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FIELDIANA: ANTHROPOLOGY
VOLUME 55
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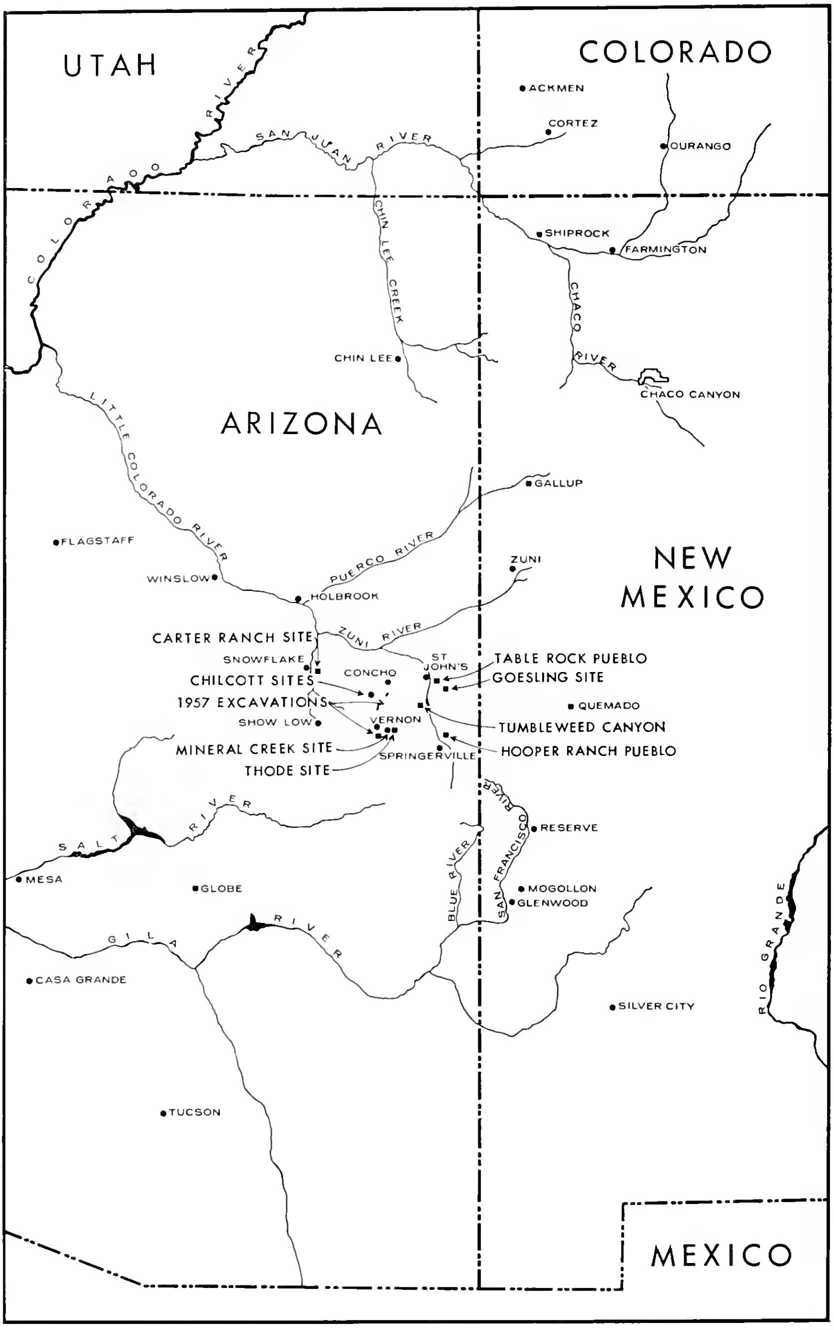

MAP SHOWING EASTERN ARIZONA AND WESTERN NEW MEXICO

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Preface

The researches reported on herein were carried out during the summers of 1961 and 1962. A grant from the National Science Foundation (Grant G-16006-22028) to the Museum for these researches in Southwestern prehistory is acknowledged with gratitude. Grateful acknowledgement is made to the Wenner-Gren Foundation for Anthropological Research for a grant that defrayed the statistical and computer costs.

The Carter Ranch Site is located about (by road) 17 miles east and north of Snowflake, Arizona. It is in the SE quarter of the NW quarter of Section 21, Twp. 13 N., Range 23 E., G. and S.R.M.

Our work on this site has been a happy and gratifying experience. Mr. and Mrs. James Carter, our archaeological hosts and owners of the ranch on which "our" site is located, showed great interest in and understanding of our work. They visited the dig at frequent intervals. Although we found some thirty burials and more than a hundred whole pieces of pottery, never did they hint or request that we relinquish any of the ceramics for decorating their fireplace. I have rarely met such good taste and restraint in this kind of situation. In addition, Mr. Carter loaned us his tractor and his bulldozer which were of great help in backfilling operations. It is difficult to find a suitable mode of thanking Mr. and Mrs. Carter but I hope that the contents of this report will bring them a feeling that they have made a far-reaching contribution to anthropology and that this will bring them lasting satisfaction.

I wish to thank the following for their help in carrying out the various activities of the expedition: Kerrin Bates, Steven Cornwell, Paul Curtis, Jr., John M. Fritz, Donald Goodman, Joe Goodman, James N. Hill, James Howe, Felipe Landa Jocano, William A. Longacre, David McQueen (artifact cataloguing), Tom Marks, John F. Martin, Jr., Genaro Nuanez, Gilbert Padilla, Martha Perry (cook), Pat Romane, John Saul III (pottery classification), Mike Sherer, Roland Strassburger (photography and maintenance), Gair Tourtellot III, and Lee Wooley.

Mr. and Mrs. Stevens Seaberg deserve praise for the help they gave us in analyzing the pottery designs. In fact, I wish to record that Mr. Seaberg's unusual facility in memorizing the many elements of design is uncanny.

Mr. Leslie Freeman and Mr. James Brown conceived the idea of using a computer for analysis of the ceramic data. To say that this was a milestone in archaeological research is an understatement. This brilliant contribution has set in motion a chain of events the end of which is not yet in sight. Prof. Lewis R. Binford, Department of Anthropology, University of Chicago, made many suggestions as work progressed. I am unable to express in full my thankfulness to these colleagues.

It is a pleasure to acknowledge aid given us by various members of the Museum staff: Messrs. John Bayalis and Homer V. Holdren, Division of Photography; Dr. Fritz Haas, Emeritus Curator, Lower Invertebrates; Mr. E. John Pfiffner and Miss Marion Pahl, Artists; Miss Susan Schanck, Artist; Dr. Bertram G. Woodland, Associate Curator, Petrology; and Mrs. Agnes McNary Fennell, Secretary, Department of Anthropology, who typed most of the manuscript and made the index.

Mr. Edward G. Nash, Editor of Scientific Publications, has helped us in bringing this report up to his high standards of excellence.

Our neighbors in and around Vernon—Mr. and Mrs. Tom Cox, Mr. and Mrs. Donald Goodman, Mr. and Mrs. William Goodman, Mr. and Mrs. Milton Gillespie, Mr. and Mrs. Cecil Naegle, Mr. and Mrs. Leonard Penrod, Mr. Kenneth Penrod, Mr. and Mrs. Floyd Penrod, Mr. and Mrs. Claude Phipps, Mr. Earle Thode, Mr. Earnest Thode, and Mr. and Mrs. Eben Whiting—were helpful and generous as only warm-hearted neighbors can be. We would be poor indeed if we did not have such unselfishness to fall back on.

Mr. C. E. Gurley, Gallup, New Mexico, Mr. and Mrs. Maxwell Hahn, Scarsdale, New York, Dr. Charles W. Keney, Gallup, New Mexico, and Mr. Judd Sackheim, Chicago, made generous contributions to the expedition. I am proud of their help and interest and wish to record my gratitude.

The administration of the Museum—Mr. Stanley Field, Chairman of the Board, Dr. Clifford C. Gregg, President, Mr. E. Leland Webber, Director, and the Board of Trustees were solidly behind our researches. I am grateful for their continued interest and support.

PAUL S. MARTIN

January 22, 1963

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By John B. Rinaldo
Associate Curator, Archaeology

PUEBLO

Location.—This medium-sized pueblo is located on the south end of the Carter Ranch roughly nine miles east of Snowflake in east central Arizona (Frontispiece). It is one of a series of pueblos scattered along Hay Hollow wash, which flows into the Little Colorado River about ten miles to the north. The ruin is made up of a roughly rectangular block of rooms which formed a mound six or eight feet high. The steep slope of the Point of the Mountain Mesa rises on the north and east less than a mile away. Another mesa, with sides ascending in a series of step-like cliffs, lies just across the arroyo to the west. The elevation here is about 5800 feet with the mesas approaching 6400 feet. Juniper trees, grama grass, prickly pear and, to a lesser extent, rabbit brush grow on the site and in the valley below.

