

as brief descriptions of occurrences in other parts of America which show evidence more or less similar to that at Clovis and Carlsbad. We shall then try to interpret the facts thus brought together in light of the present status of the problem.

First of all we do not believe that the problem as to when and how America was first peopled can be solved by archaeology alone. Geology, particularly its allied branches of palaeontology, physiography, and glacial geology, must be called upon to explain many phases of the subject that involve a wide variety of converging lines of research, presenting many peculiar difficulties. The archaeologist, starting from the point where the historian usually leaves off, soon finds it necessary to lengthen his perspective, and eventually he is faced, so far as America is concerned, with a geological problem. The recognition on his part of the importance of special studies relating to such factors as climatic changes, studies of invertebrates, analysis of diatoms, or pollen that may be found in a given deposit marks a step in the right direction. Therefore, the archaeologist must familiarize himself with these and other phases of geology which bear upon the problem, such as the study of terraces, buried soil levels, loess deposits, varved clays, ancient lakes and shore lines, and any other factors which may give a clue to the environment in which early man may have lived in America. There appears to be too big a gap between dated cultural remains and that period when extinct animals lived contemporaneously with man in America to be able to fix any time limits without a thorough examination of all such evidence as we have enumerated. Hence the importance of a field of investigation which lies somewhere between geology and archaeology, a fact which is becoming increasingly apparent as a number of scientists recognize.¹

BURNET CAVE

In any systematic search for evidences of early man, dry caves probably offer the best opportunity of finding such remains. Specimens found in such caves will be better preserved than those found in open sites. There have been, of course, many discoveries of human remains at open sites, but a large part of the prehistory of Europe has been unravelled as the result of archaeological exploration in caves of France and Spain, and Central Europe. Therefore, it is not surprising that the caves of our own Southwest have yielded at least some of the secrets of the people who inhabited that region in Pre-Columbian times.

Cave explorations in the Guadalupe Mountains of New Mexico, under

¹ Merriam, 1934; De Terra, 1934.

the direction of the University Museum of Philadelphia, were begun in 1930 and continued in 1931. In 1932 the Academy of Natural Sciences of Philadelphia joined the University Museum in supporting the work. The party, the first season, consisted of E. B. Howard, representing the University Museum, and R. M. Burnet, Norman Riley, and Julian Shattuck, of Carlsbad, New Mexico. During the season of 1931, Burnet, Riley, and I continued work begun the previous year at a cave in the South Fork of Rocky Arroyo, to be described later. We invited Dr. Barnum Brown of the American Museum of Natural History of New York to inspect the cave, which he did towards the end of the 1931 season. His experience in the field brought to bear upon our particular problem was a great inspiration to us to continue our work, and his help is gratefully acknowledged. In 1932 Burnet and Albert Ares, also of Carlsbad, and Hans Wilkens, botanist sent by the Academy of Natural Sciences, and I went back to the same cave to finish the excavations.

The country along the canyons of the Guadalupe Mountains is ideal for caves, and they can be found ranging in size from small shelters up to the enormous Carlsbad cavern. These mountains are a southward extension of the Sacramento Mountains and lie largely in Otero and Eddy Counties, New Mexico, terminating in Culberson County, Texas, in a massive limestone precipice. The highest point is about 8,000 feet. The moderately small caves seem to have been the ones chosen for occupation and for burial, and a great many were examined by us. We concentrated on one that held more interest on account of the faunal association it contained, and this one we shall describe.

The particular cave referred to is located about twenty-six miles in an air line west of Carlsbad and nearly fifty miles by actual travel in the foothills, along the eastern side of the Guadalupe Mountains. It is reached by turning off from the Carlsbad-Roswell highway to the left about ten miles from Carlsbad and following a very bad road and unfrequented trails to where Rocky Arroyo forks, and the country about here is known as Three Forks. Up the South Fork about a quarter of a mile the canyon forms a bend against the hills on the east side, leaving a small flat on the other side. Near the angle of this bend and about seventy feet above the dry bed of the canyon the cave is located. Above sea level it is approximately 4,600 feet. It is on Section 35, Range 21 east, Township 22 south, Eddy County, New Mexico. Four hundred yards west-south-west is a Lincoln National Forest monument. I have called the cave Burnet Cave² after R. M. Burnet of Carlsbad who first took me there.

² Howard, 1930; 1932.

