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ARCHAEOLOGICAL EXCAVATIONS IN THE NORTHERN SIERRA MADRE OCCIDENTAL, CHIHUAHUA AND SONORA, MEXICO

BY
ROBERT H. LISTER

WITH REPORTS BY
PAUL C. MANGELSDORF

AND
KATE PECK KENT

UNIVERSITY OF COLORADO PRESS
BOULDER, COLORADO, MAY, 1958

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ARCHAEOLOGICAL EXCAVATIONS
IN THE NORTHERN
SIERRA MADRE OCCIDENTAL,
CHIHUAHUA AND SONORA, MEXICO

BY

ROBERT H. LISTER

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WITH REPORTS BY

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PREFACE

The attention of the author was first drawn to the archaeology of northwestern Mexico in 1936, when he was a member of a field party which conducted archaeological reconnaissance and limited excavations in that area. The group, led by Donald D. Brand, then of the University of New Mexico, visited a number of the cave sites in the Sierra Madres and made stratigraphic excavations in several sites of Casas Grandes culture located in the basins and river valleys just east of the mountains. Most of the results of that field work have been published (Lister, 1939, 1946).

Although interest in the area continued, it was not until 1951 that actual field investigations were resumed. In that summer, a grant from the Council on Research and Creative Work of the University of Colorado made possible a trip to Chihuahua to formulate plans for future field work. In 1952 a grant was obtained from the Wenner-Gren Foundation for Anthropological Research which allowed us to put our plan for archaeological research into operation. A renewal of the Wenner-Gren grant was received in 1955. Another grant from the Council on Research and Creative Work of the University of Colorado allowed for laboratory and stenographic assistance during the preparation of this manuscript.

During the summer of 1952 a field party made up of six anthropology students from the University of Colorado, James Cowie, Robert Komerska, Walter Rymill, Raymond Veseth, Sally Veseth, and Paula Lundell, and the author and his wife, conducted archaeological research in Cave Valley, Chihuahua. In 1953, the author, accompanied by Hugo G. Rodeck, of the University of Colorado Museum, and Paul Cline revisited several sites in Cave Valley, Chihuahua, and tested a number of caves in Arroyo el Concho, Sonora. The most recent field work was accomplished in December, 1955, when Paul Cline accompanied the author to the Río Garabato drainage, Chihuahua, to investigate cave sites in that locality.

Without financial assistance from the University of Colorado and the Wenner-Gren Foundation for Anthropological Research the project could never have been initiated and developed to the point where we are now able to report upon certain results of our research. Sincere thanks are extended to both institutions for their generous assistance.

All of our field work in Mexico was made possible by the Instituto Nacional de Antropología e Historia from whom permits were obtained for each season's work. I wish to thank Dr. Eduardo Noguera, Director of the Division of Monumentos Prehispánicos of the Instituto, and Ing. Ignacio Marquina, Director of the Instituto Nacional de Antropología e Historia, for their splendid cooperation. Not only did they furnish us with the necessary permits but they also allowed us

to bring most of the archaeological specimens recovered to the University of Colorado for study.

In the field we were greatly aided by several residents of Colonia Juarez, Chihuahua. Bishop Brown, David Spilsbury, Irving Romney, Herman Hatch, and others gave us valuable assistance in many ways — furnishing us camping places; providing automobile, horse, and mule transportation; acting as guides; and serving as friendly consultants. Without their help, our work would have been much more difficult.

Aid in the analysis of our materials was gratefully obtained from several specialists in other fields and numerous colleagues in anthropology. Paul C. Mangelsdorf, of the Harvard Botanical Museum, studied and prepared a report upon the maize. Hugh C. Cutler, of the Missouri Botanical Garden, identified many of the other vegetal remains. Kate P. Kent analysed several textile fragments. William Weber and Sam Shushan, of the University of Colorado, aided in the analysis of textile fibers. Emil W. Haury and E. B. Sayles, of the Arizona State Museum, University of Arizona, assisted in pottery identifications, as did Paul S. Martin and John Rinaldo, of the Chicago Museum of Natural History, and Joe Ben Wheat, of the University of Colorado Museum.

Hugo G. Rodeck was responsible for the photographic record during the 1953 season. Many of his photographs are included in the report. Daniel Houtz assisted in the preparation of photographs for illustrations. The author prepared all of the maps and line drawings, with the exception of the textile drawings, which were made by Mrs. Kent.

To all of those individuals mentioned above who have assisted in the field work and in the analysis of the specimens my thanks are extended.

Finally, I would like to emphasize the assistance rendered by my wife, Florence Cline Lister, in all aspects of the project. Her aid in the field and during the preparation of the manuscript has to a large degree made this report possible.

CONTENTS

	Page
I. Introduction.....	1
II. The Natural Landscape.....	3
III. Cave Valley, Chihuahua.....	8
Swallow Cave.....	15
Slab Cave.....	22
Tau Cave.....	24
Rincon Cave.....	27
Olla Cave.....	29
Corral Cave.....	38
IV. Arroyo el Concho, Sonora.....	41
Step Cave.....	42
Arch Cave.....	44
Dark Cave.....	51
Red Paint Cave.....	55
Zigzag Cave.....	56
V. Río Garabato, Chihuahua.....	58
Las Ventanas Cave.....	59
VI. Summary of Archaeological Remains.....	67
Foodstuffs.....	67
Pottery.....	69
Stone, Bone, and Shell Artifacts.....	77
Cordage, Fiber, and Textiles.....	83
Textiles from Slab Cave and Corral Cave (by Kate Peck Kent).....	86
Wooden Artifacts.....	90
Habitations.....	92
Burials.....	93
VII. Archaeological Evidence on the Evolution of Maize in Northwestern Mexico (by Paul C. Mangelsdorf).....	96
VIII. Discussion.....	110
Summary of Culture History.....	112
Observations.....	115
Bibliography.....	120

List of Text Figures

	Page
1. Map, Parts of the States of Sonora and Chihuahua, Mexico.....	4
2. Map, Cave Valley, Chihuahua, Mexico.....	9
3. Map, Swallow Cave, Cave Valley, Chihuahua.....	16

4. Archaeological Features, Swallow Cave, Cave Valley, Chihuahua.....	18
5. Map, Slab Cave, Cave Valley, Chihuahua.....	23
6. Map, Tau Cave, Cave Valley, Chihuahua.....	25
7. Map, Rincon Cave, Cave Valley, Chihuahua.....	27
8. Map, Olla Cave, Cave Valley, Chihuahua.....	30
9. Archaeological Features, Olla Cave, Cave Valley, Chihuahua.....	36
10. Map, Corral Cave, Cave Valley, Chihuahua.....	38
11. Details of Construction, Post and Mud wall.....	39
12. Map, Step Cave, Sonora.....	43
13. Map, Arch Cave, Dark Cave, Sonora.....	51
14. Archaeological Features, Dark Cave, Sonora.....	53
15. Map, Red Paint Cave, Sonora.....	56
16. Map, Zigzag Cave, Sonora.....	57
17. Map, Las Ventanas Cave, Río Garabato, Chihuahua.....	60
18. Sandal from Swallow Cave, Showing Details of Construction.....	86
19. Diagram Showing Diamond Twill Weave of Cloth from Slab Cave, Cave Valley, Chihuahua.....	88
20. Diagram Showing Plain Weave of Cloth from Slab Cave, Cave Valley, Chihuahua.....	88
21. Diagrams Showing Sewing Stitch on Cloth, Slab Cave, Cave Valley, Chihuahua.....	88

List of Charts

	Page
1. Frequencies of Pottery Types, Swallow Cave, Cave Valley, Chihuahua ..	21
2. Frequencies of Pottery Types, Slab Cave, Cave Valley, Chihuahua.	24
3. Frequencies of Pottery Types, Tau Cave, Cave Valley, Chihuahua.....	26
4. Frequencies of Pottery Types, Rincon Cave, Cave Valley, Chihuahua...	28
5. Frequencies of Pottery Types, Olla Cave, Cave Valley, Chihuahua.....	37
6. Frequencies of Pottery Types, Corral Cave, Cave Valley, Chihuahua....	40
7. Frequencies of Pottery Types, Dark Cave, Arroyo el Concho, Sonora....	55
8. Frequencies of Pottery Types, Las Ventanas Cave, Río Garabato, Chihuahua.....	66
9. Frequencies of Pottery Types, Caves in the Northern Sierra Madre Occidental, Mexico.....	70
10. Stratigraphic Arrangement of Pottery Types, Caves in the Northern Sierra Madre Occidental, Mexico.....	75
11. Diagram of Heddle Threading for Diamond Twill Pattern.....	89
12. Measurements and Indices of Skeletal Material.....	94
13. Comparison of Culture Elements from Caves in Northern Sierra Madre Occidental and Those Present in the Mogollon Culture.....	116

List of Plates

	Page
1. Cave Valley, Chihuahua.....	11
2A. Cliff Containing Five Caves, Cave Valley, Chihuahua.....	12
2B. Excavating a Test Trench in Swallow Cave.....	12
3A. Trench 3, Swallow Cave; at start.....	13
3B. Trench 3, Swallow Cave; at completion.....	13
4A. Slab Cave, Cave Valley, Chihuahua.....	14
4B. Rincon Cave, Cave Valley, Chihuahua.....	14
5A. Olla Cave, Cave Valley, Chihuahua.....	31
5B. Granary, Olla Cave.....	31
6. House Remains, Olla Cave.....	32
7A. Corral Cave, Cave Valley, Chihuahua.....	33
7B. Post and Mud Wall, Corral Cave.....	33
8. Detail, Post and Mud Wall, Corral Cave.....	34
9. Step Cave, Arroyo el Concho, Sonora.....	45
10A. Arch Cave, Arroyo el Concho, Sonora.....	46
10B. Detail, Houses, Arch Cave.....	46
11A. Dark Cave, Arroyo el Concho, Sonora.....	47
11B. Detail, Houses, Dark Cave.....	47
12. Granary, Dark Cave.....	48
13A. Red Paint Cave, Arroyo el Concho, Sonora.....	49
13B. Figure on House Wall, Red Paint Cave.....	49
14A. Zigzag Cave, Arroyo el Concho, Sonora.....	50
14B. Detail, Houses, Zigzag Cave.....	50
15. Las Ventanas Cave, Río Garabato, Chihuahua.....	61
16. Cliff Dwelling, Las Ventanas Cave.....	62
17. Cliff Dwelling, Las Ventanas Cave.....	63
18A. Detail, Houses, Las Ventanas Cave.....	64
18B. Trench I, Las Ventanas Cave.....	64
19A. Foodstuffs.....	71
19B. Red on Brown Bowl, Swallow Cave.....	71
20. Alma Neck Banded Jar, Swallow Cave.....	72
21. Villa Ahumada Polychrome Olla, Rincon Cave.....	73
22. Shreds of Commonly Occurring Pottery Types.....	74
23. Stone, Bone, and Shell Artifacts.....	79
24. Cordage, Fiber, Gourd, and Textiles.....	80
25. Wooden Artifacts.....	81
26. Skulls.....	82
27. Variations in the Cobs from Swallow Cave.....	99

28A. Comparison between Cobs from Swallow Cave and Bat Cave; and Kernels from Dark Cave and Modern Chapalote. 100

28B. Cobs from Several Caves in Chihuahua Representing an Early Chapalote. 100

29. Tripsacoid Cobs, Swallow Cave. 101

30. Tripsacoid Cobs from Caves in Chihuahua. 102

31. Cobs of an 8-rowed Maize, Resembling the Modern Mexican Race, Harinoso de Ocho. 103

32. Cobs from Swallow Cave, Which Resemble Cristalina de Chihuahua. . . . 104

33. Kernels from Several Caves in Chihuahua. 105

ARCHAEOLOGICAL EXCAVATIONS IN THE NORTHERN SIERRA MADRE OCCIDENTAL, CHIHUAHUA AND SONORA, MEXICO

I. INTRODUCTION

Since 1951 our archaeological research in northwestern Mexico has been directed toward the general problem of Southwestern-Mexican connections. It has long been felt that a number of the elements basic to Southwestern cultures were derived from a Mexican source. Specifically, maize cultivation, pottery making, and perhaps cotton growing are believed to have spread north to influence the developmental period of Southwestern cultures. At later times a number of other traits of southern derivation, including ball courts, copper bells, certain pottery shapes and methods of decoration, clay figurines, spindle whorls, and mosaic discs also reached the Southwest and were incorporated into Southwestern cultures (Haury, 1945).

We have concentrated our field research upon an attempt to gather material relative to the problem of early contacts between Mexico and the Southwest. It was our hope that archaeological evidence from this period might be found in caves in the northern Sierra Madre Occidental, since we believed that this chain of mountains could have served as a corridor for a northerly movement of peoples and/or cultures. Prior to our investigations, attempts to establish connections had not met with success along either the west coast or on the central plateau of Mexico.

The visible features and some of the archaeological contents of a number of the caves in the Sierra Madre Occidental of northwestern Chihuahua and northeastern Sonora have been recorded in the literature for a considerable time. The work of Lumholtz (1902), the first description of the natural history and archaeology of the area, is still valuable. The writings of Blackiston (1905, 1906, 1909), Hewitt (1908), Carey (1931), Brand (1935), Sayles (1936a, 1936b), Kidder (1939), and Lister (1939, 1946, 1953), have recorded and illustrated many characteristics of these sites. Their accounts, based for the most part on reconnaissance and surface collecting with but limited excavations, led to classifying the surface remains in the caves as belonging to the Casas Grandes culture, which is well represented in many sites to the east of the Sierra Madres. The Casas Grandes culture is recognized as a manifestation of Pueblo culture featuring agriculture, large villages of mud and stone, a variety of well-executed textured and painted pottery wares, and having a time span of 1000-1450 A.D.

Since our interests were in seeking earlier remains, we went to caves thought to

contain Casas Grandes material and attempted to find earlier horizons by digging stratigraphic test trenches to the bottoms of such sites. Unfortunately, we were not successful in finding many caves with long sequences of cultural remains, and only one contained materials thought to represent the period of early contact between Mexico and the Southwest. However, our investigations have caused us to identify the culture prevalent in the caves as Mogollon rather than Casas Grandes.

In the report which follows we have attempted to describe the area and the caves with their archaeological contents, to summarize the characteristic remains, and to discuss the prehistoric culture history of the northern Sierra Madre Occidental.

Standard archaeological procedure was followed in our investigations in Chihuahua and Sonora. Surface collections were obtained from each cave visited. Then, according to the nature of the floor of the cave and after small test holes were dug in likely looking deposits, certain caves were selected for additional investigations. Twenty-three stratigraphic test trenches were dug to the rock floors of 8 caves. The trenches varied in size depending upon the type of deposits and the size of areas available for testing. Most trenches measured 4 feet by 6 feet when initiated, although several were made smaller as they progressed down into the deposits.

Test trenches were excavated in 6-inch levels, and all fill from each level was screened through $\frac{1}{4}$ inch mesh screen. Sherds and all other small durable specimens were placed in labeled cloth bags as excavated. Larger and more fragile items were packed and labeled separately.

All sherds were washed in the field. In some instances, because of the lack of transportation facilities, it was necessary to classify a portion of the sherds in the field and discard the bulk of them — retaining only representative collections. In such instances detailed records of the number and types of sherds discarded were kept.

A careful watch was maintained for specimens which were thought to be of value for Carbon 14 analysis. Some such specimens were wrapped in aluminum foil, and others were placed in glass jars after collection. Tree-ring samples were obtained from as many caves as possible. In the Cave Valley sites most wood samples came from the poles embedded in mud walls, while in the Sonora sites, where many of the roofs were still intact, we were able to secure samples from roof beams.

Officials of the Mexican Instituto Nacional de Antropología e Historia kindly allowed us to bring most of our specimens to the University of Colorado for analysis. However, a representative collection was deposited with that agency in Mexico City after it had been studied.

II. THE NATURAL LANDSCAPE

Northern Chihuahua presents two geomorphic complexes: the Basin and Range landscape, in which a practically continuous flat, gently rolling, or sloping plain is broken by short, frequently parallel mountain chains rising above the basin floors; and the Sierra Madre Occidental, which is a great plateau of extrusives, having northwest-southeast narrow structural depressions between smooth-topped ridges, mesas, and minor plateaus, and segmented by the gorges of transverse antecedent or headward-eroding streams flowing to the Pacific lowlands.

The Basin and Range section comprises all of eastern Chihuahua, extending across the Río Grande into Texas and New Mexico, and a portion of central Chihuahua. In northwestern Chihuahua the transitional zone to the Sierra Madre Occidental may be described as a line drawn along the crests west of Cuauhtemoc, Bachiniva, Namiquipa, San Buenaventura, Galeana, and Casas Grandes; thence westward along the northern flanks of the Sierra Madre Occidental proper to Manga Punta de Agua. The archaeological sites to be considered in this report all are located within the Sierra Madre Occidental; therefore, detailed discussion of that section only will be continued. (Discussion of the natural landscape is based primarily on Brand, 1937.)

The Sierra Madre Occidental. The Sierra Madre Occidental comprises the more elevated western portion of the Mexican plateau. Its eastern margin in Chihuahua is actually an indefinite transition zone marking the change from limestone Basin and Range country to the plateau area of great effusives, as was noted in the preceding paragraph. Along the western margin is another indefinite transition area toward the Sonoran Basin and Range country. A line setting off the greatest differences between the elevated, heavily volcanic-mantled Sierra Madre plateau, and the much lower, considerably denuded Sonoran Basin country of broader valleys might be drawn along the eastern side of the Bavispe-Huachinera-Nacori depression and on southward. The northern limits are debatable but may be placed along the northern base of the sierras that flank the Llanos de Carretas on the south in the vicinity of Mangas Punta de Agua. The Sierra Madre Occidental continues southward until the Cordilleran structural lines intersect the Antillean lines in the Río Santiago country of Jalisco.

The Sierra Madre Occidental is composed of a long series of effusives, volcanic material or surface lava, totaling several thousands of feet in depth. The great mass of this is 1,000 to 2,000 feet of rhyolites and light colored flat bedded volcanic tuffs above intrusive rocks, porphyry, diorite, andesite, and so forth. The northwestern portion of the Sierra Madre plateau tends to have andesite predominant upon the surface, while rhyolites prevail toward the south and east and compose the higher ridges everywhere. Basin conglomerates and sandstones fill a number of

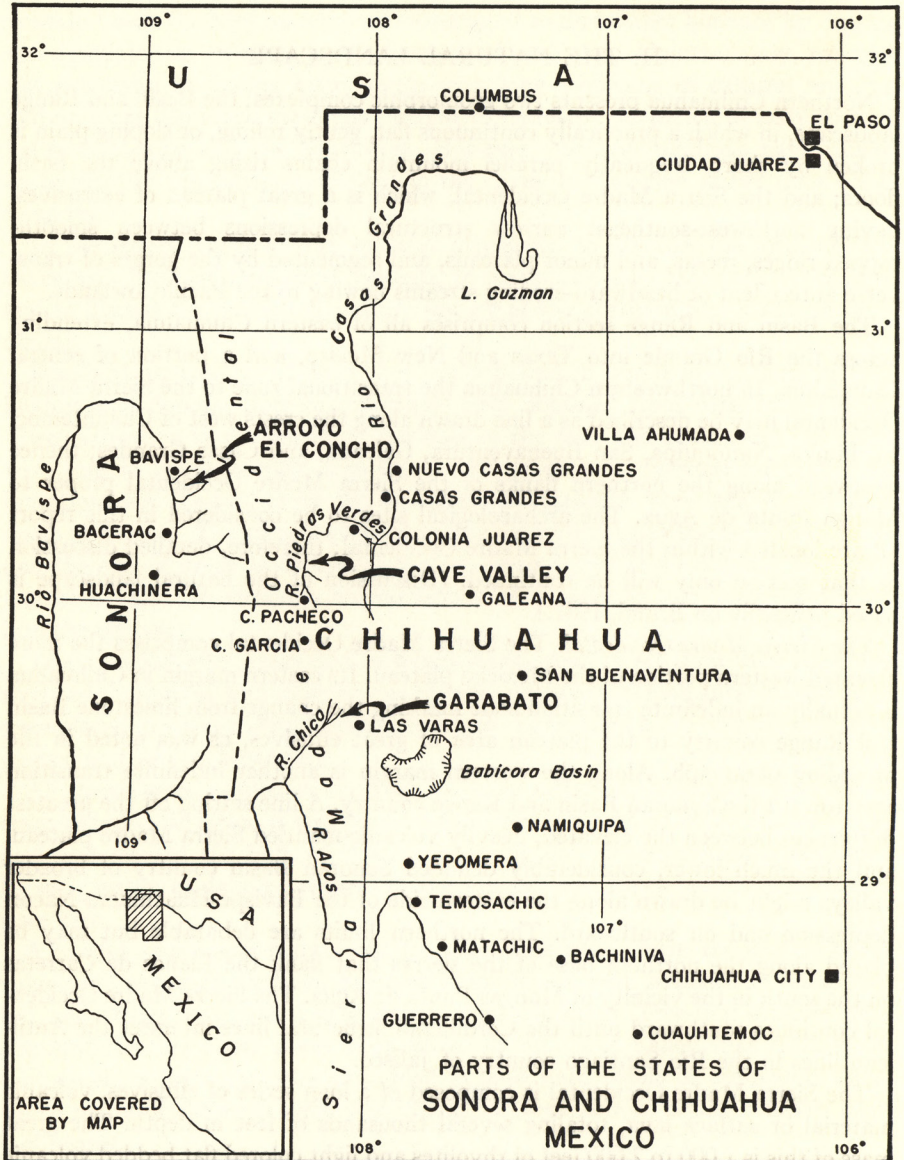


FIGURE 1

old basins. Most of the plateau in northwestern Chihuahua is a surface of slight relief, locally termed the "Top of the Mountain". Northward and southward flowing streams have cut progressively deeper canyons toward the Basin and Range sections and towards the transverse gorge of the Río Aros.

The Sierra Madre plateau averages more than 5,700 feet in elevation, with a rise to over 8,200 feet along the crests of the highest ridges. These smooth-topped ridges are separated into individual mountains or *sierras* by low saddle passes between the major laterals and headwaters of the longitudinal streams. However, the greater part of the northern Sierra Madre is composed of slightly dissected basins separated by low ridges. These basins possibly are being captured by headwaters of various rivers draining eventually both to the east and west. Some of these rivers have cut narrow box canyons which are practically impassable.

The general volcanic mantle of the mountains has weathered into a series of rich soils in the dales and on the lower slopes of the ridges. The ridge tops are somewhat gravelly, with wide exposures of the country rock. In the larger basins the alluvial fill provides a coarse textured grey-brown soil of high fertility. Where active stream cutting occurs in these basins, consolidated and semi-consolidated deposits have been extremely dissected and removed by the action of water. Mesas and benches of the old basin fill flank many of the streams.

The climate of the Sierra Madre Occidental reflects changes in elevation. The disposition of the area is somewhat continental, as it is shut off from the Gulf of California, 180 miles distant, by the western ranges of the Sierra Madre, and the Gulf of Mexico is over 500 miles away to the southeast. Nearly three quarters of the total annual precipitation falls in the summer months of July, August, and September. These rains are frequently accompanied by thunder storms and hail. The lower elevations of the Sierra Madre receive upward of 15 inches of rainfall annually, producing a semi-arid steppe climate characterized by fairly rich soils, a good grass cover, and a diversified creosote-mesquite vegetation. The higher elevations probably receive an average of around 24 inches of precipitation. This area of mesothermal savannah climate is essentially one of pines and highland meadows.

The temperatures of northwestern Chihuahua are mainly of the type traditionally termed *templada*, or temperate, by the Mexicans; however, one of Mexico's two cold extremes exists in the Sierra Madre Occidental. Here the mean annual temperature falls below 55°F., and the mean of the extreme minima is under 4°F. December is the coldest month with values averaging under 43°F. Surrounding the cold area are concentric zones which attain an annual average in excess of 54°F. Most of these areas exceed 100°F. for June, their warmest month.

The climatic complex can be summarized as involving low relative humidity,

intense insolation, excessive evaporation, considerable daily and seasonal temperature ranges, summer rainy season, prevalence of southwest winds, and a generally intense light.

The vegetation and fauna of northwestern Chihuahua are those typical of climates prevailing in this area. The lower and drier parts of the Sierra Madre Occidental coincides in its biota with those characteristic of the Upper Sonoran life zone. The higher elevations, with their mesothermal savannah climate, agree quite well with the Arid Transitional life zone.

In the lower, more arid region of steppe climate the vegetation is of the type transitional between desert shrub and mesothermal woodland. Grasses, mesquite, creosote bush, and *hojasén* (*Flourensia cernua*) dominate the landscape. Mesquite ranks first in importance. It grows best in the lowland areas of fine textured soils and high water table, but it also extends up washes between the creosote bush stands. Probably the most valuable portions of the mesquite are the pod and bean, which supply browse to animals and food to man. The mesquite blooms in spring, carries a dense foliage through the hot months, and ripens its fruits in the early fall. Also of importance to man are its huge underground stems, which are grubbed out and charred, to yield the principal fuel of northern Chihuahua. The banks of the larger streams often support a considerable tree vegetation consisting of cottonwoods, willows, sycamores, walnuts, and hackberries.

The vegetation of the Sierra Madre Occidental changes so gradually with increase in elevation that one can scarcely delimit the floristic borders. Generally speaking, the areas of higher elevation can be subdivided into a lower zone, starting at about 5,000 feet, with a characteristic juniper-oak-agave association, and an upper zone, above 7,000 feet, with a nearly pure stand of pine. Both Indians and Mexicans have utilized juniper logs for construction purposes and the fruit for food. Oaks provide woods useful for fuel and valuable food in their acorns. Agave has value as a food plant, but in recent times much of it has been utilized for the distillation of *mescal*, a fiery beverage. Around the upper limits of the junipers there is a considerable growth of pinyons, whose edible seeds are prized by birds, squirrels, and man.

The plateau top of the Sierra Madre Occidental is clothed with a fairly pure stand of open pine, which covers the ridges, descends to the bottoms of the upper canyons that dissect the area, and is broken only by the mountain meadows, in which most of the streams head. The majority of the forests consist of western yellow pine, Arizona pine, and Douglas fir. The growth is very open, with little underbrush present.

The larger animal life is diverse, bird and mammal forms being the most numerous as to species and individuals. Of greatest interest to man have been the big mammals capable of supplying food and other useful products. Two large animals

which formerly ranged into northwestern Chihuahua, but are now extinct in the area, are the buffalo and the elk. The largest mammals now existing in the area are several species of bear. Other large game include the peccary, deer, and mountain sheep. Smaller animals which are quite numerous include rabbits, squirrels, gophers, rats, mice, and beaver. Among the carnivores, in addition to bears, may be listed jaguar, mountain lion, several species of foxes, wolf, coyote, skunk, badger, civet cat, coati, and raccoon. The remaining mammalian life includes a shrew and several bats.

Bird life of northwestern Chihuahua is quite rich. The lakes, springs, and streams attract a large number of water fowl. Over the grasslands of the steppe and mountain park land range the gallinaceous birds; parrots, woodpeckers, and pigeons frequent the Sierra Madre forests; and everywhere there are perching birds and birds of rapine. The wild turkey is the greatest of the game birds and is found in the canyons in some numbers.

Despite the popular conception, northwestern Chihuahua is not overly stocked with reptiles. Lizards are most numerous. Although the number of snake species present is large, the actual population is comparatively small. The species more commonly seen are the Arizona and western garter snakes, blue and red racers, Emory's coluber, bull snake, Mexican ringed snake, western milk snake, Mexican king snake, mountain diamond rattle snake, and black-tailed rattle snake.

Trout, suckers, and cat fish are found in the perennial mountain streams. Readily observed insect life includes various ants, bees, wasps, hornets, grasshoppers, crickets, locusts, spiders, ticks, scorpions, centipedes, solougides, cockroaches, walking sticks, dragon flies, bugs, beetles, flies, fleas, moths, and butterflies.

LISTED BY V.

III. CAVE VALLEY, CHIHUAHUA

Cave Valley is the name applied to a two-mile-long stretch of the canyon of the Río Piedras Verdes in the Sierra Madre Occidental of northwestern Chihuahua. The Piedras Verdes heads in Meadow Valley southeast of Colonia Garcia and flows in a general northerly direction through the Pacheco-Corrales basin and into Cave Valley. Leaving the valley, it makes a large bend to the east, cutting through the top of the Sierra Madre plateau, and descends in a deep gorge to the plain in the vicinity of Colonia Juarez. It then flows across the plain, joining the Río Casas Grandes near San Diego.

The interbedded igneous flows that border the Piedras Verdes and its tributaries have been weathered in varying amounts to produce numerous caves and ledges, these usually being in rhyolitic tuff. Many of these were occupied by the aboriginal peoples of the area. The most spectacular archaeological remains are cliff dwellings, which vary from one- to thirty-room structures. Less outstanding, but of perhaps greater archaeological importance, are refuse deposits in caves in which no habitations were built, and similar deposits which accumulated in caves before cliff dwellings were constructed. It is obvious that many caves were utilized before the time of the building of the cliff dwellings. In some locations in the canyon bottoms and on benches just above the river there are mounds representing prehistoric villages of varying size. It would appear that these sites were, at least in part, contemporaneous with the cliff dwellings, but they probably also were occupied more recently than the cliff dwellings.

The agricultural lands of the prehistoric occupants were in the wider valley bottoms and the tributary arroyos and on adjacent slopes. Hundreds of rock retaining walls, thought to have been associated with agricultural practices, still exist along arroyos and steeply sloping cultivable land. The Río Piedras Verdes is a permanent stream, and many springs exist in the valley and in tributary canyons. Along the stream and its tributaries are growths of cottonwood, poplar, and willow. Pine, oak, juniper, and agave cover the mountain sides. The flora and fauna of the area, described in some detail in Chapter II, furnished a variety of useful plants and animals supplementing agricultural resources.

Today, all cultivable land in Cave Valley is planted, principally in corn, by the inhabitants of the small settlement of Cave Valley. North of the valley is the village of Zaragoza; and Colonia Pacheco, a declining Mormon community, lies south of Cave Valley.

To reach Cave Valley, we drove first to Nuevo Casas Grandes, the financial and commercial center of northwestern Chihuahua. Located in the heart of a rich agricultural and cattle-raising area and on the Noroeste de Mexico Railroad, it also possesses a lumber mill and a meat-processing plant. Several unimproved

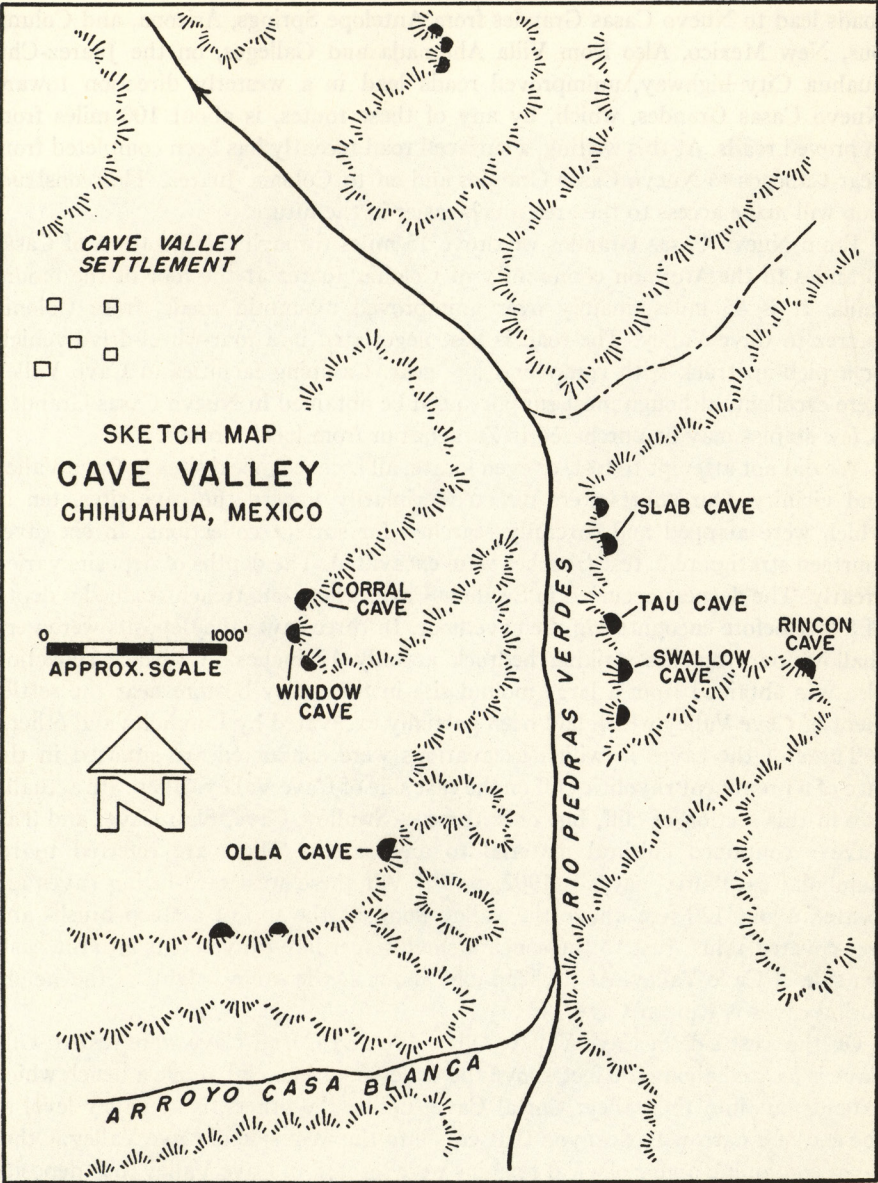


FIGURE 2

roads lead to Nuevo Casas Grandes from Antelope Springs, Arizona, and Columbus, New Mexico. Also from Villa Ahumada and Gallegos, on the Juarez-Chihuahua City highway, unimproved roads lead in a westerly direction toward Nuevo Casas Grandes, which, by any of these routes, is about 100 miles from improved roads. At this writing, a surfaced road recently has been completed from near Gallegos to Nuevo Casas Grandes and on to Colonia Juarez. This construction will make access to the area much easier in the future.

From Nuevo Casas Grandes we drove 15 miles through the old town of Casas Grandes to the Mormon community of Colonia Juarez at the foot of the mountains. It is 45 miles, mainly over unimproved mountain roads, from Colonia Juarez to Cave Valley. The road is best negotiated in a four-wheel-drive vehicle or a pick-up truck with compound low gear. Camping facilities in Cave Valley were excellent, although most supplies need be obtained in Nuevo Casas Grandes. A few staples may be purchased in Zaragoza or from local farmers.