Arrangement of Pueblo Parts (fig. 1).—The single block of rooms was constructed of rough sandstone masonry and comprises perhaps 39 rooms (of which 23 were excavated). These are arranged in the form of a hollow square containing a big kiva and a plaza. A circular Great Kiva lies about 10 meters northwest of the northernmost dwelling rooms. The central part of the pueblo is oriented roughly northeast-southwest and contains a triple row of rooms. This section is over twice as long as either of the wings. The big kiva lies at the north end of the pueblo and is adjoined by a single row of rooms, a very small kiva and a number of other rooms with features which make them appear to have had a quasi-ceremonial function. The single row of rooms with the contiguous kivas and room-kivas constitute the north wing. The south wing consists of a double row of rooms, and seems to contain a larger number of possible storerooms than the central section.

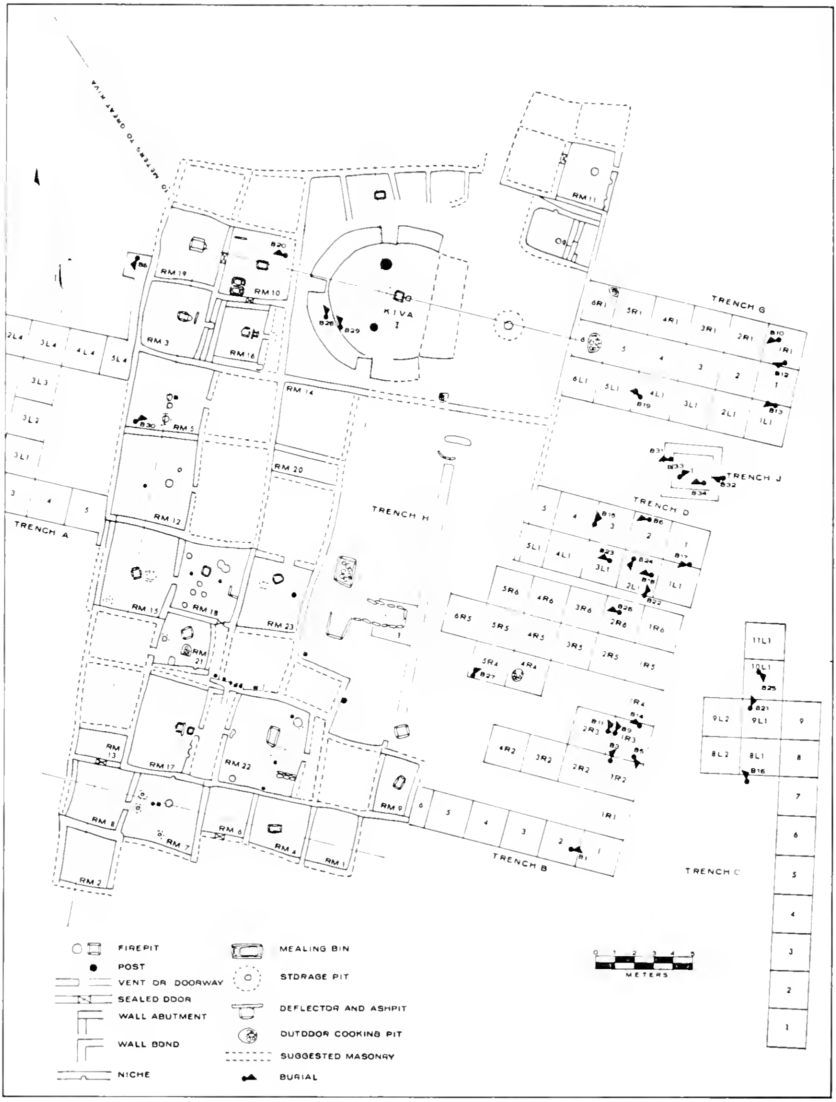

Fig. 1. Ground plan of excavated portions of Carter Ranch Site.

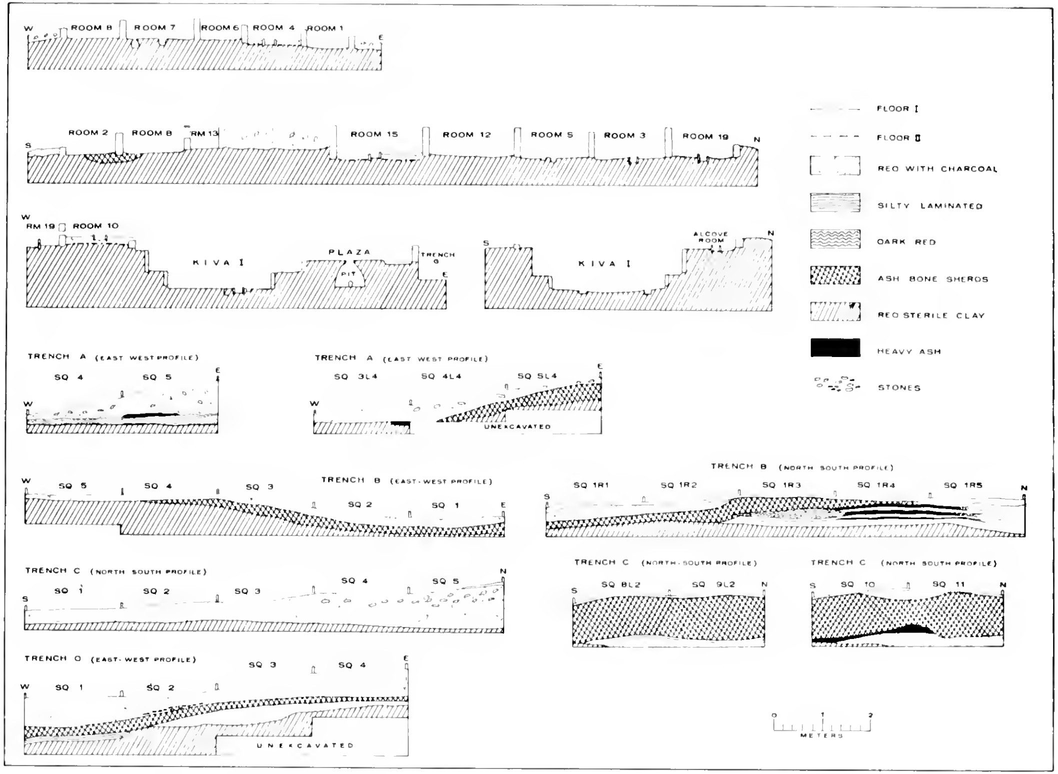

FIG. 2. Sections through refuse dump, rooms and Kiva I showing stratigraphy and profiles.

A low wall extending south from the small platform kiva toward the south wing marks the eastern boundary of the plaza and of the pueblo.

Deposits (fig. 2).—Six large, broad areas were trenched on the northeast and west sides of the pueblo, and one small trench was dug southwest of the pueblo. These revealed something of the soil levels on which the pueblo was built, the layers that had been deposited above and the extent of the pueblo structure.

The trench on the west (Trench A) and three on the east (Trenches B, D and G) (fig. 1) were started ten to twelve meters out from the pueblo walls and dug up to the walls of the pueblo or of the plaza. Simultaneously these trenches were extended in a grid system to determine the stratigraphy of the trash areas and to search for burials.

These trenches together with excavations below the floors of the rooms indicate that the pueblo was built on a low rise, consisting of hard red to brown clay. Below this member in the eastern end of the pueblo there was a layer of coarse brown sand. The gradient of this rise roughly parallels that of the present slope beyond the area of sherd concentration, and is somewhat steeper on the east side of the pueblo toward a small tributary, than it is toward Hay Hollow. This gradient may be related to the dip in the underlying sandstone as revealed in the cliffs through which Hay Hollow passes near here.

The builders leveled off the floors of their rooms by excavating them a few centimeters into the clay. These more or less follow the original contour of the rise so that the rooms on the east side of the pueblo have floors that are slightly lower than those to the west. Much of the clay excavated from these floors may have been used as mortar, roofing clay, or plaster in the construction of the pueblo.

A number of areas were used by the builders as places to dump their refuse. Perhaps the smallest of these areas was found beneath the floors and walls of Rooms 2 and 8 in the southwest corner of the pueblo. This small trash area, like most of the larger areas, contained quantities of ash, charcoal, unworked bone, sherds and gray soil.

Subsequently Rooms 2 and 8 were built and abandoned, and these and other abandoned rooms were used for dumps. Layers of trash up to 35 cm. or more thick were found in several rooms including Room 8. Deposits of darker brown clay of various thicknesses and containing rocks were found below the trash layers and seem to indicate that the rooms had been abandoned for some time before being used for refuse.

The largest area used for this purpose and for burials is east of the plaza beyond the low boundary wall, approximately in line with the central part of the pueblo (Trenches B and D). Here there was a little over a meter of stratified material appearing, when most distinct, in the form of lenses of limited extent. In at least two sections there were seven alternating layers of ashy carbon and clay. These could represent materials which washed down seasonally from higher ground—possibly ash and charcoal from winter fires and clay washed down by the late summer rains.