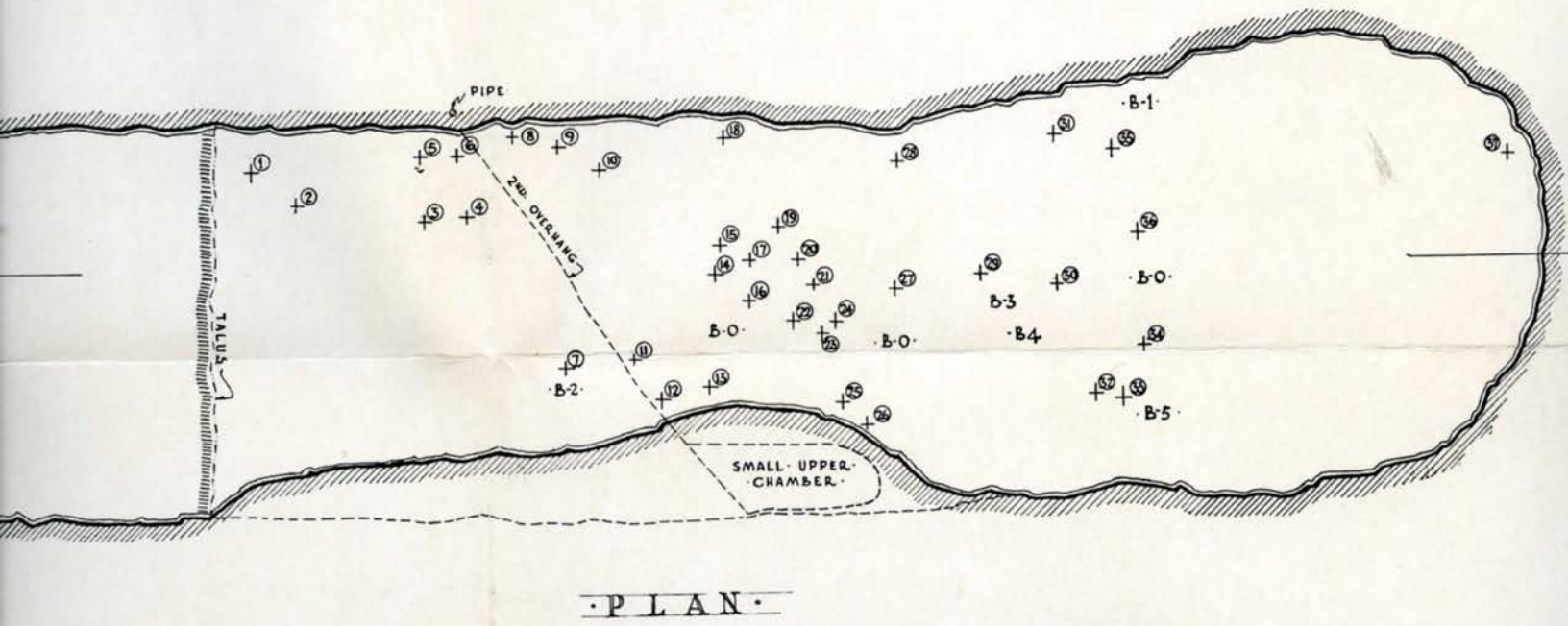
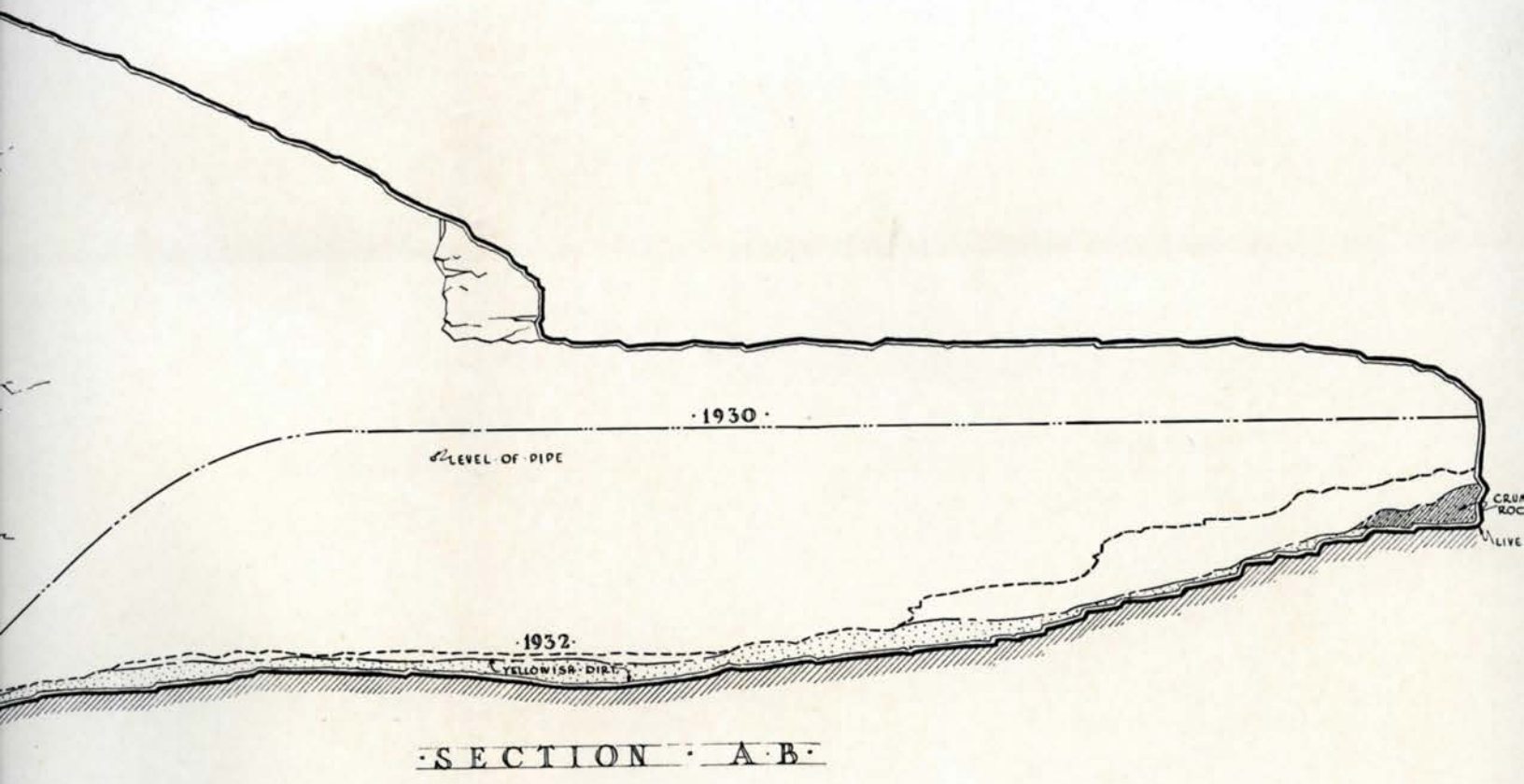
Like so many caves in the region, someone had been there before us. However, we were fortunate in being able to find these men who were apparently the first to enter the cave since it had been walled up. According to one of them (Albert Ares, of Carlsbad), there were two walls, both of which he and his brother had removed several years prior to our arrival. Inside they had dug three or four crater-like holes about three feet deep, from which they had removed several baskets, fragments of netting, hide, sandals, and beads. In one of the baskets were charred bones. Though it looked a little discouraging to us in view of the disturbed condition of the cave, a large part of the former surface was still undisturbed below the dirt and rocks thus moved, and below three feet it was undisturbed.

PLATE XXVII shows the cave from below, giving the appearance of a large high opening, but this is the result of large pieces of the roof having fallen off and forming a steep talus in front; PLATE XIV gives an idea of the shape and size, but does not show the inequalities in width due to a sloping projection of the rock along the eastern wall. As in many caves, there was an outer and inner overhang of the roof, the inner roof reducing the height at that point very considerably. Directly under the outer overhang the height was approximately twenty-five feet. The width measured a little over thirteen feet where the talus slope of the surface began, narrowed somewhat near the inner overhang and opened up again beyond. From the outer overhang to the inner overhang, along a median line, was approximately twenty feet, and from there to the rear of the cave was approximately thirty feet making a total of over fifty feet. The entrance faced east of south.