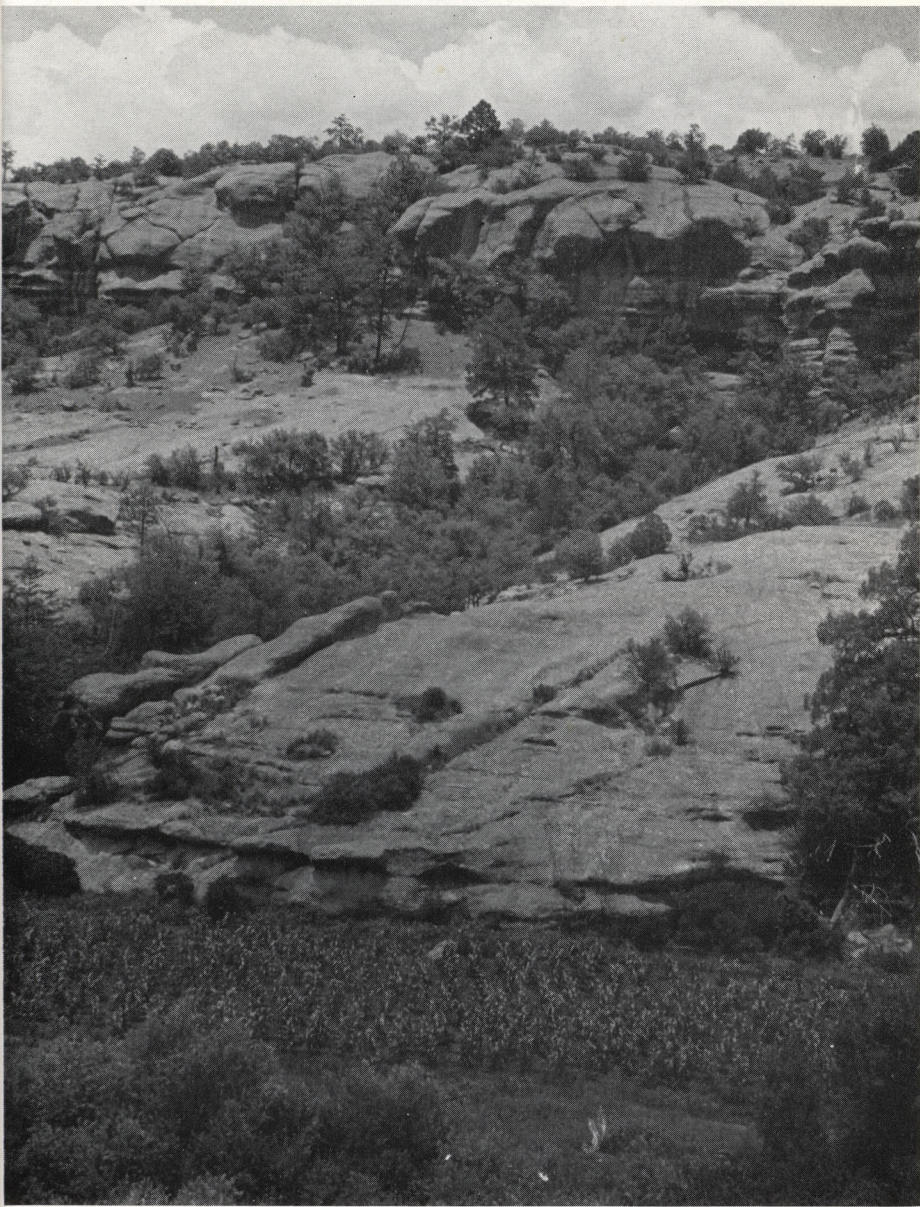
We did not attempt to test, or even locate, all archaeological sites in Cave Valley and vicinity. Our efforts were directed primarily toward the cave sites, ten of which were mapped and carefully searched for surface collections. In six caves fourteen stratigraphic test trenches were excavated. The depths of deposits varied greatly. The deepest occurred in Swallow Cave, where one trench reached a depth of 8 feet before encountering the cave floor. In three caves the deposits were very shallow, our trenches striking bedrock at only 12 inches. A surface collection also was obtained from a large mound site in the valley bottom near the settlement of Cave Valley which had been partially excavated by Lumholtz and others.

Three of the caves in which excavations were conducted are situated in the face of a prominent rhyolitic cliff on the east side of Cave Valley. There are actually five in this section of cliff, but only three — Swallow Cave, Slab Cave, and Tau Cave — contained cultural material to any extent. These are referred to by Lumholtz as "burial caves" (1902, p. 70). All these westward-facing caves are located about 120 feet above the valley floor, at the top of a steep brush- and tree-covered talus. Just to the south a small finger-like canyon cuts into the eastern side of Cave Valley. At its head and about at the same height as the neighboring caves is Rincon Cave.

On the west side of Cave Valley, Olla Cave and Corral Cave were tested. Olla Cave is located about 100 feet above the valley floor in a cliff above a bench which extends out into the valley. Corral Cave, unlike the others, is at valley level at the end of a narrow box canyon that cuts into the west side of Cave Valley. Other caves containing archaeological remains were located in Cave Valley, but deposits in these were not significant enough to warrant test trenches; surface collections were obtained from four.

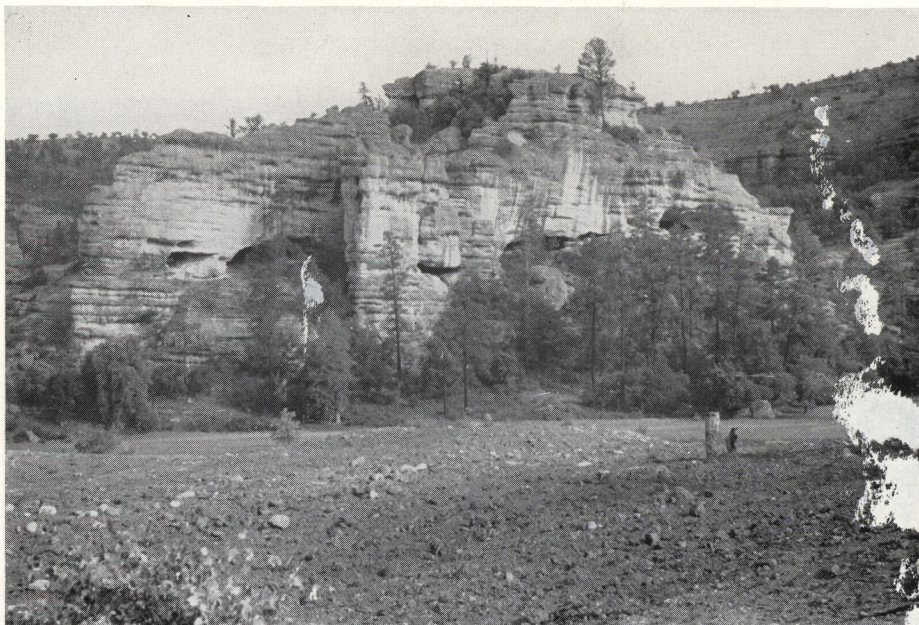
The deposits in all the caves we examined in Chihuahua and Sonora are well

PLATE 1



Cave Valley, Chihuahua

PLATE 2



A. Cave Valley. Five caves are located in the face of this cliff. Slab Cave is second from left; Tau Cave, third from left; Swallow Cave, fourth from left.



B. Excavating a test trench in Swallow Cave

PLATE 3



A. Trench 3, Swallow Cave, Cave Valley, Chihuahua. Starting the trench



B. Trench 3, Swallow Cave. Depth of trench at completion



A. Slab Cave, Cave Valley, Chihuahua. Most of the floor of the cave is covered by large slabs of rock, as shown in the foreground.



B. Rincon Cave, Cave Valley, Chihuahua. Note the step-passage doorway and the wall built of mud and rocks.

protected from the elements, hence quite dry. Digging by previous excavators, or treasure seekers, was obvious in almost all, but undisturbed deposits were located and tested in each site worthy of such attention.

SWALLOW CAVE

DESCRIPTION

Swallow Cave is the largest, and most northern, of the group of five occurring on the east side of Cave Valley and contained the best archaeological record of all caves tested in that area. The mouth is approximately 160 feet in width, and the cave averages 40 feet in depth. The southern end has a low ceiling, and on the floor there are several large blocks of stones which have fallen from the ceiling. The northern portion has a very irregular ceiling about 11 feet above the floor, where a large number of swallow nests had been built. A few stones also were scattered over the northern half of the surface.

Dirt containing cultural material covered all of the surface aside from the areas in which the large stones occurred. A structure, apparently consisting of several rooms, formerly had existed adjacent to the large rock at the northern end. Many fragments of wall- and roof-remains, hard pieces of adobe mud with pole- and grass-impressions, and willow ties which were used to bind wall elements together were found adjacent to the rock. Test trenches in that vicinity located the foundations of several walls and a human burial.

Two test trenches, one dug in the center of the cave and the other at the south end, revealed deep, stratified deposits. One was carried to a depth of 5 feet before reaching the cave floor, and the other penetrated 8 feet of deposits before encountering the floor.

EXCAVATIONS

Trench 1. This trench was located in the center of the cave, and measured 4 feet by 17 feet. It was oriented approximately east-west, and was excavated in 6 inch levels.

Level 1 (0"-6") The fill was predominantly loose dirt. In a few places the irregular rock floor of the cave was encountered. Few sherds.

Level 2 (6"-12") The western half of the trench hit hard disintegrated rock and the rock bottom of the cave. A few sherds were recovered. Charcoal and ash were fairly abundant.

Level 3 (12"-18") This level, like all lower levels, was limited to the eastern half of the trench. A complete red-on-brown pottery bowl was recovered (Pl. 19B). It was not associated with a burial and appeared to be an isolated find. Also, the top of a large wooden post, 6 inches in diameter, was encountered. The post,

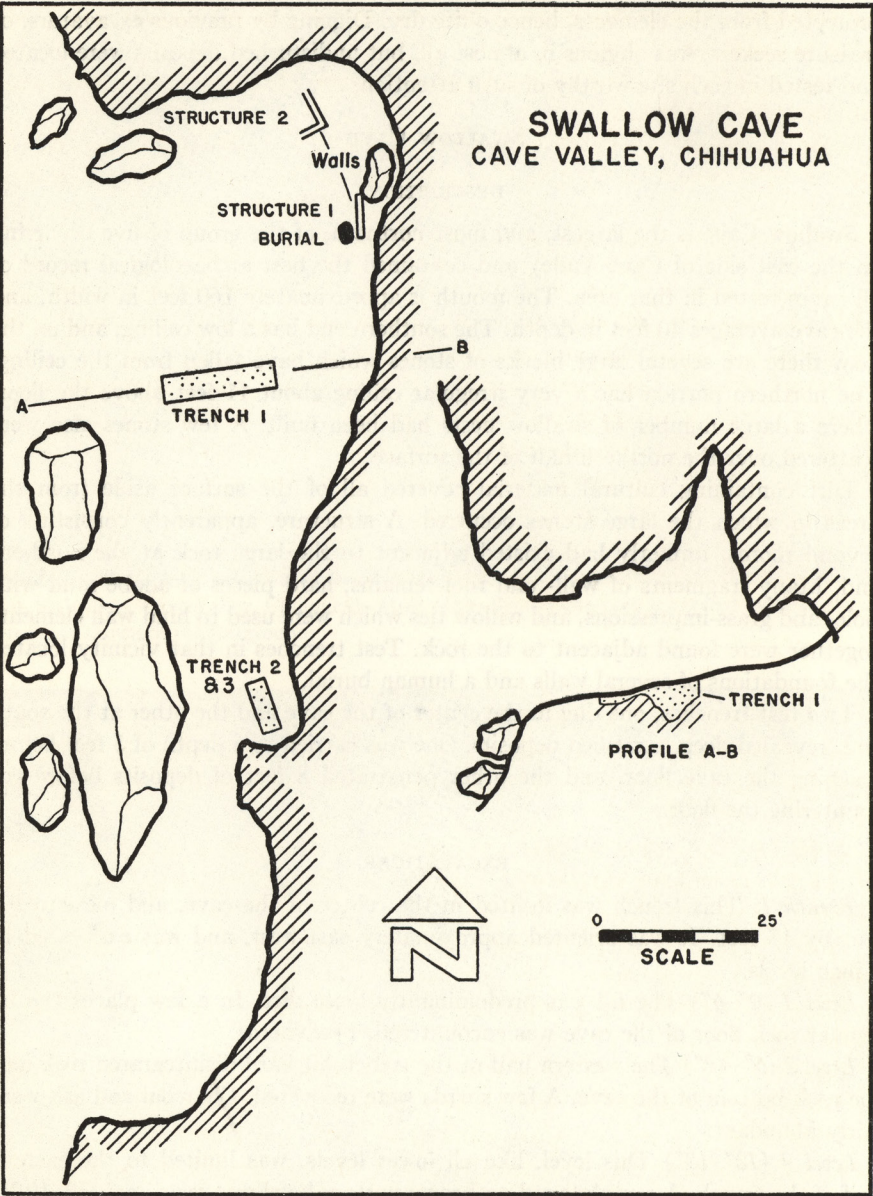


FIGURE 3

whose upper end was charred, had been set vertically in the ground. Few sherds. Charcoal and ash.

Level 4 (18"-24") No cultural material was recovered. The post mentioned above extended into this level.

Level 5 (24"-cave floor). This level was sterile. It was dug to the bottom of the cave deposit, where a very irregular rock floor was encountered. Maximum depth of deposit, 5 feet. A tabulation of sherd types from this trench, as well as all excavations in Swallow Cave, is incorporated in Chart 1.

Trench 2. Trench 2 was dug at the north end of the cave between several large slabs of stone that had fallen from the roof and the rear wall. The trench measured 4 feet by 6 feet and was excavated in 6 inch levels.

Level 1 (0"-6") Loose dirt probably of wind-blown origin. The tops of two wooden posts were encountered. Few sherds.

Level 2 (6"-12") Much charcoal and ash. Sherds were plentiful.

Level 3 (12"-18") Much charcoal and ash. Sherds were plentiful.

Level 4 (18"-24") Ash and dirt with lenses of charcoal. Sherds still plentiful.

Level 5 (24"-30") Dirt and charcoal lenses. Few sherds.

Level 6 (30"-36") Dirt and charcoal lenses. Few sherds.

Level 7 (36"-61") No sherds. Lowest charcoal lens at 42 inches below the surface. Deposit consists principally of yellow dirt.

Trench 3. Owing to the depth and the nature of the stratified deposits of Trench 2, an additional area, 4 feet by 6 feet, immediately south of and adjoining Trench 2 was excavated during our second season in Cave Valley. This trench, the deposits of which were removed in 6-inch levels, also was extended to the rock floor of the cave.

Level 1 (0"-6") Mainly loose wind-blown material with small slabs of stone which appear to have sluffed off the walls and ceiling. Few sherds. Two utilized flakes.

Level 2 (6"-12") Deposit becomes considerably darker in color. Small flecks of charcoal and ash prevalent. Sherds more plentiful. One stone core consisting of a water-worn cobble from which large flakes had been struck was obtained. Four utilized flakes.

Level 3 (12"-18") Deposit of same nature as in Level 2. Large amount of vegetal material, twigs, corn husks, yucca leaves, and grass. A sandal and fragments of matting were collected. Sherds plentiful. One small water-worn cobble that had been used primarily as a hammerstone, and perhaps secondarily as a grinding implement, came from this level. One utilized flake.

Level 4 (18"-24") This level contains a large amount of dark charcoal and ash.

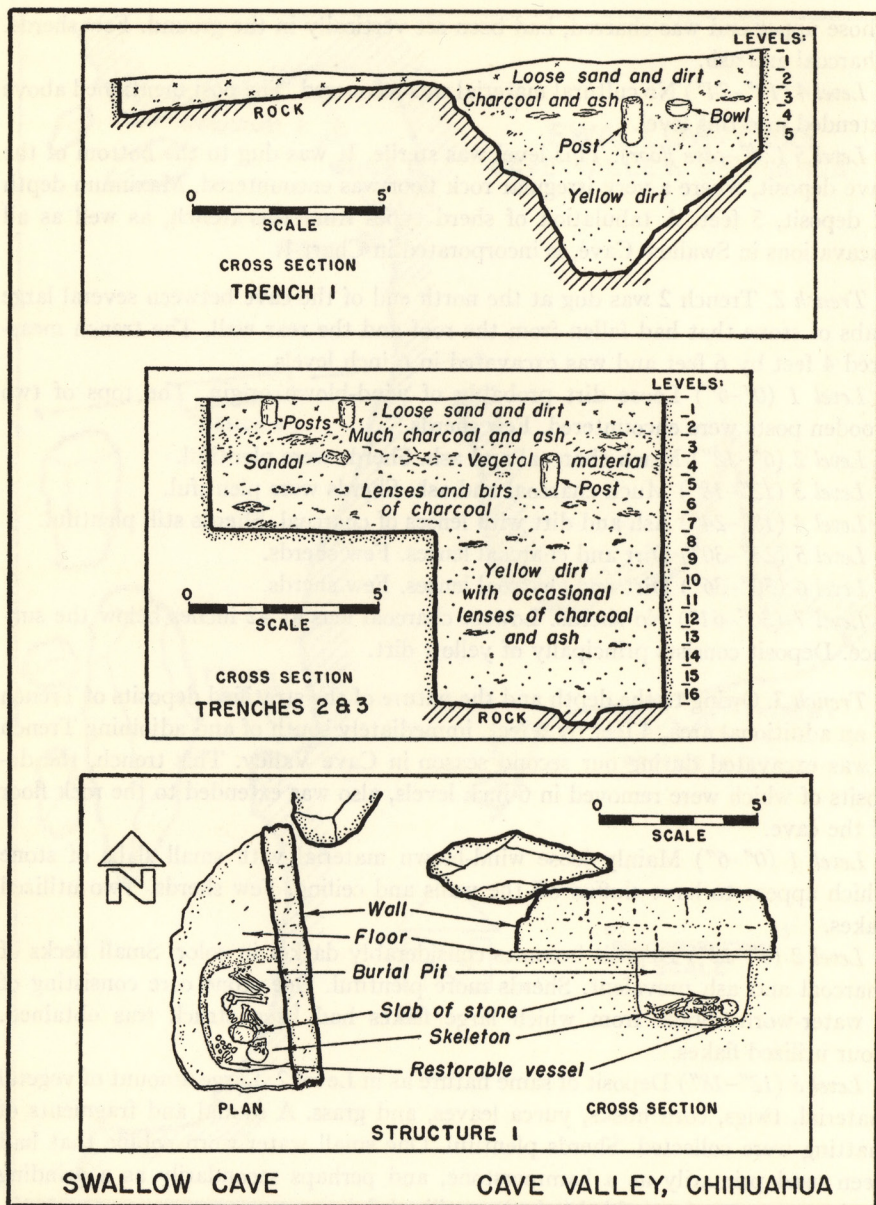


FIGURE 4. Archaeological features, Swallow Cave, Cave Valley, Chihuahua

A piece of wood, apparently the base of a post, was found. Sherds still very plentiful. Three utilized flakes.

Level 5 (24"-30") The northern half of the trench continued to contain charcoal and ash. A concentration of ash and carbonized twigs lying above hard fire-red-dened soil indicated the former presence of an unlined fire area of hearth. The southern half of the deposit consisted of yellow dirt with but little charcoal and ash. The yellow dirt seems to be decomposed native rock. Very few sherds. Two utilized flakes.

Level 6 (30"-36") Deposit consists of yellow dirt, with an occasional small fleck of charcoal. Very little cultural material. Sherds scarce. Four utilized flakes. One worked rock crystal.

Level 7 (36"-42") From this level downward the trench was reduced in size to 6 feet by 2 feet because of the unconsolidated nature of the fill which made the continuation of a large trench dangerous, and because it appeared as though the bottom of the principal culture-bearing horizon had been reached. Most of the deposit consists of yellow dirt with an occasional area of dark ashy material. Sherds very scarce. One fragment of nacreous shell.

Level 8 (42"-48") Yellow dirt. Some lenses of ash and charcoal and decomposed vegetal material. Many acorns. No sherds. One utilized flake of stone.

Level 9 (48"-54") Yellow dirt. Flecks of charcoal. Acorns continue. No sherds. One stone flake exhibiting a bulb of percussion.

Level 10 (54"-60") Yellow dirt. Flecks of charcoal. Acorn shells continue. No sherds. One utilized flake and one stone core from which flakes had been struck.

Level 11 (60"-66") Yellow dirt becomes damp. Flecks of charcoal less numerous. Few acorn shells. No sherds.

Level 12 (66"-72") Damp yellow dirt. Few bits of charcoal. Some acorns and other nuts. No sherds. Two utilized flakes.

Level 13 (72"-78") Damp yellow dirt. Two charred corn cobs and an assortment of lycium berries (?). No sherds.

Level 14 (78"-84") Damp yellow dirt. Few bits of charcoal. One acorn shell and one corn cob. No sherds.

Level 15 (84"-90") Yellow dirt becomes moist. Few flecks of charcoal. Few small seeds. Spalls of rock appear. No sherds. One utilized flake.

Level 16 (90"-96") Moist yellow dirt. Few flecks of charcoal. Spalls of rock. Bedrock was encountered at the bottom of this level. A pit 5 inches deep was dug into the bedrock to prove the existence of the cave floor. No sherds.

Structures 1 and 2. At the north end of the cave, beside a large slab of rock lying on the floor, the surface was strewn with small fragments of adobe with pole-and stick-impressions. These fragments were parts of wall and roof material of a

structure, probably a house, which had formerly existed there. Testing of the area by trenching revealed fragmentary walls of at least two rooms which were designated Structures 1 and 2, although it is likely that the rooms originally were connected. It was evident from the disturbed nature of the fill and surface that previous excavators had dug in this area.

Structure 1 consisted only of an 8-foot-long section of puddled adobe wall standing to a height of 2 feet, and a section of hard-packed mud floor extending from the base of the wall. Most of the floor had been destroyed by earlier diggers. Sherds were plentiful both above and beneath the floor. The small section that remained was cleared, revealing an oval patch immediately adjacent to the wall. Digging through this patch, we encountered a human burial 21 inches beneath the floor.

The burial was that of an adult female which had been placed in an oval pit measuring approximately 30 inches by 45 inches in horizontal dimensions and extending 24 inches beneath the floor. After it was placed in position, the floor had been replastered. The skeleton was in a flexed position, resting on its right side, facing east — the rear of the cave. Most of the bones were in a poor state of preservation. The small bones and the extremities of the larger bones were extremely fragile or had disintegrated. The skull was fairly well preserved, although the mandible was broken. The burial pit had been lined with a twilled yucca leaf mat which had been folded over the body after it had been placed in the grave. A few small bits of carbonized cloth near the skeleton indicated that the body was originally clothed or wrapped in a blanket. To the rear of the skeleton, sherds of a broken Alma Neck Banded jar were recovered (Pl. 20). It appears to have been purposely broken. A large stone, 18 inches in diameter and 4 inches thick, rested on the left shoulder of the skeleton.

The only remains of Structure 2, located about 8 feet northwest of Structure 1, were two small sections of puddled adobe walls meeting at a right angle to form a corner. The fill near the walls had been disturbed by earlier digging; however, it did contain many potsherds, corn cobs, charcoal and ash. No floor remained.

INVENTORY OF SPECIMENS FROM SWALLOW CAVE

In this inventory of specimens from Swallow Cave, as well as in subsequent inventories of specimens from other caves, no descriptive accounts of the remains are given. However, in Chapter VI specimens from all sites are described, their stratigraphic positions are noted, and their frequencies are indicated. This style of presentation was preferred to scattering artifact descriptions throughout the accounts of individual sites and should allow the reader to obtain a better over-all concept of the archaeological materials from the entire area.

Most specimens from Swallow Cave, other than pottery, were found on the surface of the cave or in Structures 1 and 2.

CHART 1. *Frequencies of pottery types, Swallow Cave, Cave Valley, Chihuahua*

Pottery Types:	Alma Plain	Alma Plain, Buff	Alma Scored	Alma Rough	Alma Incised	Alma Punched	Alma Neck Banded	Plain Corrugated	Plain Corrugated, Trilled	Incised Corrugated	Indented Corrugated	Smoothed Corrugated	Three Circle Neck Corrugated	Patterned	Red on Brown	Orange	Tan, Fine Paste	Fillet Rim	Unfired	Totals
Surface Collection	1	2								1	2									6
<i>Trench 1:</i>																				
Level 1	14		4							1	3									22
Level 2	41	6	2		2					13	1									65
Level 3	3																			3
Levels 4 & 5																				
Totals	58	6	6		2					14	4									90
<i>Trenches 2 & 3:</i>																				
Level 1	52		3			1		5		3	3	1			1	1				70
Level 2	191	18	47	21		3	2	7		14	3		1	3	5					315
Level 3	273	10	20	5			2	1	1	68	1			5	11		1			398
Level 4	147	14	5		6			3		20	1		1	3	4		1			205
Level 5	52		2	1						3					2					60
Level 6	14	1	5																	20
Level 7	2		1																	3
Levels 8-16																				
Totals	731	43	78	27	6	4	4	16	1	113	8	1	2	11	23	1	2			1071
Structure 1	215	8	5		4			7		30	6				1			1		277
Structure 2	89	6	3		5			6		9	6								4	128
Grand Totals	1094	63	99	27	17	4	4	29	1	162	26	1	2	11	24	1	2	1	4	1572

Pottery: Chart 1 records the frequency of pottery wares from our excavations in Swallow Cave. The ceramic remains recovered are greater than those from any other cave tested, and give us our best picture of cultural stratigraphy. Especially significant are the deep stratified deposits in Trenches 2 and 3. One complete red-on-brown bowl and a partially restorable Alma Neck Banded jar were recovered.

Foodstuffs: 116 corn cobs, 37 kernels of corn, 9 pieces of cucurbit rind, 4 cucurbit

stems, assortment of acorns, 11 fiber quids, 1 pinyon nut shell, 1 cherry stone, assortment of lycium berries.

Stone, Bone, and Shell Artifacts: 1 hammerstone, 1 stone ornament, 1 stone core, 1 shell ornament, 22 utilized flakes of stone.

Cordage, Fiber, and Textiles: 11 pieces of cord, 1 doughnut-shaped pot rest, 1 sandal, 2 pieces of twilled yucca leaf matting, 2 fiber bindings.

Wooden Artifacts: 4 fragments of arrows, 1 reed cigarette, 1 carved wooden ball, 4 trap triggers, 5 willow ties, 1 fragment of a gourd vessel.

SLAB CAVE

DESCRIPTION

Slab Cave, second from the north in the group of five caves on the east side of Cave Valley, is 75 feet across the mouth, averages about 50 feet in depth, and has a roof 12 feet high at the front. Several large slabs of rock extending from the rear almost to the front lay over approximately one half of the southern floor. They form a ledge or shelf standing about 2 feet higher than the remainder of the cave floor. The ceiling and the walls are coated with soot. A thin layer of dirt containing cultural remains had drifted over the rock slabs, but the greatest depth of deposits occurred in that portion of the cave not covered by the rock. The activity of previous excavators was apparent in several places, and about their diggings were scattered sherds, corn cobs, and several human vertebrae and skull fragments. It is obvious that the earlier diggers had encountered burials in their trenchings. Also observed on the surface were a large number of fragments of hard adobe mud with grass- and pole-impressions in them. These undoubtedly came from walls or roofs of a structure, but it was impossible to determine its nature from the fragmentary evidence remaining.

In addition to making a surface collection, we dug five test trenches. Two of these were excavated adjacent to the front of the slab of rock to determine whether or not cultural remains extended beneath the rock. These excavations showed that the slabs rested upon the rock floor and that only along the irregular edges of the slabs did cultural material go back beneath the rock for a short distance. Thus, it appears as though the large rocks fell before the period of human occupancy. Three other test trenches were dug against the north wall in a location where the deposits did not look as if they had been disturbed. Archaeological remains were obtained from three of the five test trenches dug.

EXCAVATIONS

Trench 1. A trench 4 feet by 6 feet was dug in front of the rock slab. Two 6-inch levels of debris were removed. At the bottom of Level 2 the rock floor was reached. A tabulation of sherds recovered from this trench, as well as those from Trenches 2 and 3 and from the cave surface, is shown in Chart 2.

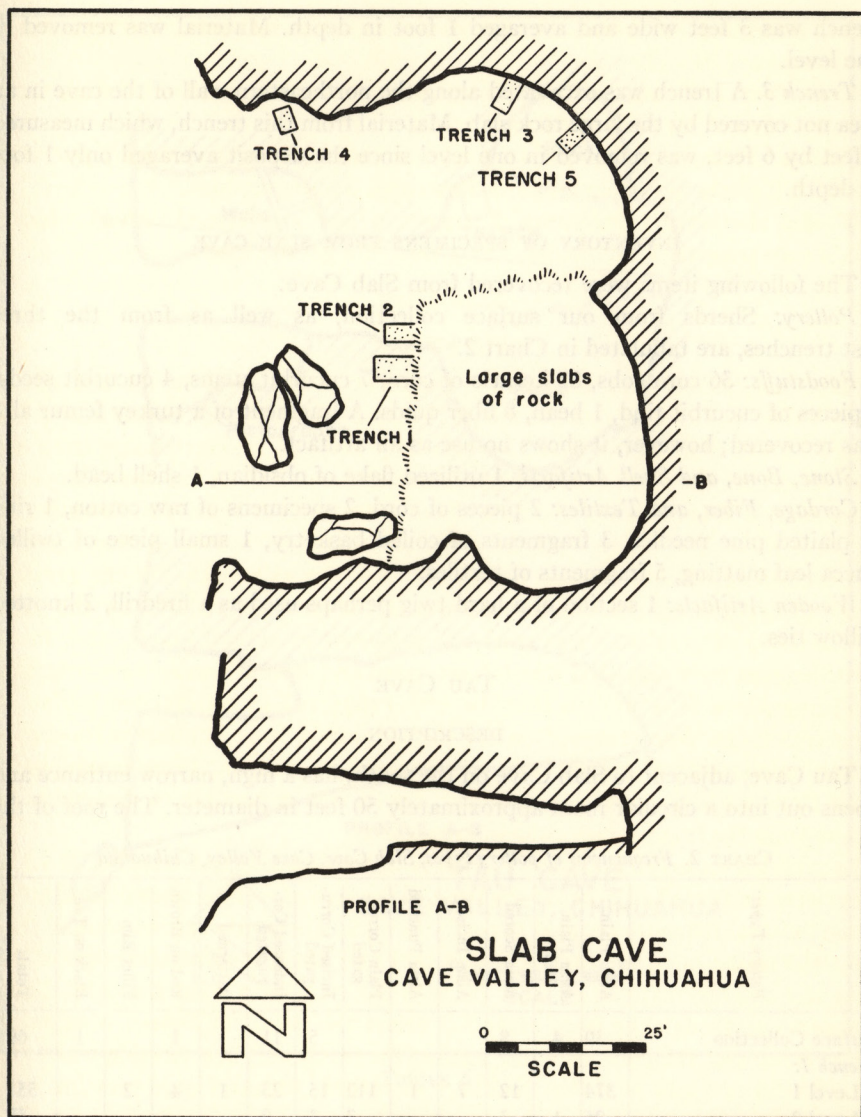


FIGURE 5

Trench 2. This trench was dug under the front edge of the slab to determine whether cultural remains extended beneath it, and if so, to what distance. As mentioned above, the slabs seem to rest on the cave floor, and dirt containing refuse had worked back under the irregular edges a short distance. Trench 2 was dug only 2 feet back from the front of the slab before solid rock was met. The

trench was 3 feet wide and averaged 1 foot in depth. Material was removed in one level.

Trench 3. A trench was excavated along the northeastern wall of the cave in an area not covered by the large rock slab. Material from this trench, which measured 4 feet by 6 feet, was removed in one level since the deposit averaged only 1 foot in depth.

INVENTORY OF SPECIMENS FROM SLAB CAVE

The following items were recovered from Slab Cave:

Pottery: Sherds from our surface collection, as well as from the three test trenches, are tabulated in Chart 2.

Foodstuffs: 36 corn cobs, 82 kernels of corn, 7 cucurbit stems, 4 cucurbit seeds, 2 pieces of cucurbit rind, 1 bean, 8 fiber quids. A fragment of a turkey femur also was recovered; however, it shows no use as an artifact.

Stone, Bone, and Shell Artifacts: 1 utilized flake of obsidian, 1 shell bead.

Cordage, Fiber, and Textiles: 2 pieces of cord, 2 specimens of raw cotton, 1 ring of plaited pine needles, 3 fragments of coiled basketry, 1 small piece of twilled yucca leaf matting, 5 fragments of textiles.

Wooden Artifacts: 1 section of a hard twig perhaps used as a firedrill, 2 knotted willow ties.

TAU CAVE

DESCRIPTION

Tau Cave, adjacent to Slab Cave on the south, has a high, narrow entrance and opens out into a circular room approximately 50 feet in diameter. The roof of the

CHART 2. *Frequencies of pottery types, Slab Cave, Cave Valley, Chihuahua*

<i>Pottery Types:</i>	Alma Plain	Alma Plain, Buff	Alma Scored	Alma Incised	Alma Punched	Plain Corru- gated	Incised Corru- gated	Indented Cor- rugated	Patterned	Red on Brown	Fillet Rim	Black on Tan	Totals
Surface Collection	39	4	8				5	11		1		1	69
<i>Trench 1:</i>													
Level 1	374		12	7	1	112	15	23	1	4	2		551
Level 2	26	1	3			3	3	2					38
Totals	400	1	15	7	1	115	18	25	1	4	2		589
Trench 2	59	1	1			22		2					85
Trench 3	13		1			9		1					24
Grand Totals	511	6	25	7	1	146	23	39	1	5	2	1	767

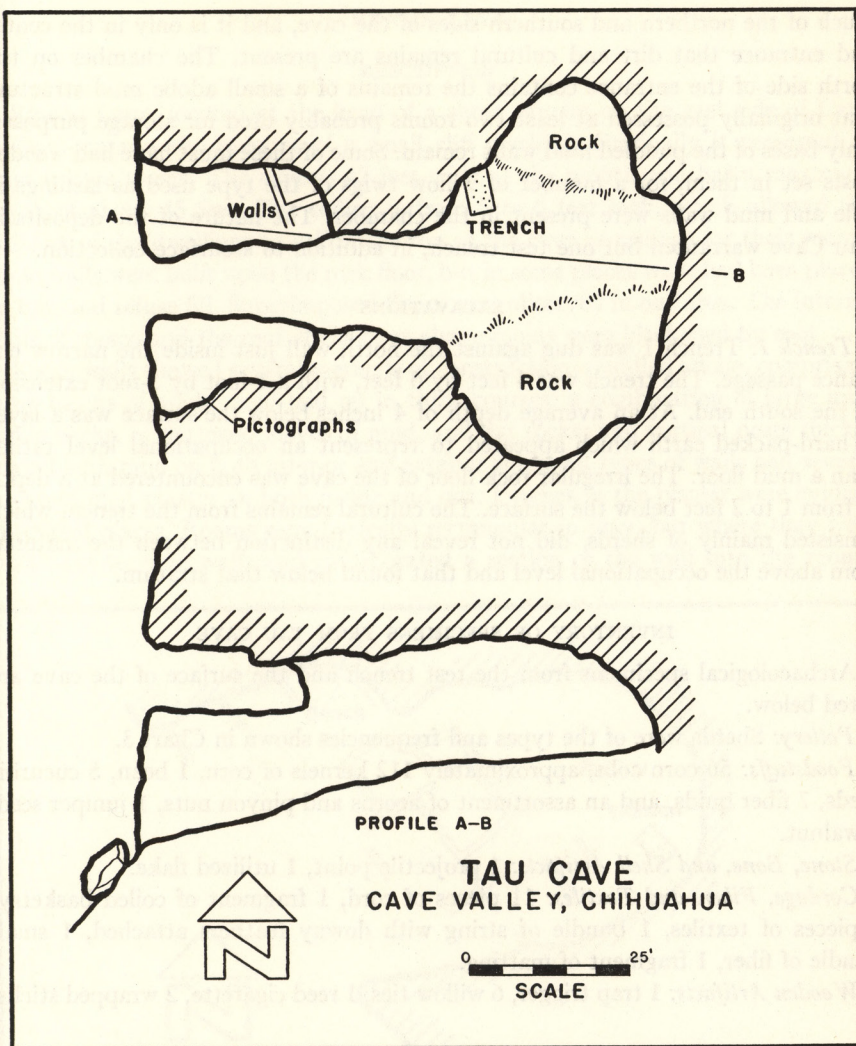


FIGURE 6

interior is about 15 feet high. On either side of the entrance passage there are small chambers whose floors are 20 feet above the level of the entrance. Their roofs are approximately 6 feet in height. As one looks from the rear of the cave through the cave entrance, the profile of the passage and adjacent chambers is T-shaped. Within the circular portion of the interior of the cave, the floor slopes steeply to the center and towards the entrance. The rock floor is exposed over

much of the northern and southern sides of the cave, and it is only in the center and entrance that dirt and cultural remains are present. The chamber on the north side of the entrance contains the remains of a small adobe mud structure that originally possessed at least two rooms probably used for storage purposes. Only bases of the puddled mud walls remain. Some of these must have had wooden posts set in them, for a number of willow twigs of the type used as lashings in pole and mud walls were present in the chamber. The nature of the deposits in Tau Cave warranted but one test trench, in addition to a surface collection.

EXCAVATIONS

Trench 1. Trench 1 was dug against the north wall just inside the narrow entrance passage. The trench was 4 feet by 6 feet, with a 1-foot by 3-foot extension at the south end. At an average depth of 4 inches below the surface was a layer of hard-packed earth which appeared to represent an occupational level rather than a mud floor. The irregular rock floor of the cave was encountered at a depth of from 1 to 2 feet below the surface. The cultural remains from the trench, which consisted mainly of sherds, did not reveal any distinction between the material from above the occupational level and that found below that stratum.

INVENTORY OF SPECIMENS FROM TAU CAVE

Archaeological specimens from the test trench and the surface of the cave are listed below.

Pottery: Sherds were of the types and frequencies shown in Chart 3.