In general, the amount of bone, ash and charcoal decreased away from this densely stratified area, which included most of the northern two-thirds of Trench B, several sections on the north end of Trench C and the eastern squares of Trench D. In the areas with less trash there were also fewer strata—frequently only three or four. These were: at the base a hard red clay sometimes laminated, and silty as if deposited by water, above that a layer of ash, or red clay mixed with flecks of charcoal, and on top a thin layer of overburden—also occasionally showing laminations. In all of Trench G and the southern half of Trench C well-defined ashy layers were absent.

It was apparent from the strata-cuts that some mixing must have occurred in the trash. Graves dug in the deeper levels of the trash area had been excavated as shallow pits in the native red clay, and in most instances these pits were excavated through some trash. Another possible source of mixing was the practice of digging cooking pits into the more consolidated trash. These were filled with charcoal and stones blackened by fire and gray from ash, and some of them cracked by the fire.

The amount of disturbance by rodents was relatively slight. Occasional rodent burrows were evident in the rooms and a few in the trash.

The trash was deepest in Trenches B, C and D between 20 and 25 meters out from the pueblo and it was also most concentrated in this area. Not only do the trash layers tend to pinch out away from this area of concentration, but there is also a decrease in the quantity of charcoal, ash and unworked bone. The trenches that were extended beyond the plaza wall did not reveal the rich deposits of ash and refuse that lie to the east and it seems probable that refuse was carried across the plaza area before dumping it.

Number of Rooms.—Twenty-three rooms, two kivas and the Great Kiva were excavated. Perhaps fifteen rooms were not excavated: these are indicated by the outlines of fallen walls.

Dimensions of Rooms.—All of the rooms were roughly rectangular in shape; length, 2.5–4.8 meters (average, 3.5 meters); width, 1.5–4.0 meters (average, 2.8 meters).

Walls

Foundation: There were no prepared foundations. Walls were based directly on hard red clay. In a few instances walls were laid on the less substantial base of trashy fill. In a number of instances (usually west walls), masonry started a few centimeters above the floor.

Types of Masonry (figs. 3, 4): Generally a number of through stones were used, but the major part of the wall was two stones thick. Rubble masonry using quantities of adobe was most common but a very crude banded masonry and three instances of vertical slab masonry were noted.

Wall Stones: Most construction was of sandstone slabs or blocks. Igneous stones were seldom used, although such material was available. A typical larger slab would be 36 cm. long, 15 cm. wide and 9 cm. thick; a typical smaller slab 11 cm. long, 6 cm. wide and 3 cm. thick. Stones up to 77 cm. long were noted but only about a third of over a hundred stones measured were over 40 cm. long. Blocks of sandstone were only occasionally used in construction and are definitely atypical of this masonry. One of these measured 35 cm. long, 33 cm. wide and 30 cm. thick.

Although they were laid so that only their flat, relatively straight surfaces and edges were visible in the wall, very few showed the dimples that resulted from dressing. Most of them were rough hewn just as they came from the quarry or they were laminated.

Joints: Some joints between stones were broken but there was no systematic or patterned arrangement of the joints. These range from stone-

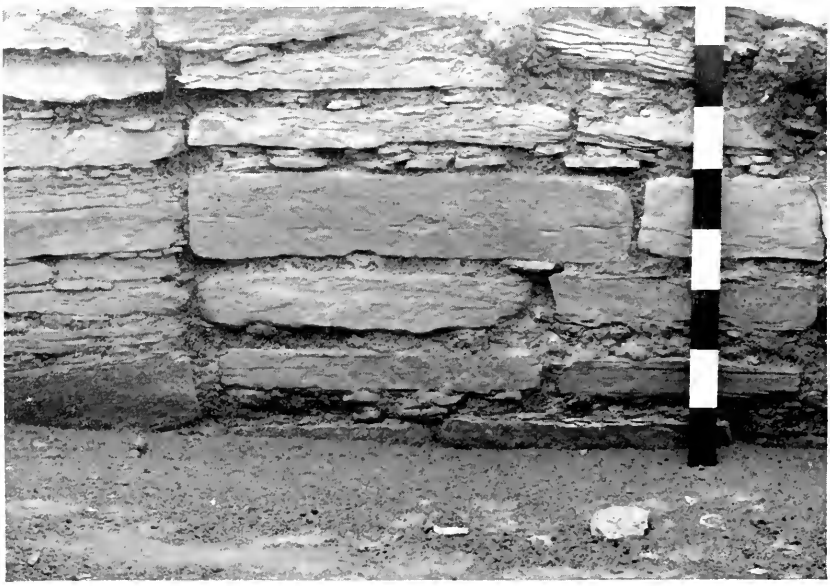

Fig. 3. Masonry, outer wall of Rooms 3 and 5. Meter stick at right.

FIG. 4. Masonry, partition wall between Rooms 3 and 5. Meter stick at left.

to-stone contact up to 5 cm. in width (or height). Generally a fairly thick cushion of mortar was spread between the stones. This might have been up to 8 cm. thick but averaged less.

Chinking: Very little use was made of small rounded pebbles as stop spalls to keep the mortar from oozing out between the courses of stones and to level up the bedding planes. Small slabs were normally used for this purpose and were laid in single or multiple courses between courses of large, long, thick slabs. In a few instances sherds had been used as stop spalls.

Mortar: The adobe used for mortar was brown, red-brown or pinkish-tan in color and in most walls quite hard—that is, difficult to scratch with the fingernail. In a few instances it was medium-hard or even soft, and this quality appears to be correlated with the amount of sand it contained. The sandy mortar was usually softer. The layer of clay on which the pueblo was built contains some sand of a red-brown color, and may have been the source of this adobe.

Courses: The stones laid in a single bedding plane were more or less of the same thickness, but in some instances stones were piled up one on top of another to maintain the general level and thickness of a course. However, particularly for interior surfaces, courses tended to slope and were uneven in appearance. The masonry used for exterior surfaces of outside walls (fig. 3), tended to be neater in every respect.

Dimensions of walls: The greatest height of a presently standing wall was 164 cm., and there were enough still remaining at 140 cm. or more to indicate that the walls must have been close to 2 meters high for rooms of a single story. Most of the walls were 20 to 30 cm. thick but a few were up to 48 cm. thick.

Plaster: A coating of coarse adobe was applied by hand (fingerprints remained on some surfaces), to fill in the interstices between wall stones and to smooth over the surface. This coat might be 2 to 5 cm. thick and was originally brown, although in some instances where a "finishing" coat had not been applied over it, the color had darkened to gray.

In over half the rooms a thin layer of adobe plaster was applied over the "veneer" or "rough" coat. In two rooms this coat had been covered by a third thin coat. These "finishing" coats had been darkened to gray on the surface by soot, but had originally been light gray (almost white) or yellow. Only two very doubtful instances of decoration were observed—one a white cross, probably a saline deposit and the other some black dots, probably from soot. These thin coats were generally no more than 3 mm. thick.

Junctures (fig. 5): Most walls were joined by abutments and walls were held together at these junctures more by the excessive amount of mortar and plaster, which was curved to form the corner, than by the arrangement of the stones.

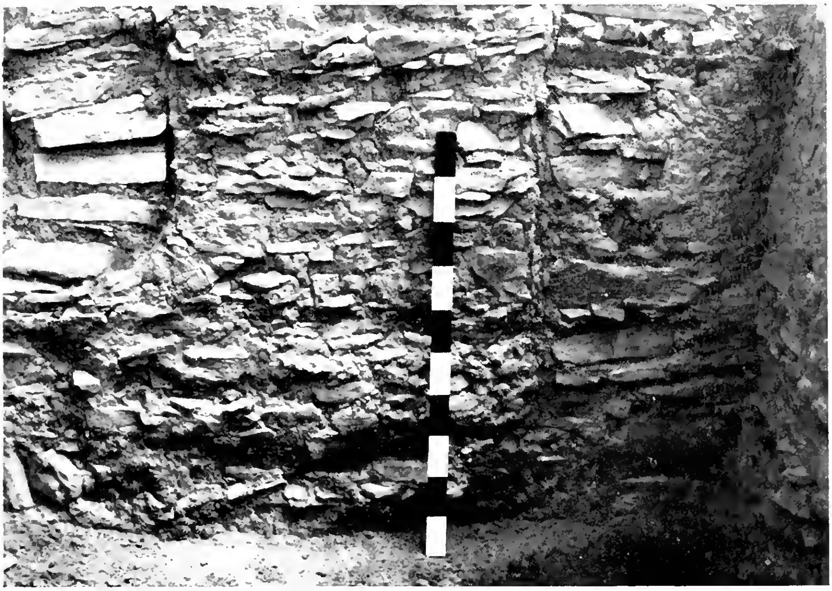

Fig. 5. North wall of Room 8, sealed doorway at extreme left, common wall juncture between Rooms 8, 13 and 17 to right of meter stick.

Both true bonds and diagonal or "Chaco type" bonds were also used to form corners. However, these tended to be crude, and without any regular placement of the stones. Courses were skipped, many of the stones spanning the diagonal across the corner between the two walls were only just long enough to reach, and for these corners, too, great dependence was placed on the mortar and plaster to maintain the strength of the structure.

