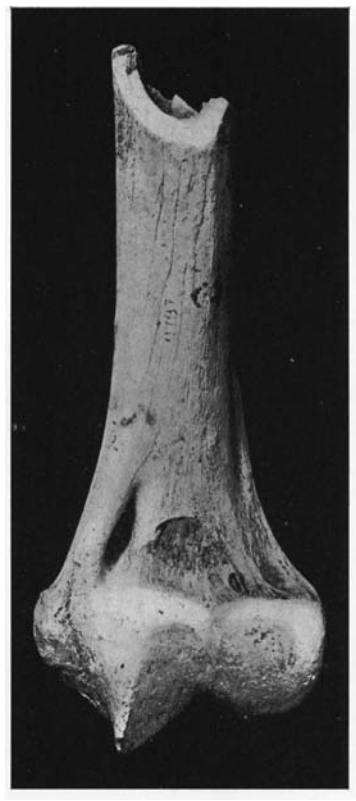
A. Cotalus sp. ? x $\frac{1}{1}$

Mylohyus x $\frac{1}{2}$



Mylohyus x $\frac{1}{2}$

Felis longicrus x $\frac{1}{2}$

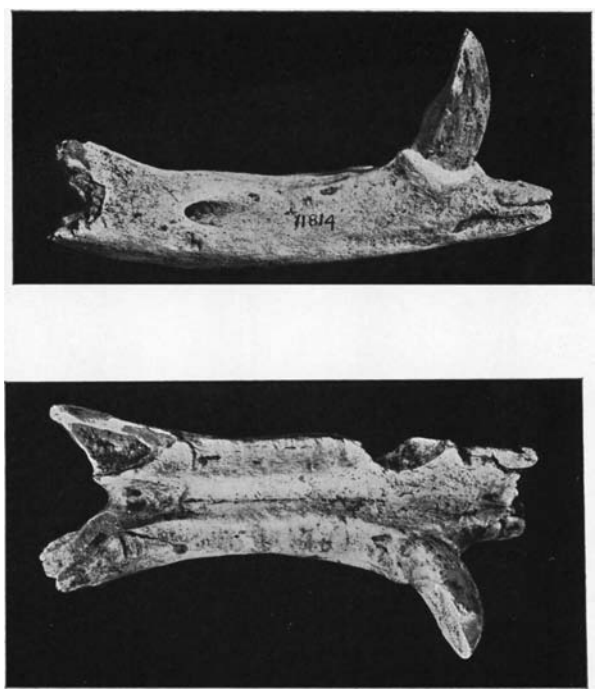


Felis longicrus x $\frac{1}{2}$

Felis cougar x $\frac{1}{2}$

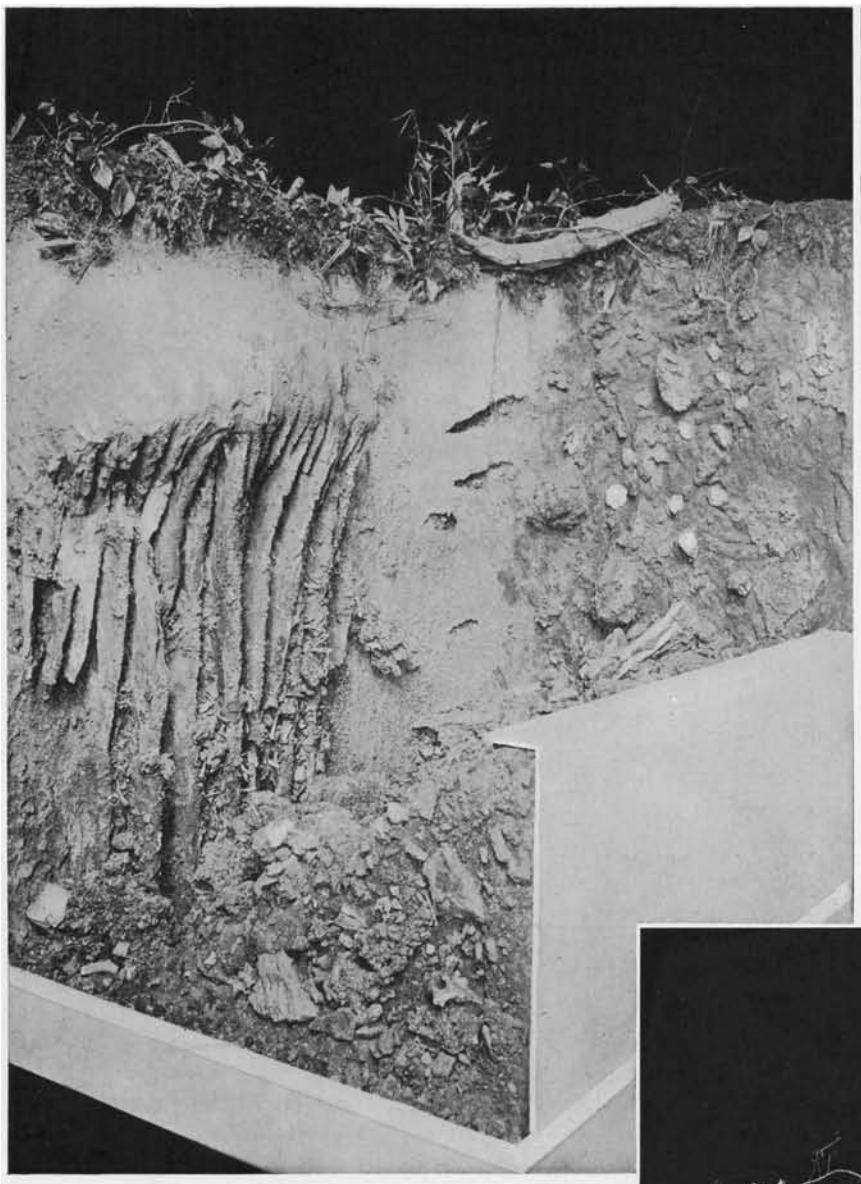
CONARD FISSURE FOSSILS.