Foodstuffs: 56 corn cobs, approximately 112 kernels of corn, 1 bean, 5 cucurbit seeds, 7 fiber quids, and an assortment of acorns and pinyon nuts, 1 juniper seed, 1 walnut.

Stone, Bone, and Shell Artifacts: 1 projectile point, 1 utilized flake.

Cordage, Fiber, and Textiles: 11 pieces of cord, 1 fragment of coiled basketry, 2 pieces of textiles, 1 bundle of string with downy feathers attached, 1 small bundle of fiber, 1 fragment of matting.

Wooden Artifacts: 1 trap trigger, 6 willow ties, 1 reed cigarette, 2 wrapped sticks.

CHART 3. *Frequencies of pottery types, Tau Cave, Cave Valley, Chihuahua*

<i>Pottery Types:</i>	Alma Plain	Alma Scored	Alma Punched	Plain Corrugated	Incised Corrugated	Indented Corrugated	Patterned	Red on Brown	Black on Tan	Total
Trench 1	160	8	2	33	5	3	1	1	1	214

RINCON CAVE

DESCRIPTION

Rincon Cave, located at the head of a short canyon on the east side of Cave Valley, contains the remains of a small cliff dwelling. Originally it possessed at least twelve rooms. The cave is 42 feet wide at the mouth and has a maximum depth of about 45 feet. The ceiling is from 5 to 6 feet high, which allowed the builders of the dwellings to utilize the top of the cave as ceilings for their rooms. Most walls were built upon the rock floor, but in some places walls had been placed on dirt and refuse fill. Superimposed floors were observed in one area. The interior walls of rooms and the roof of the cave above rooms were blackened by soot.

Room walls showed several methods of construction: puddled adobe, comprising large blocks of adobe mud laid up in thick courses; a combination of large mud turtle backs, or flattened loaves of mud, and flat rocks; and vertical posts thickly coated with mud on both interior and exterior sides. All types of walls had several layers of mud plaster on both inside and out. Patches in the plaster were evident in several places. Rooms were basically rectangular in plan, but where they were built next to cave walls and incorporated a section of the wall into the rooms,

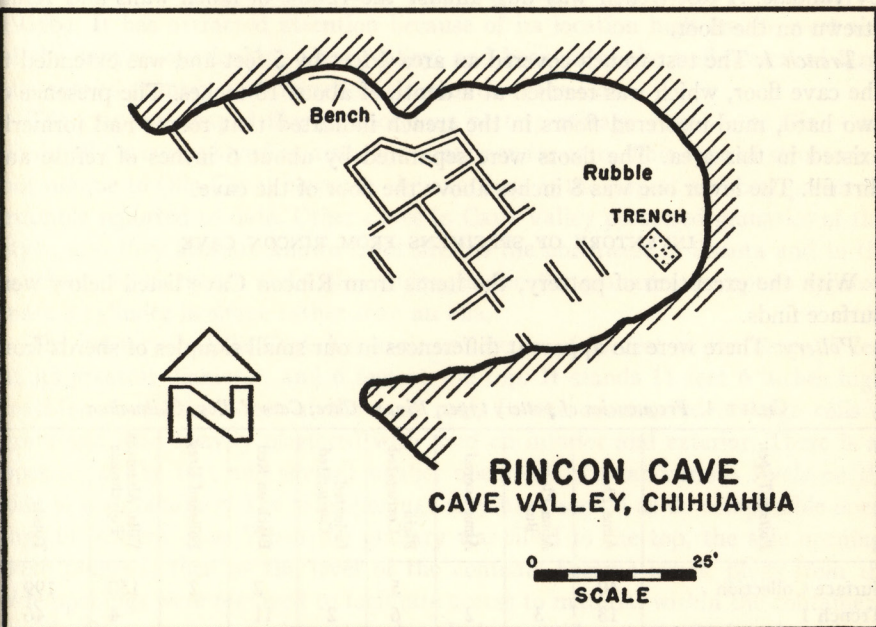


FIGURE 7

irregular shapes resulted. A few narrow rooms at the rear of the cave seem suited only for storage purposes. Rooms which could have served as habitations varied from 5 feet by 6 feet to 6 feet by 13 feet. Doorways and windows occur in most of the walls that still stand. Doorways are both rectangular and step-passage. Those that are step-passage have a small, square notch cut in the center of the bottom of an otherwise rectangular-shaped doorway. Both types of doorways average 3 feet in height and $1\frac{1}{2}$ feet in width and frequently are narrower at the top than at the bottom. They usually were placed from 3 to 6 inches above the floor level. In one instance a flat, mud platform 3 inches high had been built on the floor of a room just in front of the doorway. It may have served as a step to assist small children in using the opening. Windows were not as common as doorways and were observed only in interior walls. They were rectangular, varying from 1 to 2 feet in height. One room contained a platform-and-depressed-basin type of fireplace which consists of a low, rectangular mud platform into which a shallow, oval firepit had been fashioned.

EXCAVATIONS

In the rear of the cave a number of walls had fallen or had been pushed over by vandals. A test trench was dug amidst the rubble of fallen walls and refuse strewn on the floor.

Trench 1. The test trench covered an area 4 feet by 5 feet and was extended to the cave floor, which was reached at a depth of about 18 inches. The presence of two hard, mud-plastered floors in the trench indicated that rooms had formerly existed in this area. The floors were separated by about 6 inches of refuse and dirt fill. The lower one was 8 inches above the floor of the cave.

INVENTORY OF SPECIMENS FROM RINCON CAVE

With the exception of pottery, the items from Rincon Cave listed below were surface finds.

Pottery: There were no apparent differences in our small samples of sherds from

CHART 4. *Frequencies of pottery types, Rincon Cave, Cave Valley, Chihuahua*

<i>Pottery Types:</i>	Alma Plain	Alma Plain, Buff	Alma Scored	Plain Corrugated	Indented Corrugated	Black on Red	Polished Grey	Villa Ahumada Polychrome	Totals
Surface Collection	40			5		2	2	150	199
Trench 1	18	3	2	6	2	11		4	46
Grand Totals	58	3	2	11	2	13	2	154	245

above, between, or beneath the floors. Therefore, all sherds from the trench, as well as those collected from the surface, are lumped together in our classification shown in Chart 4. A number of sherds belonging to a large Villa Ahumada Polychrome vessel were obtained. When pieced together, they form about one quarter of a large olla (Pl. 21). The broken fragments apparently had been scattered over the surface of the cave in the area selected for our trench.

Foodstuffs: 5 corn cobs.

Cordage, Fiber, and Textiles: 2 lengths of braided yucca leaves, 1 knotted yucca leaf, 1 bundle of yucca fiber, 4 pieces of cord, 1 fragment of coiled basketry, 1 "miniature sandal", 3 fiber bindings.

Wooden Artifacts: 2 parts of trap triggers, 1 fragmentary perforated wooden disc, 6 willow ties, 3 fragmentary corn cobs tied together.

OLLA CAVE

DESCRIPTION

The best-known archaeological site in Cave Valley is Olla Cave. It was first reported by Lumholtz (1902) and has been described and illustrated by several more recent investigators. (Brand, 1943; Hewett, 1908; Kidder, 1939; Sayles, 1936b). It has attracted attention because of its location high on the west side of the canyon overlooking Cave Valley, and because of the well-preserved large olla-shaped granary constructed in the mouth of the cave.

The granary, shaped like an enormous pottery storage vessel — or *olla* — undoubtedly was employed as a storage container for corn. This type of structure is not unique to Olla Cave; however, the one there is the largest and best-preserved example reported to date. Other caves in Cave Valley possessed granaries of this style, and they also are known from sites to the northwest in Sonora and to the south on the Garabato and Chico drainages. Smaller granaries are apt to approximate a cylinder in shape rather than an olla.

The granary in Olla Cave has a circumference of 27 feet at the base, 37 feet at its greatest diameter, and 6 feet at the top. It stands 11 feet 6 inches high, reaching to within 2 feet of the cave roof. It was constructed of large coils of grass and mud heavily plastered with mud on interior and exterior. There is an opening at the top, and several smaller openings occur at various levels on the side of the container. The side openings may have served as do comparable openings in modern silos. When the granary was filled to the top, the side openings were plugged; then as the level of the contents became lower, plugs from the side openings were removed to facilitate access to material within the container.

Olla Cave presents an irregular plan. It has a wide mouth, 56 feet from north to south, a large central area, and two lobes extending to the rear. The northern lobe is a narrow, dark corridor reaching over 100 feet to the rear of the main

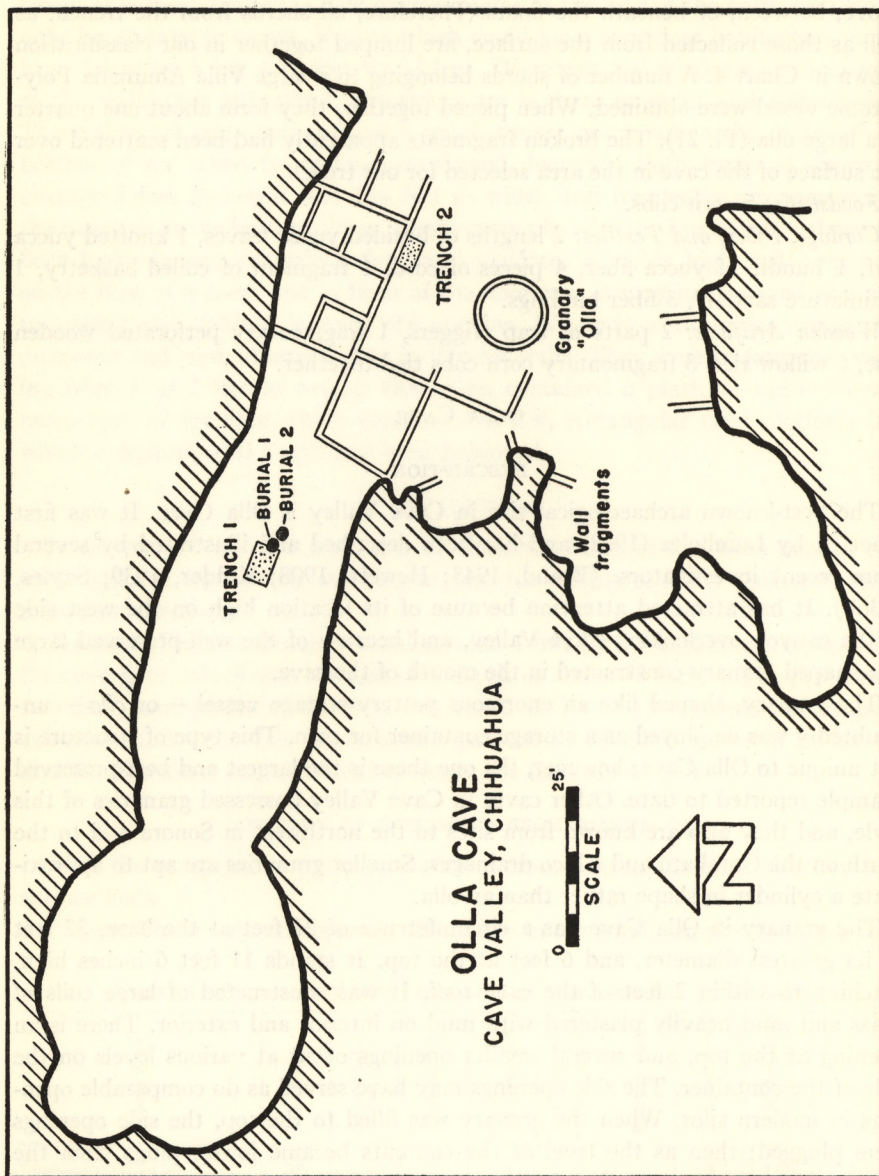


FIGURE 8

PLATE 5



A. Olla Cave, Cave Valley, Chihuahua



B. Olla Cave. The large mud-and-grass granary in the front of the cave



Olla Cave. House remains. Note where second-story rooms had formerly abutted against the cave ceiling.

PLATE 7



A. Corral Cave, Cave Valley, Chihuahua. House remains located in the dark, rear portion of the cave.



B. Corral Cave. Portion of a post-and-mud wall showing the vertical posts, horizontal sticks, and mud plaster.

PLATE 8



Corral Cave. Detail of post-and-mud wall. Note the willow binding used to tie the horizontal sticks to the vertical posts.

section of the cave. The ceiling of the central part is approximately 13 feet above the floor.

A cliff dwelling of at least 15 rooms had been built in the cave. Most of the better-preserved rooms are concentrated in the northern half of the front adjacent to the large granary. Wall foundations and pieces of wall remains in the southern portion of the main section of the cave and in the southern lobe indicate the former presence of rooms in those areas. Most of the existing rooms are rectangular in plan and range in size from 6 feet by 7 feet to 11 feet by 15 feet. A few smaller rooms, probably utilized for storage purposes, were built against the cave walls. Most of the structures were built of puddled adobe, frequently with the addition of flat slabs of rock. Mud plaster was spread over both sides of walls, and in one room the plastered walls had been decorated with figures drawn in black and red pigments.

Wall openings are numerous. Step-passage doorways are more frequent than rectangular-shaped ones. A few small, rectangular windows were noted. No wood remains in any of the structures; however, originally pole and mud roofs and wooden lintels over doorways and windows were employed. Some second-story rooms had existed as evidenced by markings on the cave roof where walls of second-story rooms had been built to the top of the cave. Such rooms utilized the cave ceiling as ceilings for the rooms.

EXCAVATIONS

Two test trenches were excavated in Olla Cave. One was located within a room in order to test the nature of deposits below floor level. A second trench was dug in the narrow, dark corridor behind the rooms. Two human burials were uncovered by this latter trench, and it seems likely that more burials might be present in this part of the cave.

Trench 1. This trench was dug in the long, dark chamber behind the rooms. The floor of this part of the cave was devoid of cultural material. An area 4 feet by 6 feet, oriented east-west, was laid out and excavated in 6-inch levels to the bottom of the cave. The first three levels produced but few sherds, and below level 3 the deposit was sterile. The uneven cave floor was reached at an average depth of 40 inches below the surface. Sherds from this trench, as well as those from Trench 2, have been classified and recorded in Chart 5. The only other artifact recovered from the trench was a metate found in level 2.

A human burial was encountered at the western edge of the trench. The body had been placed in the bottom of a pit dug to the rock floor of the cave. The skeleton was that of an adult male and was found in a seated position facing east. The knees were drawn up in a semi-flexed position, the right leg crossed over the left. The arms were folded over the pelvis. Most of the larger bones were in a good

state of preservation. No artifacts accompanied the burial. In the process of removing this skeleton, a second burial was encountered. It was located immediately southwest of the first and had been treated identically. The second skeleton was that of an adult female found in a seated position facing east. The knees were semi-flexed; the arms folded over the pelvis. No artifacts were found in association with the burial. After the soft parts of the body had decomposed,

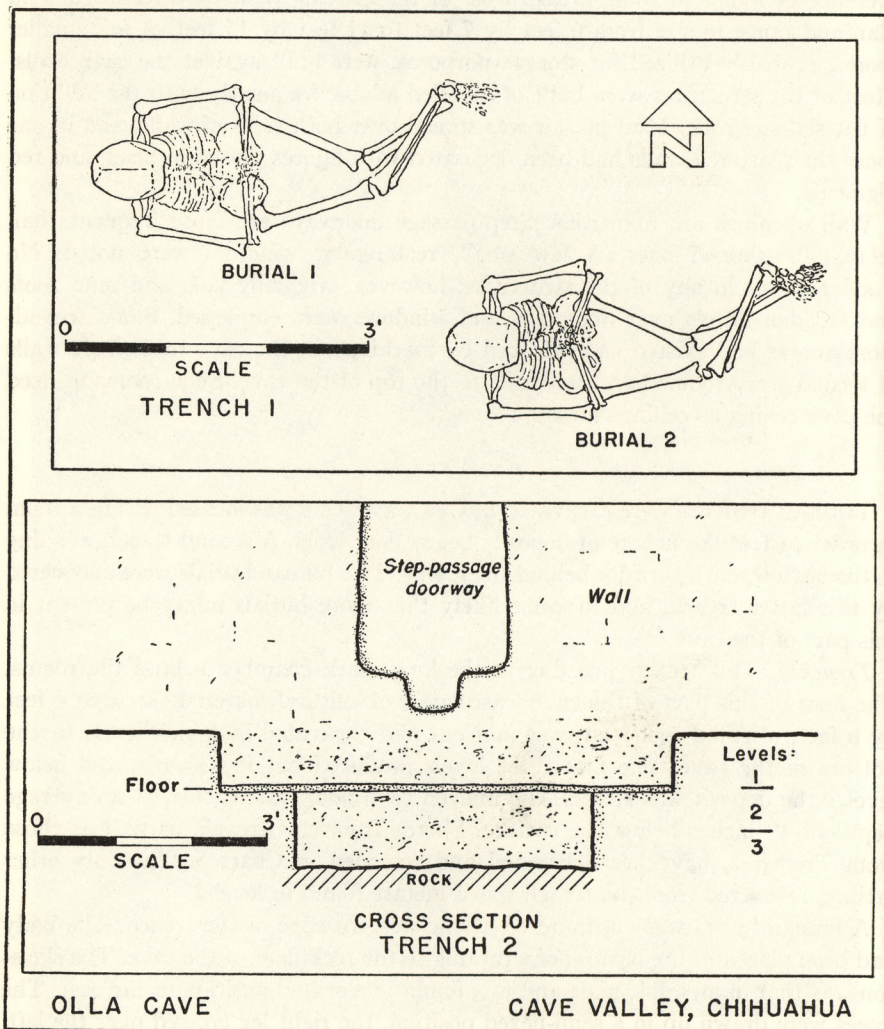


FIGURE 9. Archaeological features, Olla Cave, Cave Valley, Chihuahua

dirt had not filled in around the skeleton, so that the bones were found in a cavity which approximated the shape of the body. In a few places textile impressions were detected in the dirt which had been in contact with the body, indicating that a blanket, or cloth wrapping, had been placed around the corpse before burial.

Trench 2. A second trench was dug in Olla Cave adjacent to one of the room walls in front of the cave. It was assumed, and correctly so, that this trench would expose a floor of the room and reveal the nature of the deposits below floor level. The trench covered an area 5 feet by 6 feet above the floor, and was narrowed to 4 feet by 3 feet below that level so that no material from the upper level would fall into the lower deposits. It was excavated in 6-inch levels. The plastered mud floor was reached at the bottom of the first level. Above the floor, a large number or sherds, fragments of adobe with reed impressions — undoubtedly parts of roof — corn cobs, and utilized flakes of stone were collected. Only 12 inches of fill occurred between the floor and the bottom of the cave. Cultural remains were much less abundant below floor level and consisted only of sherds.

INVENTORY OF SPECIMENS FROM OLLA CAVE

Very little archaeological material was recovered from the surface of Olla Cave, and the test trenches produced only a few specimens other than sherds.

Pottery: Sherds from Olla Cave are tabulated in Chart 5.

CHART 5. *Frequencies of pottery types, Olla Cave, Cave Valley, Chihuahua*

Pottery Types:	Alma Plain	Alma Plain, Buff	Alma Scored	Alma Incised	Plain Corrugated	Incised Corrugated	Black on Tan	Polished Grey	Totals
<i>Trench 1:</i>									
Level 1	19				6	1			26
Level 2	15			7	5				27
Level 3	7								7
Totals	41			7	11	1			60
<i>Trench 2:</i>									
Level 1	227	1	6				1	1	236
Level 2	18		6						24
Level 3	3								3
Totals	248	1	12				1	1	263
Grand Totals	289	1	12	7	11	1	1	1	323

Foodstuffs: 31 corn cobs, 11 kernels of corn, 3 cucurbit stems, 18 cucurbit seeds, 3 beans, 17 acorns, 2 pinyon nut shells, 5 fiber quids.

Stone Artifacts: 3 metates, 4 utilized flakes.

Textiles: Impressions of a textile in the dirt adjacent to one of the burials indicated that the corpse had been wrapped in woven material at the time of burial.

Wooden Artifacts: 1 trap trigger.

CORRAL CAVE

DESCRIPTION

Corral Cave is situated at valley level in the rear of a narrow canyon tributary to Cave Valley on the west. The mouth is but 26 feet wide; however, the cavity

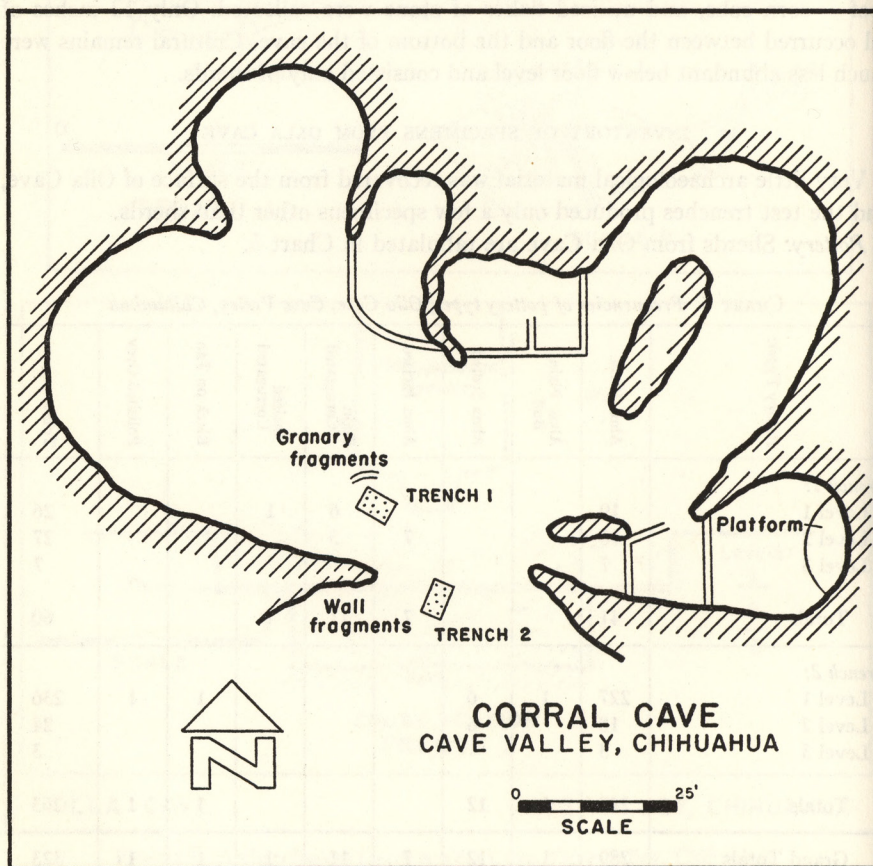


FIGURE 10

becomes much larger in the interior. It has a very irregular plan with five finger-like chambers radiating from the central area. Its greatest dimension from east to west is about 135 feet, its maximum depth is approximately 85 feet, and the ceiling height is greater than 10 feet in most places. It faces south. In recent years a pole fence has been placed across the mouth, and the cave has been a corral for cattle, sheep, and goats. The interior, away from the mouth, is very dark. Our mapping, collecting, and testing had to be accomplished with the aid of flashlights.

At least seven rooms and a granary had been built in Corral Cave. Most of the rooms had been constructed adjacent to the walls and consequently were of various shapes. In several locations rooms had been formed by closing off small, natural chambers with straight or curved walls. Rooms were observed to have been built of puddled adobe mud in some places and of pole and mud construction in others. Throughout most of the cave the roof was too high to have been used as the ceiling for rooms; therefore, most rooms originally possessed pole and mud roofs, but none were still intact. Both rectangular and step-passage doorways

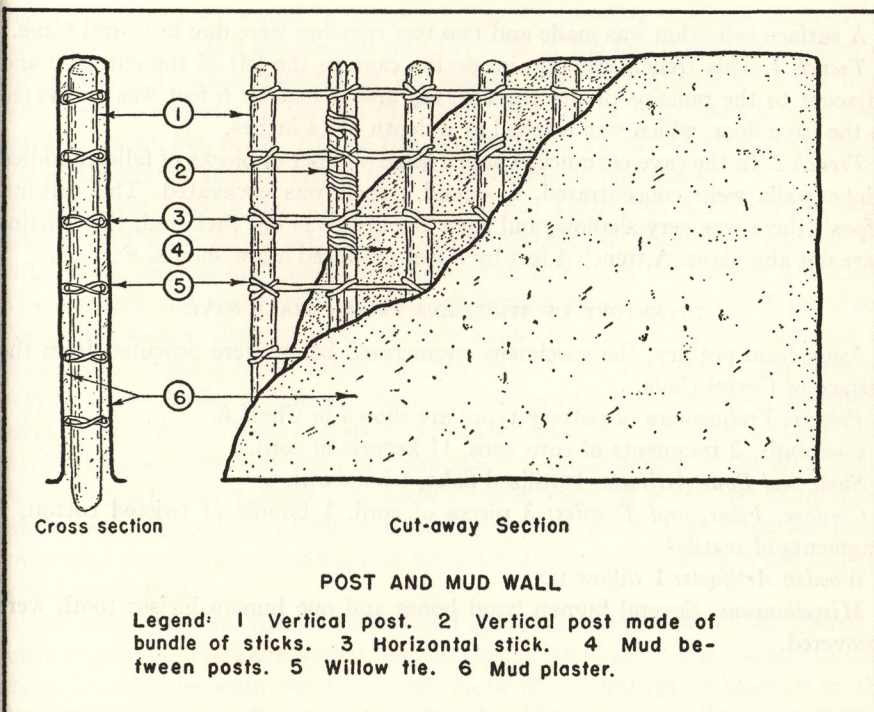


FIGURE 11. Details of construction, post-and-mud wall

CHART 6. *Frequencies of pottery types, Corral Cave, Cave Valley, Chihuahua*

Pottery Types:	Alma Plain	Alma Plain, Buff	Alma Scored	Alma Rough	Alma Incised	Plain Corrugated	Incised Corrugated	Indented Corrugated	Totals
Trench 1	95		3	1	2	1	6	1	109
Trench 2	46	1							47
Grand Totals	141	1	3	1	2	1	6	1	156

were present. A quantity of large blocks of adobe mud in the mouth of the cave suggested that a wall formerly had crossed the entrance. Inside the mouth of the cave the foundations and a few grass-and-mud sections of a granary were found. Whether the structure had been cylindrical or olla-shaped could not be ascertained.

EXCAVATIONS

A surface collection was made and two test trenches were dug in Corral Cave.

Trench 1. This trench was dug inside the cave to the left of the entrance and adjacent to the remains of the granary. An area 4 feet by 6 feet was excavated to the cave floor, which was reached at a depth of 14 inches.

Trench 2. In the cave entrance, where a large number of blocks of fallen puddled adobe walls were concentrated, a second trench was excavated. The cultural deposit there was very shallow, and since the area was not sheltered, the remains were not abundant. A trench 4 feet by 8 feet produced a few sherds.

INVENTORY OF SPECIMENS FROM CORRAL CAVE

Aside from pottery, the specimens enumerated below were procured from the surface of Corral Cave.

Pottery: Frequencies of pottery types are shown in Chart 6.

Foodstuffs: 2 fragments of corn cobs, 11 kernels of corn.

Stone and Bone Artifacts: 1 utilized flake, 1 bone awl.

Cordage, Fiber, and Textiles: 3 pieces of cord, 1 bundle of twisted cotton, 2 fragments of textiles.

Wooden Artifacts: 1 willow tie.

Miscellaneous: Several human hand bones and one human incisor tooth were recovered.

IV. ARROYO EL CONCHO, SONORA

Archaeological sites in the Arroyo el Concho and vicinity, Sonora, may be reached from Nuevo Casas Grandes, Chihuahua. A road, used primarily by lumber trucks, turns off the Casas Grandes-Colonia Juarez road a short distance before Colonia Juarez is reached and heads northwest up the Arroyo Tinaja and into the Sierra Madres. The road has been improved since 1942 as a result of rather extensive lumbering operations in the mountains. It has some steep grades as it climbs into the mountains and in places it is rough, but other stretches are surprisingly good.

Once the mountain-top country is reached, the road passes through Valle Grande, a relatively recently developed lumber-mill-and-agricultural community. The continental divide is crossed west of Valle Grande at an elevation of approximately 7,000 feet, and the route descends to the small settlement of Gavilan. Continuing on to the northwest for 18 miles, we left the main road and drove over poor logging roads to the rim of an extremely rough canyon area locally termed "The Hole". *From that point the view westward is one of successive rugged mountain ranges separated by deep north-south trending canyons. Steep-sided tributary canyons and arroyos cut into the sides of the mountain ridges. Most of this country is in the drainage of the Río Bavispe. The trip of 75 miles from Nuevo Casas Grandes to the rim of "The Hole" can be negotiated in a pick-up truck in about five hours. At the rim we were met by natives with pack mules and saddle horses, and the rest of the trip was made on horseback.*

The canyon west of the rim is that of the Río Terracitas. A narrow but well-defined trail leads down into this canyon, crossing the boundary between the states of Chihuahua and Sonora just before the bottom of the canyon is reached. A few houses and small fields of corn are located along the banks of the river. Continuing almost directly west, we rode about four hours up the west side of the canyon, crossing many ridges and canyons. In but very few places were we able to follow trails, and in several spots horses had to be led over unusually rough terrain. At the head of a steep canyon we came to Step Cave, actually only about 2 airline miles from the Río Terracitas but much longer by the circuitous route we had to follow. From Step Cave we rode north for about two hours down into a deep canyon, over a ridge, and into Arroyo el Concho. Here camp was made for several days beside a small spring while the archaeological sites in the vicinity were investigated.

The country of the Río Terracitas and Arroyo el Concho which we visited is much like that of the Cave Valley area. In fact, it is a straight-line distance of only about 35 miles between the two areas. None of the valleys or canyons in the Sonora area present as favorable agricultural conditions as existed in Cave Valley.

In many cases, the only lands available for cultivation were on precipitous mountain slopes or in narrow arroyos. That these areas were utilized agriculturally is suggested by the presence of numerous rock walls. When located on the slopes, these walls form terrace-like arrangements, and when placed in arroyos they could have served as check dams. Higher elevations support oak and pine growths, mountain sides are densely covered with an association of scrub oak and agave, and in the canyon bottoms willows, poplars, walnuts, and other broad-leaved trees are found.

The Arroyo el Concho, a narrow, steep-sided canyon oriented east-west, heads about a mile west of our camping place and drains to the east into the Río Terracitas, which in turn flows south to the Río Bavispe. The canyon was dry at the time of our visit, but it was obvious from the deep stream bed and water-eroded outcrops and boulders that considerable water flows through it at times. The cliffs of the canyon are of volcanic agglomerates.

Four caves were investigated in Arroyo el Concho. They are located within a one-quarter-mile-long section of the north wall of the canyon and are situated about midway up the side of the canyon at the top of a talus 200 feet above the canyon bottom. Arch Cave is simply a rock overhang, but the other caves are of a type which offered excellent protection to their inhabitants.

STEP CAVE

DESCRIPTION

Step Cave is located at the head of a small canyon high on the mountainous ridge 2 miles to the west of Río Terracitas. It is in a very remote and isolated area. No source of water was noticed in the vicinity, but it is likely that water is present in the bottom of the canyon below the site at least part of the year.

The cave, which faces almost due east, is in a cliff of fairly soft agglomerate. Its mouth is 80 feet wide and is divided in half by a rock pillar reaching from floor to ceiling located in the approximate center of the entrance. Depth of the cave is about 35 feet, and the ceiling height is 12 feet.

Within the cave a cliff dwelling of twelve to fifteen ground-floor rooms exists. Many rooms are well preserved, with walls and roofs completely intact; however, walls of other rooms appear to have been pushed over by vandals. Most walls stand two stories high, and in one place a three-story section still stands. Although the majority were built of mud, a few walls of vertical pole and mud construction were observed. Mud for the walls seems to have been obtained by mixing water with the soft agglomerate of the local cliffs. Walls frequently had a large number of irregular rocks incorporated in their cores, and layers of mud plaster were present on both interiors and exteriors.

SKETCH MAP
STEP CAVE
SONORA

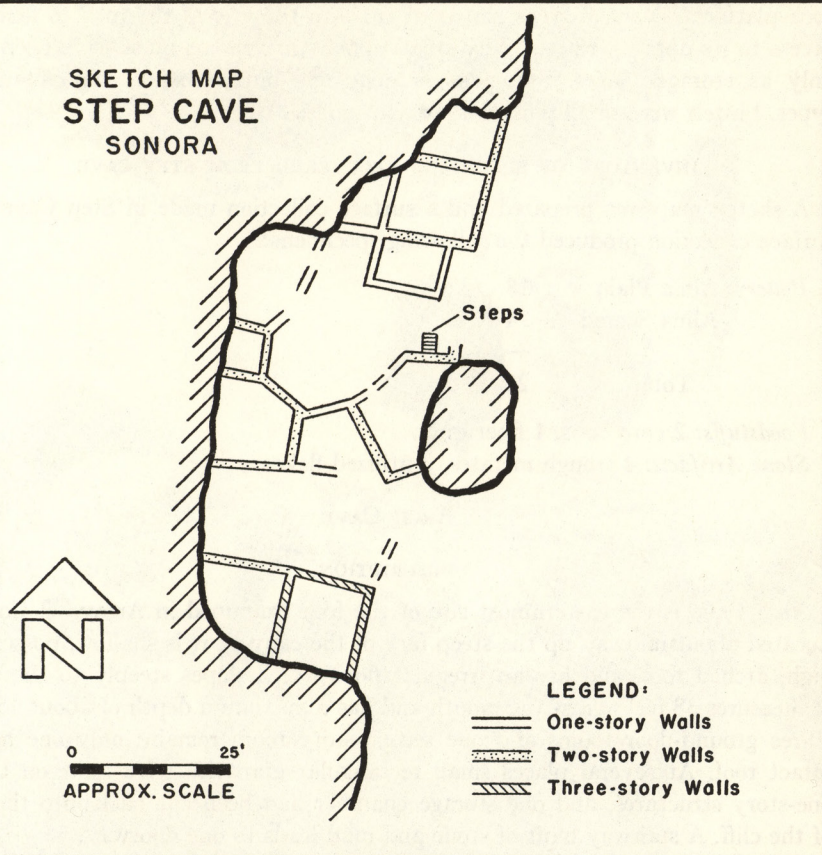


FIGURE 12

Roofs were fashioned of pine beams 4 to 5 inches in diameter, normally spanning the narrow width of the room. A layer of split poles was placed on top of and at right angles to the beams. Finally a thick layer of mud was spread over the split poles. In cases where a floor for an upper room was needed, a smooth layer of mud plaster was added. In some instances builders of roofs had eliminated the layer of split poles and had placed a heavy layer of mud on top of closely spaced beams. The interior of one room contained several vertical posts which had been placed to give additional support to the roof.

Although most rooms were rectangular in plan, those which were built against the rear and side walls of the cave were irregular in shape. Adjacent to the rock pillar in the front of the cave a two-story structure had been built on a natural

rock platform. A set of steps had been cut into the side of the rock to facilitate access to its upper surface. Many small upper-story rooms must have been used only as storage places. Step-passage doorways outnumbered the rectangular types. Lintels were small pine poles or split poles.

INVENTORY OF SPECIMENS RECOVERED FROM STEP CAVE

A sketch map was prepared and a surface collection made in Step Cave. The surface collection produced the following specimens:

<i>Pottery:</i> Alma Plain	18
Alma Scored	4
	—
Total	22

Foodstuffs: 2 corn cobs, 1 fiber quid.

Stone Artifacts: 4 trough metates, 3 utilized flakes.

ARCH CAVE

DESCRIPTION

Arch Cave is the easternmost site of the four examined in Arroyo el Concho. Located about midway up the steep face of the canyon, it is shallow, possesses a high, arched roof, and has an irregular floor which slopes steeply to the front. It measures 38 feet across the mouth and has a maximum depth of about 15 feet. Three ground-floor rooms and one second-story room remain; only one has an intact roof. At several places small rectangular granaries were built on top of one-story structures, and one storage chamber had been cut back into the face of the cliff. A stairway built of stone and mud leads to one doorway.

Walls were made of adobe mud and large river cobbles which in places resemble stone masonry. Roofs were of pine beams, a row of split poles laid at right angles, and a thick layer of mud on top of the poles. Walls and floors were plastered with mud. Low, narrow mud benches had been built along single sides of two rooms. Step-passage doorways outnumber the rectangular type. Lintels were of split poles.