Doorways (figs. 6, 7): All of the doorways in the pueblo were rectangular except for one which was "T"-shaped. Many of them had been sealed with masonry, although the attempt was seldom made to match the masonry of the surrounding walls. Some, if not all, sealed doorways were plastered over as well. No lintels were in place but large, long stone slabs found in the upper section of five doorways could indicate the use of slab lintels. Sides of doorways or jambs were of masonry or more frequently adobe plaster over masonry. The sills were either stone slabs or adobe plaster over masonry.

FIG. 6. "T"-shaped doorway in south wall of Room 6. Meter stick at left.

The sealed "T"-shaped doorway in Room 6 was the only exterior doorway. Direct access to the rooms must have been through hatchways in the roofs. One fragment of a ring slab like those found at Table Rock Pueblo (Martin and Rinaldo, 1960b, p. 222) and at Hawikuh (Hodge, 1922, p. 6) was found in the roof fill and corroborates this idea.

Doorways ranged in width from 40 to 55 cm. and averaged 44 cm. Heights ranged from 56 to 100 cm., average, 74 cm.

Doorsills ranged from floor level to 40 cm. above floor level.

With four exceptions doorways were placed near the middle of a wall. Two doorways were located close to the corners. Since most of the rooms with doorways are nearly square, and some of the rooms are provided with two doorways diagonally across from one another, the question of whether it was customary to put the doorways through side walls rather

FIG. 7. Rectangular doorway in west wall of Room 7. Meter stick at left.

than end walls seems pointless. Three of the supposed doorways (in Rooms 5, 12, 15) may be large ventilator openings. One doorway in Room 10 had been reduced to a ventilator hole when a new floor was constructed.

Ventilators (fig. 8): Eight rooms were equipped with small openings located at floor level in line with the firepits. These openings range in size from 16 cm. wide and 20 cm. high to one opening 40 cm. wide and 60 cm. high which may have also functioned as a doorway. The average size was 29 cm. wide and 33 cm. high.

The smaller openings were framed either by horseshoe-shaped slabs (fig. 9) or by slabs set on edge and a slab lintel.

Although the ventilator in Room 10 opposite Kiva I and one in Room 22 centered in the middle of the west wall, all others were oriented to draw fresh air from the east. Four of the ventilators (Rooms 3, 16, 17, 22) opened outside the rooms into vertical shafts in the cores of double walls.

FIG. 8. Firepit, deflector and ventilator opening in Room 3. Arrow between firepit and deflector points magnetic north.

Fig. 9. Ventilator opening framed with horseshoe-shaped slab in east wall of Room 11. Meter stick at left.

Floors

Material: Floors in rooms with firepits were plastered with special adobe clay that had been brought in and constituted a layer from 0.5 to 7.0 cm. thick (average 2.5 cm.). Most of them were only fairly level and smooth. Undulating, cracked and sloping surfaces were common and on the surface many were a dark gray color. In two instances a few stone slabs were laid in the floor as a partial paving.

Firepits (fig. 10): Seventeen of the excavated rooms were furnished with sunken hearths. These were of three types which apparently were used contemporaneously.

One type, represented by twelve pits in ten rooms, was a rectangular slab-lined box. Nine were lined only on the sides, and three on the sides and bottom. They ranged in length and width from 50 by 40 cm. to 68 by 49 cm.; depths ranged from 18 to 40 cm.

There were five circular firepits (fig. 11). One of these was slab-lined, the others had been lined with adobe plaster. None had a raised rim. These ranged in diameter from 30 to 62 cm. and in depth from 20 to 40 cm.

A third type was "D"-shaped. These two firepits were slab-lined on three sides and adobe lined on the bottom and the curved end. These were 15 cm. deep and about 40 cm. in width. One firepit was 50 cm. long and the other 40 cm.

Firepits were ordinarily located near the center of the rooms. Most were oriented with their long dimensions running east and west, and this

Fig. 10. Rectangular slab-lined firepit in Room 4, Floor I. Tape extended to length of one meter at left for scale.

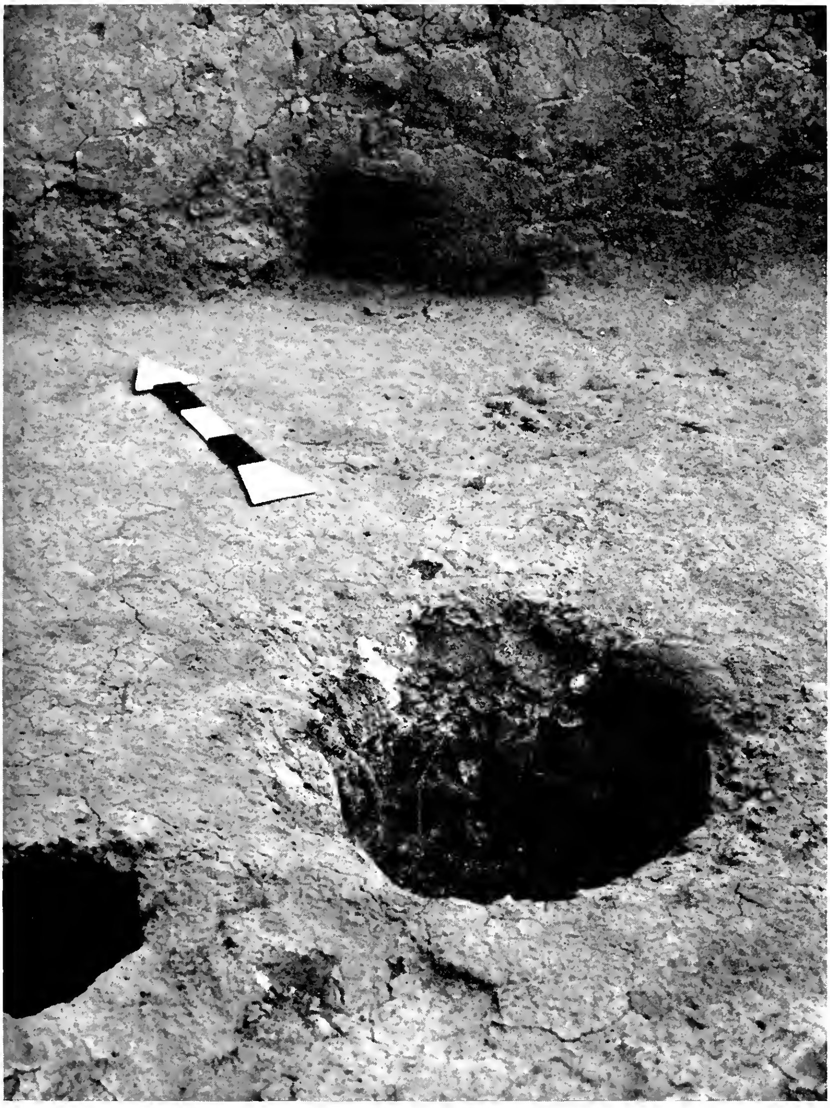

Fig. 11. Circular adobe-lined firepit and niche directly behind it in base of north wall in Room 7. Arrow 50 cm. long points magnetic north.

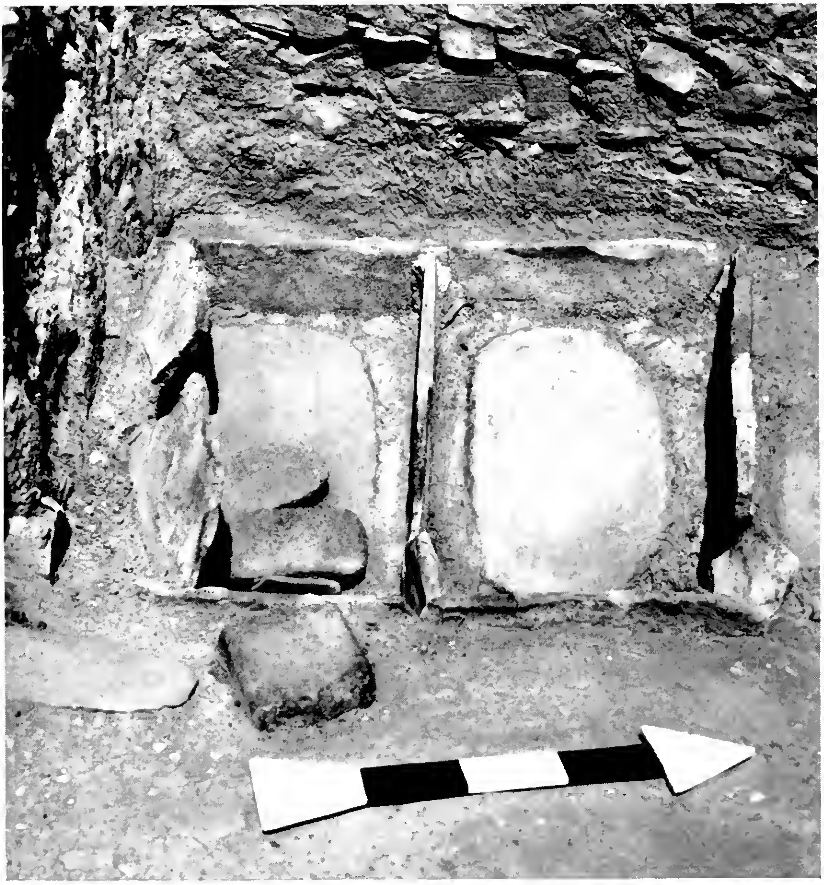

FIG. 12. Detail of mealing bins and associated manos and metates in southwest corner of Room 10. Arrow 50 cm. long points magnetic north.

orientation is also that of the ventilator complex in both rooms and kivas. However, four, in Rooms 9, 15, 18 and 22, had their long dimensions running north and south.