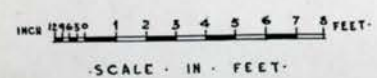
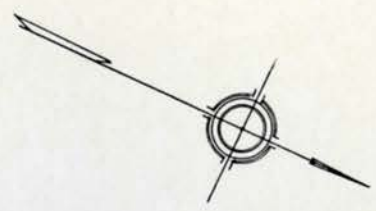
The work the first season consisted in digging a trench about three feet deep and four feet wide along the west wall, where it looked less disturbed. The following season several weeks were spent excavating the cave to deeper levels, and the third season (1932) we completed the work.

Before going on to a description of the material recovered from the cave, it will be well to point out further details of the cave itself. It is formed in limestone of a late Carboniferous or Transitional Permo-Carboniferous Age. Portions of the roof have fallen from time to time so that intermingled with the very fine dust are spalls as well as rocks of a size requiring three men to move. Many of the larger rocks are blackened on one side, and some of the deeper ones had charcoal and ash adhering to the under sides.

Microscopic examination of the cave dirt showed that most of it is disintegrated material from the roof and walls. It is very fine and absolutely dry. It goes readily through a two hundred mesh screen, a fact which made it necessary to wear respirators in order to protect the lungs. There was no definite stratification, only a long continuous deposition of weathered and



· BURNET · CAVE ·
 · SOUTH FORK · ROCKY ARROYO ·
 · EDDY · COUNTY · N.M. ·



windblown dust mixed with rock falls—no floor levels packed down by use indicating long occupancy, but rather temporary occupation at long intervals. There was no change in the character of the dirt, except where pockets of charcoal and ashes indicated scattered hearths, till near the very bottom where the color of the dirt changed somewhat to a yellowish hue. In some places the dirt accumulation was over nine feet deep. The bottom rock sloped up quite sharply towards the rear of the cave in an irregular manner, and the limestone had a dip of about twenty degrees towards the west.

While there was no stratification so far as the geological evidence of the cave went, there was some archaeological evidence of a time interval. This consisted in the fact that the baskets, bags, and other material resembling a Basket Maker culture were not over three feet below the surface, some of them being as near the surface as one and one-half feet. Charcoal and ashes, burned and unburned bones of extinct animals, a grooved spearpoint, and three bone awls were found below this level, some of the bones reaching to nearly nine feet below the surface as we found it. Considering the number of places in the cave where charcoal and ashes were found ranging from approximately three feet down to eight and a half feet, and the quantity of animal bones of various kinds, mostly broken and some burned, it hardly seems possible that these facts can be explained by saying that the bones and charcoal worked down from the surface. It seems unlikely that charcoal and ashes could work down to such depths in lens-shaped pockets. Analysis by Drs. W. M. McNab and C. K. Deischer, of the Department of Chemistry of the University of Pennsylvania, showed that certain bones submitted for examination were burned. This question of charcoal and ashes in deposits is a very important one. It is evident that many occurrences of charcoal under thick overlying deposits are not always the results of man-made fires but might be from brushfires started by lightning. However, lens-shaped deposits of charcoal, and ashes, and slivers of bone, at various places and in different depths in a cave indicate the presence of human beings, and so there is little doubt that such deposits in Burnet Cave were the result of fires made by man. Reference further on shows the location of the larger "hearths" in the cave.

Though, as already mentioned, the cave showed disturbance down to about three feet in several places, the undisturbed surface came within three feet of the inner roof, making it necessary during our first visit to use lights and to work into the rear of the cave on hands and knees. We took as a datum point a pipe which we drove into the west wall of the cave in line with the west end of the inner "overhang"; this point was a foot below the

surface as we found it in 1930, and approximately seventy feet above the creek bed. As the dirt and rock were removed and the levels lowered, we fixed, at the original surface, four foot squares of string running north and south, dividing the cave into sections so as to facilitate the location of objects removed.

Of the objects recovered from the cave, the grooved point, three bone awls, and most of the animal bones came from below the level of the human burials, while most of the other objects could be traced to association with the burials. It must be recalled that Albert Ares states that there were an inner and outer wall in the cave when he first went there. This information was borne out by our finding an accumulation of larger rocks at approximately the place where the outer wall was said to have been. The outer wall went across the inner overhang of the cave to the roof, and the inner wall was a few feet further in the cave and reached to within about one foot of the roof. The wall in this cave had been observed by others from Carlsbad.

The fact that nothing of human manufacture found in the cave seemed to be later than the burials was probably due to the walls, which not only obstructed later entrance till they were entirely removed, but might also have tended to check weathering and deposition of dust in the cave. Walled caves are hard to see after the wall has been up long enough to look like the rest of the rock thereabouts, and not many have been found along the Guadalupes. The walls, however, would not have prevented the goings and comings of the smaller animals, such as the pack-rat, which has a way of carrying things up and down in caves. Some of the animal bones found near the surface of the cave along the undisturbed walls were undoubtedly brought up from below by pack-rats. It occurs to mind at once, therefore, that if objects are brought up from below by pack-rats, objects from above could also have worked down through burrows of the same animals. Taken by itself, the position of a grooved point found five or six feet below the surface of the cave might be questioned on these grounds. However, in considering all the factors involved, it seems plain that the point was not let down through a pack-rat nest. First, because there was no pack-rat nest where it was found. Secondly, the numerous lens-shaped charcoal and ash deposits of varying thicknesses, scattered throughout the cave at different depths below the burial levels down to eight feet six inches, are hard to explain on any other ground than that they represent the remains of man-made fires. If this is granted, then, the spearpoint should also be considered to have been in place, since it was associated with such an occurrence. Thirdly, this grooved point is of a very distinct type, unknown to the cave dwellers who left their dead in the upper layers of the cave, and unreported

from recent Indian camp sites, but, on the other hand, of a type similar to those found elsewhere associated with extinct animal bones.

On the sketch plan of the cave in PLATE XIV five burials are represented marked B1, B2, B3, B4, B5, those marked B0 representing locations of holes made before our arrival. Four of these contained charred human bones, and with regard to B1, though no actual bones were found in the baskets with it, the assumption is that it was more or less similar to the others, as the following descriptions will show. B1 was the first burial that we found. It consisted of two coiled baskets, one evidently placed over the other, though the upper one had been somewhat crushed by the rocks above it, and most of the centre had been knocked out. Inside of the lower basket were what seemed to be remains of disintegrating human bones, and judged by the other basket and bag burials in the cave that contained charred human bones, B1 also seems to have been a burial. The baskets were approximately eighteen inches below the surface. A description of them appears further on.