INVENTORY OF SPECIMENS RECOVERED FROM ARCH CAVE

Because of the sloping nature of the floor, very little debris was left in the site. We collected the items listed below.

Pottery: 2 sherds of Alma Plain.

Foodstuffs: 9 corn cobs.

Stone Artifacts: 3 utilized flakes.

PLATE 9



Step Cave, Arroyo el Concho, Sonora. Method of roof construction is shown



A. Arch Cave, Arroyo el Concho, Sonora



B. Arch Cave. Rooms were built on the steeply sloping floor of this shallow cave. Dirt fill was placed within the rooms to level the floors.

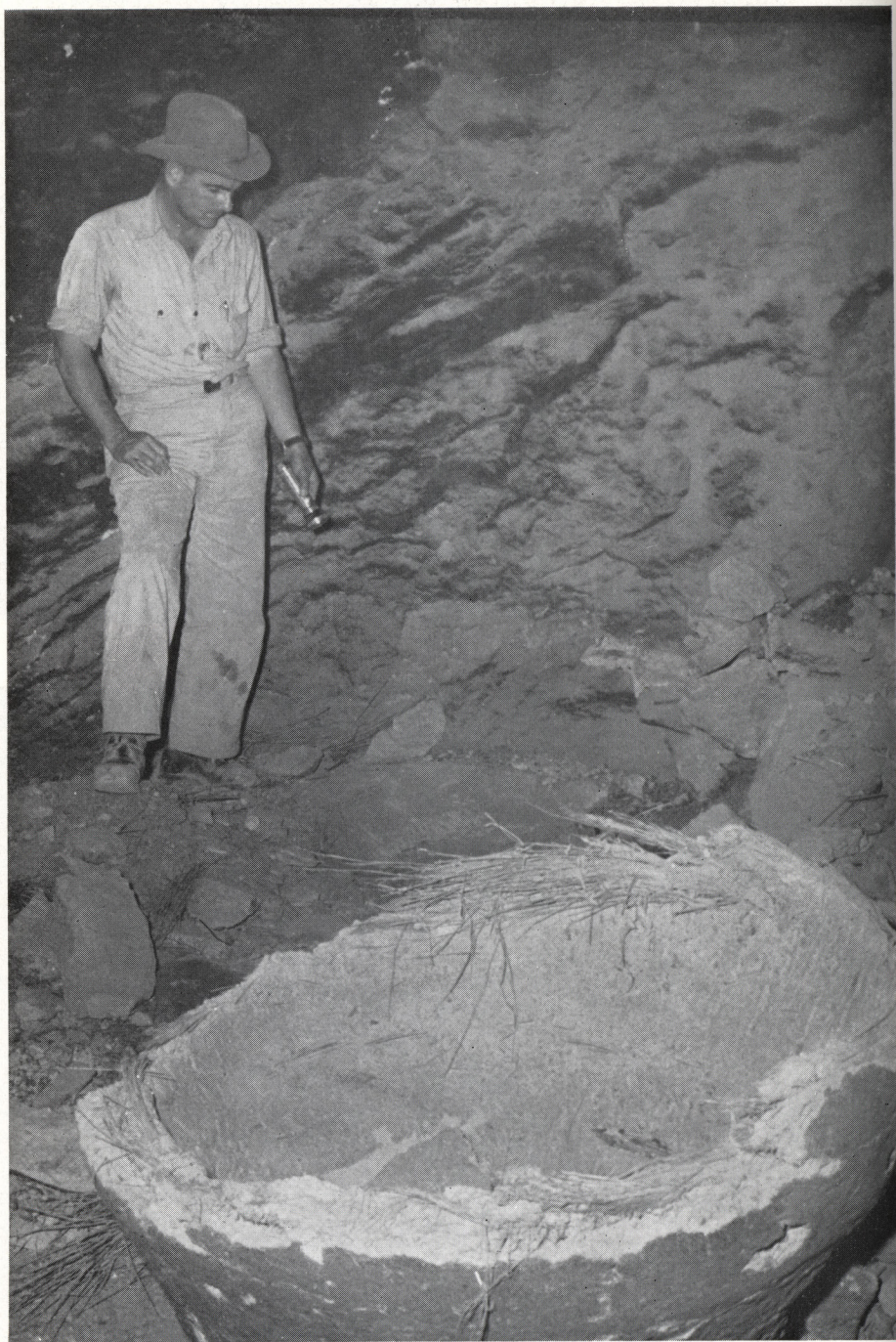
PLATE 11



A. Dark Cave. Arroyo el Concho, Sonora



B. Dark Cave. The poorly preserved nature of the puddled adobe mud walls of rooms in the outer portion of the cave is shown.



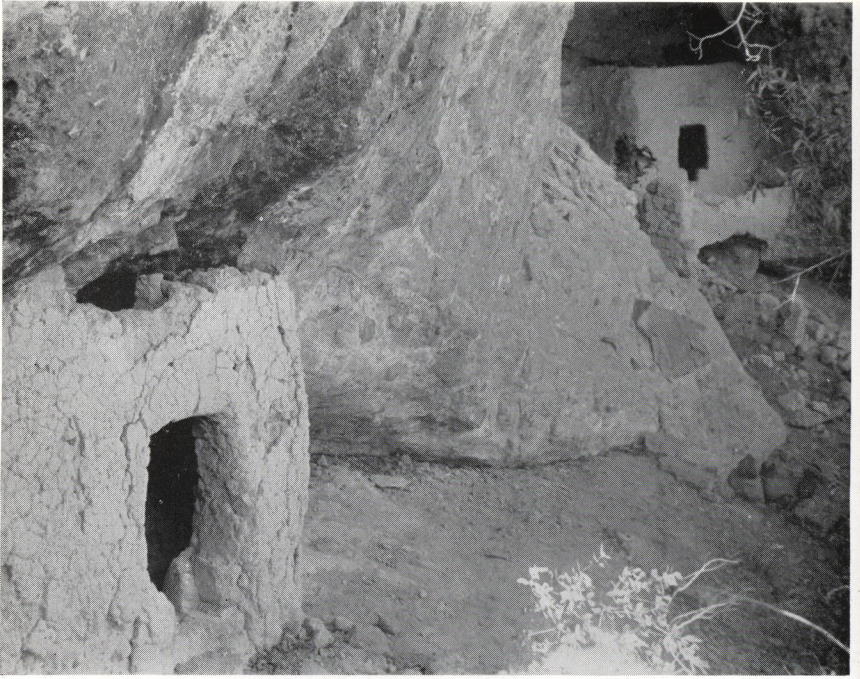
Dark Cave. Remains of large grass-and-mud granary



A. Red Paint Cave, Arroyo el Concho, Sonora. Note how room walls are built to ceiling of cave in places. A trough metate and a rectangular mano are on the ground in front of the figure.



B. Red Paint Cave. Human figure painted in red on an exterior wall of a room



A. Zigzag Cave, Arroyo el Concho, Sonora



B. Zigzag Cave. Walls shown are constructed of puddled adobe mud with a few unshaped stones incorporated.

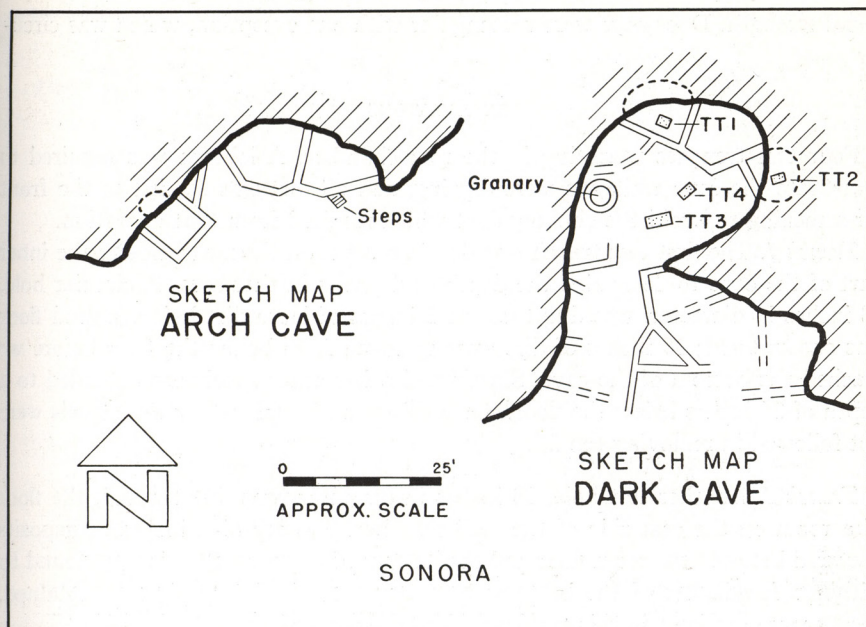


FIGURE 13

DARK CAVE

DESCRIPTION

One hundred yards west of Arch Cave and on the same level of the cliff face is Dark Cave. It has an outer chamber about 35 feet wide and 20 feet deep containing the remains of eight poorly preserved rooms. A dark, inner chamber approximately 30 feet in diameter has four rooms in a better state of preservation. The dirt floor is littered with refuse.

Most of the walls in the outer chamber had been pushed over, but walls of three rooms in the rear are standing. One room has a pole-and-mud roof. Two rooms in the back of the cave had been enlarged by hollowing out sections of the cave wall. The foundation and lower portion of an olla-shaped storage granary of coiled mud and grass was found in the inner chamber. It stands only 25 inches high and is 44 inches in diameter. The roof of the front of the cave is low enough so that it was employed as the ceiling for rooms built in that area.

Walls had been constructed of several materials: puddled adobe mud, cobblestones set in a large amount of mud mortar, and vertical posts and mud. A few puddled mud walls had horizontal posts built into their cores to give them addi-

tional strength. Doorways were rectangular with one exception, which was circular.

EXCAVATIONS

Four test trenches were dug in the rear chamber. A lantern was required to illuminate the cave while we were digging, and all dirt was carried to the front for screening to avoid the choking dust which resulted from that operation.

Trench 1. The first test trench was dug in a room on the north side of the inner part of the cave to determine the depth of deposits in that area. A circular hole, 18 inches in diameter, was dug through 2 inches of loose dirt before a mud floor was encountered; 39 inches of dirt were removed from below the floor before we reached the bottom of the cave. Sherds and a few other specimens extended to a depth of 26 inches below the floor. Since this was an exploratory test, levels were not followed in removing the fill.

Trench 2. Another test hole, 18 inches in diameter, was dug through the floor of a room on the east side of the rear chamber. Twenty-nine inches of deposits occurred between the room floor and the bottom of the cave. Sherds were found to within a few inches of the bottom; however, a total of only six was obtained. Levels were not kept in this test.

Trench 3. An area 4 feet by 5 feet was laid out in the center of the rear of the cave and was excavated in 6-inch levels.

Level 1 (0"-6") The surface consisted of a 3-inch level of hard-packed black, greasy dirt containing vegetal material. This appeared to represent an occupation level, consolidated by the movements of people living in the cave, rather than a purposely constructed floor. Below this, the deposit was soft, unconsolidated dirt mixed with a large amount of grass, ash, and charcoal. Chart 7 shows types and frequencies of sherds recovered from all levels of Trench 3. Several human bones and artifacts of stone and fiber also occurred.

Level 2 (6"-12") This level, like all lower levels, was 3 feet by 5 feet because the trench was shifted 1 foot to the south to avoid a rodent burrow which appeared at the bottom of Level 1. The deposit continued to consist of light, powdery dirt containing ash, vegetal material, and charcoal. An assortment of fragmentary human hand- and foot-bones, ribs, pelves, and humeri, many of them partially burned, was recovered. If they represent a burial, they were badly disturbed. In addition to sherds, a variety of foodstuffs including corn cobs, an assortment of acorns and juniper seeds, fragments of cucurbit rind, and fiber quids were collected. Six utilized flakes.

Level 3 (12"-18") The deposit consists predominantly of ashy dirt containing charcoal and vegetal remains. Pieces of dark, grease-impregnated earth, which

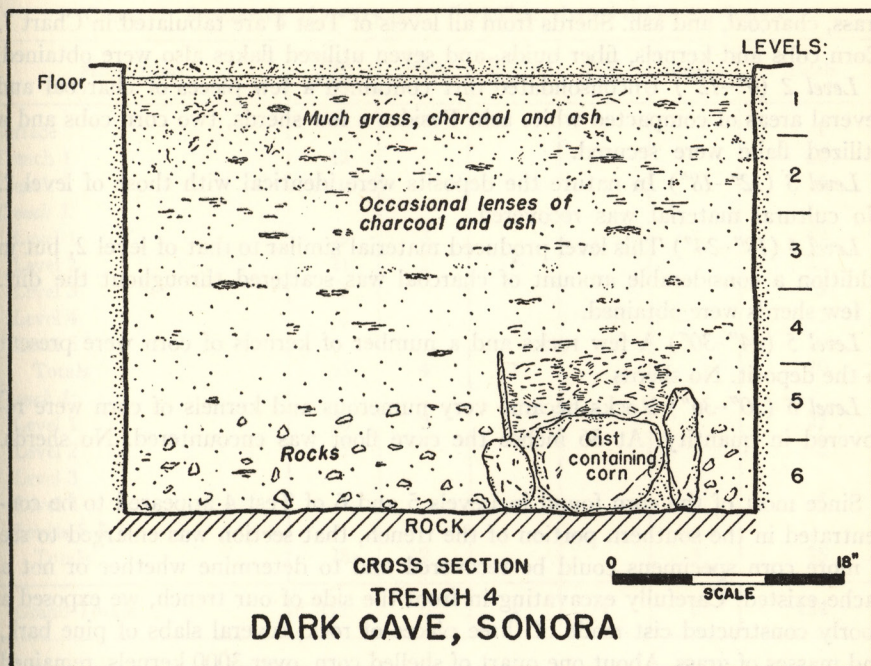


FIGURE 14. Archaeological features, Dark Cave, Sonora

might have been associated with a fireplace, also were encountered. Also there were concentrations of what appeared to be white wood ash. Very few sherds came from this level. Other remains included a kernel of corn, six acorns, two fiber quids, one pointed wooden stick, three utilized flakes, and a fragment of ground slate. A few small fragments of burned human bones were present.

Level 4 (18"-24") This level was composed mainly of dirt and rocks that had broken off the irregular floor of the cave. Sherds were scarce, and a little ash and charcoal were present. Additional objects recovered included a corn cob, a fragment of cucurbit rind, fiber quids, a bundle of yucca fiber, some feathers, and one utilized flake.

Level 5 (24"-36") Level 5 was dug to the rock floor, which was reached at a depth of 36 inches. The deposit contained a large number of rocks which increased in frequency near the floor. No cultural material was encountered.

Trench 4. The fourth test trench was located a few feet east of Test 3. The area tested measured 2 feet by 4 feet and was excavated in 6-inch levels.

Level 1 (0"-6") This stratum extended to just below the hard-packed occupation level encountered in Level 1 of Test 3, and contained a large amount of

grass, charcoal, and ash. Sherds from all levels of Test 4 are tabulated in Chart 7. Corn cobs and kernels, fiber quids, and seven utilized flakes also were obtained.

Level 2 (6"-12") Unconsolidated dirt contained a few pieces of charcoal and several areas of compacted white ash. Besides a few sherds, two corn cobs and a utilized flake were secured.

Level 3 (12"-18") In nature the deposits were identical with those of level 2. No cultural material was recovered.

Level 4 (18"-24") This level produced material similar to that of level 2, but in addition a considerable amount of charcoal was scattered throughout the dirt. A few sherds were obtained.

Level 5 (24"-30") A few rocks and a number of kernels of corn were present in the deposit. No sherds.

Level 6 (30"-36") Rocks became very numerous and kernels of corn were recovered in quantity. At 36 inches the cave floor was encountered. No sherds.

Since most of the corn found in Levels 5 and 6 of Test 4 appeared to be concentrated in the southern portion of the trench, that section was enlarged to see if more corn specimens could be recovered and to determine whether or not a cache existed. Carefully excavating in from the side of our trench, we exposed a poorly constructed cist made of three pieces of rock, several slabs of pine bark, and masses of grass. About one quart of shelled corn, over 3000 kernels, remained in the cist. The cache was 20 inches in diameter, and rested on the cave floor at a depth of 42 inches. Over the cache there was a thick layer of white ash.

INVENTORY OF SPECIMENS RECOVERED FROM DARK CAVE

The following items include specimens recovered from the surface of the cave as well as those from the test trenches. Cultural remains in Dark Cave were second in depth to those exposed in Swallow Cave. Pottery, vegetal remains, and other cultural items were found to be present throughout the deposits.

Pottery: A tabulation of sherd frequencies from the several tests is shown in Chart 7.

Foodstuffs: 26 corn cobs, 8 kernels of corn and a cache of shelled corn approximately one quart in volume, 7 pieces of cucurbit rind, 15 fiber quids, assortments of acorns, 18 juniper seeds, 1 bean, 1 yucca or agave pod, 1 corn tassel.

Stone Artifacts: 21 utilized flakes, 1 piece of worked slate, 1 piece of red ochre.

Cordage, Fiber, and Textiles: 1 piece of cord, 1 knotted yucca leaf, 1 bundle of twigs, 2 bundles of fiber, 1 bundle of bear-grass leaves, 3 pieces of matting, 1 carrying device of fiber, 1 fiber binding.

Wooden Artifacts: 1 fragmentary perforated wooden disc, 1 reed cigarette, 1 digging stick, 1 fragment of worked gourd rind.

Miscellaneous: An assortment of human bones, 3 feathers.

CHART 7. *Frequencies of pottery types, Dark Cave, Arroyo el Concho, Sonora*

<i>Pottery Types:</i>	Alma Plain	Alma Scored	Red on Brown	Poly- chrome	Unfired	Totals
Surface				1		1
Trench 1	12					12
Trench 2	6					6
<i>Trench 3:</i>						
Level 1	39	3				42
Level 2	21	1	1			23
Level 3	3					3
Level 4	2					2
Level 5						
Totals	65	4	1			70
<i>Trench 4:</i>						
Level 1	20	2			5	27
Level 2	5					5
Level 3						
Level 4	3					3
Levels 5 & 6						
Totals	28	2			5	35
Grand Totals	111	6	1	1	5	124

RED PAINT CAVE

DESCRIPTION

Red Paint Cave, named because of red paintings on the exterior walls of two rooms, is the third site from the eastern end of the series in Arroyo el Concho. It is about 300 feet west of, and slightly higher than, Dark Cave. The cave measures over 100 feet across its mouth; however, the western half of the mouth is clogged with large rocks, and the ceiling of that portion of the cave is so low that it was not suitable for habitation. All rooms were built in the eastern section in a two-lobed chamber approximately 50 feet wide and 40 feet deep. Some rooms in the front were constructed independent of the cave walls and hence are rectangular in plan and have roofs of poles and mud; other rooms were built against the side and rear walls, are irregularly shaped, and frequently used the cave roof as ceilings. Behind one such room were two small chambers cut into the cave wall. The cave floor is very uneven, resulting in rooms at various levels.

At least thirteen ground-floor rooms, many now partially destroyed, had existed. In two places there were second-story rooms. Two types of wall construction were employed: vertical pole and mud, and large unworked stones set in an abundance of mud mortar. Most doorways were of the step-passage variety.

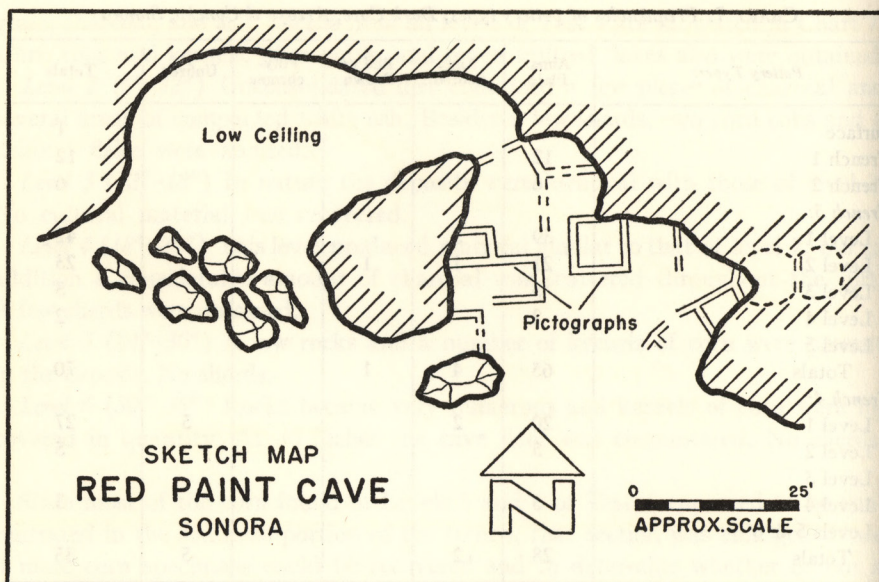


FIGURE 15

INVENTORY OF SPECIMENS RECOVERED FROM RED PAINT CAVE

A surface collection in Red Paint Cave produced these items:

Pottery: 2 polychrome sherds.

Foodstuffs: 10 corn cobs, 2 fragments of cucurbit rind.

Stone Artifacts: 2 fragments of manos, 1 fragment of metate, 1 axe, 1 utilized flake.

ZIGZAG CAVE

DESCRIPTION

Zigzag Cave is the westernmost of the Arroyo el Concho sites. It is shallow with a high, arched roof and a very uneven floor. The mouth is 50 feet wide; the greatest depth, 30 feet, is at the eastern end. A large red zigzag line had been painted on the wall. Rooms had been built at several levels on the rough floor. In two locations steps had been carved on the steep edges of rock outcrops.

Remains of five rooms were noted in Zigzag Cave. Two of those built against the cave wall had been enlarged by digging small semi-circular chambers back into the wall of the cave. Walls were of unworked slabs of stone and cobbles held together by a large quantity of mud mortar and plastered inside and out. One room possesses a well-preserved roof made of pole beams, a layer of split poles, and a heavy coating of mud.

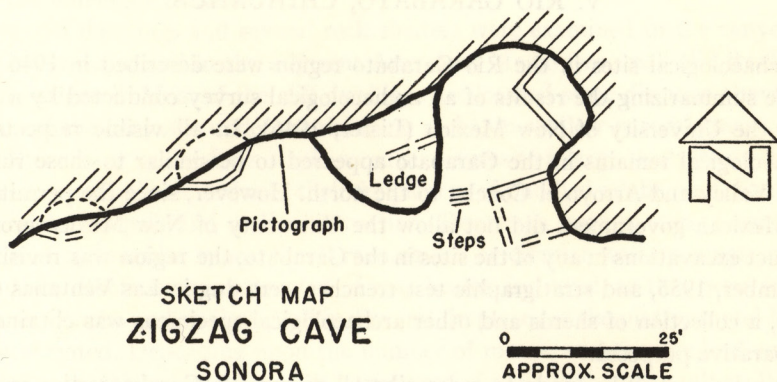


FIGURE 16

INVENTORY OF SPECIMENS RECOVERED FROM ZIGZAG CAVE

The specimens listed below were collected from the surface of Zigzag Cave.

Foodstuffs: 4 corn cobs, 1 fiber quid.

Stone Artifacts: 3 manos.

Textiles: 2 fragments of matting.

V. RÍO GARABATO, CHIHUAHUA

Archaeological sites in the Río Garabato region were described in 1946 in an article summarizing the results of an archaeological survey conducted by a party from the University of New Mexico (Lister, 1946). In all visible respects, the archaeological remains in the Garabato appeared to be similar to those ruins in Cave Valley and Arroyo el Concho to the north. However, since the permit from the Mexican government did not allow the University of New Mexico group to conduct excavations in any of the sites in the Garabato, the region was revisited in December, 1955, and stratigraphic test trenches were dug in Las Ventanas Cave. Thus, a collection of sherds and other archaeological specimens was obtained for comparative purposes.

No attempt will be made to redescribe all of the Río Garabato sites reported upon in the above-mentioned article. However, a brief summary of the area and its archaeological remains and an account in some detail of Las Ventanas Cave will follow.

The Río Garabato, which heads in the mountainous country immediately west of the Babicora basin, is a tributary of the Río Chico, which in turn enters the Río Aros. The Aros joins the Río Bavispe to form the Río Yaqui, flowing into the Gulf of California. The area lies approximately 50 miles southeast of Cave Valley. It may be reached by automobile by turning off the Ciudad Juarez-Chihuahua City highway onto the new Casas Grandes highway and travelling west 70 miles to San Buenaventura. Then, a dirt road is followed southwesterly over the Sierra del Arco into the Babicora basin and up into the Sierra Madres at Las Varas. A 14-mile stretch of rough road leads from Las Varas to the edge of the Garabato canyon. The 85 miles between San Buenaventura and the Garabato are best negotiated in a pick-up truck. An alternative route may be taken from Chihuahua City west on the paved road to Cuauhtemoc, then on the dirt road, which becomes progressively worse, northwesterly through Guerrero, Matachic, Temosachic, and Yepomera, into the Babicora basin and to Las Varas and the Garabato. By this route the distance from Chihuahua City to the Garabato is 245 miles.

The canyons in the Garabato vicinity are true *barrancas*, or deep gorges, some of which are over 1,000 feet deep. The flat-bedded volcanic tuffs of the region are especially suited for the formation of caves. On the mountain and mesa tops, which average 7,000 feet high, pines, oaks, and juniper are the common vegetation. The drier canyons contain oaks, juniper, agave, and madrones; in the better-watered canyon bottoms sycamores, elms, and maples grow. The narrowness of the canyon bottoms and their sloping sides probably would have limited agricul-

tural practices by the Indian inhabitants to the mountain tops and mesas between the numerous canyons.

Eight cliff dwellings and several rock shelters were examined in the canyon of the Río Garabato, and in the adjacent Arroyo en Medio five small cliff dwellings were investigated. Most of the cliff dwellings are located some distance above the bottoms of the canyons, under overhanging rocks, in shallow natural caves, or in clefts. Ruins vary in size from single-room structures to a large thirty-room dwelling. Walls were built, in order of their frequency, of puddled adobe mud, boulders set in mud, and pole and mud construction. Doorways were of step-passage, T-shape, and rectangular types. Small rectangular or circular wall openings served as windows. Roofs were constructed of pole beams and mud, as they were in the Arroyo el Concho and in Cave Valley. Several fireplaces of the platform-and-basin type were noted. Depending upon the number of rooms, and the size and outline of the cave in which they were built, structures of various shapes resulted. Where a few rooms were placed in a small cave, the cave walls were normally incorporated into the room, resulting in irregularly shaped structures. In large caves many rooms were built independent of the walls and were generally rectangular in plan.

Granaries built of large coils of grass plastered inside and out with mud are common. Most of them have straight or slightly convex walls. The largest example in the Garabato area stands 9 feet high and is 6 feet in diameter.

Most of the cliff dwellings in the Garabato are constructed on the rocky floors of caves; therefore, there is no detritus beneath the structures. In only a few caves is there cultural material situated lower than the cliff dwellings; where it does occur, it is shallow.

LAS VENTANAS CAVE

DESCRIPTION

This is the largest site in the Garabato, and has been described or illustrated by a number of previous investigators (Lumholtz, 1902; Blackiston, 1905; Hewett, 1908; Carey, 1931; Kidder, 1939; Brand, 1943; Sayles, 1936b; Lister, 1946). The dwelling was built in a large cave, 175 feet wide at the mouth and 35 feet deep, situated on the west side of the canyon 450 feet from its bottom. It originally possessed at least thirty rooms, arranged so as to fill most of the oval-shaped floor of the cave. They had been built in two rows along the rear of the cave. Those in the front row probably stood only one story high; those built against the rear wall still are standing two stories high, and from marks on the roof of the cave, there appear to have been a few third-story rooms originally. Walls were of puddled adobe mud, mud with flat rocks incorporated, and poles and mud, with the first type predominating. Roofs were of horizontal pole beams and mud. Some of the

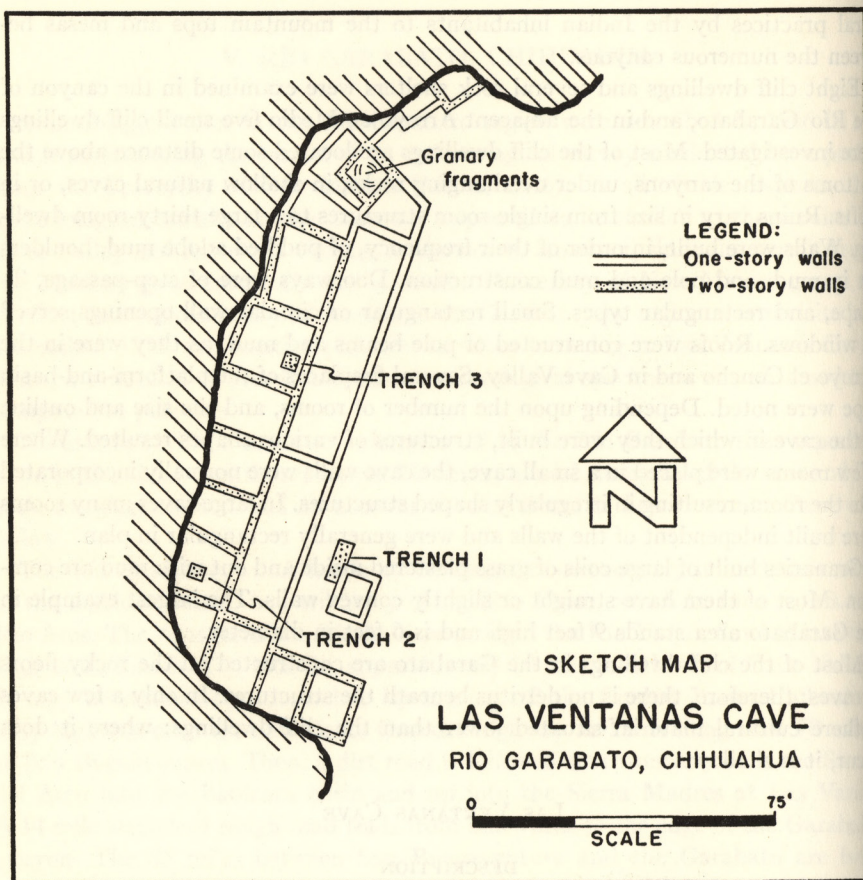
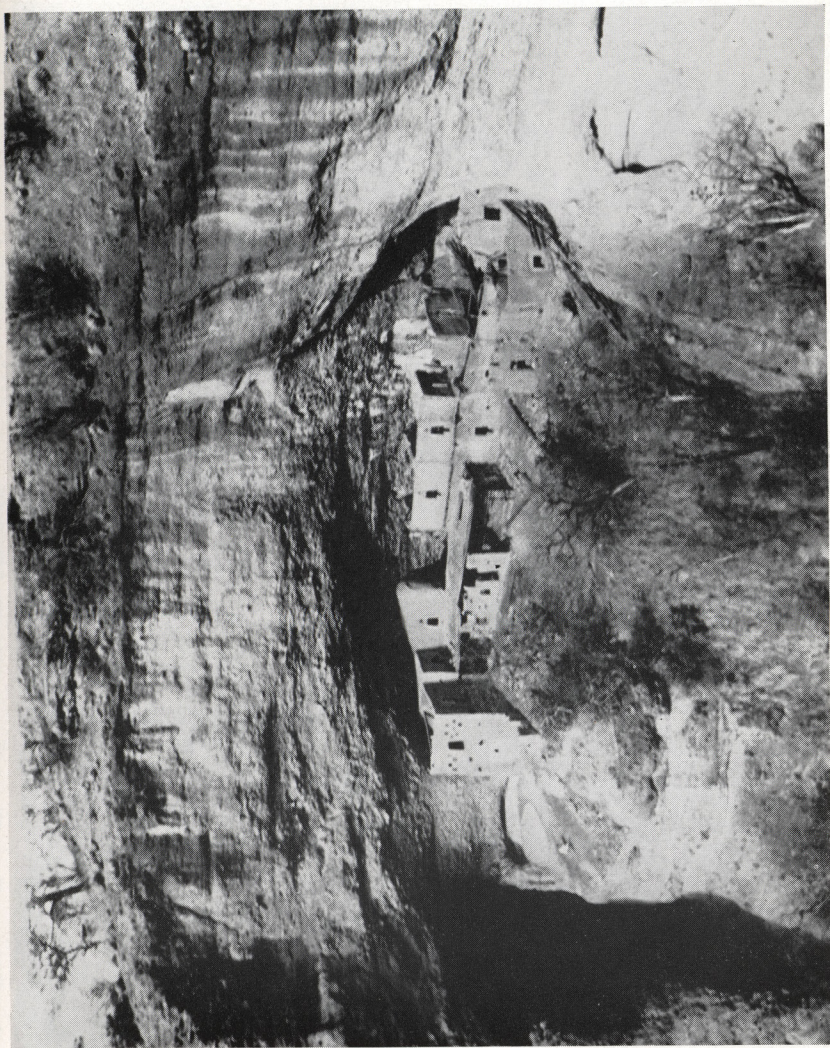


FIGURE 17

larger rooms had vertical posts set within the room to give additional support to the roof. Doorways were of three types: T-shaped, step-passage, and rectangular. Small rectangular and circular wall openings served as windows.

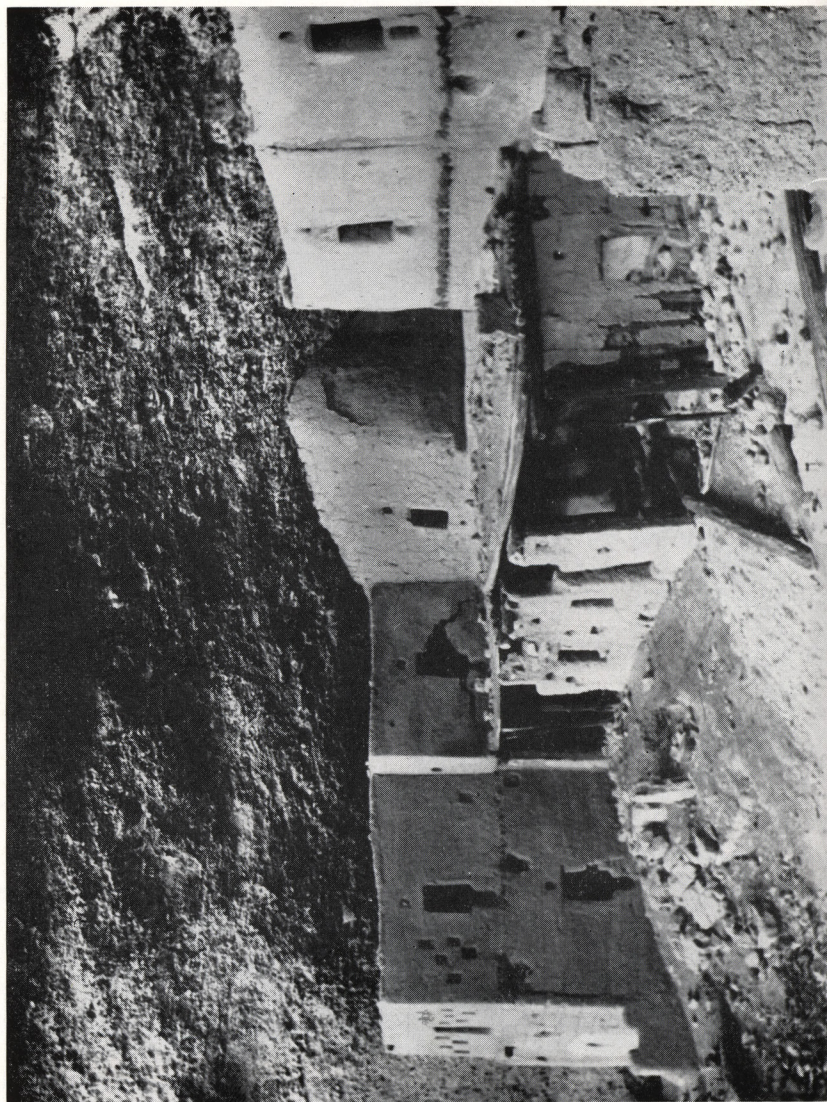
One second-story room at the south end of the structure originally contained eighteen small rectangular openings, some of which had been sealed with wooden slabs. It is this feature of the cave which gives it the name Las Ventanas, or The Windows. The room may have served as a lookout tower, since views out of the windows command all approaches to the cave. Two of the rooms in the front row are unusually long, suggesting their use as hallways or porches. Doorways from these rooms led to rooms in the back row.