An unusual amount of charcoal was found in many of the firepits, but mainly in the upper portion—the bottom contained the usual compacted white ash. One firepit contained a stone pot rest.

Ashpits: Six rooms were furnished with ashpits. Two of these were small, square, box-like pits lined on the sides with stone slabs. They were about 24 cm. square, and only 10 cm. deep. One had been plugged with an upright stone. Four more were simple shallow plaster-lined depressions, two contiguous to the firepits (in Rooms 3 and 19), and the others adjacent to the firepit (in Rooms 5 and 22) but not immediately so.

Storage pits: Bell-shaped storage pits were found in Rooms 5, 7, 18, 21 and 22. Some of these were capped with circular stones and others were covered by the adobe floor. Some pits were empty and others trash-filled but all were the same shape as the much larger pit adjacent to Kiva I. This larger pit contained much charred corn.

Mealing Bins: Whole or fragmentary mealing bins were uncovered in four rooms (Rooms 4, 10, 18 and 22). Room 10 had two contiguous bins and Room 22 had three. The bins in the other two rooms were for single metates. Three of these had their sides and ends formed by thin sandstone slabs set on edge. Only one of the multiple bins (that in Room 10, see fig. 12) remained intact and in this instance the partition between the metates was a single slab. In the others the indications were that the partitions had been of adobe. The tops of the slabs which formed the sides of the bins were sloped parallel to the surfaces of the metates so that the upper end extended about 20 cm. above the floor and the lower ends were almost at floor level around the catch basins.

The slab metates were set firmly in place at an oblique angle with adobe plaster curved up slightly on the left side of each bin. A small, thin slab a little larger than a large mano formed the floor of each flour receptacle. Bins ranged from 68 to 75 cm. long and 40 to 50 cm. wide. When they were placed near the corner of the room, the closer end of the metate was only 44 to 50 cm. out from the wall, thus leaving just enough room for the miller to kneel with her feet braced against the wall.

Fragments of a charred twill-plaited ring basket were found in one flour receptacle.

Bench (fig. 13): A raised portion of the floor had been built in the north and south ends of Room 16. These were faced with masonry and floored with adobe plaster. The bench on the north was 32 cm. wide and 15 cm. high, that on the south 38 cm. wide and 58 cm. high.

Ceilings.—Remains of three charred roofs were uncovered, two were above Floor I of Rooms 4 and 10 and the third was above Floor II (the lower floor) of Room 15. Timbers of several other roofs were uncovered in a decayed condition.

Height: The highest standing wall (Room 5) was 1.65 meters and only slightly lower walls (1.6 meters) were standing in Rooms 12 and 15. It is estimated that the ceiling may have once stood a little over 2 meters high.

Construction: Known by inference only. A major beam crossed the approximate center of the shorter dimension of the room, here called the width although some rooms were nearly square. Above these and at right angles to them were laid poles or secondary beams some distance (50 cm. is indicated by fallen fragments) apart. A third layer consisted of split poles or branches and occasionally mats, and the fourth or top layer was adobe. No evidence was seen for the use of juniper bark or small twigs between the split material and the clay.

There were at least two additional variations on this type of structure. One was to have two or more major beams; and another was to omit these

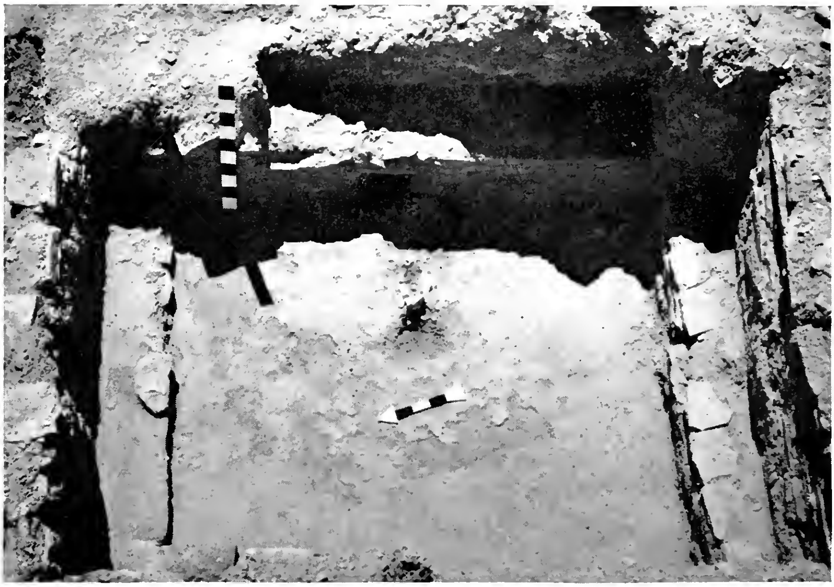

FIG. 13. Room 16 showing benches on either side of room and platform over ventilator opening. Arrow 50 cm. long points magnetic north, meter stick in background.

larger beams entirely so that a number of poles carried the weight of the top layers. Actually there was not much difference in the size of the various classes of beams—they ranged from 8 to 12 cm. in diameter.

The direction of the main beams was alternated in contiguous rooms, so that if in one room they ran east and west, in the adjacent room they were oriented north and south.

Vertical supports: Postholes and the butts of posts ranging in diameter from 11 to 25 cm. and in depth from 12 to 40 cm. were situated near the middle of a few of the rooms, usually in line with the firepit. These served as secondary or extra roof supports, under the major beams. One such post with the top broken off 82 cm. above the floor stood in Room 18 beneath fragments of a beam.

The ends of the major beams may have passed through the wall or rested in sockets in the masonry. The secondary beams or poles ordinarily rested on the major beams with their ends possibly supported like the major beams in masonry.

Uses of Rooms.—The rooms in the vicinity of Kiva I had certain kiva-like features. Some of these features were: a ventilator-deflector-ashpit-firepit complex, a ventilator framed by a ring-slab, benches, posts recessed in the east wall. The presence of these features which were not present in other rooms of a similar size suggests that these rooms had a quasi-ceremonial function.

Another series of rooms were equipped with firepits, in several instances ventilators or doors opposite the firepits, storage pits below the floor and in one instance a niche. These rooms probably served as dwelling rooms and the objects found on the floors of two of them—Rooms 4 and 10 (fig. 14)—seem to bear this out.

A third group lacked firepits, were of slightly smaller size and possibly served as storage rooms. Most of these rooms contained fewer artifacts than those classed as dwelling rooms. However, there was nothing in their features or contents to suggest this use as they contained no more corn than the "dwelling rooms."

Fig. 14. Room 10, Floor I. Foreground firepit; background left to right, mealing bins, ventilator opening and storage bin. Arrow 50 cm. long points magnetic north, meter stick in background.

Number of Stories.—The quantity of wall stones found in Rooms 5 and 12 suggests that the pueblo reached two stories in this portion of the central section. The walls of these rooms also remained standing at the greatest height of any walls except those of Kiva I.

KIVA I

(Figures 1, 15)

Location.—This structure is situated in the north end of the pueblo and adjoins the north wing.

Shape.—The outer wall had roughly the form of the capital letter "D," the flat side of the "D" was represented by the east wall of the platform.

Dimensions.—The inside diameter from north to south above the banquette was 8.1 meters. The back wall of the banquette was 110 cm. high, the front wall 85 cm. high.

Walls.—The walls were faced with a veneer of rubble masonry composed of sandstone slabs. Some of these stones were as large as 57 cm. long, 15 cm. wide and 7 cm. thick. The surface of the walls was plastered with two coats of adobe plaster—a rough coat 2.0 cm. thick and a gray finish coat 0.3 cm. thick.

Floor.—The floor was made of hard-packed adobe plaster ranging up to 15 cm. thick, but in most areas only 2.0 cm. thick. This material was used to cover an ashpit west of the firepit. The plaster of the floor was curved up to meet the plaster on the face of the banquette.

Firepit (fig. 16).—This was rectangular in shape, lined on the sides with squared stone slabs set on edge, and the bottom lined with adobe. The stone slabs extended above the floor 4.0 cm. and formed a rim. The pit was 64 cm. long, 45 cm. wide and 27 cm. deep, and was filled with white wood ash and some charcoal. Both the ashpit and firepit were centered between the north and south walls quite close to the face of the platform.