Burial B2, nearer the front of the cave and resting on a part of the sloping shelf of solid rock along the east wall, consisted of a finely made twined-woven bag (University Museum Catalogue #31-47-27)³ of two-strand yucca cord alternating red and white. The bag was further decorated with black and yellowish lines and bands at intervals of from three to eight and a half inches. It had a circumference of approximately four feet near the open end, and a maximum longitudinal length of slightly over two feet. It compares with typical Basket Maker bags from the San Juan region. The bag had been split part way to the bottom, and charred bones were found resting on a piece of antelope skin with the hair turned in, and on top of it was resting a small piece of buffalo hide with the hair still intact. This was found at a depth of only a foot and a half. Also in the bag was a string of seed beads (#31-47-29), and a feather head-dress (#31-47-30) composed of cords similar to the bag. The feathers are those of the Golden Eagle, according to Dr. Wetmore of the United States National Museum.

B3 was rather disintegrated, but evidently another cremated burial with fragments of a twined-woven bag and bits of some sort of grass basket. It was three feet below the surface and not far from the edge of one of the holes dug by the men who had first been in the cave. A large *Unio* shell and a smaller shell fragment (#32-25-24), both perforated for use as ornaments, were found with the burial. Among the bones were fragments of an uncharred adult skull and of a very small human skull, probably embryonic. The adult skull was put together at the American Museum of Natural History in New York. It seems to be a dolicocephalic type. B4 was

³ See *University Museum Bulletin*, Vol. 3, #1, Nov. 1931, PLATE V.

another cremated burial at a depth of two feet ten inches under undisturbed surface. Charred bones and fragments of skull were recovered, along with very fragile bits of some sort of grass basket like that in B3.

B5 was also a cremated burial, though arranged somewhat differently. One and a half to two feet deep, resting on a sloping rock ledge and near the east wall, well back in the cave, were basket fragments and a rather confused assortment of sticks and tule rushes. The sticks had evidently been joined together by ties of yucca cord. Further along the slope were more sections of fragile sticks and tule running across the whole width. This was apparently some sort of covering for the burial that we then found, as we proceeded. It was three feet below the surface in very fragile fragments of bag, that in turn was placed in a coiled basket, and probably covered by another basket that came to light somewhat further to the west. In one of the baskets was found the "spur" end and several other pieces of an atlatl (# 32-25-26), partly adhering to the side of the basket. Likewise there was a pinkish quartz pebble with a distinct band about the middle as though it may have been used in connection with the atlatl.⁴

The basketry found in this cave was examined by Miss Gene Weltfish.⁵ The various types are described as follows:

1. (# 32-25-5) Fragment of coiled basket, rod surrounded by bundle foundation, wood sewing thread. Basket Maker type of coiling, 7-8 stitches and 4 coils per inch.

2. (# 32-25-1) Fragment of coiled basket formed of bundle of grass foundation (possibly split cat-tail) with two kinds of sewing thread—split twig of a dark brown color and a grass or leafy material of a tan color, 4 coils and 10 stitches per inch.

2a. (# 32-25-3) Fragments of coiled basket. Heavy split twig sewing, with heavy splint of twig foundation, through which stitches pass. Interlocking stitches worked toward left of worker, 6 stitches, 4 coils per inch. Miss Weltfish states (March, 1932) that she has no direct modern or ancient comparisons to offer for this piece, suggesting, however, a resemblance to material from caves in Coahuila.

3. (# 32-25-2) Fragments of coiled basket, two-rod-and-bundle foundation, non-interlocking stitches, 10 per inch and 7 coils per inch, with wood sewing splints. Altogether a Basket Maker technique including the characteristic distance between the individual stitches. The texture is especially fine for this type of work.

3a. (# 32-25-4) Same as 3. These two baskets, each measuring about 12 inches in diameter, were found with burial B5.

Miss Weltfish says that specimens marked # 3 are typical Basket Maker, as is also # 1 which is a typical Basket Maker variant on a rod-surrounded-by-bundle foundation. Number 2, she points out, is a very unusual piece

⁴ Mason, 1928.

⁵ Weltfish, 1932.

for this region, and this specimen together with 2a may point to a connection with Northern Mexico, while #1 and #3 point to the Basket Maker type.

The two fragmentary baskets (#30-43-64 and #30-43-65) forming part of burial B1, are two-rod-and-bundle foundation with cottonwood or willow twigs for sewing thread, 4 coils and 8 stitches per inch, worked toward left of worker. Indications are that the surface was in two colors with a design in triangular elements. One basket measured twenty-one and a half inches in diameter, the other about twenty-two and three-quarter inches.

One other type of basket fragment found is described by Miss Weltfish as identical in technique with the coiled material found by F. M. Setzler⁶ in the D. G. Knight cave in Texas. This specimen is coiled on a bundle of grass foundation with stitches split on the non-work surface, worked toward the left of the worker, probably on the concave surface. The sewing thread is made of yucca blades.

The few stone objects found were mostly associated with the burials, that is, were found at or above the three foot level. The grooved point, PLATE XXXV, 3, (#31-47-36) was found deeper. It was five feet seven inches below the surface at point 18 on PLATE XIV, and about four feet below the level of burial B2. It was directly under a rock, the under side of which was covered with charcoal and ashes as though it had fallen directly from the roof or wall upon the remains of a fire [PLATE XV]. At the same place were found remains of bison and an animal of the musk-ox family (see list of fauna). The type of point seems to correspond best with what we have described later on as a Folsom-like point, since it is not a true Folsom point, being more crudely made and having a different kind of base. It has a groove on each face, and looks like the type found at so many places on the surface in the United States, but not associated with recent camp sites, nor with mounds. It is totally unlike the artifacts found associated with the cave people. These latter types correspond to the usual ones found in Basket Maker caves and Prehistoric Pueblo sites. Of these, we recovered from Burnet Cave only three or four knives and projectile points—one (#32-25-25) being of a type which Kidder⁷ describes under the heading "Projectile points and knives with stems, expanding stem narrower than shoulder". This type has a barbed shoulder produced by deep notches at an angle to the long axis of the specimen. Similar types occur in typical Basket Maker caves, Pueblo sites, and in burned rock mounds in Texas, and very likely in other places.