Some rooms are in a good state of preservation; the walls are sound and the roofs

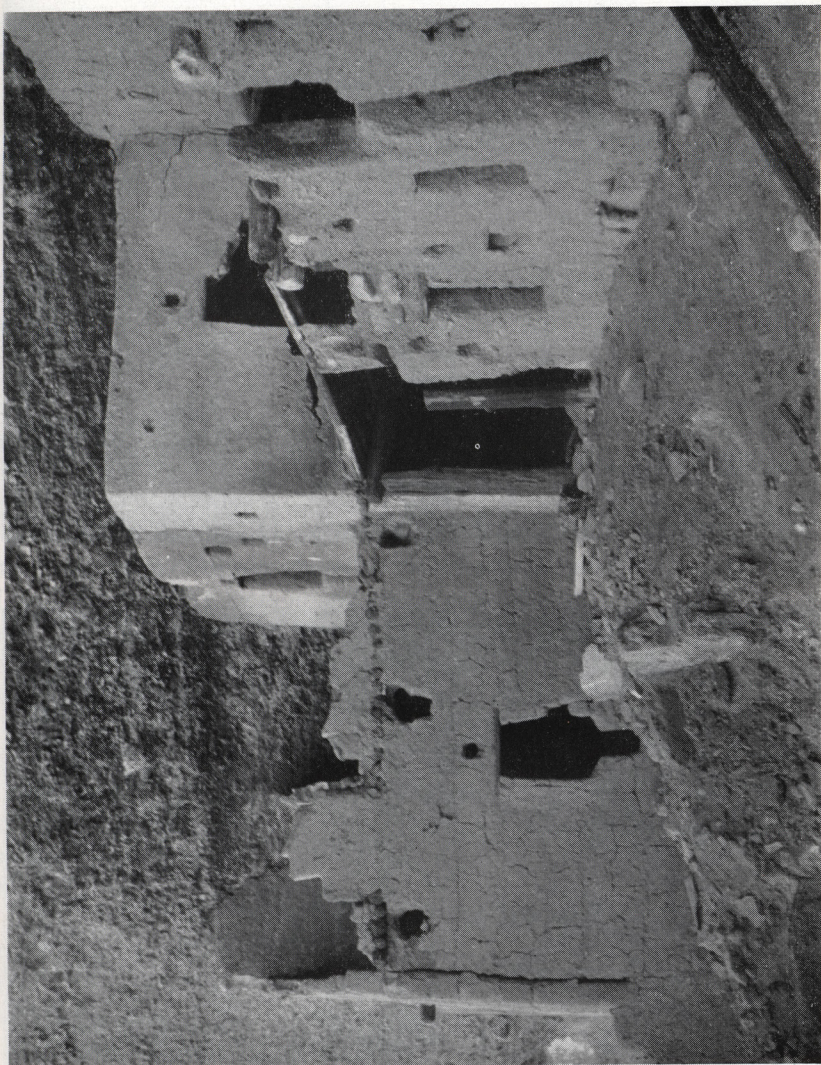


Las Ventanas Cave, Río Garabato, Chihuahua

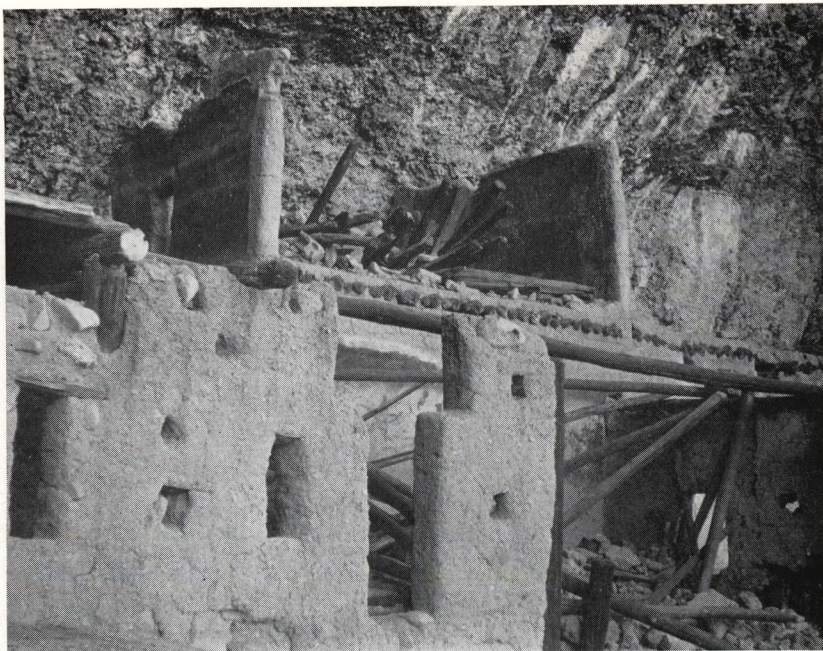
PLATE 16



Las Ventanas Cave. Photo taken in 1936. The second-story room at the left has 18 small windows.



Las Ventanas Cave. Photo taken in 1955. Note how walls of room containing the numerous windows have been destroyed by vandals.



A. Las Ventanas Cave. Note T-shaped doorway, rectangular windows, and fallen roof beams



B. Las Ventanas Cave. Trench 1 was dug adjacent to the partially exposed walls in the foreground. T-shaped doorway in rear wall.

are intact. On the other hand, parts of the dwellings have suffered from vandalism, and walls have been toppled over and roofs caused to collapse. Test trenches revealed no significant depth to the deposits beneath the cliff dwellings. In fact, in most places the bases of walls extended to within a few inches of the cave floor.

EXCAVATIONS

A surface collection was obtained from Las Ventanas Cave, and five test trenches were dug. Only three trenches produced any material of importance; the others revealed shallow deposits or produced few, if any, archaeological specimens.

Trench 1. A trench 3 feet by 6 feet was dug adjacent to the remains of a room in the front of the cave. This room apparently had been constructed prior to the rooms behind it and at a lower level. Seemingly the room had been abandoned and the walls removed or collapsed until they stood to a height of only 3 feet. Then, the room and the area behind it were filled with debris, and the bases of walls immediately to the rear were constructed on this fill. Most of the debris originally in this room had been removed by previous excavators.

The first 3 feet of dirt from this trench, taken from both the interior of the room and the area behind it, was above the floor level of the room. An additional 6 inches of sterile deposits below the floor were removed before the cave floor was encountered. The material from the trench appeared to post-date the time of the building of the room in and adjacent to which the trench was dug, and to pre-date the construction of the rooms behind this isolated structure. Owing to the disturbed nature of at least part of the area in which the trench was located, all specimens from the test were grouped together.

Archaeological specimens from Trench 1 included sherds, foodstuffs, cordage, and a utilized flake of stone.

Trench 2. This was a small trench, measuring 2 feet by 2 feet, beneath the floor of a rear room. Fourteen inches of deposits were excavated before reaching the rock floor of the cave. Five sherds of pottery and one utilized flake were recovered.

Trench 3. This was another small trench, 2 feet by 2 feet, below the floor of another rear room. The walls of the room were badly destroyed. Only 10 inches of deposits lay over the cave floor. A few cultural remains, consisting of several sherds, fragments of cucurbit rind, a corn cob, and a utilized flake, were collected.

In addition to the test trenches described above, a surface collection was made in Las Ventanas Cave.

INVENTORY OF SPECIMENS RECOVERED FROM LAS VENTANAS CAVE

Pottery: Sherds from three test trenches and from the surface of Las Ventanas Cave are tabulated in Chart 8.

CHART 8. *Frequencies of pottery types, Las Ventanas Cave, Río Garabato, Chihuahua*

<i>Pottery Types:</i>	Alma Plain	Alma Plain, Buff	Indented Corrugated	Red on Brown	Black on Orange	Poly-chrome	Totals
Surface Collection	61	3	2	1		4	71
Trench 1	37				3		40
Trench 2	5						5
Trench 3	13						13
Grand Totals	116	3	2	1	3	4	129

Foodstuffs: 60 corn cobs, 5 fragments of cucurbit rind, 14 fiber quids.

Stone Artifacts: 3 utilized flakes, 2 manos, 1 metate.

Cordage, Fiber, and Textiles: 4 pieces of cord, 1 piece of matting, 1 textile fragment.

Wooden Artifacts: 4 fragmentary arrows, 1 miniature bow, 1 piece of worked gourd rind, 4 trap triggers, 1 reed cigarette, 3 willow ties.

VI. SUMMARY OF ARCHAEOLOGICAL REMAINS

In Chapters III, IV, and V descriptive accounts of each site excavated and an inventory of their archaeological contents were presented. This chapter will summarize the archaeological remains from all sites examined in the northern Sierra Madre Occidental. The material has been classified under several headings; descriptions of items are given, and their provenience, frequency, and stratigraphic positions noted.

FOODSTUFFS

A large selection of the corn cobs and kernels from our caves has been studied by Dr. Paul C. Mangelsdorf, of the Harvard Botanical Museum. His report on these specimens is presented in its entirety as Chapter VII of this paper. A more detailed discussion of this maize from a botanical point of view has been presented elsewhere (Mangelsdorf and Lister, 1956). A portion of the remaining vegetal material was examined and identified by Dr. Hugh Cutler, of the Missouri Botanical Garden. His identifications are listed in brackets in the following summary of foodstuffs.

Corn Cobs. Frequency: 116, Swallow Cave (7, 0"-6" subsurface; 35, 6"-12" subsurface; 9, 12"-18" subsurface; 62, surface to 18" subsurface; 2, 72"-78" subsurface; 1, 78"-84" subsurface); 36, Slab Cave (surface to 12" subsurface); 56, Tau Cave (51 surface; 5, 0"-18" subsurface); 31, Olla Cave (surface to 6" subsurface); 2, Corral Cave (surface); 5, Rincon Cave (surface); 4, Zigzag Cave (surface); 10, Red Paint Cave (surface); 26, Dark Cave (8, surface; 9, subsurface; 2, 0"-6" subsurface; 6, 6"-12" subsurface; 1, 18"-24" subsurface); 9, Arch Cave (surface); 2, Step Cave (surface); 60, Las Ventanas Cave (57, surface; 3, subsurface). Total: 357.

Corn Kernels. Frequency: 37, Swallow Cave (36, surface; 1, 0"-6" subsurface); 82, Slab Cave (surface to 12" subsurface); 112, Tau Cave (40, surface; 72, 0"-18" subsurface); 11, Olla Cave (0"-6" subsurface); 11, Corral Cave (surface); cache plus 8, Dark Cave (7, 0"-6" subsurface; 1, 12"-18" subsurface; cache of approximately 3,775, 24"-36" subsurface). Total: cache of approximately 3,775 plus 261.

Cucurbit Rind. Frequency: 9, Swallow Cave (1, surface; 8, 0"-6" subsurface [*Lagenaria* gourd]); 2, Slab Cave (surface); 2, Red Paint Cave (surface); 7, Dark Cave (1, subsurface; 4, 0"-6" subsurface [*Cucurbita* (cultivated)]); 1, 6"-12" subsurface; 1, 18"-24" subsurface); 5, Las Ventanas Cave (1, surface; 4, subsurface). Total: 25.

Cucurbit Stems. Frequency: 4, Swallow Cave (surface); 7, Slab Cave (surface)

2 are [*Cucurbita pepo*]; 3, Olla Cave (6"-12" subsurface) [*Cucurbita mixta* (?) or *pepo* (?)]. Total: 14.

Cucurbit Seeds. Frequency: 5, Tau Cave (subsurface) [*Cucurbita pepo*]; 4, Slab Cave (surface) [*Cucurbita pepo*]; 18, Olla Cave (2, 0"-6" subsurface; 16, 6"-12" subsurface; all are [*Cucurbita pepo*]). Total: 27.

Beans. Frequency: 1, Tau Cave (subsurface) [*Phaseolus vulgaris*]; 1, Slab Cave (surface) [*Phaseolus vulgaris*]; 3, Olla Cave (2, 0"-6" subsurface; 1, 6"-12" subsurface); all are [*Phaseolus vulgaris*]; 1, Dark Cave (0"-6" subsurface) [*Phaseolus vulgaris*]. Total: 6.

Acorns. Frequency: assortment, Swallow Cave (assortment, surface; assortment, 42"-48" subsurface; assortment, 48"-54" subsurface; assortment, 54"-60" subsurface; assortment, 60"-66" subsurface; assortment, 66"-72" subsurface; assortment, 72"-78" subsurface; 1, 78"-84" subsurface); assortment, Tau Cave (surface); 17, Olla Cave (7, subsurface; 6, 0"-6" subsurface; 4, 6"-12" subsurface); assortment, Dark Cave (assortment, 6"-12" subsurface; 6, 12"-18" subsurface). Total: not recorded.

Pinyon Nut Shells. Frequency: 1, Swallow Cave (72"-78" subsurface); assortment, Tau Cave (surface); 2, Olla Cave (subsurface) [*Pinus edulis* (?)]. Total: not recorded.

Fiber Quids. These are wads of fiber which have been chewed. They apparently were discarded after the pulp and juice had been removed from the plant. Almost all of the specimens show teeth impressions.

Frequency: 11, Swallow Cave (9, surface; 2, 12"-18" subsurface); 8, Slab Cave (surface); 7, Tau Cave (4, surface; 3, subsurface); 5, Olla Cave (3, subsurface; 2, 0"-6" subsurface); 1, Zigzag Cave (surface); 15, Dark Cave (1, subsurface; 6, 0"-6" subsurface; 4, 6"-12" subsurface; 2, 12"-18" subsurface; 2, 18"-24" subsurface); 1, Step Cave (surface); 14, Las Ventanas Cave (9, surface; 5, subsurface). Total: 62.

Several fibers are represented in these wads according to Cutler. Some are hard fibers, such as agave or yucca, others are soft or bast fibers, one is a chewed corn husk, and another is perhaps the chewed fruit of milkweed.

Juniper Seeds. Frequency: 1, Tau Cave (subsurface); 18, Dark Cave (6"-12" subsurface); identified by Cutler. Total: 19.

Walnut. Frequency: 1, Tau Cave (subsurface); identified by Cutler.

Yucca or Agave Pod. Frequency: 1, Dark Cave (0"-6" subsurface); identified by Cutler.

Corn Tassel. Frequency: 1, Dark Cave (0"-6" subsurface); identified by Cutler.

Cherry Stone. Frequency: 1, Swallow Cave (72"-78" subsurface); identified by Cutler.

Lycium Berries (?). Frequency: assortment, Swallow Cave (72"-78" subsurface); identified by Cutler.

Animal Bones. Such remains were very scarce in caves we examined. Fragmentary bones of deer, turkey, and rodents can be identified.

POTTERY

Pottery was collected from eleven caves in the northern Sierra Madre Occidental. In some instances our samples are the result of surface collection, but in most cases sherds were obtained from stratigraphic test trenches. The provenience of all sherds has been listed in Chapters III, IV, V of this paper, where the results of our work in each cave were presented. A total of 3,556 sherds was obtained. Chart 9 shows the frequencies of pottery types for all caves examined, and Chart 10 summarizes the stratigraphic arrangement of types from all caves in which it was possible to establish such relationships.

One complete red-on-brown bowl (Trench 1, Level 3, Swallow Cave), an almost completely restorable Alma Neck Banded jar (associated with Burial 1, found near Structure 1, Swallow Cave), and a partially restorable Villa Ahumada Polychrome olla (surface, Rincon Cave) were recovered (Pls. 19B, 20, 21). The bowl and jar remains are not entered in the sherd count, but the Villa Ahumada sherds have been included.

The list of the types of pottery found in our caves indicates the presence of a large variety of wares; however, when the frequencies of these types are considered, it is apparent that except for a few sites in Cave Valley, the pottery assemblage in most caves consists of relatively few types. The number of types present in any site reflects the depth of deposits in that cave. Where stratigraphic test trenches were dug through deep accumulations of cultural deposits, the variety of pottery types was greater than in instances where the tests exposed shallow remains.

Most of the pottery types represented in our collection have been previously described. Therefore, lengthy descriptions of these established types will not be repeated. However, for the benefit of the reader not acquainted with these types, reference to previous descriptions and a brief characterization of each are presented. Examples of the most commonly occurring types are shown in Plate 22.

Alma Plain (Haury, 1936a, p. 32). Construction: coiled. Paste: brown to buff; coarse; core may be black; slightly friable. Temper: predominantly crushed rock; some mica. Finish: exposed surfaces partially polished but left bumpy; walls of uneven thickness. Surface color: light tan through reddish brown to dark brown and gray; fire-clouding common. Cultural association: the main culinary pottery of the Mogollon culture, and from it a series of sub-types developed. Alma Plain continued as a basic ware of the ceramic complex throughout Mogollon history.

Variations and Textured Forms of Alma Plain

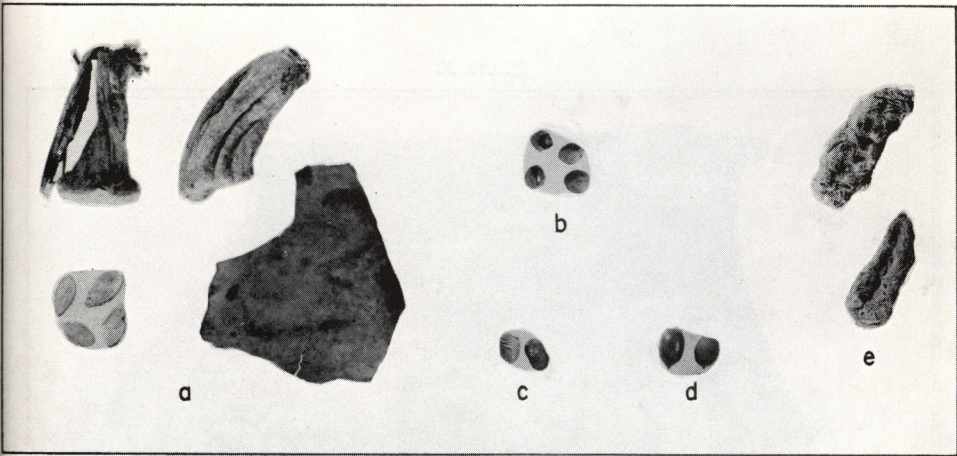
Alma Rough (Martin and Rinaldo, 1940, pp. 78-80)

An unpolished variety of Alma Plain. It is characterized by hand smoothing

CHART 9. *Frequencies of pottery types, caves in the northern Sierra Madre Occidental, Mexico*

Pottery Types:	Alma Plain	Alma Plain, Buff	Alma Scored	Alma Rough	Alma Incised	Alma Punched	Alma Neck Banded	Plain Corrugated	Plain Corrugated, Trilled	Incised Corrugated	Indented Corrugated	Smooth Corrugated	Three Circle Neck Corrugated	Patterned	Fillet Rim	Tan, Fine Paste	Orange	Polished Grey	Red on Brown	Black on Tan	Black on Red	Black on Orange	Villa Ahumada Polychrome	Polychrome	Unfired	Totals
Swallow Cave	1094	63	99	27	17	4	4	29	1	162	26	1	2	11	1	2	1	24							4	1572
Slab Cave	511	6	25		7	1		146		23	39			1	2			5		1						767
Tau Cave	160		8			2		33		5	3		1					1		1						214
Rincon Cave	58	3	2					11			2							2			13	154				245
Olla Cave	289	1	12		7			11		1								1		1						323
Corral Cave	141	1	3	1	2			1		6	1															156
Step Cave	18		4																							22
Red Paint Cave																							2			2
Arch Cave	2																									2
Dark Cave	111		6															1					1	5		124
Las Ventanas Cave	116	3									2							1			3		4			129
Grand Totals	2500	77	159	28	33	7	4	231	1	197	73	1	2	13	3	2	1	3	32	3	13	3	154	7	9	3556

PLATE 19

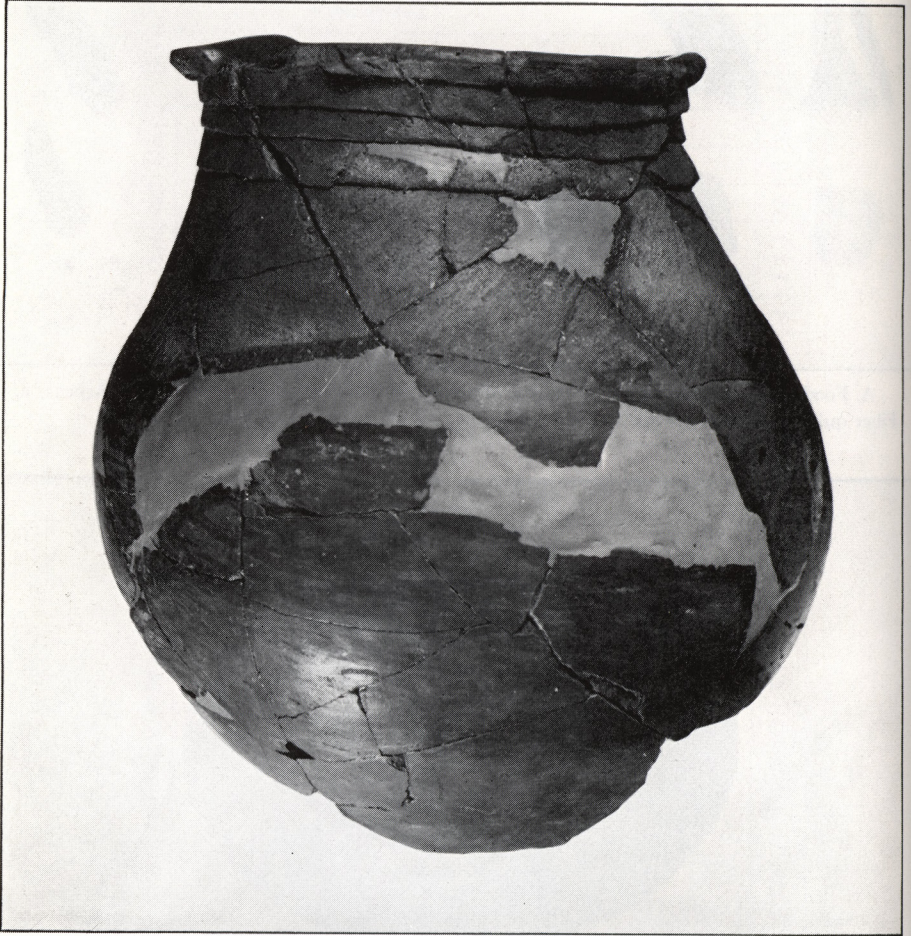


A. Foodstuffs. a, cucurbit stems, seeds, and rind. b, Juniper seeds. c, Beans. d, Acorns. e, Fiber quids. All items are not to same scale.



B. Red on brown bowl, Swallow Cave. Greatest diameter, $6\frac{1}{2}$ inches

PLATE 20



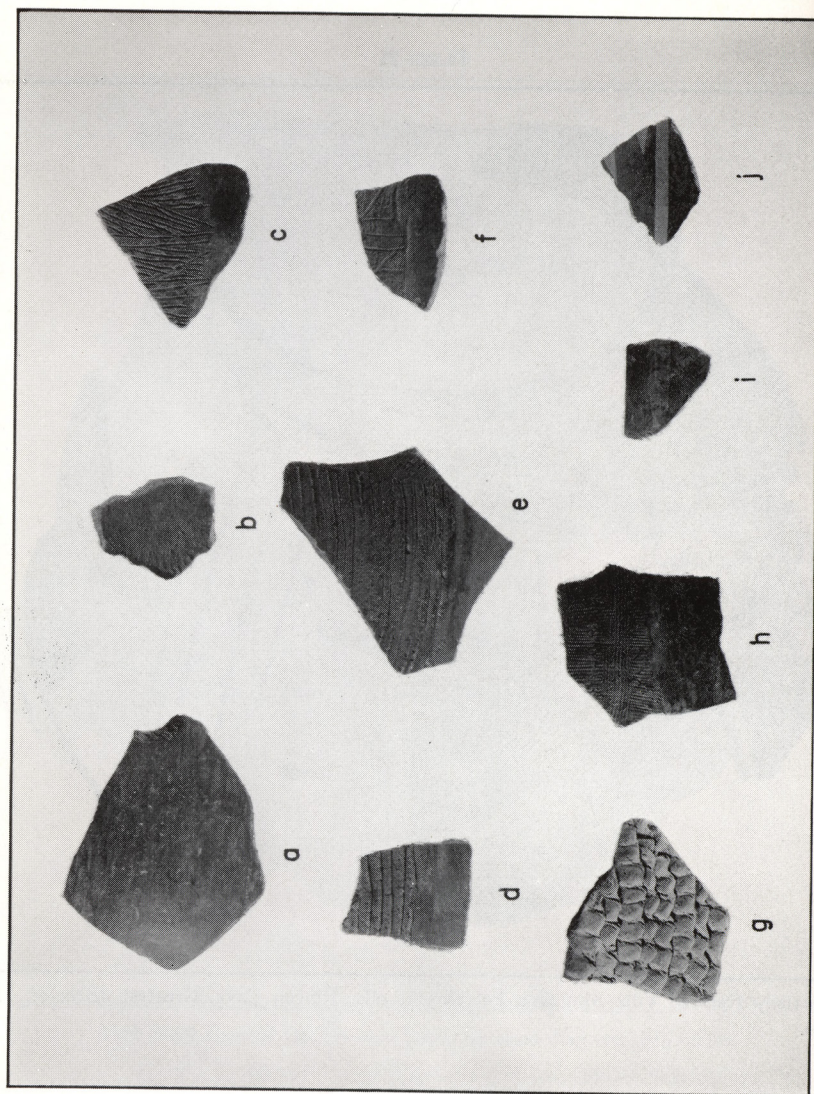
Alma Neck Banded jar, Swallow Cave. Greatest diameter, $8\frac{1}{2}$ inches

PLATE 21



Partially restored Villa Ahumada Polychrome olla, Rincon Cave. Greatest diameter, $11\frac{3}{4}$ inches.

PLATE 22



Sherds of commonly occurring pottery types. a, Alma Plain. b, Alma Rough. c, Alma Scored. d, Plain Corrugated. e, Plain Corrugated, Trailed. f, Alma Incised. g, Indented Corrugated. h, Pattered. i, Red on Brown. j, Polychrome.

rather than polishing, which results in irregular surfaces. Some may be hand molded rather than built up by coiling. Predominant color is brown.

Alma Plain, Buff

A variety of Alma Plain exhibiting a finer paste, a smoother surface finish, and a buff surface color.

Tan, Fine Paste

This ware appears to be related to Alma Plain Buff, and is probably a variant of that type. Paste is slightly finer than Alma Plain, Buff.

Alma Scored (Haury, 1936a, p. 38)

A variation of Alma Plain in which the neck or entire outside of jars was brushed over with a grass brush or some similar object, which left the surface irregularly scored.

Alma Incised (Haury, 1936a, p. 40)

Marked by crude crisscross incised pattern on jar necks. Derived from Alma Plain.

CHART 10. *Stratigraphic arrangement of pottery types, caves in the northern Sierra Madre Occidental, Mexico*

Pottery Types	Levels				
	All Levels	Surface and Level 1	Levels 2-3	Levels 4-5	Levels 6-7
Polychrome		X			
Black on Orange		X			
Orange		X			
Black on Red		X			
Villa Ahumada Polychrome		X			
Polished Grey		X			
Black on Tan		X			
Fillet Rim		X			
Unfired		X			
Smoothed Corrugated		X			
Alma Punched		X	X		
Plain Corrugated		X	X	X	
Indented Corrugated		X	X	X	
Incised Corrugated		X	X	X	
Patterned		X	X	X	
Alma Incised		X	X	X	
Red on Brown		X	X	X	
Alma Neck Banded			X		
Plain Corrugated, Trailed			X		
Three Circle Neck Corrugated			X	X	
Tan, Fine Paste			X	X	
Alma Rough			X	X	
Alma Plain	X	X	X	X	X
Alma Plain, Buff	X	X	X	X	X
Alma Scored	X	X	X	X	X

Alma Punched (Haury, 1936a, p. 39)

Exteriors of vessels were partially smoothed and then covered with a design of indentations punched in with the end of a small implement or with the fingernails. Designs are crudely executed. Derived from Alma Plain.

Alma Neckbanded (Haury, 1936a, p. 35)

Neck made up of two to six broad, flat coils laid up with a slight overlap. Polishing over the coils so that they are largely obliterated is normal; finger indentations of coils rare. Body identical with Alma Plain.

Patterned

A variation of Alma Plain in which the exterior of the vessel is lightly scored in a pattern consisting of alternating groups of vertical and horizontal lines. The resulting pattern somewhat resembles textile impressions.

Three Circle Neck Corrugated (Haury, 1936a, p. 36; Martin, Rinaldo, and others, 1952, pp. 60, 80). A development of Alma Neck Banded. Narrower coils, laid obliquely in a clapboard style, may cover as much as the upper one third of the vessel.

Incised Corrugated (Martin and Rinaldo, 1950a, p. 359; 1950b, p. 501). A variant or derivation from Three Circle Neck Corrugated. It is Three Circle Neck Corrugated that has been incised over the fillets or corrugations. This incising generally forms a diagonal pattern.

Plain Corrugated (Martin and Rinaldo, 1950b, pp. 500, 528). Includes all-over corrugated, such as Mimbres Corrugated, and neck corrugated, such as Mimbres Neck Corrugated. These two types were not distinguished.

Plain Corrugated, Trailed. Like Plain Corrugated, with the addition of a design formed by smoothing areas within the corrugated portions of the vessel.

Indented Corrugated (Gladwin, 1934, p. 18; Martin and Rinaldo, 1950b, pp. 501, 530). Corrugations, especially those on the necks of vessels, were indented with a blunt instrument or by punching with the fingers.

Smooth Corrugated. Corrugations largely obliterated by smoothing over with some sort of implement. Bumpy surface.

Reserve Fillet Rim (Martin and Rinaldo, 1950a, p. 360). Resembles Alma Plain, with the addition of a plain corrugated fillet on the exterior just below the rim.

Polychrome. This category includes small sherds of indeterminate polychrome vessels, assignable to the Casas Grandes culture. However, owing to the small size of the specimens and to the fact that many have been burned, it is impossible to classify them with accuracy. Black and red designs had been applied to orange or cream surfaces in most cases. Many sherds appear to be similar to Babicora Polychrome. (Sayles, 1936a, p. 19).

Villa Ahumada Polychrome (Brand, 1935, p. 295; Sayles, 1936a, p. 13). Construction: coiled. Paste: light tan to brown; fine with small amount of tempering

material. Temper: fine. Finish: exposed surfaces smoothed and covered with chalky slip; slip frequently flakes off carrying the decoration with it. Surface: white or ivory-colored slip on zone of decoration; designs applied in red or orange and black; sometimes polished over decoration. Cultural association: characteristic of the Babicora and Ramos phases of the Casas Grandes culture.

Black on Red. May be Madera Black on Red (Sayles, 1936a, p. 23); however, smallness of sherds and of the sample makes identification difficult. Construction: coiled. Paste: deep red to brown. Temper: fine. Finish: surface well smoothed. Surface color: red slip. Decoration: painted in black, polished over decoration. Cultural association: Babicora phase of Casas Grandes culture.

Red on Brown. This ware, represented by a small number of sherds and one complete vessel, comes closest to resembling Medanos Red on Brown (Sayles, 1936a, p. 1). In fact, two of the sherds which show texturing on the neck may be so classified. However, most of the remaining sherds are from bowls, a shape not identified with Medanos Red on Brown. A description of those sherds which do not appear to be Medanos Red on Brown follows:

Construction: coiled. Paste: brown to buff, medium coarse; core may be grey or black. Temper: both angular and rounded particles, some mica. Finish: exposed surfaces smoothed but bumpy; sometimes polished. Shape: bowls and possibly jars. Surface color: light tan through brown, fire-clouding on occasion. Decoration: designs in dull red paint on bowl exteriors; rims have a band of red which extends slightly into bowl interiors. Zone of decoration on the complete bowl is a band about 1 inch in width encircling the exterior of the vessel; the design consists of a series of hatched pendant triangles. A few sherds show the use of concentric triangles. Most designs are executed in fine lines. Cultural association: Medanos Red on Brown is associated with the Medanos phase of Casas Grandes culture. The cultural association of the other red-on-brown sherds is probably Mogollon.

Unfired. These are thin-walled sherds of medium paste and temper. Paste is brown. They apparently represent the remains of unfinished vessels, and in no way are they suggestive of unfired clay containers.

Miscellaneous. Black-on-orange, black-on-tan, polished grey, and polished orange sherds were recovered in small quantities. This assortment of sherds appears to belong to undecorated or partly decorated portions of polychrome vessels. They all have medium fine paste and are well smoothed or polished.

STONE, BONE, AND SHELL ARTIFACTS

Manos. All of the manos, or handstones, observed or collected are rectangular-shaped. Sides of the specimens usually are parallel, but the ends are rounded. They are made of basalt and had been shaped by grinding and pecking. Most manos have but one faceted grinding surface; hence they appear wedge-shaped

in cross section. They probably were used in trough metates. They are of such size and weight that they must have been propelled by two hands. A typical specimen measures as follows: length, 8 inches; width, 5 inches; greatest thickness, $2\frac{1}{2}$ inches. Frequency: 3, Zigzag Cave (surface); 2, Red Paint Cave (surface); 2, Las Ventanas Cave (surface). Total: 7.

Hammerstone. One hammerstone was recovered. It is a small waterworn cobble, oval in outline, one end of which is considerably battered. The stone fits the hand and would have been an efficient implement for hammering and pecking. One face of the specimen shows a slight amount of wear, suggesting that it also may have served as a grinding stone; however, it is smaller than any of the manos. Length, $3\frac{1}{2}$ inches; width, $2\frac{3}{4}$ inches; thickness $1\frac{7}{8}$ inches. Frequency: 1, Swallow Cave (12"-18" subsurface).

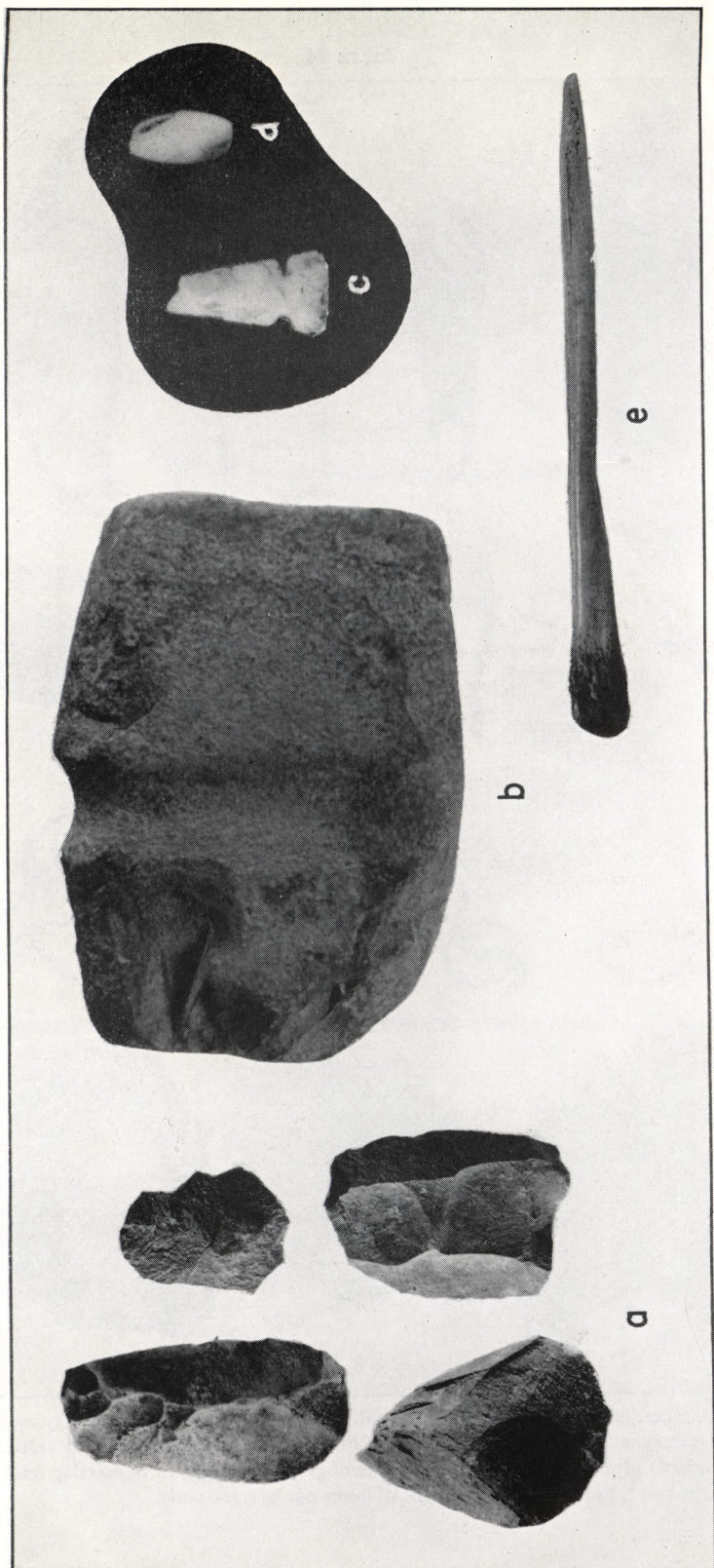
Metates. All metates, or nether grinding stones, observed were of the trough type with one end open. One specimen shows the addition of a shallow oval depression, or mano shelf, located above the closed end of the trough. This style metate is generally known as the Utah type. All metates were made from slabs of basalt which had been shaped into rectangular blocks by pecking and grinding. Depth of the trough varied depending upon the amount of use to which the specimen had been subjected; most contained troughs 2 to 4 inches deep. A complete specimen from Olla Cave measures as follows: length, 28 inches; width, 12 inches; thickness, 8 inches; depth of trough, 3 inches. Frequency: 3, Olla Cave (2, surface; 1, 6"-12" subsurface); 4, Step Cave (surface); 1, Red Paint Cave (surface); 1, Las Ventanas Cave (surface). Total: 9.