Ashpit.—A shallow depression in the form of a square with rounded corners, approximately 30 cm. long on a side and 8 cm. deep, adjoined the firepit on the east. The contents were white ash and a very little charcoal.

Deflector.—Two stone slabs set on edge formed the east side of the firepit and partitioned it from the ashpit. These slabs extended above the floor and above the height of the other sides of the firepit. Although it would not have formed a very practical deflector, this structure is in a normal position for features of this sort and may have supported a movable stone slab.

Fig. 15. Kiva I showing ashpit, firepit, eastern platform, banquette, and pilasters. Arrow 50 cm. long points magnetic north, meter stick in background.

Platform.—The veneer masonry face of this feature had collapsed except for one short section on the south end. The floor had been paved with adobe plaster but this paving remained only in small patches, which were 99 cm. above the level of the floor around the firepit. This raised

Fig. 16. Firepit and ashpit, Kiva I. Arrow 50 cm. long points magnetic north.

area was located at the east end of the room. Part of the south wall was still standing, the north and east walls had collapsed. This platform was five meters wide and 175 cm. deep from front to back.

Ventilator.—Trenching of the platform failed to reveal a ventilator tunnel.

Pilasters.—There were three of these masonry supports for the roof: two were located near the centers of the north and south wall arcs respectively, and the third near the center of the west wall in line with the firepit, ashpit and the center of the platform. These pilasters were constructed of the same masonry as the walls. The south pilaster was somewhat smaller than the other two but extended to the edges of the bench whereas the east and west pilasters were set in a few centimeters. All were fairly large—90 to 100 cm. high and 70 to 80 cm. deep. No two sides of any one pilaster were of the same length.

Banquette.—This fairly wide bench-like feature was floored with gray adobe plaster laid on top of red clay and faced with rubble masonry and plaster. Much of the plaster and some of the masonry facing had disappeared. The top of the banquette stood approximately 80 cm. above the floor all around. It tapered in width from 110 cm. on the west at either side of the western pilaster to 85 cm. wide where it adjoined the platform.

Sipapu, niches.—A rectangular ash-filled trench was encountered 12 cm. below the floor, 23 cm. west of the firepit. This feature was 68 cm. long, 27 cm. wide and 30 cm. deep. No niches were discovered but they may have occurred in the fallen portion of the banquette.

Roof.—The structure of the ceiling or roof is known by inference only. It is assumed that one major beam or girder crossed the kiva from north to south between the two pilasters, and probably rested on posts that were based in the large post holes in line with these pilasters. Another major beam parallel to the first may have crossed above the face of the platform. The ends of this beam may have rested on the upper or "back" walls of the banquette at the two east ends where they join the north and south walls of the platform. A smaller beam may have rested with one end on the western pilaster and the other on the middle of the large central beam. The western pilaster is smaller and its masonry stands at a higher level than that of the other two pilasters.

On top of these beams there were laid poles stretching across the shorter spans, and above these, mats of small rods and finally adobe. Evidence for the top layers consisted of charred remains and impressions in adobe.

SMALL PLATFORM KIVA

(Figure 17)

Location.—This structure is situated three meters northeast of the big Kiva I.

Shape.—It was rectangular although the western corners were curved.

Fig. 17. Small platform kiva showing adobe and slab-lined "D"-shaped firepit, slab-lined ashpit and partially paved eastern platform. Arrow 50 cm. long points magnetic north, meter stick in background.

Dimensions.—The length inside including the platform was 2.4 meters, the width, 2.0 meters. The north wall was standing at one meter high.

Walls.—For the construction of the east wall in particular, and to a lesser extent for the other walls, many through stones were used. These were thick slabs of sandstone laid up in fairly level courses. Over this masonry a single coat of gray plaster about 1.5 cm. thick had been applied. In addition, a veneer of slabs set on edge had been erected at the base of the wall above the floor of the platform and in the northeast corner against the face of the platform.

Floor.—The native red clay had been coated with adobe plaster. The surface of this material was fairly level and had turned dark gray.

Firepit.—The firebox was in the shape of a capital "D" with the flat side of the "D" toward the east. This pit was lined with adobe plaster fired red except on the east side where there was a stone slab set on edge. The firepit was 40 cm. long, 30 cm. wide and 30 cm. deep.

Ashpit.—A small square stone box 28 cm. on a side and 12 cm. deep adjoined the firepit on the east. Its sides were made of slabs set on edge and it was filled with white ash.

Deflector.—Although the east side of the firepit and the west side of the ashpit extended above the general level of the surrounding floor about 2 cm., they probably served only as support for the base of a slab which functioned as a damper and which was found in the mouth of the ventilator tunnel beneath the platform.

Platform.—The floor at the east end of the kiva was not excavated to the deeper level of the west end. The platform left by this procedure stood 46 cm. above the remainder of the floor and was 1.2 meters deep from front to back. Part of the floor of the platform near the edge had been paved with smooth rectangular stones with square corners, the largest of which was 123 cm. long and 17 cm. wide. The remainder of the floor was paved with dark gray adobe plaster.

Ventilator.—A tunnel ran below the surface of the platform underneath the slab paving. The mouth of this tunnel opened in the face of the platform opposite the ashpit. Sticks supported the roof.

Pilaster(?)—A post 18 cm. in diameter was recessed in the masonry of the north wall 85 cm. west of the platform. There was no indication of a similar recessed post in the opposite partially collapsed wall.

Niches and Sipapu.—Were not located.

Roof.—The exact character of the roof is unknown. It could have been roofed with a flat roof like the dwelling rooms. The short span across the width would present no problem.

THE GREAT KIVA

(Figures 18, 19)

Shape of floor-plan.—The outer wall has roughly the shape of the exterior coil of a loosely-rolled scroll.

Dimensions.—The inside diameter from north to south above the bench is 17.3 meters, between the faces of the north and south benches it is 14.8 meters. The face of the bench averages 70 cm. in height and the present greatest height of the outer wall is 53 cm. The masonry in these walls has an average thickness of 24 cm. The greatest depth of the central floor below ground level is 163 cm.

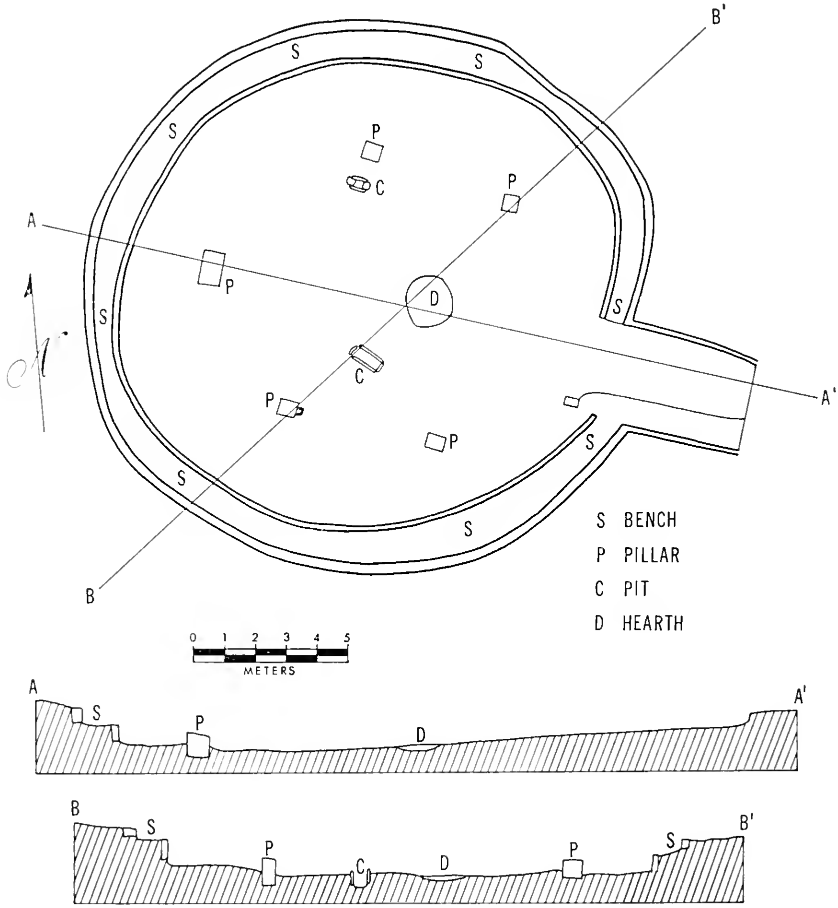

Fig. 18. Ground plan and sections of Great Kiva, Carter Ranch Site.