A fine drill (#31-47-35) was also found in the cave at the edge of one of

⁶ Setzler, 1934.

⁷ Kidder, 1932.

the holes left by the previous excavation. It appears to be made of material much like the grooved point, but, since it was found above the lowest level of the cave burials, belongs, no doubt, with the other artifacts associated with these people. There are similar drills from Basket Maker and Cliff Dweller caves of Utah.

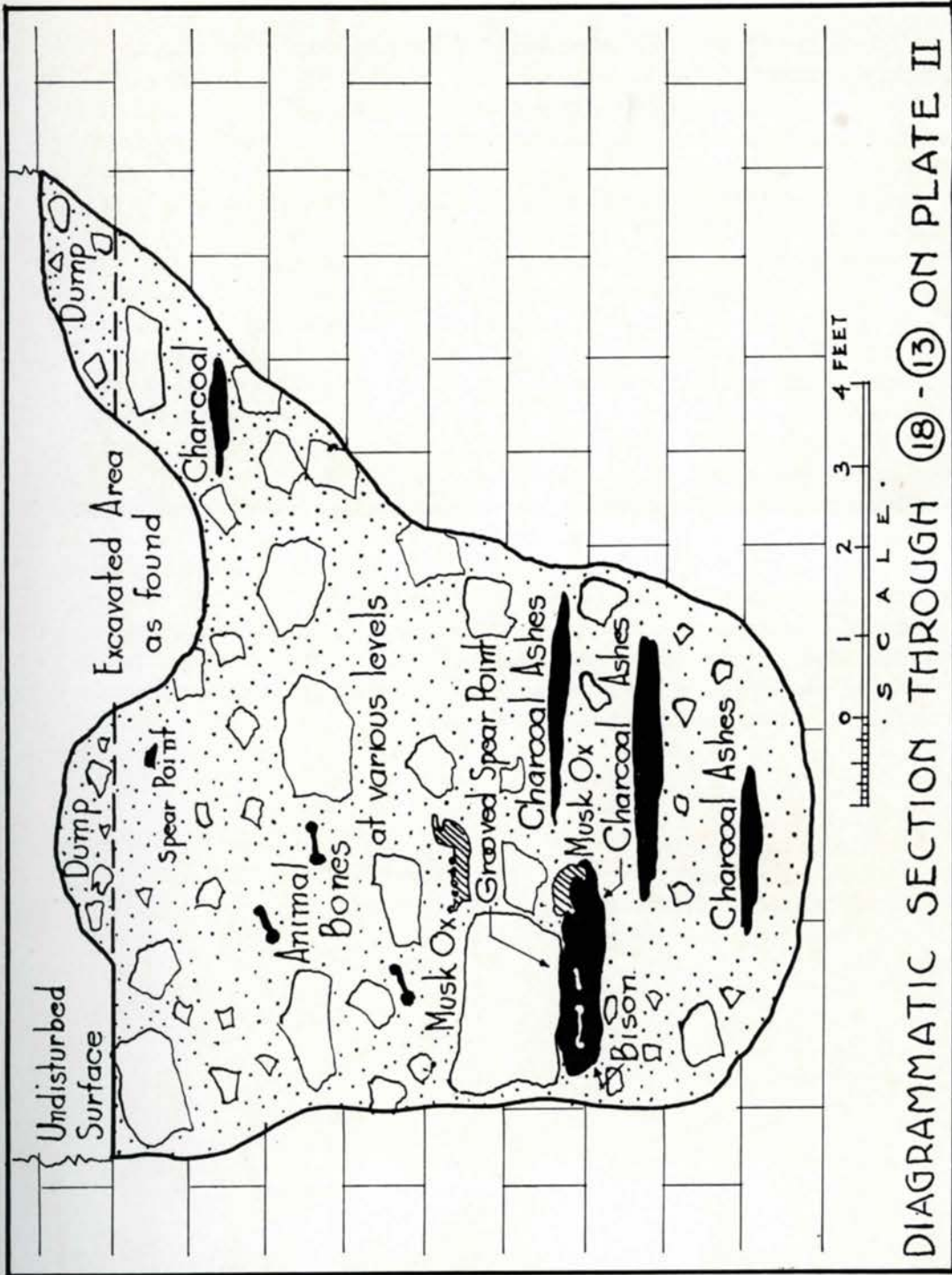
Two wooden foreshafts were recovered above the three foot level from Burnet Cave—one (# 30-43-68) five and a half inches long and notched at one end to receive the stone point, the other (# 30-43-68) seven and a half inches long with the distal end pointed. Four bone awls, one broken, were found, one at location marked 2 on PLATE XIV with charcoal at a depth of eight feet; another one about four inches long, seven feet six inches below the surface just above a hearth, taken from location 6, PLATE XIV. The broken one was from approximately the same depth (Cat. nos. 32-25-21 to -23). All are probably made of antelope or deer bone and are very much decalcified, and further show contact with the charcoal. The fourth one (# 30-43-67) was from the burial level, and shows little decalcification.

Only two sandals are represented. They came from the location marked 37 on PLATE XIV. One is seven inches long and the other six and a half inches, found at fourteen inches and twelve inches below the surface. They are made of yucca on two warp elements with pointed toe and "fish tail" type of heel, like so many of the other sandals found in caves along the Guadalupe and Sacramento Mountains. Similar ones to these have been found in the Big Bend region of Texas⁸ and also in the southwestern part of the state by C. B. Cosgrove of the Peabody Museum, Cambridge, Massachusetts, descriptions of which are to be published shortly by Mr. & Mrs. Cosgrove.

Charcoal and ashes were found at many places in the cave at different levels. (See PLATES XV and XVI for cross sections.) The following shows the depths of these "hearths":

WEST WALL	MIDDLE	EAST WALL
—	—	1' 6"
—	2'	2'
—	—	3'
—	—	4'
—	5' 2"	—
5' 6"	—	—
5' 7"	—	—
—	5' 8"	5' 8"
—	6' 2"	—
—	6' 6"	6' 8"
—	—	7'
—	7' 6"	—
8' 6"	8' 6"	—

⁸ Setzler, 1935.