Worked Stone Slab. A small fragment of a thin piece of slate exhibiting one ground edge was obtained. It is 3 inches square, so small that it is impossible to determine its purpose. Frequency: 1, Dark Cave (12"-18" subsurface).

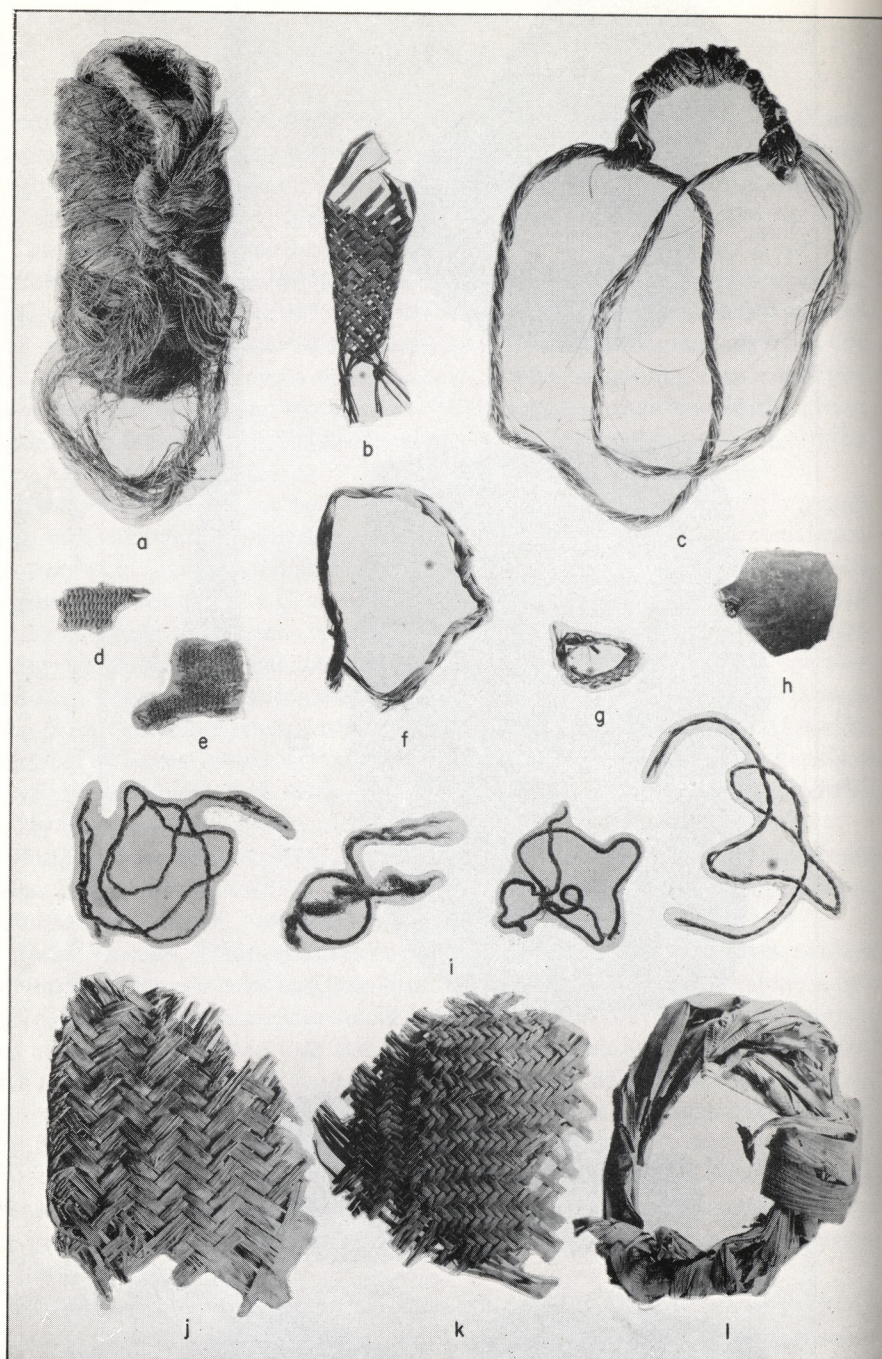
Stone Ornament. This appears to be an unfinished stone ornament. It is a cuboid crystal in which two holes had been drilled from opposite sides of the stone apparently in an attempt to prepare a hold for suspension. However, since the holes do not meet, it is suggested that the stone may have been lost before the project was completed, or that the hardness of the stone may have caused abandonment of the task. The stone measures approximately $\frac{1}{2}$ inch on a side. Frequency: 1, Swallow Cave (30"-36" subsurface).

Axe. The only axe recovered is a fragmentary specimen of felsite (Pl. 23). The bit is broken, and the butt end is badly battered. It has a three-quarter groove. Length, $4\frac{3}{8}$ inches; greatest width, $3\frac{1}{4}$ inches; thickness, $1\frac{1}{2}$ inches. Frequency: 1, Red Paint Cave (surface).

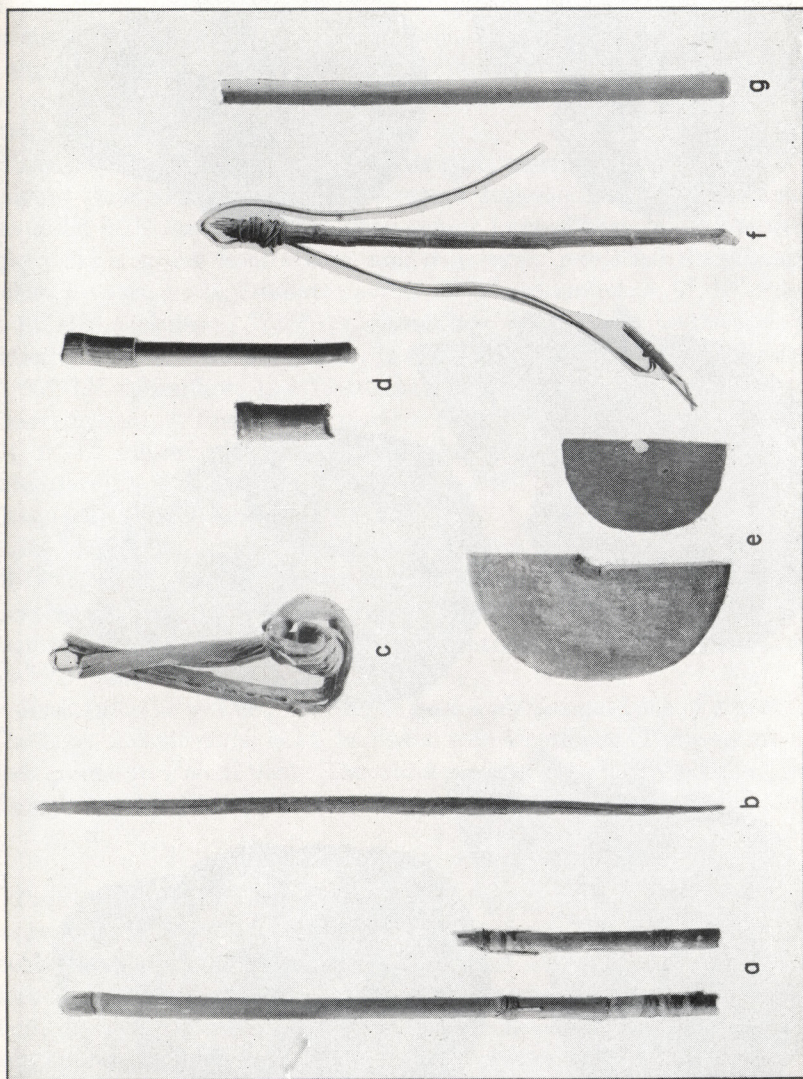
Projectile Point. Only a single specimen was found in all of the caves examined (Pl. 23). It is a small, triangular-shaped, straight-based, side-notched point of opal. Length, 1 inch; width of base, $\frac{1}{2}$ inch; greatest thickness, $\frac{1}{8}$ inch; notches placed $\frac{1}{4}$ inch above base. Frequency: 1, Tau Cave (surface).



Stone, bone, and shell artifacts. a, Utilized flakes of stone. b, Stone axe. c, Projectile point. d, Shell bead. e, Bone awl. All items are not to same scale.

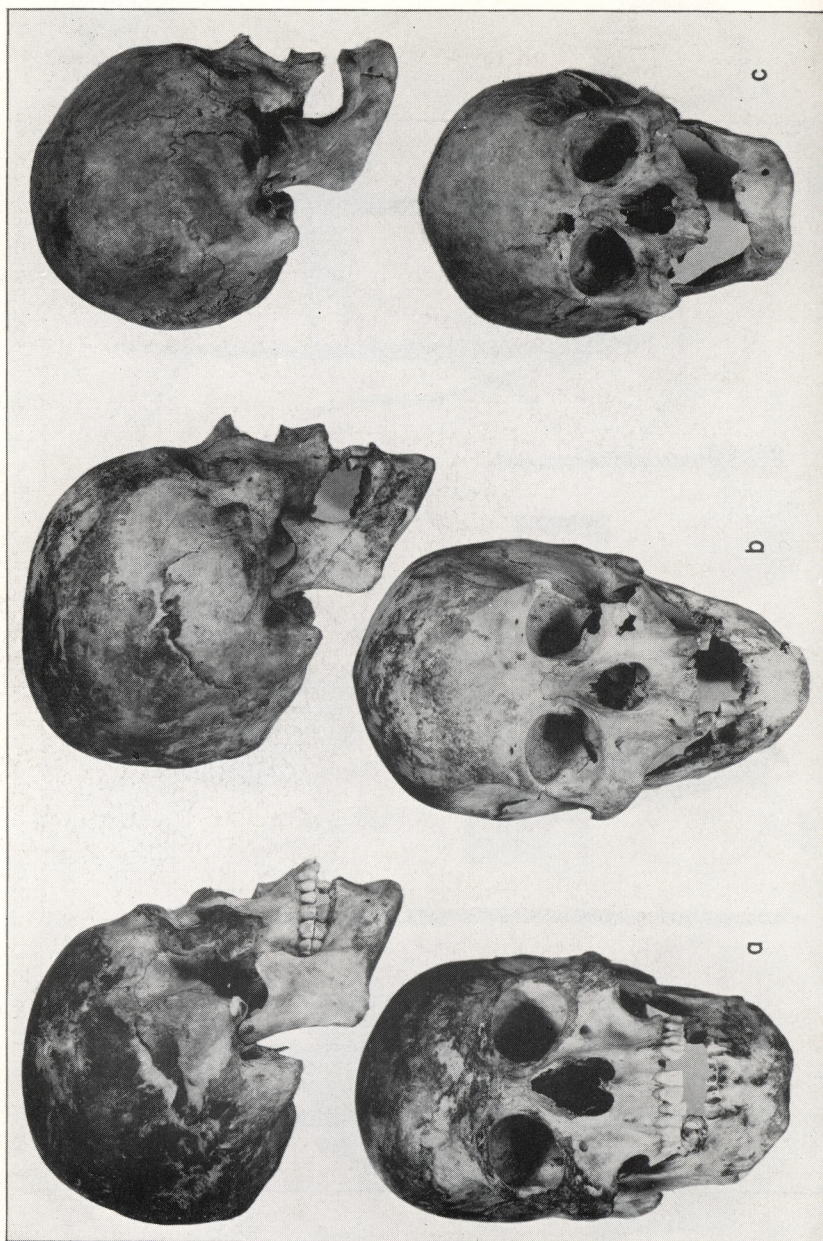


Cordage, fiber, gourd, and textiles. a, Sandal. b, Miniature sandal (?). c, Carrying device of fiber. d, Basketry. e, Textile. f, Fiber binding. g, Fiber ring. h, Fragment of gourd vessel. i, cordage. j, Fragment of matting made of wide leaves of grass. k, Fragment of matting made of narrow yucca leaves. l, Pot rest of corn husks. All items not to same scale.



Wooden artifacts. a, Nock ends of arrow shafts. b, Arrow foreshaft. c, Willow tie used in post and mud type of wall. d, Reed cigarettes. e, Wooden spindle whorls. f, Trap trigger. g, Fire drill. All items not to same scale.

PLATE 26



Skulls. a, Burial 1, Olla Cave. b, Burial 2, Olla Cave. c, Burial 1, Swallow cave

Utilized Flakes of Stone. Many of the caves examined yielded specimens of this type (Pl. 23). They are flakes of chert, chalcedony, flint, and occasionally obsidian which appear to have been used as cutting or scraping implements. All have one or more sharp edges and most show a bulb of percussion. A few examples exhibit a slight amount of retouching, but the majority do not. The edges of some appear to have been dulled through use. Several stone cores from which such flakes were struck were recovered.

The prevalence of stone flakes of this type, together with the absence of such chipped stone tools as knives and scrapers, suggests that the inhabitants of the caves did little stone chipping. They appear to have been content to use sharp-edged flakes struck from a core, and only rarely retouched the edges of such flakes. Frequency: 22, Swallow Cave (2, 0"-6" subsurface; 4, 6"-12" subsurface; 1, 12"-18" subsurface; 3, 18"-24" subsurface; 2, 24"-30" subsurface; 4, 30"-36" subsurface; 1, 42"-48" subsurface; 1, 48"-54" subsurface; 1, 54"-60" subsurface; 2, 66"-72" subsurface; 1, 84"-90" subsurface); 1, Slab Cave (surface); 1, Tau Cave (surface); 1, Corral Cave (surface); 3, Step Cave (surface); 21, Dark Cave (10, 0"-6" subsurface; 7, 6"-12" subsurface; 3, 12"-18" subsurface; 1, 18"-24" subsurface); 1, Red Paint Cave (surface); 3, Arch Cave (surface); 3, Las Ventanas Cave (1, surface; 2, subsurface). Total: 56.

Shell Ornaments. A small olivella shell had been fashioned into a bead by cutting off the spire so that string could be passed through it (Pl. 23). Length, $\frac{5}{8}$ inch; greatest diameter, $\frac{1}{4}$ inch. Frequency: 1, Slab Cave (surface). A fragment of nacreous shell also may have been part of a pendant. Frequency: 1, Swallow Cave (36"-42" subsurface).

Bone Awl. The awl had been made from a metacarpal bone of a deer (Pl. 23). The bone, including the head, had been split lengthwise. The working end had been ground to a blunt point. The entire specimen was highly polished, probably through use. Length, $6\frac{1}{2}$ inches. Frequency: 1, Corral Cave (surface).

CORDAGE, FIBER, AND TEXTILES

Twisted Fiber Cord. Cordage was made of yucca and cotton fibers, the former predominating (Pl. 24). One small length was made of human hair. There are a few specimens of single-strand yarn, but most examples are two-yarn strands. Both Z twist (twisted to the left, counterclockwise) and S twist (twisted to the right, clockwise) construction techniques are illustrated. When twisting a two-yarn strand, the yarn twist is normally the reverse of the strand twist. There is one example of a four-strand cord. Strands vary from $\frac{1}{16}$ inch to $\frac{1}{8}$ inch in diameter, and from 5 to 16 twists per inch. Frequency: 11, Tau Cave (surface); 2, Slab Cave (surface); 4, Rincon Cave (surface); 3, Corral Cave (surface); 11,

Swallow Cave (surface); 1, Dark Cave (surface); 4, Las Ventanas Cave (surface). Total: 35.

Pot Rest. A doughnut-shaped bundle of corn husks appears to have been used as a pot rest (Pl. 24). It would have been especially useful with globular-bottomed pottery or gourd vessels, types which are known to have existed in this area. Diameter, 5 inches. Frequency: 1, Swallow Cave (surface).

Ring of Fiber. A small ring of plaited pine needles was collected (Pl. 24). It is a narrow band woven by an over-two-under-two technique and is about the correct size to have served as a finger ring. Width of band, $\frac{3}{8}$ inch; diameter, $\frac{7}{8}$ inch. Frequency: 1, Slab Cave (surface).

Carrying Device of Fiber. One specimen of this type was recovered (Pl. 24). It consists of a single length of twisted grass fiber formed into two loops, each $4\frac{1}{2}$ inches in diameter, connected by a string 4 inches long. The diameter of the string connecting the two loops had been increased by wrapping a cord around it. This would make the object more practical as a carrying device since the wrappings would keep the string from cutting into the hand of the user. Just what was carried with the aid of this device is conjectural. The loops are not adjustable; hence it may have been used but once, or always in association with objects of the same size. With the loops crisscrossed it could have served to carry a globular- or pointed-bottom pottery or gourd vessel. Such loops might also have assisted in carrying long poles, such as were used in house walls or ceilings. The loops are about the same diameter as many of the poles used in the construction of houses. If handles of this type were placed near each end of a long pole, two individuals probably could carry the pole with greater ease than simply by hand. Martin, *et al.*, (1952, p. 226) refer to such devices as "handcuff" carrying loops. Frequency: 1, Dark Cave (surface).

Fiber Bindings. In addition to twisted fiber cordage, narrow yucca leaves also were used as bindings or ties (Pl. 24). Several such leaves, or lengths of braided leaves, with ends tied together were observed. Square knots commonly were employed for tying both leaves and cordage. Frequency: 3, Rincon Cave (surface); 1, Dark Cave (subsurface); 2, Swallow Cave (surface). Total: 6.

Bundles of Fiber. Bundles of yucca fiber and bear grass found in four caves probably represent raw material from which cordage or baskets were to be made. Frequency: 1, Tau Cave (surface); 1, Rincon Cave (surface); 2, Dark Cave (surface); 1, Corral Cave (surface). Total: 5.

Feather Cord. A small bundle of feather cord suggests that blankets were made of such material. Small, downy feathers had been attached to the cord by inserting their shafts into the string during the process of manufacture. Once the fibers of the string were twisted together, the feathers were held tightly in the string. Frequency: 1, Tau Cave (subsurface).

Basketry. The few small basketry fragments all show the same method of manufacture: close coiling; simple stitch, uninterlocked; one-rod foundation (Pl. 24). However, variations are apparent. Two specimens are very tightly woven and have small, flat coils. The splints, which appear to be of grass or narrow strips of split bark, are only $\frac{1}{16}$ of an inch wide and closely encircle the small twigs which served as the foundation rods. The twig rods average about $\frac{1}{8}$ inch in diameter. On the other hand, three examples of basketry have widely spaced splints of grass, about $\frac{1}{4}$ inch wide, encircling small twig foundation rods. This resulted in a loosely woven basket. However, both the interior and exterior surfaces had been covered with a hard, black substance, probably a gum or pitch which would have made them waterproof. Frequency: 1, Tau Cave (surface); 3, Slab Cave (surface); 1, Rincon Cave (surface). Total: 5.

Matting. Twilled matting was common (Pl. 24). The majority of the specimens were constructed of narrow leaves of yucca, averaging about $\frac{1}{8}$ inch in width; however, matting of bear grass and soft reeds also was noted. An over-three-under-three technique of manufacture was employed in most examples. One specimen shows a predominant over-two-under-two construction technique, but in places it is over-one-under-two, and in other places over-two-under-three. It is possible that some of the fragments which are classed as matting may have been parts of ring baskets, but no rim sections were found. Frequency: 2, Swallow Cave (surface); 3, Dark Cave (surface); 2, Zigzag Cave (surface); 1, Slab Cave (surface); 1, Tau Cave (surface); 1, Las Ventanas Cave (surface). Total: 10.

Sandal. One complete sandal of two-warp, wickerwork construction was collected (Pl. 24). All elements are of twisted juniper bark cord. The warp elements had had been twisted together to form a continuous oval unit; the weft is woven back and forth over and under the warp. The heel is semi-circular and the toe is square. Ties emerge from the toe of the sandal and from near the heel. They are knotted together over the instep. A small cord connects the rear ties across the back of the heel. The size of the sandal and the length of the heel tie suggests that it was used as a toe sandal rather than as a covering for the entire sole of the foot. Length, $5\frac{3}{4}$ inches; width, 3 inches. Frequency: 1, Swallow Cave (12"-18" subsurface).

Miniature sandal (?). An object of plaited yucca leaves is shaped like a sandal; however, it is so small that its actual use is problematical (Pl. 24). It is constructed of seven narrow yucca leaves which are bent at the "toe" and plaited in an over-two-under-two style. At the "heel" the leaves are tied into two bundles which are knotted around one another to form a fish-tail pattern. The heel is narrower than the toe and there are no ties. Length, $3\frac{3}{4}$ inches; greatest width, $1\frac{1}{2}$ inches. Frequency: 1, Rincon Cave (surface).

Cotton. Specimens consist of several cotton seeds to which fiber is still attached. Frequency: 2, Slab Cave (surface).

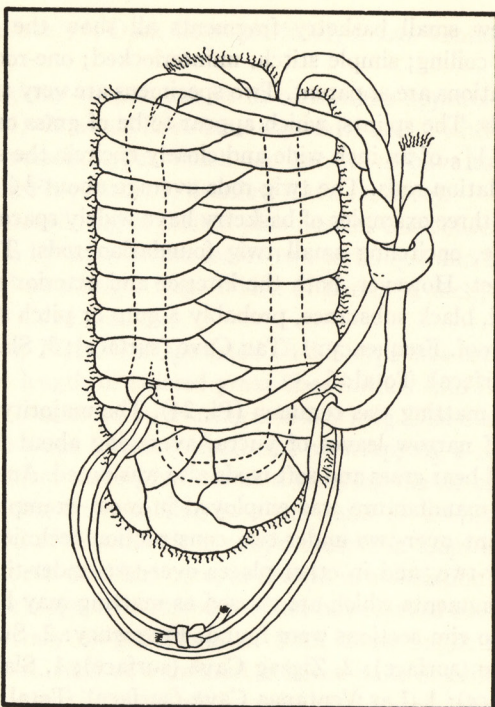


FIGURE 18. Sandal from Swallow Cave, showing details of construction

Textiles. All textile specimens were found on the surfaces, or within a few inches of the surfaces, of the caves. Cotton fiber and apocynum fiber have been identified in the cloths (Pl. 24). The weaving technique exhibited by most specimens is a plain over-one-under-one type; however, one specimen was woven in diamond twill. Frequency: 5, Slab Cave (surface); 2, Tau Cave (surface); 2, Corral Cave (surface); 1, Las Ventanas Cave (surface). Total: 10. Three of the cloths have been analyzed by Kate Peck Kent. Her report follows:

TEXTILES FROM SLAB CAVE AND CORRAL CAVE

BY KATE PECK KENT

Textile finds consist of three small fragments of cloth, two of apocynum fiber, and one of cotton thread. The fiber cloths are woven in regular plain weave, the wefts passing over-one warp under-one warp (Fig. 20). They are both warp-face; that is, there is a marked preponderance of warps over wefts to the inch. It is

assumed that these cloths were woven on a loom of a type common in the Southwest in pre-Spanish times. If so, a string loop heddle controlled one set of warps (say the odd-numbered ones), while the second set was governed by a shed rod.

One of the apocynum fragments consists of two pieces with raw edges folded under and sewed together. This is probably a mended tear, as the two parts are identical in manufacture. The stitch used is shown in Fig. 21. It is the same as that employed in joining fabrics and mending tears in cloth from Canyon Creek Ruin in east central Arizona (Haury, 1934, p. 90, Fig. 17,e).

The general character of the fiber fragments appears to be closely similar to that of woven apocynum cloths from Chihuahua described by O'Neale (O'Neale, 1948. See, in particular, pp. 114-115). Unfortunately, there are no specialized features, such as selvages, warp stripes, or bound eyelets to make the resemblance more meaningful. O'Neale's specimens are tentatively dated as Basketmaker II (O'Neale, 1948, p. 99).

The cotton cloth is a diamond twill with an over-two-under-two rhythm which breaks at intervals to create the diamond pattern (Fig. 19). This weave required the use of three heddles and a shed rod. The cloth is more loosely woven than other known diamond twills from the Southwest, and the heddle rig differs from any previously recorded. However, it is clearly a part of the weaving tradition of that area. A study of prehistoric pueblo cottons as a whole has disclosed at least 58 twills from 24 different sites (Kent, 1957). Seventeen of the sites are Pueblo III Anasazi, and all but seven of the twills come from them. Nine diamond weaves are included in the series. These are from Grand Gulch, White House, Floating House, Aztec, Montezuma Castle, Tularosa Cave, and unknown sites in northern Arizona and southern Utah.

Whether the loom used in the manufacture of the three cloths was of the upright type common among the Anasazi, or horizontal to the ground like that recorded for southern Arizona and northern Mexico in early historic times, cannot be determined.

SPECIMEN NO. I

Specimen No. 1 is a fragment of diamond twill cotton cloth, no selvages or finished edges.

Source: Slab Cave, Chihuahua.

Dimensions: Warp stretch, 6 inches; weft stretch, 5 inches.

Thread count: Warps per inch, 20; wefts per inch, 20.

Material: Warps, cotton, single-ply Z-spun. Threads about $\frac{1}{32}$ inch in diameter. No evidence of dye. Wefts, same.

Weave technique: Diamond twill. The basic rhythm is over-two warps, under-two warps. The loom could have been strung with 3 heddles and a shed rod to

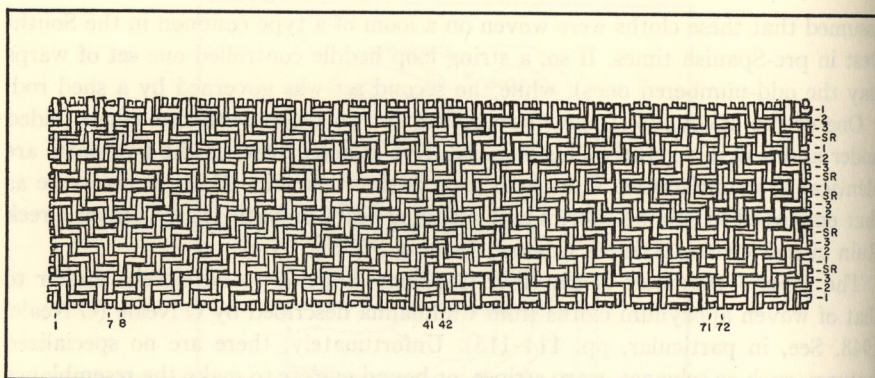


CHART 11. *A theoretical stringing of heddles for the first 46 warps of the diamond twill is shown in the following diagram. Warps clasped by a heddle are indicated by numbers. Dashes represent warps, not controlled by the heddle, over which the weft floats. Rhythm shifts are underlined.*

Shed rod: 1 -- 4, 5 -- 8, 9 -- 12, 13 -- 16, 17 -- 20, 21 -- 24, 25 -- 28, 29 -- 32, 33 -- 36, 37 -- 40, 41 -- 44, 45 --
 Heddle 3: -- 3, 4 -- 7 - 9, 10 -- 13, 14 -- 17, 18 -- 21, 22 -- 25, 26 -- 29, 30 -- 33, 34 -- 37, 38 -- 41 - 43, 44 --
 Heddle 2: - 2, 3 -- 6, 7 -- 10, 11 -- 14, 15 -- 18, 19 -- 22, 23 -- 26, 27 -- 30, 31 -- 34, 35 -- 38, 39 -- 42, 43 -- 46
 Heddle 1: 1, 2 -- 5, 6 - 8 -- 11, 12 -- 15, 16 -- 19, 20 -- 23, 24 -- 27, 28 -- 31, 32 -- 35, 36 -- 39, 40 - 42 -- 45, 46

accomplish this weave, and it is assumed that this was the case. In our reconstruction of the weave, as shown in the accompanying diagram and in Fig. 19, breaks in the basic over-two-under-two rhythm occur in heddles 1 and 3 on warps 7-8, 41-42, and 71-72. Hence there are 34 warps between the first and second rhythm shifts, and 30 warps between the second and third shifts. This irregularity probably represents an error in the original stringing of the heddles, as shifts usually occur at regular intervals in Southwestern diamond twills. Near the center of the fragment the upper half of a completed diamond pattern may be distinguished. This was made by inserting 36 wefts with the heddle order 1-4-3-SR, 1-4-3-SR, and repeat, before reversing the order of pulling the heddles. Thus, in this part of the cloth, the pattern being woven probably consisted of sets of nested diamonds, eight in each set.

SPECIMEN NO. 2

Specimen No. 2 consists of two fragments of plain weave apocynum cloth sewed together. No selvages or finished edges.

Source: Slab Cave, Chihuahua.

Dimensions: Warp stretch, $6\frac{1}{2}$ inches; weft stretch, $3\frac{1}{2}$ inches.

Thread count: Warps per inch, 44; wefts per inch, 22.

Material: Warps, apocynum S-twist threads. These threads appear to be two-ply, although the twist of the initial single plies is difficult to see. Warps are less than $\frac{1}{32}$ inch in diameter, and are very brittle. Wefts, same as warps, but about $\frac{1}{32}$ inch in diameter, and quite soft.

Weave technique: Plain weave, warp-face (Fig. 20).

Mending stitch: The raw edges of the two pieces are folded on each other and sewed with the stitch illustrated in Fig. 21. One piece is gathered into folds by the mend. This probably represents the sewing of a torn cloth, as the pieces are identical in character.

SPECIMEN NO. 3

Specimen No. 3 is a fragment of plain-weave apocynum cloth.

Source: Corral Cave, Chihuahua.

Dimensions: Warp stretch, $6\frac{1}{2}$ inches; weft stretch, 5 inches.

Thread count: Warps per inch, 36; wefts per inch, 20.

Material and weave technique are the same as for Specimen No. 2, except that the cloth is not quite so finely woven.

WOODEN ARTIFACTS

Arrows. Arrows are of the compound variety, consisting of a reed mainshaft and a wooden foreshaft (Pl. 25). No complete mainshafts were recovered, but several proximal ends show that a wooden plug was inserted into the end of the reed before the V-shaped notch was cut into both the reed and the plug. Sinew wrappings were placed below the notch to act as a reinforcement and also to hold the rear end of the feathers in place. A second band of sinew binding held the front of the feathers to the shaft. Quills remaining in place beneath the sinew bindings indicate that arrows were fletched with either two or three feathers. Another sinew binding was placed around the distal end of the reed mainshaft to hold the foreshaft in place and to prevent the mainshaft from splitting. One specimen has a band of red paint encircling the mainshaft just forward of the feathers.

Foreshafts were made of carved and smoothed sticks. The distal end tapers to a point. There are no indications that they were tipped with stone. The proximal end has a shouldered tang for insertion into the mainshaft. The only complete foreshaft measures as follows: length, 10 inches; greatest diameter, $\frac{1}{4}$ inch.

Since only one stone projectile point (Pl. 23) was recovered from all caves investigated, and none of the arrow foreshafts found were fitted with stone points, it is suggested that wooden-pointed arrows were commonly employed. Frequency: 4, Swallow Cave (3, surface; 1, 12"-18" subsurface); 4, Las Ventanas Cave (surface). Total: 8.

Perforated Wooden Discs. These objects in all likelihood served as spindle whorls, although they were not attached to spindle shafts when found (Pl. 25). Each fragmentary example consists of one half of a thin disc of wood, slightly thicker in the center than on the edges, with a perforation through the center. The common occurrence of cordage and textile fragments in the caves would suggest the use of spindles and spindle whorls for twisting various fibers into yarn and cordage. The larger disc measures as follows: diameter, $3\frac{3}{4}$ inches; thickness, $\frac{1}{8}$ to $\frac{1}{4}$ inch; diameter of perforation, $\frac{3}{8}$ inch. Frequency: 1, Rincon Cave (surface); 1, Dark Cave (surface). Total: 2.

Fire Drill. The specimen consists of a section of a hard stick one end of which

is rounded and charred (Pl. 25). The other end is broken. The shaft of the stick is smooth and of uniform diameter. Length, 7 inches; diameter, $\frac{3}{8}$ inch. Frequency: 1, Slab Cave (surface).

Digging Stick. A pointed wooden stick could have served as a digging implement. It is fairly straight and of uniform diameter except at one end where it tapers to a blunt point. The shaft is smooth. Length, 14 inches; diameter, 1 inch. Frequency: 1, Dark Cave (12"-18" subsurface).

Miniature Bow. This is a miniature self-bow made of a bent twig. The twig is circular in cross section and has the bark remaining. There are no nocks, but a yucca-fiber bow string is wrapped around one tip. Length, $9\frac{1}{2}$ inches; diameter, $\frac{1}{4}$ inch. Frequency: 1, Las Ventanas Cave (surface).

Wooden Ball. A small piece of wood had been carved into a round ball. Use unknown. Diameter, $\frac{3}{4}$ inch. Frequency: 1, Swallow Cave (surface).

Worked Gourd Fragments. Several fragments of gourd rind had been worked in such a way as to suggest that they had been parts of vessels. Two small pieces appear to have been portions of rims since they each have a smoothed edge. A third, larger fragment was obviously part of a vessel rim. It has a rounded edge and a crack in the rim. The crack had been repaired by drilling holes on either side of it and tying a fiber string through them. The larger specimen measures $2\frac{1}{8}$ inches square. Frequency: 1, Dark Cave (subsurface); 1, Swallow Cave (surface); 1, Las Ventanas Cave (surface). Total: 3.

Reed Cigarettes. Three are short sections of reeds with a node in the center (Pl. 25). The septum had been pierced. All exhibit one smoothed end and one charred end. They average in size as follows: length, $1\frac{3}{8}$ inches; diameter, $\frac{1}{2}$ inch. A fourth cigarette is a compound type consisting of two reeds, one of small diameter inserted into another of larger diameter. The end of the smaller reed is cut at right angles to the shaft and smoothed and must have served as the mouth-piece. The end of the larger reed is charred. It measures $4\frac{1}{4}$ inches, average length. Frequency: 1, Swallow Cave (surface); 1, Dark Cave (surface); 1, Tau Cave (surface); 1, Las Ventanas Cave (surface). Total: 4.

Willow Ties. When the first specimens of this type were recovered, they presented a problem as to their use. However, when caves containing remains of room walls were examined, the use of such ties became apparent since many specimens were observed in place (Pls. 7B, 8; Fig. 11). They were employed to hold together the wooden elements in pole and mud walls. The vertical poles of such walls were reinforced by having several rows of small horizontal poles lashed to either side of them. Lengths of green willow twigs, averaging about $\frac{3}{16}$ of an inch in diameter, were wrapped about each intersection of the vertical and horizontal wall members.

In several instances the recovery of willow ties in caves indicated that struc-

tures had existed in these caves, although all other evidence for their former presence had disappeared. Frequency: 5, Swallow Cave (surface); 2, Slab Cave (surface); 6, Tau Cave (surface); 6, Rincon Cave (surface); 1, Corral Cave (surface); 3, Las Ventanas Cave (surface). Total: 23.