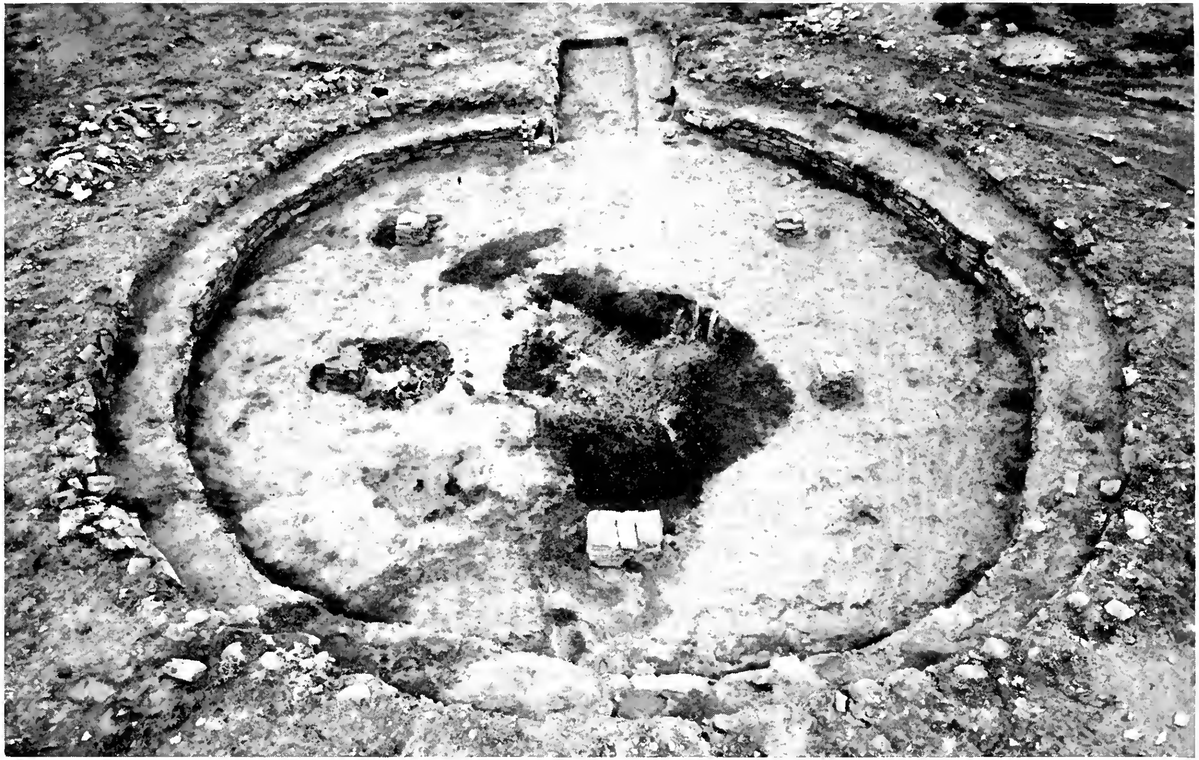

FIG. 19. Great Kiva from the west. Ramp entryway and pillars in background; pillars and vaults in foreground. Arrow 50 cm. long on hearth area points magnetic north, meter stick in background.

Walls.—The lower part of this structure was subterranean and was originally excavated in approximately its final form. The earth of the walls and benches thus shaped was stabilized by facing it with rubble masonry (fig. 20). This differed from the masonry in the dwelling rooms in that many of the component stones were quite long, ranging in size up to one which was 120 cm. long, 18 cm. wide and 15 cm. thick. Sandstone was the more common material, but a few igneous rocks were used. The face of the bench consisted entirely of horizontal masonry laid as uneven courses in a mud mortar.

Some use was made of smaller slabs to level up the courses and as chinking. The course at the base of the outer wall consisted of vertical slab masonry.

The quantities of wall stones both behind and in front of the outer wall make it seem probable that it stood a meter or two higher than at present.

No plaster was found on the walls, nor any niches, or other recesses in them.

Entrance (fig. 21).—An entryway in the form of a ramp 3 meters wide and 5.5 meters long is located in the approximate center of the east side and extends in a direction a few degrees south of east. The floor of this ramp is divided down the middle into two paths—the one on the north slopes upward at a steeper gradient and a few centimeters below the other. The walls of the entrance were faced with vertical-slab masonry.

The path on the south side of the ramp, floored with adobe clay of a dark red color, curved to the left behind a small masonry column at the inner end.

Floor.—There was no prepared surface found on the central floor area even in the vicinity of the hearth. Apparently the surface of the original excavation into the native red-brown to pink clay was used. This bumpy surface generally slopes down from the base of the masonry at the bench toward the center of the kiva.

Hearth Area.—An irregular expanse of burned earth was located about one-half meter west of a line between the two eastern pillars, and centered on the middle of the entrance. Its horizontal limits were indefinite but it was about 10 cm. longer than wide with a maximum extent of about 270 cm. The clay in this area was burned down to a depth of about 5 cm. Both white and dark gray ashes and many small pieces of charcoal covered the area.

Pits, Vaults or Crypts(?)—Three relatively small stone-lined pits of roughly rectangular shape were located: (1) 70 cm. west of the pillar in the northwest quadrant; (2) 160 cm. southwest of the hearth area on

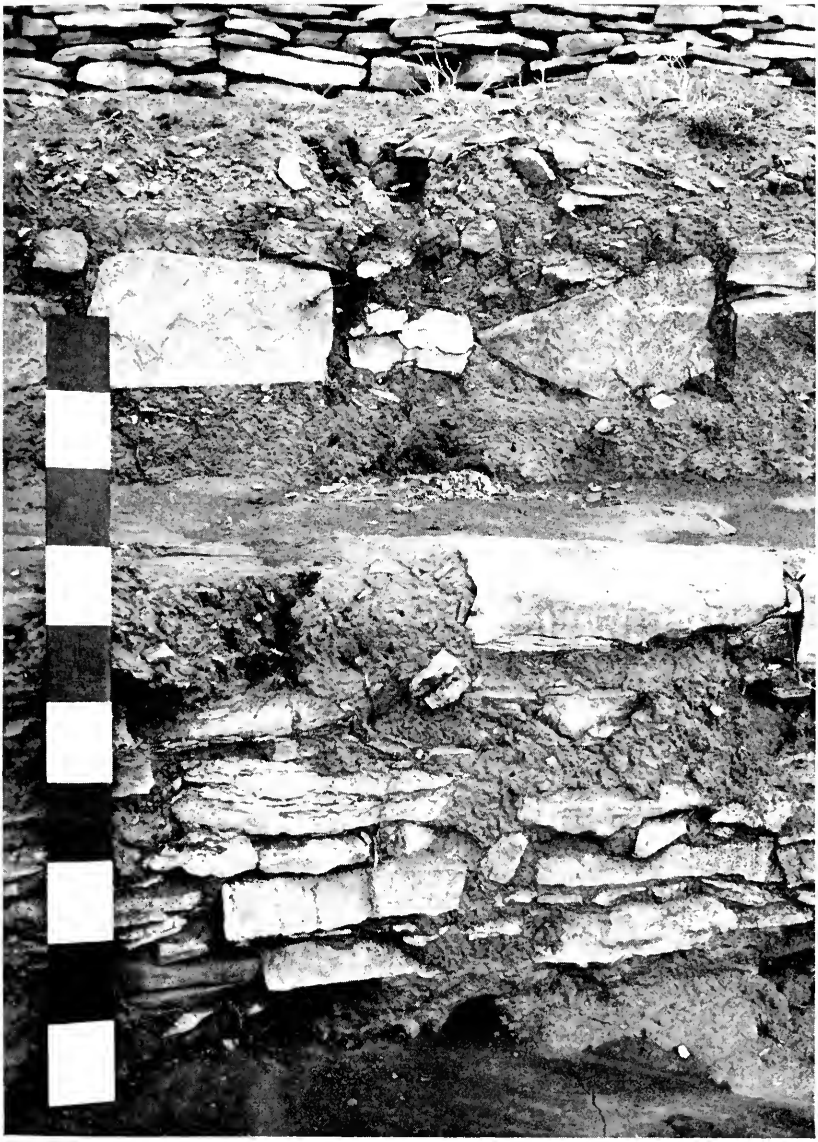

FIG. 20. Masonry in face of banquette and upper wall, west end of Great Kiva. Meter stick with 10 cm. divisions at left.

FIG. 21. Ramp entryway, Great Kiva, from west showing masonry wall of vertical slabs and lower path at left, and higher narrow path behind small masonry column at right. Meter stick in background.

a diagonal between the pillar in the northeast quadrant and that in the southwest quadrant; (3) adjoining the pillar in the southwest quadrant. The first measured 29 cm. long, 24 cm. wide and 30 cm. deep. This had vertical sandstone slabs lining the north and south sides near the surface and thick horizontal slabs on the ends.

The largest pit (2) also had a lining of vertical slabs on the north and south sides, but had masonry built up of small stones at the west end. If masonry were present in the east end, it had been torn out by the falling-in of the large slab which had formed the north wall.

The smallest pit was a small stone box of vertical slabs about 15 cm. square.

The floors of all the pits were of the red-brown native clay. Their contents were a few sherds that apparently had washed in.