DIAGRAMMATIC SECTION THROUGH (18) - (13) ON PLATE II

A SECTION IN BURNET CAVE
For Plate II read Plate XIV

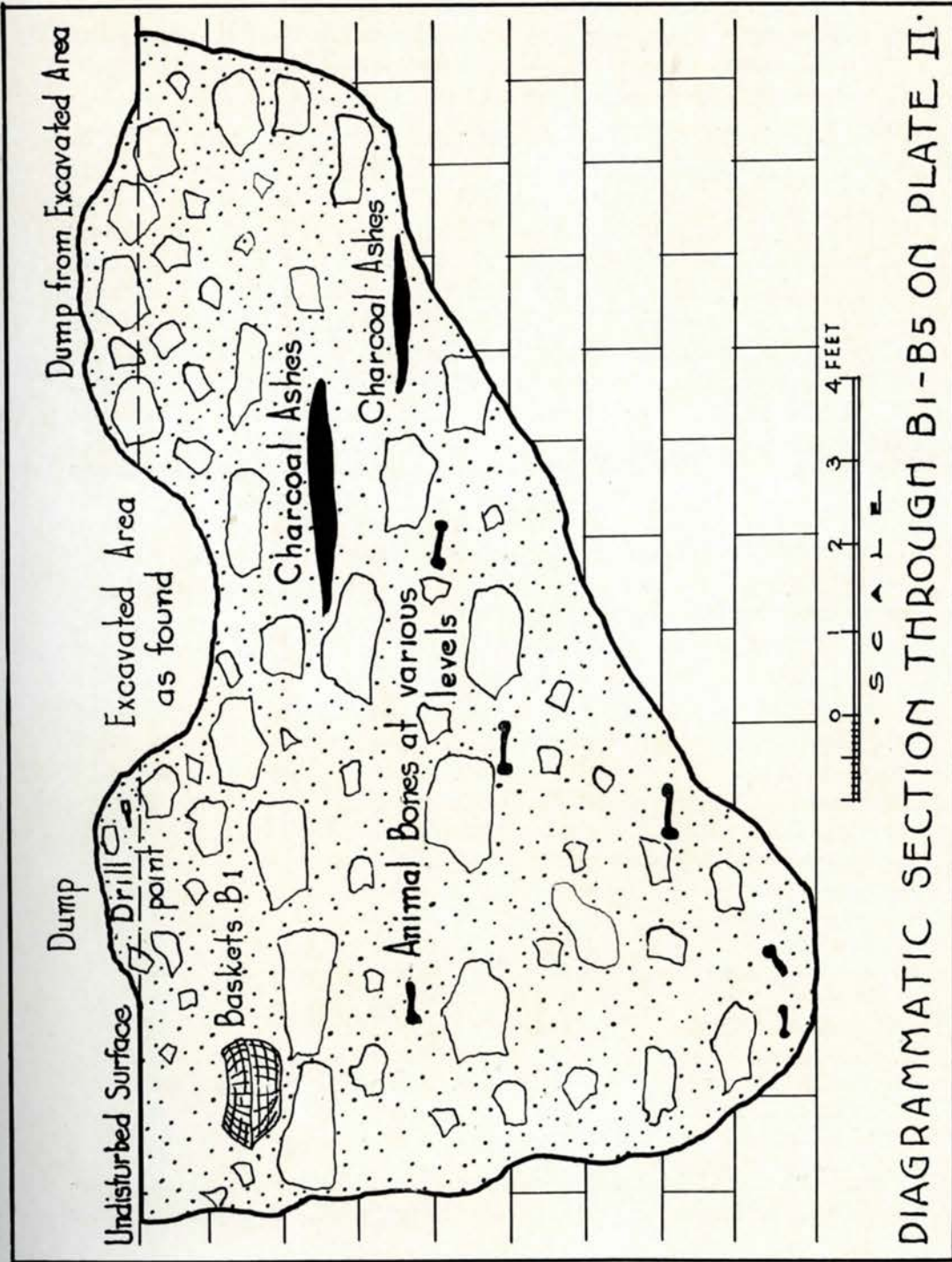
The larger ones were located horizontally as shown on PLATE XIV at points marked 1, 3, 7, 9, 11, 12, 13, 14, 17, 18, 21, 22, 23, 24, 25, 32, and 33. Bits of charcoal from one of these hearths were submitted to Dr. R. W. Chaney of the University of California and were identified as *Pseudotsuga* which apparently belongs to the living species *P. taxifolia* (Douglas Spruce). This species⁹ grows today chiefly in the Canadian Zone of the Las Vegas, Sacramento and Organ ranges westward.

In addition to the objects mentioned, were found associated with the burials the usual fragmentary pieces of yucca cord, reed, gourds, and small sticks, encountered in excavating dry caves. The plant remains consisted largely of bits of mescal, sotol, lechuguilla, and other botanical specimens found in the region today, and no doubt dragged into the cave by pack-rats. No cultivated plants were found—no corn. Nor was any pottery found in this cave, though sherds are plentiful in other caves and shelters nearby and around the so-called "mescal pits" on the valley flats.

We may now take up the question of the fauna from the cave. A study of this fauna is being made by C. B. Schultz of the University of Nebraska, the results of which it is hoped will shortly be published in the *Proceedings* of the Academy of Natural Sciences of Philadelphia. A tentative list of the various animals represented follows, all of the larger ones being extinct types; those that are not extinct, in the region in question, are represented by types that live in cooler climates, including such of the smaller mammals as the rabbit, marmot, badger, and pack-rat.

Bison	Gopher (2 species)
Antelope (four horned)	Mouse (2 species)
Camel (large)	Pack-rat
Deer (2 species)	Sparrow hawk
Mountain Sheep	Cooper's hawk
Musk-ox-like	Turkey vulture
animals { Preptoceras	Turkey
{ Euceratherium	California condor
Caribou-like animal	Flicker
Horse (2 species)	Great Horned owl
Bear	Western grebe
Badger	Crossbill
Mountain Lion	Prairie falcon
Wolf	Sandbill crane
Coyote	Mountain quail
Bob cat	Lesser Prairie chicken
Skunk	Black vulture
Fox	

⁹ Wootton & Standley, 1915.



DIAGRAMMATIC SECTION THROUGH BI-B5 ON PLATE II.