Trap Triggers. A type of artifact which appears with some frequency consists of a stick, to one end of which are attached a pair of yucca leaves or pine needles (Pl. 25). To the ends of the leaves or needles a short twig is tied. It has been suggested that such devices served as trap triggers (Sayles, 1936b, p. 80). The stick may be a section, complete with bark, about 7 inches long, and $\frac{3}{8}$ inch in diameter, or such a stick split in half lengthwise. The yucca leaves or pine needles, which extend from the stick 5 to 8 inches, were attached to one end of the shaft by wrapping them around it several times. A small twig, 1 inch long and $\frac{1}{8}$ inch in diameter, was tied to the free ends of the leaves or needles. Only four specimens are complete; the fiber portions of the others are broken. Frequency: 4, Swallow Cave (surface); 1, Tau Cave (surface); 2, Rincon Cave (surface); 1, Olla Cave (surface); 4, Las Ventanas Cave (surface). Total: 12.

Corn Cobs Tied to a String. Three corn cobs were tied at regular intervals to a set of four strings. A loop in the string indicates that a fourth cob originally had been attached. Use unknown. Length of entire specimen, 5 inches. Frequency: 1, Rincon Cave (surface).

HABITATIONS

Our investigations suggest three stages in the habitation pattern for the caves under consideration. There was no evidence of any type of structures in the lower levels of caves. It is therefore believed that they were first used as camping places, and that the natural protective features made them attractive to man.

Next we found that in four caves the subsurface deposits contained fragmentary remains of adobe mud walls or portions of wooden posts set into the ground. In Swallow Cave, sections of buried mud walls and a hard-packed mud floor indicated the former presence of rectangular rooms. Also in Swallow Cave, and in two other caves, excavations revealed buried posts, but they were not frequent enough to determine any pattern from their positions. Five caves contained no evidence for subsurface structures. Thus, it appears that there is represented in the caves a period in which man continued to use them as camping places but also began to build mud-walled houses or to erect some type of structures about frameworks of poles.

The latest period of occupation is characterized by the construction of cliff dwellings. It seems likely that this architectural development is due to Pueblo influence from the north. Houses varying from one to thirty rooms were built in caves or under overhanging rock shelters. Walls of such structures were constructed of poles and mud, puddled adobe mud, or large, unshaped stones, or

cobbles, set in mud mortar. Interiors and exteriors of rooms were coated with layers of mud plaster. Rooms built independent of cave walls were normally rectangular in plan; those built adjacent to cave walls, and incorporating a portion of the cave wall in the room, were irregular in shape. In a few cases, small rooms were cut into the soft rock of the cave walls. Horizontal wooden beams laid across the tops of walls supported mud roofs except in instances where walls extended to the tops of caves and utilized the cave ceiling as the ceiling for rooms. Wooden poles also were employed as lintels over wall openings. Two-story structures were frequent, and structures built originally to a height of three stories were present in two caves. Doorways were rectangular, step-passage, or T-shaped. Windows were usually square or rectangular, although an occasional circular opening was observed. In a few cases, vertical posts had been set in the interiors of rooms to give additional support to the roof. Floors were of hard-packed mud. A few platform-and-depressed-basin type of fireplaces were noted within rooms.

BURIALS

Three human burials were encountered in our excavations in Cave Valley, Chihuahua. One was found beneath the floor of Structure 1 in Swallow Cave (Fig. 4) and two were exposed in the trench dug in the long, narrow corridor behind the cliff dwelling in Olla Cave (Fig. 9). Occasional human skeletal remains were encountered in other caves in Cave Valley, Arroyo el Concho, and on the Río Garabato. However, in all such cases, only a few bones, or fragments of bones, were recovered. Apparently these remains had been exposed and scattered by previous excavators.

The skeleton found in Swallow Cave is that of an elderly female. The burial had been placed in a pit dug beneath the mud floor of a poorly preserved room. The skeleton was found in a flexed position, lying on its right side, head to the south, facing east — the rear of the cave. A large slab of stone had been placed above the left shoulder of the individual. Adjacent to the skeleton were a few bits of twilled mat and carbonized cloth. A broken Alma Neck Banded jar was found near the skull.

The two burials revealed when a test trench was dug in the rear of Olla Cave had been treated identically. Both skeletons were of adults; one male, one female. The burials had been made in pits dug adjacent to one another and to the rock floor of the cave. The skeletons were in a sitting position with knees flexed. Arms were folded over the pelvis and the right leg was crossed over the left. They both faced east, the mouth of the cave. No artifacts were associated with the skeletons; however, textile impressions in the dirt adjacent to one indicated that the corpse had been clothed, or wrapped in a blanket, at the time of burial.

Chart 12 lists selected measurements and indices.

CHART 12. *Measurements and Indices of Skeletal Material*

	Burial 1 Swallow cave	Burial 1 Olla Cave	Burial 2 Olla Cave
Sex	Female	Male	Female
Age	56 plus	21-35	36-55
<i>Crania Measurements</i>			
Maximum length	151.	175.	174.
Maximum breadth	145.	137.	145.
Basion-bregma height	132.	137.	140.
Nasion-menton	—	129.	—
Bizygomatic	—	134.	—
Bigonial	82.	93.	96.
Bicondylar	111.	119.	125.
Minimum frontal	82.	88.	95.
Nasion-prosthion	62.	76.	71.
Nasion-basion	91.	97.	97.
Basion-prosthion	82.	98.	90.
Exterior palatal length	—	54.	—
Exterior palatal breadth	—	62.	—
Mandibular angle	114°	119°	123°
Height of ascending ramus	53.	64.	55.
Height of orbit	left 33.	left 32.	right 37.
Breadth of orbit	left 35.	left 39.	right 40.
Nasal height	49.	52.	52.
Nasal breadth	25.	27.	24.
Symphysial height (mandible)	—	37.	35.
Minimum breadth of ascending ramus	31.	37.	34.
<i>Indices</i>			
Length-breadth (cranial)	96.02	78.28	83.33
Length-height (cranial)	80.79	78.28	80.46
Breadth-height (cranial)	91.03	100.00	96.55
Total facial	—	96.27	—
Upper facial	—	56.71	—
Orbital	94.28	82.05	92.50
Nasal	51.02	51.92	46.15
Exterior palatal	—	114.81	—

CHART 12. *Continued*

	Burial 1 Swallow Cave		Burial 1 Olla Cave		Burial 2 Olla Cave	
Sex	Female		Male		Female	
Age	56 plus		21-35		36-55	
<i>Skeleton Measurements</i>	Right	Left	Right	Left	Right	Left
Femur: Greatest length	375.	376.	451.	453.	399.	401.
Maximum diameter of head	36.	37.	45.	44.	39.	39.
Platm. A-P	19.	20.	26.	23.	21.	21.
Platm. transverse	27.	28.	31.	30.	29.	27.
Mid-shaft diameter A-P	22.	23.	30.	28.	24.	24.
Mid-shaft diameter transverse	20.	21.	25.	25.	23.	23.
Tibia: Greatest length	311.	313.	393.	392.	345.	346.
Mid-shaft diameter A-P	26.	25.	31.	31.	27.	27.
Mid-shaft diameter transverse	16.	16.	22.	22.	20.	20.
Humerus: Greatest length	—	276.	326.	—	292.	287.
Maximum diameter of head	—	34.	47.	—	41.	40.
Ulna: Greatest length	—	—	269.	—	245.	—
Radius: Greatest length	—	—	256.	—	223.	223.
Clavicle: Greatest length	—	—	—	—	—	149.
Innominate: Greatest height	—	—	194.	196.	—	182.
Greatest breadth	—	—	154.	153.	—	145.
Pelvis: Mean height	—	—	195.	—	182.	—
Maximum breadth	—	—	276.	—	249.	—
Antero-posterior	—	—	95.	—	91.	—
Transverse	—	—	123.	—	113.	—
<i>Indices</i>						
Femur: Platymetric	70.37	71.43	83.87	76.67	72.41	77.77
Tibia: Index cnemius	61.54	64.00	70.97	70.97	74.07	74.07
Innominate: Height-breadth	—	—	79.38	78.07	—	79.67
Pelvis: Height-breadth	—	—	70.65	—	73.01	—
Pelvic outlet index	—	—	77.23	—	80.53	—
Stature (Pearson formula)						
Male 71.272 + 1.159 (femur + tibia)			169.091 approx. 5'6"			
Female 69.154 + 1.126 (femur + tibia)	146.397 approx. 4'10"				152.928 approx. 5'	

VII. ARCHAEOLOGICAL EVIDENCE ON THE EVOLUTION OF MAIZE IN NORTHWESTERN MEXICO

BY PAUL C. MANGELSDORF

The archaeological remains of maize described in this report come from five caves in the states of Chihuahua and Sonora in northwestern Mexico. The material from only one of these, Swallow Cave, is sufficiently abundant and varied to show an evolutionary series. The remains from the other caves are useful in furnishing corroborative evidence.

The cobs from Swallow Cave comprise five recognizable types, all but one of which still exist among the modern races of maize in Mexico, described by Wellhausen *et al.*, 1952.

The earliest intact cob, from Swallow Cave, comes from Level 13. This is a carbonized specimen, $1\frac{3}{8}$ inches long, having twelve rows with an average of nine kernels per row. In shape, it is quite similar to the earliest cobs from Bat Cave in New Mexico, dated at 5000 years. It also resembles the Bat Cave corn in having prominent rachis flaps, cupules widely spaced on the rachis, and long rachillae. It differs from the Bat Cave corn in the surfaces of the cupules, which are quite hairy. Two fragments of cobs, one from the same level and another from an earlier level, 14, resemble the intact specimens in their cupules and are therefore presumed to be specimens of the same race.

This early maize from Swallow Cave also shows some resemblance to the modern race, Chapalote, which occurs in the western part of Mexico, and which has been collected from the state of Chihuahua. The cob of the early Swallow Cave corn is much shorter than that of modern Chapalote, but it has the same shape, tapering at both ends; the same row number, 12; and prominent rachis flaps. Of the living races of maize in Mexico today, Chapalote seems to be the only one which could be the modern counterpart of the earliest Swallow Cave corn, and we are therefore designating the latter as "Pre-Chapalote".

The next recognizable element in the Swallow Cave cobs is clearly related to Chapalote; this type has the characteristic shape of Chapalote, tapering at both ends; it has approximately the same row number, 12, prominent glumes, perhaps representing a weak allele of Tunicate, which Chapalote is known to possess, and prominent rachis flaps. Cobs of this type, designated as "Early Chapalote" are found in several of the caves. Specimens from Swallow and Slab Caves are illustrated in Plate 28B.

The fact that Chapalote was once grown in this region is proved by the extensive collections of kernels from Dark Cave. Several thousand kernels of this

type are available from Levels 5 and 6; almost all of these are very similar to the kernels of modern Chapalote in their size, shape, and brown pericarp color. Chapalote is the only race in Mexico which has brown pericarp color. The resemblance between the kernels of modern Chapalote and the archaeological specimens is well illustrated in Plate 28A.

Beginning with Level 2 in Swallow Cave, there is evidence of teosinte introgression in small cobs with strongly indurated glumes and the occasional occurrence of single spikelets or the partial abortion of the second, or pedicillate, spikelet. There is even more evidence of this introgression in some of the specimens from the surface layer, some of which have strongly indurated crateriform lower glumes, which are set at right angles to the rachis like the teeth of a coarse wood rasp. Glumes of this kind are quite characteristic of certain segregates from maize-teosinte hybrids, and some of these archaeological specimens can be almost exactly duplicated by modern specimens obtained from experimental cultures. The combination of these characteristic glumes and single, or partly aborted, spikelets leaves little doubt that there has been introgression of teosinte in the maize of Chihuahua in prehistoric times. Teosinte is fairly common in western Mexico and has been collected in the state of Chihuahua. Furthermore, Lumholtz reports that the Indians of western Mexico practiced the custom of inter-planting corn and teosinte for the purpose of improving their corn.

The same evidence of teosinte introgression is to be found in the cobs from other caves. Plate 29 shows Tripsacoid cobs from Swallow Cave; Plate 30 illustrates Tripsacoid cobs from other caves.

About the same time, first becoming evident in Level 2, there has come into the picture an 8-rowed large-seeded corn, probably similar to Harinoso de Ocho, which is still found rarely in western Mexico, including the state of Sonora. This type of corn is definitely related to a race in Colombia known as Cabuya. It also shows some resemblance to the prehistoric flour corn of Cañon del Muerto, described by Anderson and Blanchard (1942) and it certainly has affinities with the 8-rowed flour corn of the Northern Plains Indians, especially the Mandan. Specimens of cobs of this type of corn are illustrated in Plate 31, and a single kernel from Dark Cave is illustrated in Plate 33.

The fifth type of corn in Swallow Cave (with one exception, two cobs in Level 3, which are perhaps intrusions) is found only in the surface layer. This cob is larger than any of the preceding types, is more or less cylindrical in shape, and represents an excellent blending of the characteristics of the three preceding elements: Chapalote, teosinte, and Harinoso de Ocho. The cobs of this maize have their counterparts in a modern race collected in Chihuahua and described by Wellhausen *et al.* under the name, Cristalina de Chihuahua. The archaeological cobs are shorter than typical cobs of the modern race, but in other respects they are

quite similar. Furthermore, the kernels from several of the caves resemble the kernels of the modern race in being flinty, predominantly white, and thick. This type of corn definitely has affinities with the modern corn of some of the Southwestern Indians. We have found counterparts of it in both Zuni and Navaho maize.

Some of the cobs of this type have a very definite "honeycomb" appearance, which results from the deep pockets formed by the upper and lower glumes and represents a combination of characteristics provided by the three separate elements which have gone into this maize. Chapalote has contributed long glumes; as already mentioned, it is known to have an allele at the tunicate locus. Harinoso de Ocho has contributed thickness to the glumes, and introgression from teosinte has caused the glumes to be indurated. We have specimens of modern maize which duplicate these cobs very closely. They were obtained by crossing segregates from maize-teosinte hybrids with the gene for half tunicate. These deep pockets are characteristic of some of the maize of the Indians of the Southwest.

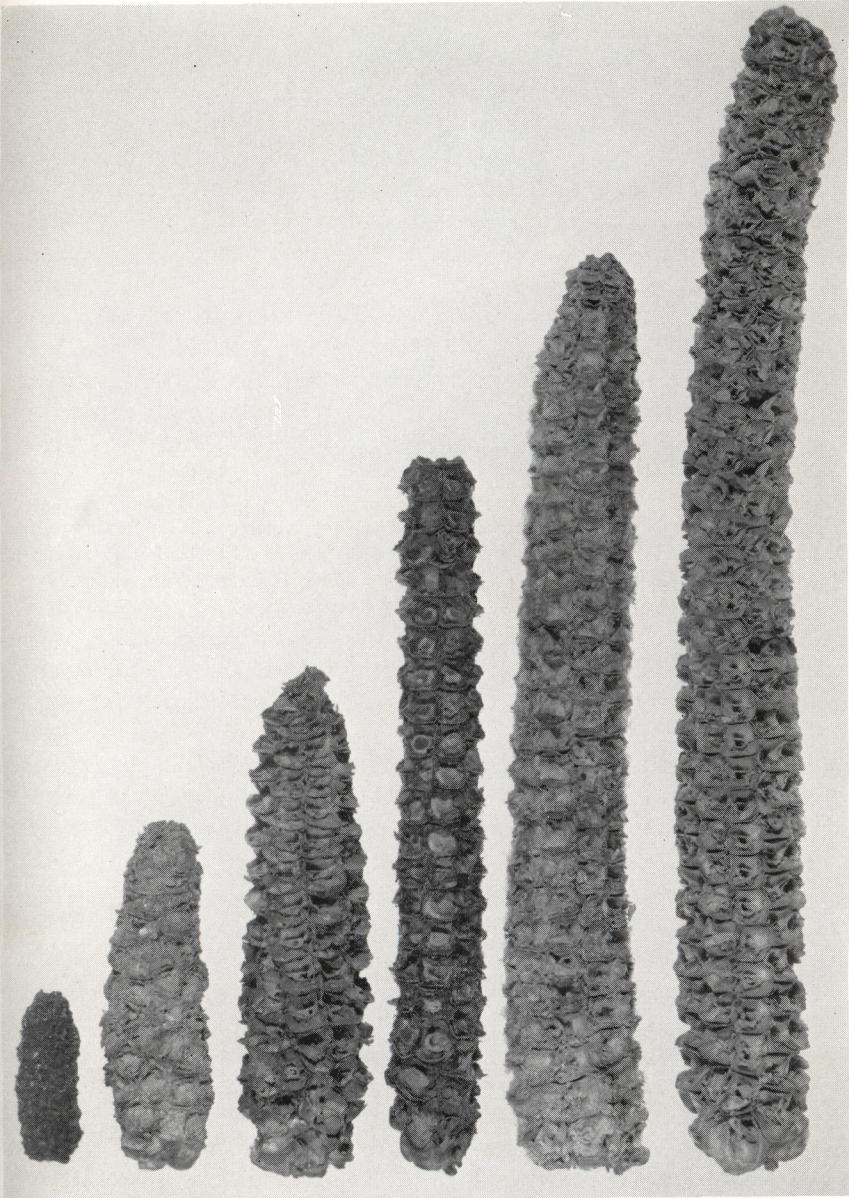
The evolutionary picture in Chihuahua seems fairly clear; three distinct elements representing early forms of Chapalote, teosinte introgression, and Harinoso de Ocho have combined to produce a precursor of the modern race, Cristalina de Chihuahua. All three of these elements and counterparts of the final product have been found, or are still to be found, among the archaeological remains of maize and among modern races of maize in the American Southwest. This, in itself, is not proof that the maize of the American Southwest originated in northwestern Mexico, but there is a strong presumption that this is the case. It seems much more likely that the movement was from Mexico to the Southwest, rather than the reverse. It must be remembered, however, that so far nothing has been found in Mexico which is as small and primitive as the earliest corn from Bat Cave in New Mexico.

A brief description of the specimens from the several caves follows.

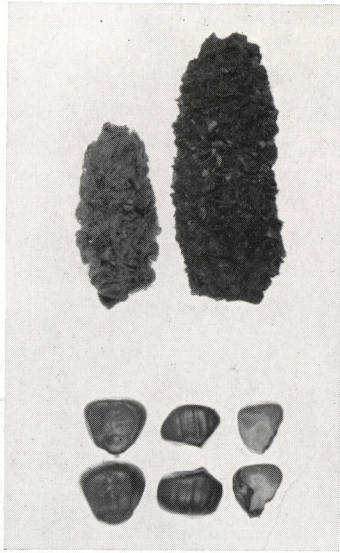
SWALLOW CAVE

Trench 3, Level 14 (78"-84"). Fragments of a carbonized cob. These fragments contain the same type of cupules found in the intact cob from Level 13. The cupules are about as broad as long, the upper margin being slightly indented at the center, giving the cupule a broad, heart-shaped appearance. There is an indication that the cupules are widely spaced; their surface is hairy. These fragments probably represent "Pre-Chapalote".

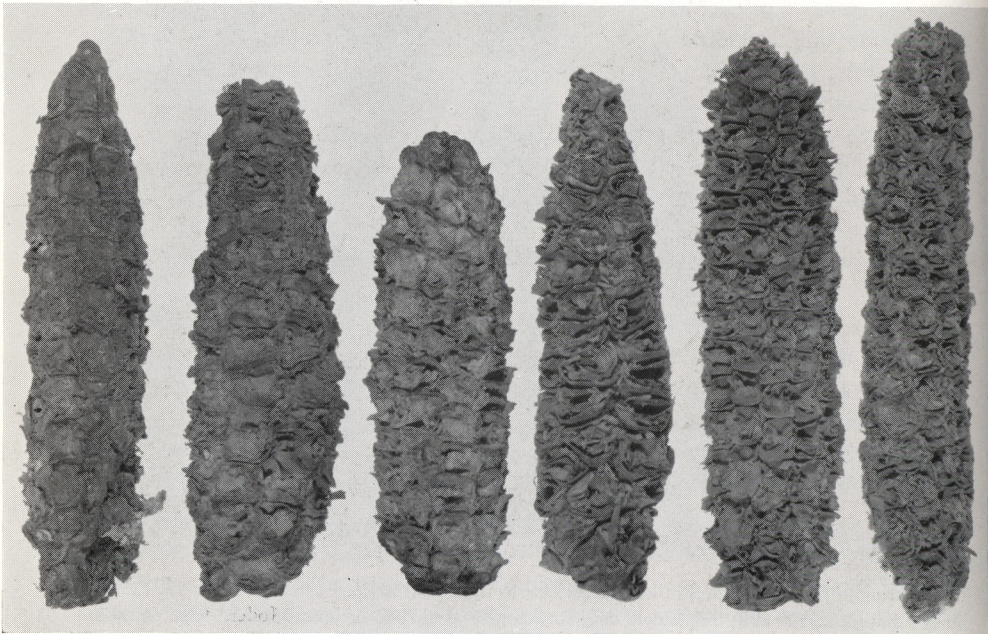
Trench 3, Level 13 (72"-78"). One intact cob carbonized, $1\frac{3}{8}$ inches long, twelve rows, nine kernels per row, slightly flattened. Shape of cob similar to those of earliest Bat Cave corn. Other similarities: cupules spaced on rachis, prominent rachis flaps. Cupules differ from those of Bat Cave corn in being slightly broader



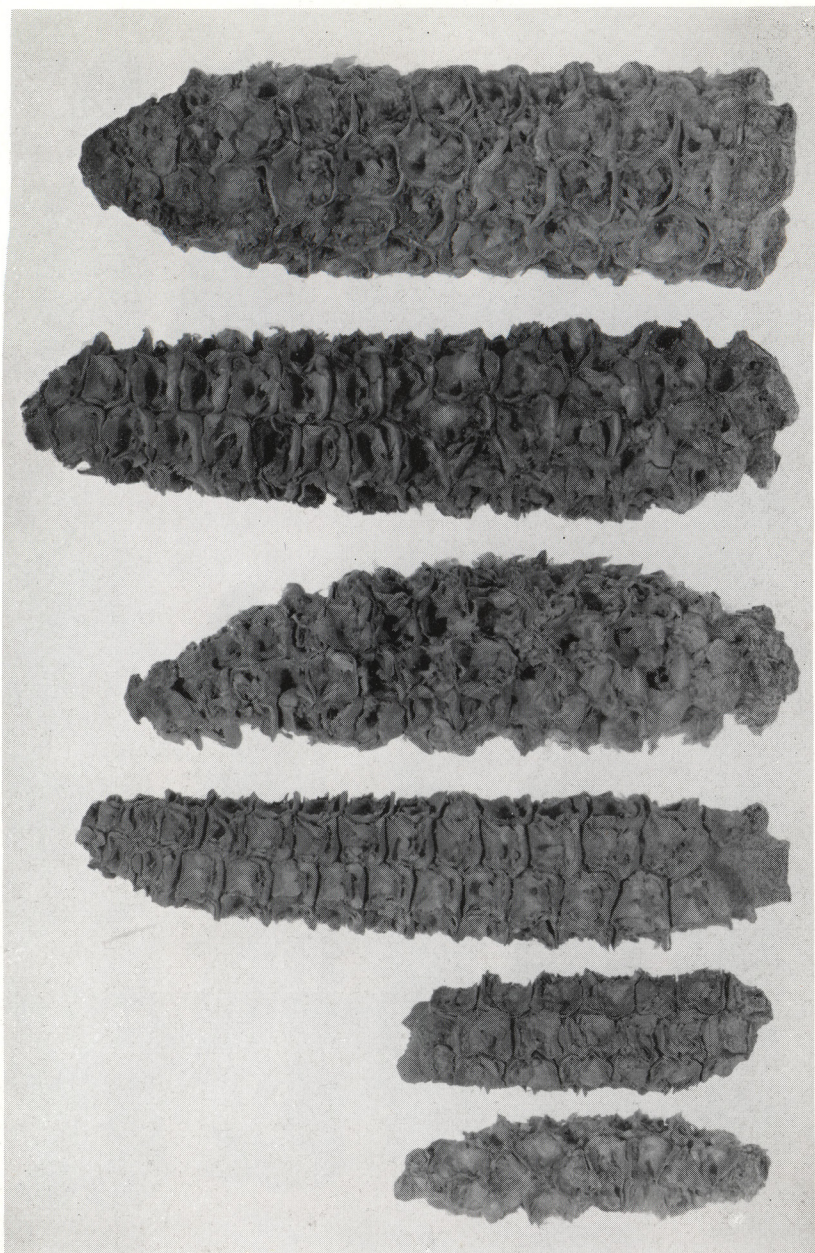
Variation in the cobs from Swallow Cave. Left to right: Carbonized cob from Level 13, 72-78"; Early Chapalote, Level 2; Tripsacoid cob, surface; 8-rowed cob, surface; Modern type (2 cobs), surface. Note deep pockets formed by glumes in cob at extreme right. This condition can be duplicated almost exactly by crossing certain segregates of maize-teosinte hybrids with half tunicate. About two-thirds natural size.



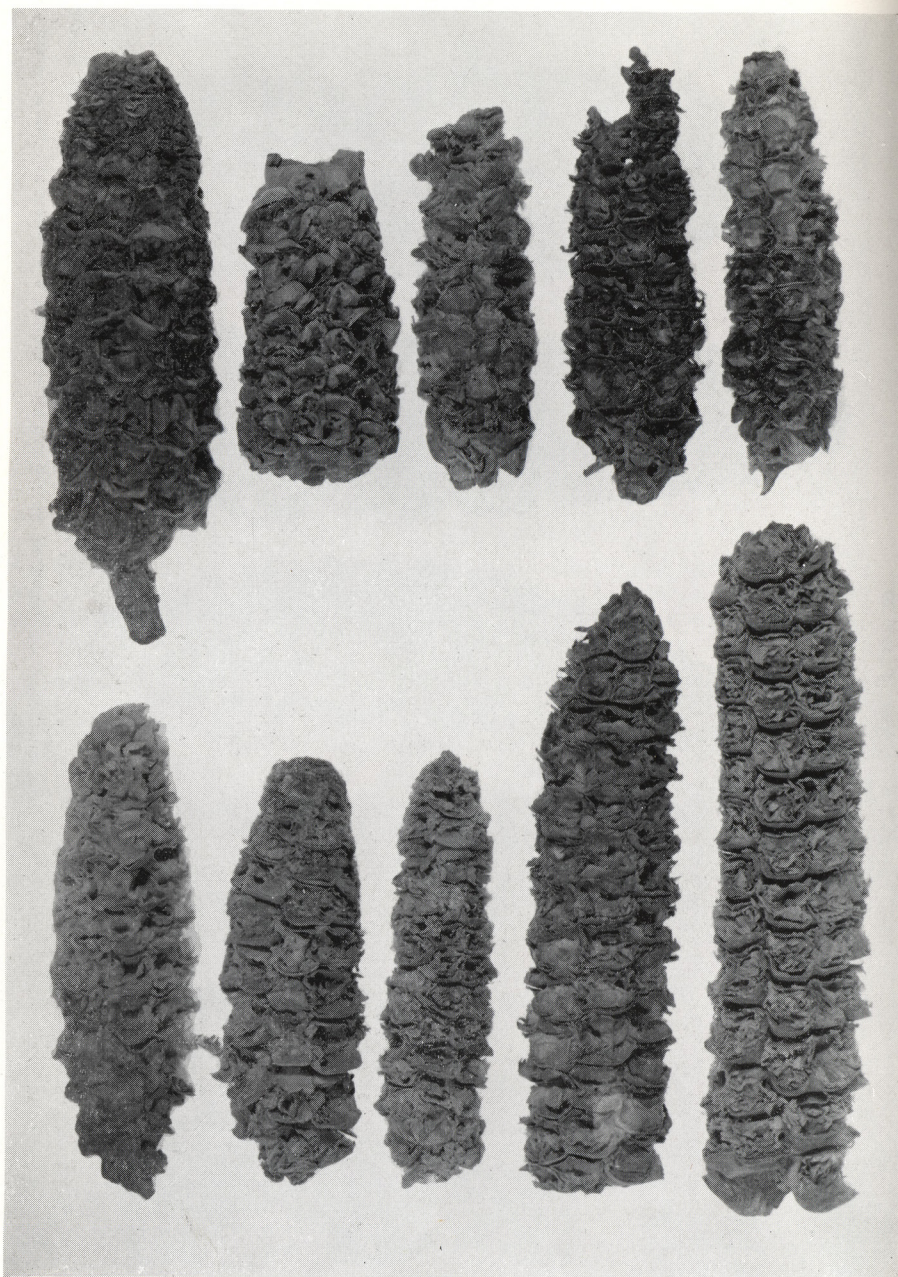
A. Upper: Earliest cob from Bat Cave (left) and earliest intact cob from Swallow Cave (right). Lower: Kernels of modern Chapalote (above) and from Level 6, Dark Cave (below). Note similarities in size, shape, and color, and in striations on dorsal surface. Natural size.



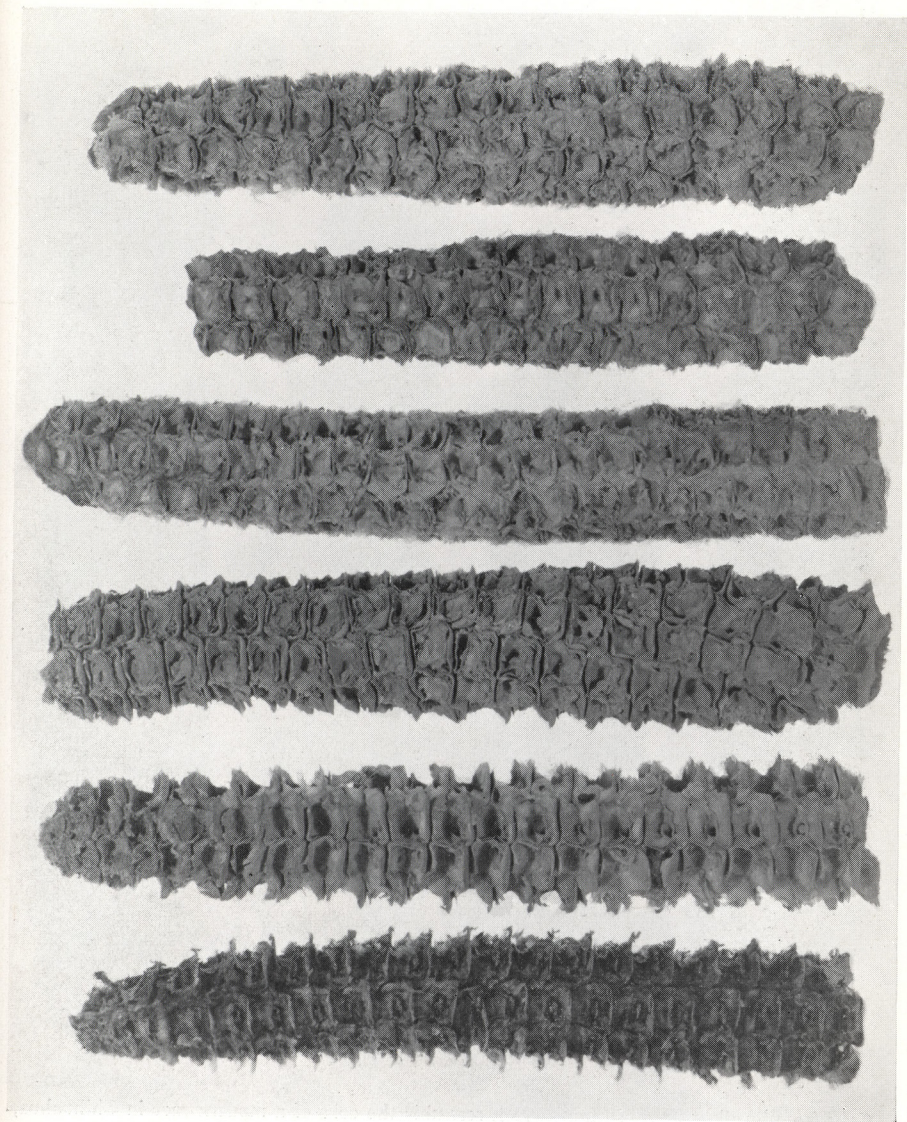
B. Cobs from several caves in Chihuahua representing an early form of Chapalote, a race still found in Western Mexico. a, Swallow Cave, Level 3; b, c, Swallow Cave, Level 2; d, e, f, Slab Cave. Natural size.



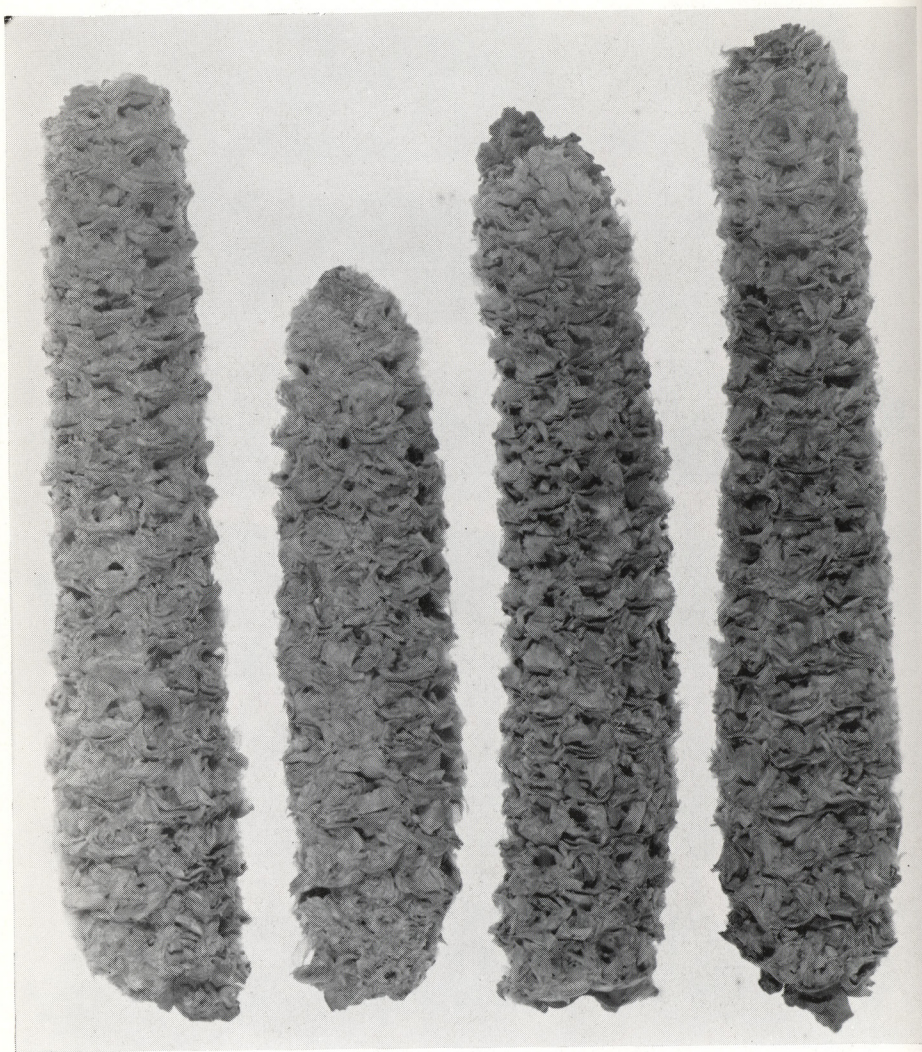
Tripsacoid cobs, Swallow Cave. a, b, Level 2; c-f, Surface. Note indurated crateriform lower glumes in f. These are characteristic of segregates from maize-teosinte hybrids. Natural size.



Tripsacoid cobs from caves in Chihuahua. Upper row: a, Tau Cave; b-e, Olla Cave. Lower row: Slab Cave. Natural size.