Mylohyus sp. c. x $\frac{1}{2}$.

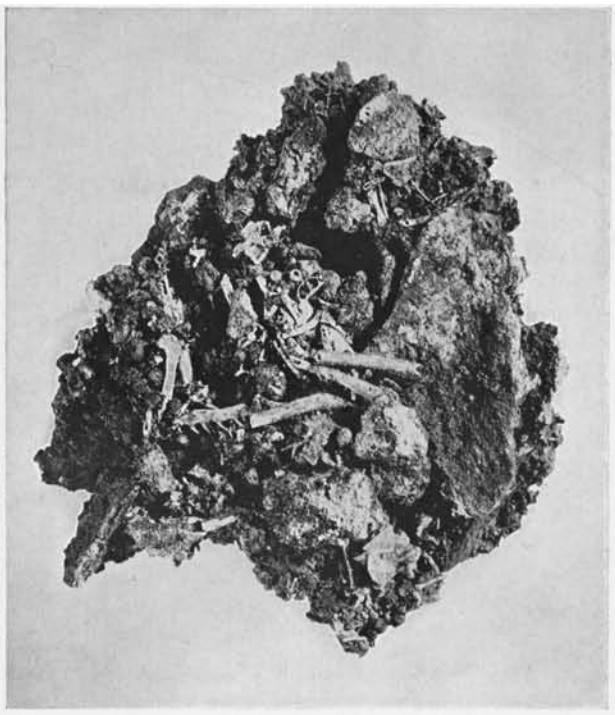


Mylohyus sp. b. x $\frac{1}{2}$

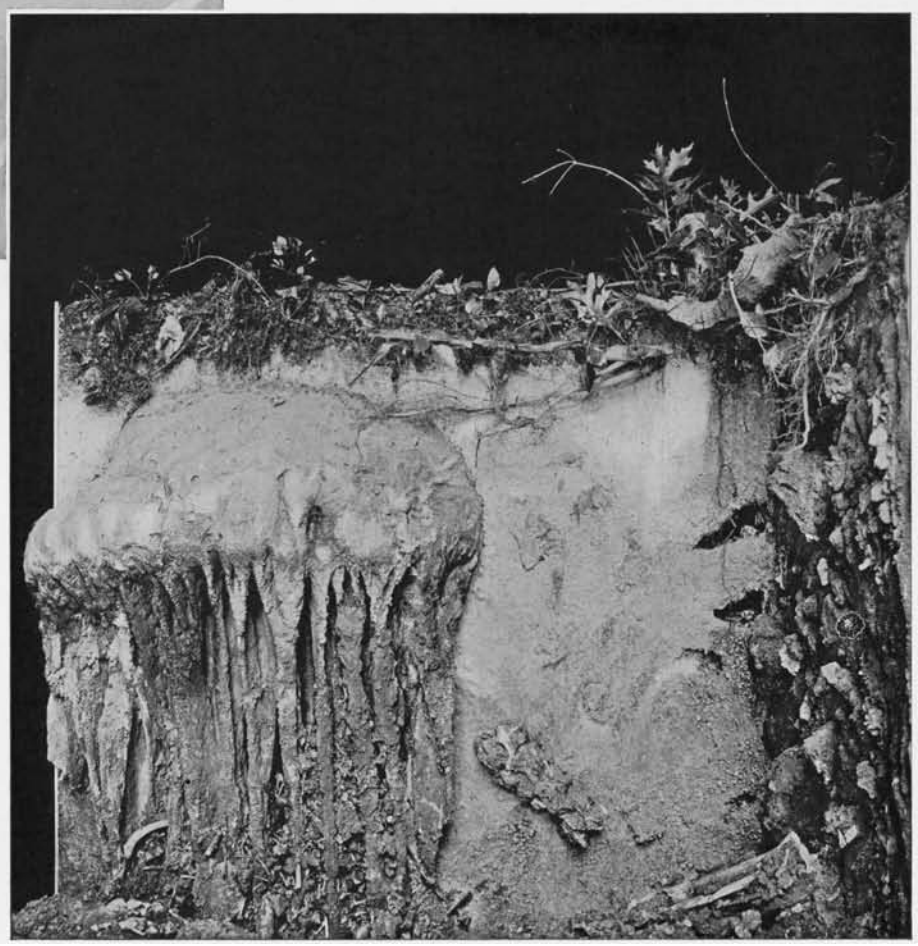
Mylohyus sp. a. x $\frac{1}{2}$



Model of fissure with residual clay and fallen blocks.



Fragment of matrix with bones x $\frac{1}{1}$



Model showing stalactites with bones and weasel holes in angle of fissure

(*Continued from 4th page of cover.*)

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