A SECTION IN BURNET CAVE
For Plate II read Plate XIV

Rabbit (2 species)
 Marmot
 Prairie Dog
 Squirrel

Swainson's hawk
 Short eared owl
 Yellow headed blackbird

The following list refers to the numbers shown on PLATE XIV. Only the more important specimens of animal bones are shown, showing the depths at which found. It should be noted that towards the rear of the cave the rock sloped up, and in places at the very back of the cave and along the east wall bare ledge was exposed. The deepest part of the cave was approximately nine feet below the surface. Where the dirt changed to a somewhat brownish color, a few inches above the floor of the cave, mostly small mammal and bird bones were found. A few of the animal bones, particularly horse, were found above the three foot level. These were at first thought to be associated with the burial levels, but upon further examination were found to be at places near the edges of the disturbed upper parts of the cave, or where ledges near the surface prevented deeper accumulations of dirt. There was no dung layer in the cave.

1. Four-horned Antelope	5' 8"	19. Musk-ox	4' 6"
Bison	5' 6"	Bison	7' 3"
2. California Condor	5' 9"	20. Deer	5'
3. Horse	8' 2"	21. Four-horned Antelope	5' 8"
4. Bison	8'	22. Bison, (hearth—3' 6")	8' 6"
5. Horse	6' 6"	23. Rangifer (?)	7' 2"
Bison	8'	24. Hearth	5' 8"
6. Deer	8' 6"	25. Hearth	2' 6"—3'
7. Bison	4'	26. Bison	7' 6"
8. Horse	2' 8"	27. Crossbill	4' 7"
9. Horse	6' 6"	28. Camel	6' 8"
10. Four-horned Antelope	3½'-4'	29. Horse	3'
11. Hearth	2' 6"	Bison	3'
12. Hearth	2'	30. Deer	8' 6"
13. Hearth	2' 6"	31. Horse	7'
14. Sandbill Crane	4' 7"	32. Horse	2'
Horse	5' 6"	33. Bison	3½'-44'
15. Musk-ox	5' 6"	Horse	3½'-"
16. Woodchuck	7' 10"	34. Prairie Falcon	5' 9"
17. Mountain Sheep	5' 6"	35. Horse	2' 8
18. Musk-ox	5' 7"	Horse	6'
Bison	5' 6"—6'		

From this faunal list it will be noted at once that some animals are represented that no longer live in that region today, while others are altogether

extinct in North America. Animals, for example, such as the marmots no longer live at such low elevations in that general region. The caribou-like animal lives far north of this latitude.

The musk-ox-like animals are, no doubt, some relation of the musk-ox that is found today in Greenland and the Hudson Bay region. The former and present distribution of the musk-ox is given in detail in a recent publication of the American Committee for International Wild Life Protection, contributed by the Wilderness Club of Philadelphia.¹⁰ In Europe the musk-ox is found to have been contemporaneous with the mammoth, horse and buffalo. In Europe, as well as in Siberia, the musk-ox seems to have died out in prehistoric times, living on in America, no doubt, for the same reason that many of the earlier forms of plants lived on here while dying out in Europe. This can probably be attributed to the north-south extension of the American continent, and to the north-south direction of the Rockies which may have furnished a corridor for certain northern animal forms, giving them a better chance to migrate back and forth with major climatic changes. There are Pleistocene records of musk-ox from Alaska, Alberta and British Columbia, and of the related types, *Boötherium Symbos*, and *Liops*, there are records from Indiana, Iowa, Kansas, and Pennsylvania. Hay¹¹ records remains of these animals from Arkansas, California, Colorado, Illinois, Indiana, Iowa, Kansas, Kentucky, Maryland, Michigan, Minnesota, Mississippi, Nebraska,¹² New Jersey, Ohio, Oklahoma, Pennsylvania, South Dakota, Utah, and West Virginia. In addition to the types from Burnet Cave, which adds New Mexico to the list, we have recently seen one from Virginia, and one has also been reported from a cave in the Big Bend Country of Texas¹³

This is a sufficient list to show that the musk-ox family had a rather wide distribution that was not confined altogether to the region glaciated by the Wisconsin ice-sheet, nor adjacent thereto.

Romer¹⁴ gives us a summary of the Pleistocene vertebrates in America, in which he points out the many difficulties in the way of applying the study of their succession and extinction to the dating of associated human remains. Of some six hundred or more species reported from the Pleistocene, he lists the following more important forms:

Nothrotherium
Megalonyx

¹⁰ Hone, 1934.

¹¹ Hay, 1923; 1924; 1927.

¹² Barbour, 1931.

¹³ Smith, V. J., 1934.

¹⁴ Romer, 1933.

Mylodon
 Megatherium
 Homesina (Chlamytherium), (Giant Armadillo)
 Boreostracon (Glyptodont)
 Arcodus, Tremarctotherium (Short-faced Bears)
 Smilodon, Smilodontopsis, Trucifelis, Dinobastis (Sabre-toothed "cats")
 Felix atrox (Large Lion)
 Stegomastodon (Gomphotherium)
 Mastodon
 Mammonteus (Woolly Mammoth)
 Parelephas (Columbian Mammoth)
 Archidiskodon (Imperial Mammoth)
 Tapirus (Tapirs)
 Equus (Horse)
 Tagassu, Platygonus, Mylohyus (Peccaries)
 Camelops, Tanuropolama (Camelids)
 Cervalces (Giant Elk)
 Cervus, Odocoileus, Rangifer (Elk, Deer, and Caribou)
 Antilocapra, Tetrameryx, Capromeryx (Antelopes)
 Bison
 Ovibos, Boötherium, Symbolos, etc. (Musk-ox)
 Taurotragus, Aftonius, Gidleya (Sheep, Goats)
 Castoroides (Giant Beaver)
 Hydrochoerus (Capybara), (Giant Rodent)

Most of the larger animals that were present in the Pleistocene have completely disappeared. Osborn¹⁵ suggested an Ovibos-Rangifer Zone corresponding to the Wisconsin glaciation, and a Cervus Zone corresponding to Post-Glacial times, during which elephants, horses, and other forms became extinct.

Romer¹⁶ lists the following forms as Post-Pleistocene:

Nothrotherium	Platygonus
Megalonyx	Camelops
Mylodon	Tanuropolama
Felix atrox	Cervalces
Mastodon	Tetrameryx
Parelephas	Boötherium, Symbolos
Mammonteus	Bison, sp. var.
Tapirus?	Castoroides
Equus	

¹⁵ Osborn, 1910, pp. 434-500.

¹⁶ Romer, 1933, pp. 82-83.