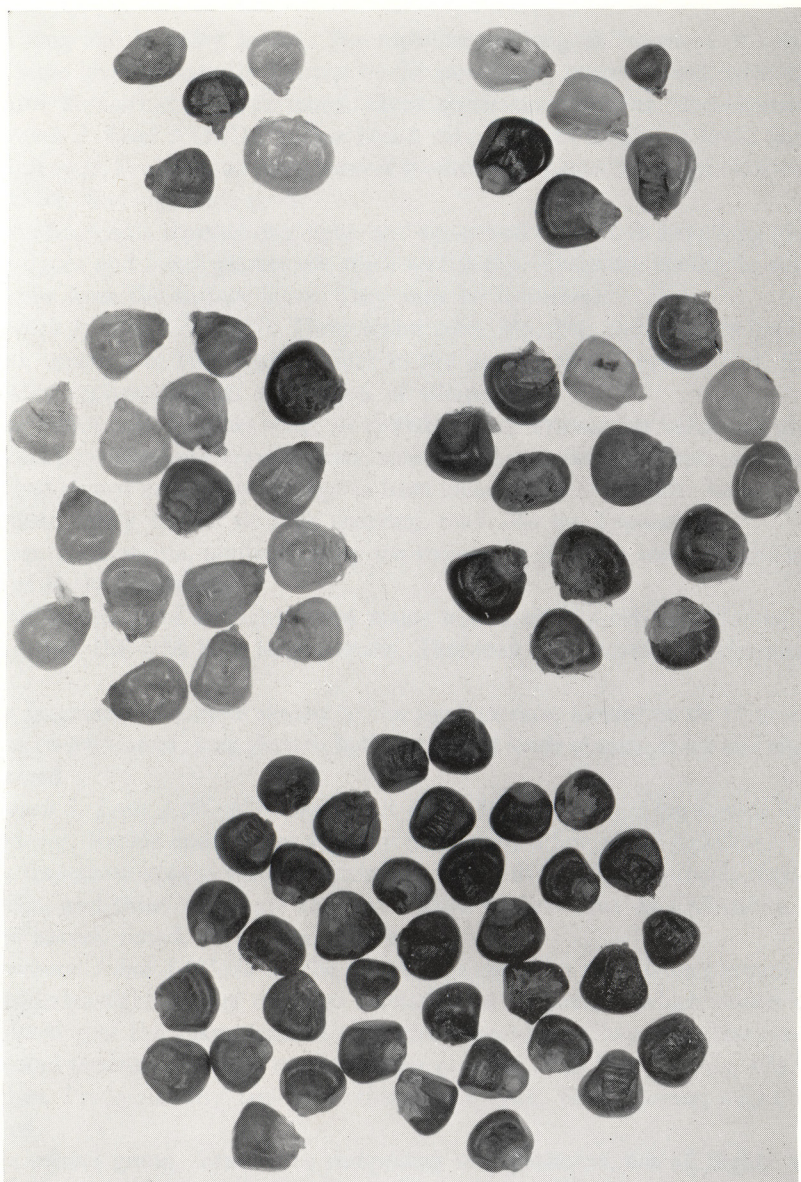


Cobs of an 8-rowed maize, resembling the modern Mexican race, Harinoso de Ocho. a, An acid-eroded cob of modern Mandan Flour; b-e, Cobs from Swallow Cave, surface; f, Cob from Slab Cave. Natural size.

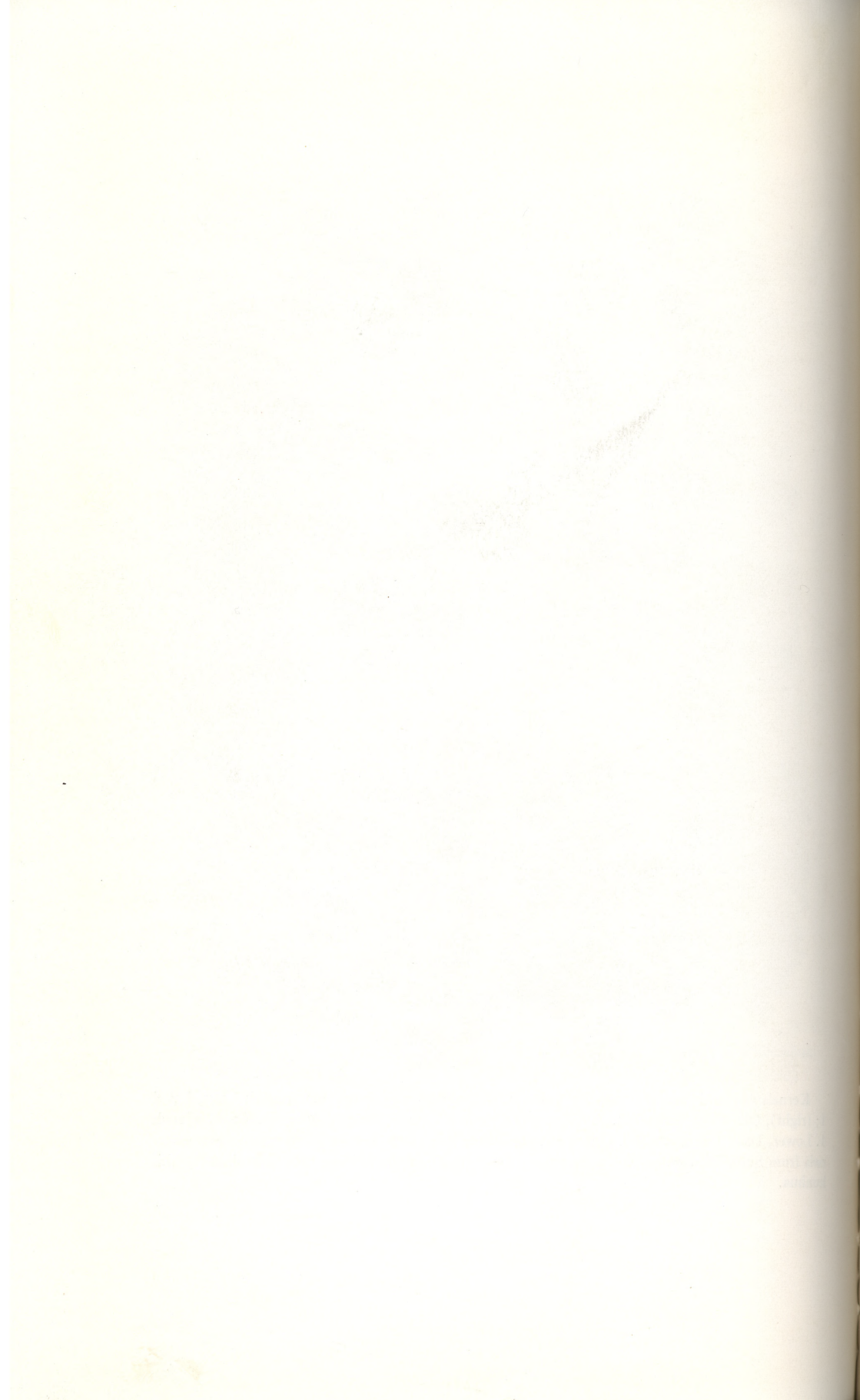


Cobs from Swallow Cave, surface, which resemble the cobs of a modern race in Chihuahua, Cristalina de Chihuahua. Natural size.

PLATE 33



Kernels (natural size) from several caves in Chihuahua. Upper row (left), Dark Cave, Level 1; (right), Olla Cave, Trench 2. Middle row (left) Slab Cave, surface; (right) Tau Cave, Trench 1. Lower, Dark Cave, Level 6. Upper left shows one large kernel of an 8-rowed corn. Some kernels from Slab, Tau, and Olla Caves are similar to those of the modern race *Cristalina de Chihuahua*.



than long and in being hairier. The rachillae are long. A fragment of cob from this same level apparently belongs to the same race, twelve-rowed, with similar cupules. Somewhat more flattened. These specimens represent "Pre-Chapalote".

Trench 3, Level 3 (12"–18"). One intact cob, 3 inches long; ten rows; tapering at both ends. Probably an early form of modern Chapalote. Six fragments; twelve, eight, ten, ten, eight, ten rows.

Two fragments representing eight- and ten-rowed cobs. Both have long glumes; both upper and lower glumes are thick and fleshy. These are similar to some of the cobs from the surface layer. They may be intrusions.

Trench 3, Level 2 (6"–12"). Three intact cobs, $2\frac{3}{8}$, $2\frac{3}{4}$, and 3 inches long, ten-rowed, tapering at both ends, similar to the intact cob in Level 3; and, like it, probably representing an early form of Chapalote.

One intact cob, 2 inches long; six-rowed; highly Tripsacoid; indurated glumes and rachis; crateriform lower glumes; some single spikelets. The specimen can be matched almost exactly by segregates from maize-teosinte hybrids. An additional fragment, badly eroded through charring, may also be Tripsacoid.

Twenty fragments, predominantly ten-rowed, all of which resemble the intact cobs of Early Chapalote.

Five fragments of an eight-rowed maize with a slender cob and glumes, indicating that the cobs bore large kernels. This may be precursor of Harinoso de Ocho.

Six fragments of a type similar to the modern race, Cristalina de Chihuahua. Ten to twelve-rowed; long glumes; both upper and lower glumes; thick and slightly indurated.

Trench 3, Level 1 (0"–6"). One intact cob, $1\frac{3}{4}$ inches long; ten-rowed; highly Tripsacoid. Rachis and glumes strongly indurated; a few single spikelets.

Six fragments approaching Chapalote in type; five which approach Harinoso de Ocho, and three which are similar to those of Cristalina de Chihuahua.

One kernel, broad, flinty, and brown.

Structures 1 and 2 (0"–18"). The intact cobs comprise two distinct groups; the first includes eight cobs of the type Cristalina de Chihuahua, which results from the blending of the characteristics of earlier elements — Chapalote, Harinoso de Ocho, and teosinte. Cobs are medium to long, 4, $4\frac{3}{4}$, $5\frac{1}{8}$, $5\frac{1}{8}$, $5\frac{1}{2}$, $6\frac{7}{8}$, $6\frac{7}{8}$, and 9 inches. Predominantly ten- to twelve-rowed; long, thick glumes; slightly indurated.

The second group, intact cobs comprising ten specimens, are all highly Tripsacoid. Lengths $2\frac{1}{2}$, 3, $3\frac{1}{8}$, $3\frac{3}{8}$, $3\frac{3}{8}$, 3, 3, $3\frac{3}{4}$, $3\frac{3}{4}$, $4\frac{3}{8}$ inches; all have indurated glumes and rachises. In some specimens, the glumes are crateriform and highly indurated. There are no single spikelets; but in several of the specimens, the second, or pedicillate, spikelet is greatly reduced in size — a condition which

represents a transition between double and single spikelets, and one which is common in segregates of maize-teosinte hybrids.

The cob fragments from this level, comprising 32 specimens, fall into three more or less distinct groups. The largest number, thirteen, are similar to the intact cobs of *Cristalina de Chihuahua* mentioned above. Those of the second group, comprising ten fragments, are slender and eight-rowed, and are pretty obviously cobs of *Harinoso de Ocho*, or something very much like it. The third group, comprising nine cobs, is intermediate between these. The cobs represent *Harinoso de Ocho*, only slightly modified by the introgression of other elements. They may be similar to the present-day "Maiz Blando de Sonora", described by Wellhausen *et al.*, which, in turn, has some similarity to the Pima-Papago corn of southern Arizona.

There are twelve unclassified fragments from this level.

No cobs which could be clearly assigned to Chapalote are found in this surface level. Apparently, this primitive race was almost completely replaced by *Harinoso de Ocho* and the modern race evolving from the amalgamation through hybridization of earlier races.

SLAB CAVE

Trench 2 (0"-12"). Five intact cobs, $2\frac{1}{2}$, 3, 3, $3\frac{1}{2}$, and 4 inches in length. The first four appear to be cobs of a short-eared form of Chapalote. The last resembles *Harinoso de Ocho*. Three additional intact cobs, $2\frac{1}{8}$, $2\frac{1}{8}$, $2\frac{3}{8}$ inches in length, are Tripsacoid with indurated glumes and rachises and a slight tendency towards suppression of one member of a pair of spikelets. Two fragments are also Tripsacoid.

The remaining fragments can be separated into three more or less distinct groups. The first, comprising eleven specimens, shows some resemblance to cobs of Chapalote. The second group, nine specimens, is related to *Harinoso de Ocho*; and the third group, also nine specimens, is similar to the most recent maize from Swallow Cave, which, as already mentioned, is similar to the modern *Cristalina de Chihuahua* described by Wellhausen *et al.*

Collection from this test trench includes 82 well-preserved kernels, of which fifteen have brown pericarp. The kernels are thick, wedge-shaped and flinty, and, in these respects, resemble the kernels of *Cristalina de Chihuahua*, illustrated in Fig. 130 of Wellhausen *et al.* There are no typical kernels of Chapalote, but the influence of this race is apparent in the brown pericarp of a small percentage of the kernels.

OLLA CAVE

Trench 2, Level 1 (0"-6"). No intact cobs; ten fragments which may be related to Chapalote; three fragments which show some resemblance to *Harinoso de Ocho*; one fragment resembling *Cristalina de Chihuahua*; and three fragments of

Tripsacoid cobs. Six kernels — two brown, one red, one yellow, and two white; one of the brown kernels is exactly like those of Chapalote; one of the white kernels is like those of the modern Cristalina de Chihuahua.

Trench 1, Level 1 (0"-6"). Two intact cobs, both 2 inches long, both Tripsacoid, and an additional fragment which is Tripsacoid. Of the remaining ten fragments, nine can be assigned to Chapalote and one to Harinoso de Ocho. Five kernels — two brown, one red, one yellow, one white; one brown kernel is typical of Chapalote.

TAU CAVE

Trench 1 (0"-18"). Two intact cobs, $2\frac{3}{8}$ and 4 inches long. The first is a highly Tripsacoid cob with stiff, indurated crateriform glumes and indurated rachis. There is a slight tendency towards the suppression of one spikelet of the pair. The second cob has relatively long, soft glumes and is similar to Chapalote. Three cob fragments resemble Cristalina de Chihuahua, being large in diameter and possessing deep pockets, formed by long, thick, slightly indurated glumes. Seventy-two kernels, of which 63 are brown, one is red, and eight are white. The brown kernels are predominantly short and broad, flinty in endosperm texture, and, except for being slightly larger, similar to those of Chapalote.

DARK CAVE

Trench 4, Level 6 (30"-36"). About 775 kernels (182 grams, kernels weighing 23.6 grams per hundred). The kernels are almost identical in size, shape, and color to the kernels of modern Chapalote. A few kernels have red pericarp.

Trench 4, Levels 5 and 6 (24"-36"). About 3,000 kernels (709 grams, kernels weighing 23.2 grams per hundred). Like the kernels from Level 6, these are similar to modern Chapalote in size, shape, and color. There is very little evidence that this race, at this stage, has been modified, if at all, by the introgression of other races.

Trench 4, Level 1 (0"-6"). One fragment similar to Cristalina de Chihuahua; five kernels, three of which are small and brown like Chapalote; one is small, white, and flinty; one is large and broad and similar in size and shape to the kernels of modern Harinoso de Ocho. This kernel is the only one from any of the caves in this category. It is possible that large, floury kernels would not have been as easily preserved as flinty kernels of other races.

SUMMARY

The archaeological maize of Chihuahua and Sonora can be explained entirely in terms of three elements which still exist in western Mexico — Chapalote, teosinte, and Harinoso de Ocho. These three elements have combined to produce the modern race Cristalina de Chihuahua, which has affinities with the modern maize of the Southwest.

VIII. DISCUSSION

Prior to our recent research in the northern Sierra Madre Occidental, it was believed by some, including the author, that the cliff dwellings in that locality represented a final stage of Casas Grandes culture (Brand, 1935, p. 305; Lister, 1946, p. 451). It was postulated that the Casas Grandes culture, a southern extension of late prehistoric Pueblo culture, had developed in the valleys and basins to the east of the Sierra Madres and had spread to the mountains as a result of pressure from nomadic peoples. The move to the mountains provided more protective sites at a sacrifice of agricultural land. Another group of students believed that the cliff dwellings in the mountains, as well as a number of the village sites to the east, represented the earliest well-developed phases of the Casas Grandes culture (Sayles, 1936b, Table 1 facing p. 84). They recognized the Pueblo features of Casas Grandes culture, but were of the opinion that its earliest manifestation showed relationships to the Mogollon culture which had been defined to the north in southwestern New Mexico and southeastern Arizona (Sayles, 1936b, p. 88; Gladwin in Sayles, 1936b, p. 94). The foregoing deductions were made mainly as a result of archaeological reconnaissance and survey in the Sierra Madre sites, since few excavations were conducted prior to 1952.

The author believes that neither of the above concepts is correct, but the one proposed by Sayles and Gladwin comes closest to the situation as we see it. Instead of labeling the culture associated with the cliff dwellings as Casas Grandes, we prefer to define it as Mogollon. Also, the cultural remains containing pottery and situated below the cliff dwellings are likewise Mogollon. As we visualize it, the Casas Grandes culture developed from a Mogollon base and, under Pueblo influence, spread eastward from the mountains into northwestern Chihuahua and southwestern New Mexico.

The Mogollon nature of the cave material is evident from the cultural inventory presented in Chapter VI, and in the comparative chart in this chapter. The pottery complex featuring Alma Plain, a variety of textured Alma wares, and corrugated types is Mogollon. (Haury, 1936a; Martin, *et al.*, 1952; Wheat, 1955). Stone, fiber, and wooden artifacts also can be fitted into the Mogollon tradition (Haury, 1936b; Martin, *et al.*, 1952). Types of foodstuffs, the burial pattern with few, if any, associated grave furnishings, and even the practice of building cliff dwellings in caves may be duplicated in the Mogollon culture (Martin, *et al.*, 1952, 1954). On the other hand, it is true that remains from the Sierra Madre caves lack a number of features typical of Mogollon culture to the north. A notable lack in the ceramic complex is San Francisco Redware. Normally this type of pottery is a common ingredient in almost all Mogollon sites. Chipped stone artifacts, repre-

sented by but few specimens in our collection, are more numerous in other sites of Mogollon culture. The variety of items made from perishable material is smaller than that found in caves in New Mexico, but this can probably be accounted for by the smallness of our sample.

The significant fact about the archaeological material recovered from the Sierra Madre caves is that, despite the lack of some Mogollon traits, practically every element present in the sites can be fitted into the Mogollon complex.

A small amount of Casas Grandes pottery was collected from the surfaces of the caves. A few polychrome sherds, some black-on-red sherds, and one textured sherd are of types assignable to Casas Grandes culture. Such wares occurred so infrequently that it is believed that they represent trade items rather than locally manufactured pottery.

As is pointed out above, the archaeological remains from caves in the Sierra Madres can for the most part be assigned to the Mogollon culture. It is definitely believed that the material supports a case for setting up a Chihuahua branch of Mogollon culture, although there is difficulty in establishing culture phases based upon the materials we have collected and the information we have gained to this time. Unfortunately, stratified deposits of significant depth rarely were encountered. Most caves did contain two types of remains: those present on the surfaces of caves and normally associated with multi-roomed cliff dwellings, and those which are subsurface and frequently beneath the floors and walls of such structures. In a few instances, portions of buried posts and mud-wall foundations indicated the existence of structures in some caves prior to the building of the cliff dwellings, but most subsurface deposits did not contain evidence of habitations. With but one exception all subsurface deposits contained pottery and specimens characteristic of an agricultural economy. The exception was Swallow Cave where a horizon was found which lacked pottery but which included maize, among other remains.

The principal difficulty in assigning our archaeological material to phases results from the fact that so many elements typical of Mogollon culture, and found in our sites, are of little value in phase determination. If our sample had been larger, and from stratified deposits yielding longer culture sequences, we would be in a better position to make phase assignments. Many of the culture elements which we have listed in summarizing the archaeology of the area are represented by a few specimens, or in some cases by a single specimen, thus making it impossible for us to speak of the frequency of the occurrence of such elements. Of course, the presence or absence of culture elements is of significance in establishing cultural affiliations, but in making phase allocations one places great emphasis upon such conditions as predominance, increase, or decrease of particular elements at certain periods of time. A sample such as ours does not yield much information of this

sort. Therefore, in attempting to set up a chronological arrangement for our materials, we have used the broader frame of reference, employing culture periods, as set forth recently by Wheat (1955), rather than trying to make phase assignments. It also is possible that even were our sample larger, the Sierra Madre material might not fit into any established phases of Mogollon culture.

The deeply buried deposits, situated below Mogollon remains in Swallow Cave, comprise the earliest horizon we have encountered.

SUMMARY OF CULTURE HISTORY

As a result of our investigations, the following summary of culture history in the northern Sierra Madre Occidental may be presented:

1. The earliest horizon postulated was found in the lower levels (Levels 8-14) of trenches in Swallow Cave, Cave Valley, Chihuahua. The presence of such an horizon was revealed during the 1952 season and carefully checked in 1953. No evidence of habitations was found in these levels; therefore, it is assumed that the cave was used simply as a camping place during that period. The culture remains consisted of a few corn cobs, of a type designated as pre-Chapalote by Mangelsdorf, an assortment of acorn shells, flakes of stone which had been utilized as cutting or scraping implements, several stone cores from which flakes had been struck, and small bits of charcoal and ash. The presence of maize unassociated with pottery is not unusual, for such occurrences have been reported a short distance to the north in Bat Cave, New Mexico, (Mangelsdorf and Smith, 1949) and in other caves in southwestern New Mexico (Martin, *et al.*, 1952).

This horizon in Swallow Cave pre-dates the Mogollon material found above it, which is described in the following paragraphs. Our earliest Mogollon remains, however, would appear to be no earlier than Mogollon 3, whose terminal date may be set at approximately 900 A.D. (Wheat, 1955, p. 160). How much earlier the deposits in the lower levels of Swallow Cave are than the Mogollon remains above them is not known. The presence of maize 30-36 inches below the lowest Mogollon level suggests that they are considerably older. No dates from radioactive carbon have been obtained as yet, although it is hoped that such information may be forthcoming shortly. It is felt that these remains, the earliest we have encountered in our investigations, strengthen the belief that early cultural contacts existed between Mexico and the Southwest, and that a corridor for the movement of culture elements from south to north was the Sierra Madre Occidental mountain chain.

2. Next in chronological order is the Mogollon culture. It was found in all caves investigated. As mentioned above, it is possible to make a distinction between that Mogollon culture which is situated stratigraphically lower than the cliff dwellings and that which is associated with such structures.

The subsurface deposits in all caves except Swallow Cave, whose non-ceramic levels have just been discussed, contain Mogollon culture remains extending to the rock floors of the caves. These deposits produced pottery, simple stone cutting and scraping implements, artifacts of bone, wood, and fiber, and vegetal remains. In most caves there appear to be no habitations associated with these strata, but in a few instances there is evidence for the former existence of dwellings. The pottery is almost exclusively types associated with Mogollon culture. The principal types include Alma Plain, Alma Scored, Alma Rough, Alma Neck Banded, Alma Incised, and Incised Corrugated. Although some of these pottery types were common throughout Mogollon history, the presence of such types as Alma Neck Banded, Alma Incised, Alma Scored, and Incised Corrugated would indicate that the deposits are no earlier than late Mogollon 3, approximately 900 A.D. (Wheat, 1955, p. 160). A small amount of red-on-brown pottery also is present. It is usual for red-on-brown wares to be present in a Mogollon pottery complex, but it is difficult to classify our red-on-brown sherds as belonging to any previously described type. The fact that our sherds have a fine line red decoration indicates that they are relatively late, since the earlier types are characterized by broad line decoration.

These people were agriculturalists, growing maize, beans, and squash and also utilizing available wild plant products. Scarcity of animal bones in the deposits would lead one to believe that hunting was not of great importance. It is possible that a few domestic structures built of mud, or around pole frameworks, were constructed in some of the caves, but most subsurface deposits show no evidence for the use of habitations.

A well-developed culture is evidenced by the presence of basketry, fiber cordage, textiles of cotton and other fibers, sandals, the bow and arrow, grinding implements of stone, burial of the dead, and so forth. One art which does not appear to have been well established is stone chipping. There is a paucity of chipped stone implements. Utilized flakes of stone, similar to those found in the early horizon in Swallow Cave, continued to be the style for cutting and scraping implements. Arrows employing sharpened wooden foreshafts seem to have been the predominant type.

It is obvious that there is a temporal gap between the deposits of this horizon and those found in the lower levels of Swallow Cave. We have found no Mogollon remains earlier than Mogollon 3. Thus, there is a hiatus in our record caused by the apparent lack of Mogollon 1 and 2 culture in the caves. This could cause one to believe that the Sierra Madre caves were occupied by people possessing Mogollon culture only after the culture had developed to the period-3 stage farther to the north and then spread southward. Whether there are pit-house villages containing earlier Mogollon culture in this area awaits further research.

3. The most recent remains in the caves, those occurring on the surfaces or a few inches below the surfaces, are associated with cliff dwellings. These structures vary in size from a single room to thirty-room affairs. Some were built to a height of three stories. Many such structures are fairly well preserved. Those located in the more remote caves still have the original wooden ceiling beams and door lintels in place. However, a certain amount of destruction by vandals is obvious in most of the more accessible sites. Archaeological specimens from cave surfaces, or from the first six inches below the surfaces (Level 1), continue to be predominantly of Mogollon culture.

Objects of perishable materials, such as cordage, matting, textiles, basketry, wooden artifacts, and vegetal remains, continued to occur. Stone artifacts and potsherds were more numerous, both in quantity and type, from this horizon than from lower levels. However, the apparent tradition of utilizing very simple chipped stone implements, noted in earlier horizons, was still in vogue. In addition to the Mogollon pottery wares found in the subsurface strata, later types, such as Smoothed Corrugated, Fillet Rim, and certain Casas Grandes wares, appeared. Presence of these wares suggests that this horizon should be assigned to the Mogollon-4 period, approximately 900-1000 A.D. (Wheat, 1955, p. 160) or early Mogollon-5, post 1000 A.D. (Martin, *et al.*, 1952, p. 483).

A few potsherds of Chihuahua textured, Madera Black-on-red, and Villa Ahumada and Babicora Polychrome wares collected from the cave surfaces are types characteristic of the Casas Grandes culture. However, since sherds of these types were present in such small quantities, it is felt that they represent trade items rather than locally manufactured wares. It seems that villages to the east of the mountains where the Casas Grandes wares were made, were becoming established during the final period of cave occupation. The few Casas Grandes potsherds found in the caves belonged to wares attributed to the Medanos and Babicora phases, the earliest phases of Casas Grandes Culture. Dates of 1000-1100 A.D. have been assigned to the earliest manifestations of Casas Grandes culture (Sayles, 1936b, p. 88; Gladwin, in Sayles, 1936b, p. 94).

The most significant cultural addition in this horizon is architecture. Apparently the possessors of Mogollon culture living in the northern Sierra Madre were affected by the same Pueblo influence which caused Mogollon people to the north to adopt Pueblo architecture. Soon after this architectural form was put to use in the cave sites, it spread to areas east of the mountains, where it became the typical architecture of early Casas Grandes villages. Aside from the addition of cliff dwellings to the culture pattern, this horizon is believed to have been a continuation, with some elaboration, of the way of life described for the Mogollon-3 horizon.

Abandonment of the Mogollon cave sites in the mountains, dated at approxi-

mately 1000-1100 A.D., is concurrent with the beginnings of Casas Grandes culture in villages along river valleys and basins east of the Sierra Madre. Therefore, it is postulated that the Mogollon people who had already come under some Pueblo influence, i.e. in architectural forms, began moving out of the mountains into the open country, perhaps seeking better agricultural lands, and came under even greater Pueblo influence. Soon the culture lost its Mogollon identity and became predominantly Pueblo. This is the complex that has become known as the Casas Grandes culture. This same phenomenon wherein Mogollon culture became so dominated by Pueblo culture as to lose its identity also occurred in the Mimbres area of New Mexico. As future archaeological research is conducted in the Casas Grandes culture, it is believed that it will become apparent that certain culture elements from central Mexico also influenced the Casas Grandes people.

OBSERVATIONS

In the Introduction to this paper it was stated that the purpose of our archaeological research in the northern Sierra Madre Occidental of Chihuahua and Sonora, Mexico, was to search for early connections between the cultures of central Mexico and those of the American Southwest. Our field work to date has produced some information relative to this subject but not as much as we had anticipated. However, we have obtained artifacts and knowledge of the culture associated with cliff dwellings in the northern Sierra Madre caves which lead us to assign them to the Mogollon culture rather than to the Casas Grandes culture, as had previously been done, and we have found one site with pre-Mogollon remains.

In planning our excavation program, we proposed to go to those caves in the northern Sierra Madre thought to contain remains of the Casas Grandes culture and to dig beneath such remains in hopes of finding material from earlier horizons — horizons which might represent early contacts between Mexico and the Southwest. We believed that the Sierra Madre Occidental, with its numerous north-south trending canyons, might have served as a corridor for movements of peoples and/or culture elements from Mexico to the Southwest. We felt that the direction of such movements was from south to north.

On our examining the surface remains in the caves and digging 23 stratigraphic test trenches to the rock floors of 8 caves, it became evident that the principal occupation of those caves was by people possessing Mogollon culture, not Casas Grandes culture. Our initial analysis of the Mogollon remains encountered during the first season in the field led us to believe that perhaps some of the material found beneath the cliff dwellings represented "early" Mogollon (Lister, 1953, p. 168). This spurred us on, for if we did have early Mogollon remains, they might

CHART 13. *Mogollon culture elements found in caves in the northern Sierra Madre Occidental. Their period assignments, where possible, are based upon Martin et al., 1952, and Wheat, 1955*

Culture Element	Occurrence in Caves in Northern Sierra Madre Occidental		Mogollon Occurrence:		
	Subsur- face	Surface	Period 3	Period 4	Period 5
<i>Foodstuffs:</i>					
Corn cobs	X	X	X Wheat, 163	X Wheat, 163	X Martin, 486
Corn kernels	X	X	X Wheat, 163	X Wheat, 163	X Martin, 486
Cucurbit stems, rind, seed	X	X	X Wheat, 163	X Wheat, 163	X Martin, 486
Beans	X	X	X Wheat, 163	X Wheat, 163	X Martin, 486
Acorns	X	X	X Martin, 486	X Martin, 486	X Martin, 486
Pinyon nuts	X	X	X Martin, 478	X Martin, 478	X Martin, 478
Fiber quids	X	X	X Martin, 487	X Martin, 487	
Juniper seeds	X				
Walnuts	X		X Martin, 486	X Martin, 486	X Martin, 486
Yucca or agave pods		X	X Martin, 486	X Martin, 486	X Martin, 486
Cherry stones	X				
Lycium berries	X				
Animal bones scarce	X	X	X Martin, 499	X Martin, 499	X Martin, 499
Deer, turkey, rodents	X	X	X Martin, 204	X Martin, 204	X Martin, 204
<i>Pottery:</i>					
Alma Plain	X	X	X Martin, 492	X Martin, 492	X Martin, 492
Alma Rough	X		X Martin, 492	X Martin, 492	
Alma Plain, Buff	X	X			
Alma Tan, Fine paste	X				
Alma Scored	X	X	X Martin, 492	X Martin, 492	
Alma Incised	X	X	X Martin, 492		
Alma Punched	X	X			
Alma Neckbanded	X		X Wheat, 94		
Alma Patterned	X	X			
Three-Circle Neck Corrugated	X		X Martin, 492		
Incised Corrugated	X	X			X Martin, 492
Plain Corrugated	X	X			X Martin, 492
Plain Corrugated, Trilled	X				
Indented Corrugated	X	X			X Martin, 492
Smooth Corrugated		X			
Reserve Fillet Rim		X			X Martin, 492
Red on Brown, Fine Line	X	X	X Wheat, 162	X Wheat, 162	
Unfired		X	X Wheat, 151		

CHART 13. *Continued*

Culture Element	Occurrence in Caves in Northern Sierra Madre Occidental		Mogollon Occurrence:		
	Subsur- face	Surface	Period 3	Period 4	Period 5
<i>Stone, Bone, Shell Artifacts:</i>					
Manos, rectangular, 2 hand		X	X Wheat, 116	X Wheat, 116	X Martin, 486
Hammerstone, cobble	X		X Wheat, 122	X Wheat, 122	X Martin, 489
Metates: Utah type	X		X Wheat, 111	X Wheat, 115	
Trough, one end open		X	X Wheat, 111	X Wheat, 111	X Martin, 486
Worked stone slab	X		X Wheat, 121	X Wheat, 121	
Stone ornament, cuboid	X				
Axe: $\frac{3}{4}$ grooved		X			X Wheat, 123
Projectile points scarce	X	X			
Triangular body, straight base, side notched		X	X Wheat, 130	X Wheat, 130	
Utilized flakes of stone	X	X	X Wheat, 127	X Wheat, 127	X Martin, 489
Shell ornaments, olivella	X		X Wheat, 147	X Wheat, 147	X Martin, 485
Bone awls, split bone		X	X Wheat, 138	X Wheat, 138	X Martin, 490
<i>Cordage, Fiber, Textiles:</i>					
Twisted fiber cord: Bast, hard, hair fiber		X	X Wheat, 151	X Martin, 491	
Cotton fiber		X			
Pot rest		X	X Wheat, 151	X Martin, 490	X Martin, 490
Ring of fiber		X			
Carrying device of fiber		X	X Martin, 226	X Martin, 226	
Fiber bindings	X	X			
Bundles of fiber		X			
Feather cord	X		X Martin, 485		
Basketry: coiled, uninterlocking, 1-rod foundation		X			
Pitch covered		X			
Matting, twilled		X	X Martin, 491	X Martin, 491	X Martin, 491
Sandal, wickerwork, two warp, toe sandal	X		X Wheat, 150	X Martin, 485	X Martin, 485
Sandal, miniature		X			
Textiles: plain over one, under one weave, cotton		X		X Martin, 491	X Martin, 491
Apocynum fiber		X		X Martin, 491	X Martin, 491
<i>Wooden Artifacts:</i>					
Arrows, reed shaft, wooden foreshaft and point		X	X Martin, 488	X Martin, 488	X Martin, 488
Perforated discs, spindle whorls		X			
Fire drill		X	X Martin, 487	X Martin, 487	X Martin, 487
Digging stick	X		X Martin, 486	X Martin, 486	X Martin, 486

CHART 13. *Concluded*

Culture Element	Occurrence in Caves in Northern Sierra Madre Occidental		Mogollon Occurrence:		
	Subsurface	Surface	Period 3	Period 4	Period 5
Miniature bow		X	X Wheat, 151	X Martin, 494	X Martin, 494
Wooden ball		X			
Worked gourd	X	X	X Martin, 495	X Martin, 495	
Reed cigarettes		X	X Martin, 494	X Martin, 494	X Martin, 494
Willow ties used in wall construction		X			
Trap triggers		X	X Martin, 486		
Corn cobs tied to string		X			
<i>Habitations:</i>					
Use of caves	X	X			
Structures of poles and mud	X				
Multi-roomed, multi-storied, walls of mud or poles and mud		X			X Martin, 487
<i>Burials:</i>					
Beneath floors		X		X Wheat, 162	
In caves		X			
Pit, flexed, artifacts		X	X Wheat, 71	X Wheat, 71	
Pit, sitting, no artifacts		X	X Wheat, 71	X Wheat, 71	

well represent the initial movement of such traits from south to north. Subsequent excavations, and a careful analysis of all specimens recovered during our three seasons in the field, have not supported our first assumption.

It now appears that we must assign the most recent occupation of the caves, that which is associated with the cliff dwellings, to Mogollon 4 or early Mogollon 5, 900-1100 A.D. Those Mogollon remains stratigraphically lower than the cliff dwellings, and in many cases extending to the floors of the caves, can be dated no earlier than late Mogollon 3, 900 A.D. The earlier periods of Mogollon culture do not appear to be represented in the caves. This could lead one to the assumption that the Mogollon remains present in the caves we have examined represent a southern extension of the Mogollon culture area established to the north in southeastern Arizona and southwestern New Mexico. However, our work does not rule out the possibility of finding early Mogollon culture in, or adjacent to,

the Sierra Madres, for our work has been solely in cave sites. To the north, most early Mogollon material has been recovered from pit-house villages located in the open. Perhaps a search, especially along the foothills east of the mountains, may reveal such sites. Our material does support the establishment of a Chihauhua branch of Mogollon culture.

In only one site, Swallow Cave, did we find cultural evidence below the Mogollon level. The remains represent the earliest we have encountered in our investigations. The deposits typify the sort of cultural material that we anticipated finding when we set up our project in northwestern Mexico. We regret not finding more sites containing such records. Obviously, the material is older than Mogollon 3, but just how much older it may be is impossible to say at this time. The contents of this horizon appear to support the premise that movement of a culture based upon maize agriculture progressed from south to north through the Sierra Madres at a time before the use of pottery.

We still hold to our original belief that the Sierra Madre Occidental served as a corridor for early contacts between Mexico and the American Southwest. To date, we have not encountered an early ceramic complex in the caves, but we hope that additional work in cave sites and also in open sites may produce such material.

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13. If the article is one for which a summary can be prepared it is highly desirable to make a summary, having it somewhat less than one page in length.

UNIVERSITY OF COLORADO STUDIES

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