Romer shows that a faunal sequence may be built up on several lines of evidence, the chief one of which, as applied to Pleistocene successions, is that of extinction. He says: "A priori, the most reasonable hypothesis would seem to be that of a gradual extinction during the course of the Pleistocene as was suggested by Osborn." On the other hand, Hay¹⁷ postulated a rather rapid extinction of many types following the Aftonian. Further studies, particularly those of Schultz in Nebraska, should throw more light on this.

Romer continues:¹⁸ "The overwhelming trend of the evidence is that very little extinction appears to have taken place among mammals during the Pleistocene proper, and that a vast amount of extinction, reducing the fauna to its present impoverished condition, has taken place in a comparatively short period which presumably cannot have had its initiation more than, roughly, 20,000 years or so ago."

Further: "We do not know of any post-glacial climatic or floral changes which could have caused any greater general tendency towards extinction than might have been true at earlier stages, although increasing local aridity may have been responsible for some local extermination. . . . But it might be suggested (very tentatively) that the appearance on the scene of a new form of this sort (Man) might possibly have thrown out of balance a fauna in delicate adjustment, and indirectly have caused considerable changes." Regarding man's association with these now extinct animals, Romer has this to say: ". . . Indeed our principal difficulty is that if a true Early-Pleistocene human occurrence on this continent should turn up it would be difficult to establish the fact on faunal evidence."

In conclusion he says: "The association of man in America with certain fossil forms is unquestioned, and there is a growing body of evidence strongly suggesting his contemporaneity with a considerable number of mammalian types no longer living. Such contemporaneity, however, by no means indicates any remote geological antiquity for man on this continent, and there is at present almost no palaeontological evidence suggesting his presence here at a time earlier than that of the withdrawal of the last Pleistocene ice-sheet."

Of the causes of extinction of animals, it would appear that, so far as the Pleistocene forms that died out at the end of that period or early in Post-Glacial times are concerned, climatic changes, directly or indirectly, probably operated as the major cause. Osborn¹⁹ gives many causes, bearing

¹⁷ Hay, 1927, p. 140; 1912.

¹⁸ Romer, 1933, p. 76.

¹⁹ Osborn, 1906.

largely upon changes of climate that in turn affected food supply, water supply, control of forest barriers, insect pests, and diseases. He points out also the possibility of destruction of food supply of some of the larger mammals by smaller browsing types. Whatever the causes,²⁰ the forms we are concerned with either died out altogether, or if any survived, their related types now live in a different region, where the environment is perhaps more like what it was then in the region in question.

We may summarize briefly the excavation of Burnet Cave, New Mexico, by consideration of the following facts: Here we have a dry cave that was used last as a burial chamber by a people whose cultural status, judging from the material associated with a number of cremated burials, resembles closely that of the Basket Maker of the San Juan region of Utah, differing only in sandal types and in the fact that the bodies were cremated instead of being buried in stone cysts, and in the additional fact that corn was absent. The burials did not exceed three feet below the surface. Though a few animal bones were found above this level, as shown, practically all were recovered at depths below this and down to nearly nine feet, which in about the middle of the cave represented the bottom. One stone point with grooved faces, of a Folsom-like type (see later section for description), was found at more than five feet below the surface under a large rock with bones of bison and a musk-ox-like form and charcoal. Also below the three foot level were found three bone awls. The charcoal and ash deposits were numerous throughout the cave from depths of two feet near the east wall, where the dirt was thin on the sloping ledge-rock, to over eight feet six inches. These lens-shaped deposits of charcoal and ash, some as wide as three feet and from two to six inches or more thick, contained animal bones that in a few cases were burned, as a chemical analysis showed. The occurrences are hard to explain on any other basis than that they represent the remains of man-made fires. With a variety of animal bones, many of them representing species such as the Musk-ox-like animals, Caribou, and others, that no longer live in that region, it would seem to be a fair interpretation to say that prior to the use of the cave as a burial place, man lived there at irregular intervals over a period of years reaching back to a time when the climate must have been considerably cooler in that region than it now is. Indications point to this as being before the Basket Maker.

There seems to be no way to estimate the time of human occupancy of the cave on the basis of the depth of the dust and spall deposits, since it was probably not uniform, nor is there any way to tell how soon after the cave was first occupied that this deposition began. The chief clue to the time

²⁰ Tolmachoff, 1928-30.

elapsed since the first intermittent fires were made in the cave rests, therefore, on the association of extinct animal bones. Some of the bones could have been dragged in by carnivores, but this does not explain the burned bones nor the hearths. Many bones were split, but whether by human agency cannot be determined. However, before making any attempt to estimate this time we should continue in our attempt to set forth other observations relating to the subject.

CLOVIS

Having given the principal facts in connection with the work accomplished at Burnet Cave, we shall now consider the second occurrence of associated "finds" to which we referred in the beginning of this report, namely that covered by archaeological and geological work done in the region of Clovis, New Mexico. The area covered by these investigations lies between Clovis and Portales near the boundary between Curry and Roosevelt Counties, New Mexico [PLATE XVII]. Here in Township 1 south and extending from Range 34 east to the edge of Range 36 east we concentrated our efforts. Between the towns of Clovis and Portales, a distance of about eighteen miles by the highway and running in a general east-southeast direction are a series of shallow dry basins, resembling old lake beds, which may be the remnants of a once larger drainage system. Udden²¹ points out that the Brazos River once headed in the eastern flanks of the New Mexico Mountains.

This topography is quite different from that just described along the Guadalupe Mountains. Clovis stands on the "Llano Estacado" or "Staked Plains"—a flat region where only sand dunes, rising along the edges of shallow depressions, break the monotony of the landscape till one reaches close to the broken country, dipping down to the Pecos River. About seven miles south of Clovis on the highway to Portales one comes to sand dunes above a depression, which deepens somewhat as one proceeds towards Portales, and which locally is known as Black Water Draw. In places it is hard to distinguish it from the level land of the Llano Estacado. No water stands at the surface, except in one or two places near its western end, and again near the Texas line to the east, where springs feed several very shallow alkaline lakes. The headwaters of the Brazos River are not far away in Texas, and this, and other more or less parallel depressions between Clovis and Portales, may well represent a tributary of that river when it was fed by a much greater rainfall than is now found there.

All the evidence points to a former period of greater precipitation than the

²¹ Udden, *et al.*, 1916.