Roof Supports (fig. 22).—Five masonry pillars were based on the native clay and fine gravelly sand into which the kiva was excavated. The horizontal masonry of which each was built started from 30 to 50 cm. below the floor level where it was braced by one or more vertical slabs placed in the excavation. Four of the pillars were arranged in a rectangle with one in each quadrant. These smaller pillars averaged 60 cm. long and 55 cm. wide. The highest of these when excavated was that in the northwest quadrant which stood 50 cm. above the floor. A single pillar about twice the size of these (100 cm. long, 70 cm. wide, 55 cm. present height), stood in line with the hearth and entrance at the west end of the kiva 235 cm. east of the bench. The masonry of these pillars was of a construction in which larger slabs often spanned the width (or length) of the column and alternated with smaller stones laid in courses. This construction seems reminiscent of that in which alternate courses of juniper poles and masonry were built, as observed at Aztec (Morris, 1921, p. 117), the Village of the Great Kivas (Roberts, 1932, p. 87), and at Lowry (Martin, 1936, p. 47).

The large number of dressed stones found adjacent to the pillars seems to indicate that they once stood much higher than at present. Whether these columns served as supports for the main girders themselves, or possibly simply as bases for upright wooden pillars, remains a question. The exceedingly small fragments of charcoal into which the roofing was reduced by fire precludes more definite data. The peculiar masonry con-

Fig. 22. Masonry pillar in northeast quadrant, Great Kiva, showing construction. Meter stick in 10 cm. divisions at left.

struction of these pillars, however, appears to favor their use without wooden extensions.

Roof.—A layer of very small charcoal fragments associated with some burned adobe containing the impressions of branches indicates that brush and adobe layers were built over the heavier timbers.

The quadrangular arrangement of the four smaller pillars seems to indicate a rectangular arrangement of the main girders such as was indicated by charred remains at Aztec (Morris, 1921, pp. 128–129).

The function of the large fifth pillar may have been to reduce the length of span needed for the poles at this end of the structure, where the distance from the hypothetical girders to the outer wall is much greater (9 meters as compared with 4.5 meters).

Artifacts.—Two ceramic feet were found, one in the fill near the pillar in the southwest quadrant, the other also in the fill near the pillar in the northeast quadrant. The former is light gray or "white" and painted in black. It appears to have been broken off a human effigy jar. The latter is of soft "pinch" pottery. It is oval and has eight toes or claws.

OUTDOOR STRUCTURES

Jug-shaped Pit.—A large storage pit 150 cm. in diameter at the floor and 145 cm. deep was found in the plaza in line with the western pilaster, the firepit and ashpit of Kiva I. An upright stone slab was found in the center of the pit just below the opening which was 45 cm. wide. The upright slab may have served as a step to help in getting out of the pit.

A "cap" for the opening was found directly above the "step," in the fill. This round flagstone cap was burnt on one side and measured 2.5 cm. thick and 45 cm. in diameter. Between 12 cm. and 15 cm. of burned corn was found on the floor.

Cooking(?) Pits.—Four roughly circular piles of rocks in pits were found by trenching. One of these was in Trench B through the trash east of the pueblo, two were in Trench G adjacent to the small platform kiva, and one beside a low wall bordering the south side of the Kiva I area.

These pits were found in the upper three levels of the trenches through the trash and generally extended from 10 cm. below the surface down to as deep as 60 cm. below the surface. One was lined with slabs.

The pits ranged in diameter from 72 cm. to 1 meter, and were about 40 cm. deep. Some of the rocks in these pits were cracked by fire and all of them discolored. Ashes, charcoal and burned clay extended beyond the areas of the rocks. The stones ranged in size from rounded cobbles 7 to 10 cm. in diameter in the smaller group, up to small rectangular boulders

FIG. 23. Cooking pit below floor of Room 21; pile of rocks discolored and cracked by fire in bottom. Arrow 30 cm. long points magnetic north.

30 cm. long, 10 cm. wide and 10 cm. thick. Fifty-three cobbles were counted from one pit.

A fifth pit is mentioned here because it obviously performed the same function as the outdoor "cooking" pits, although it was found below the floor of Room 21. This cavity (fig. 23) was roughly rectangular in shape (50 cm. long, 40 cm. wide and 45 cm. deep) and contained considerable ash and a pile of rocks discolored and cracked by fire. The walls and floor of the pit were burned red.

Another series of three rectangular pits had been constructed in the plaza just east of Room 23 (Trench H, fig. 24). These were lined with unusually large sandstone slabs set on edge. In two of these pits only a single slab was used to line a side or an end. One of these "ovens" was 130 cm. long, 100 cm. wide and 40 cm. deep, and another 140 cm. long, 95 cm. wide and 40 cm. deep. These structures were filled with fragments of slabs at the top, then a layer of charcoal and on the floor between thirty and forty burned cobbles mixed with more charcoal and ash. The slabs that formed the walls of these structures were also burned by the fire.

Ramada(?).—A rectangular fire-box lined with stone slabs was found near the center of Trench E. Associated with this feature were four doubtful postholes which may have served as the base for a brush-shelter

FIG. 24. Cooking pit in plaza east of Room 23 showing slab lining and stones discolored and cracked by fire in bottom. Arrow 30 cm. long points magnetic north.

or ramada. The firepit was similar in every respect to those found within the secular rooms. It was 52 cm. long, 43 cm. wide and 25 cm. deep. The burials uncovered in Trench E were all located beyond the limits of this structure as indicated by the floor and the postholes.

Another rectangular slab-lined firepit was found under a layer of trash 25 cm. below the surface, 110 cm. north of Room 9. This firepit also was essentially of the same construction as those found inside the rooms. Although it was not enclosed by the walls of a room at the time it was uncovered, there were some indications that it had been used in a room rather than in the plaza. The character of the floor between this firepit and Room 9 and a short wall-stub projecting from the west wall of Room 9 seem to indicate that a room was located in this general area at one time.

SEQUENCE OF CONSTRUCTION

Considerable evidence that there had been much remodeling and alteration of the pueblo during the period of its occupation was encountered. New rooms were added, new floors were laid over old and new walls were built to make rooms smaller. From a study of the abutments and bonding of the corners of rooms in conjunction with a study of the masonry types and doorways, I can make some rough guesses as to the order in which the various sections of the pueblo were built. This ordering is based on two assumptions: (1) that walls which are bonded together were built at the same time; (2) that walls built of neat appearing masonry—usually a type of incipient banded—were at first exterior walls with neat-appearing face exposed, and that any abutment which hides the neat-appearing face ends a wall of later construction. (The corollary of this is that the surfaces of walls with crude rubble masonry were always interior walls and were covered with plaster.) Although the difficulty encountered in identifying some of the junctures as bonds or abutments does not increase confidence in the validity of this interpretation, some corroboration is afforded by general impressions.

Nuclear Unit

The first rooms to be built in the pueblo were apparently those in the north end of the central section (Rooms 19, 3, 5, 12, 15, 18, 16, 10). These rooms appear to have been built as a unit because they share continuous walls that are bonded together. One of these walls without any break in it forms the west wall of Rooms 19, 3, 5, 12 and Room 15, floor II. Another continuous wall bonded into this one forms the south wall of Rooms 3 and 16, and the north wall of Room 5. Still another, the north wall of Room 15, floor II and of Room 18, which is also the south wall of Room 12, is also bonded into this west wall of the pueblo. The east wall of Rooms 10 and 16, which also forms the west wall of the courtyard in which Kiva I was built, is a continuous wall and links these two rooms together. It continues in a straight line forming the east walls of the unexcavated rooms east of Rooms 5 and 12 thus enclosing these rooms into the nuclear unit. Finally, although there is a break in the construction at the northeast corner of Room 18, this wall continues on past Room 18 without any pronounced jog in it. Other clues to the coeval construction of this series of rooms are: (1) the general regularity and symmetry of this group as contrasted with some subsequent additions; (2) the similarity in placement of the doors or vents in the western tier of rooms; and (3) a thicker, heavier style of wall construction.

The reasons for thinking that this unit is earlier are: (1) the walls of Room 3 are bonded (it is the only room in the pueblo with all four walls bonded together), and all other rooms are abutted on to it; (2) the majority of these rooms had either been used extensively as trash dumps, or had been remodeled, whereas the rooms in the other groups had been subjected less often to these processes; (3) the walls of this nuclear unit were built on the native clay, whereas those of a number of the rooms in the other groups were built on trash; (4) more of these rooms are linked by doorways which were subsequently sealed with masonry or converted into ventilators.

Later Additions

However doubtful the sequence or exact number of additions to the nuclear unit may be, it is clear that there must have been at least four periods of construction. The evidence for so much building is contained in: (1) the stratified position of the walls of Rooms 2, 7 and 8 on trash; (2) a number of stubs of walls standing unconnected to present rooms in the space between Rooms 17, 21 and 22; (3) the remodeling of a number of the rooms by the construction of new floors, roofs and walls; and (4) the occurrence of former exterior walls in addition to those now standing.

The pueblo expanded principally to the east and south, very little to the north, and not at all to the west. This seems to have taken place by increments of at least four groups of rooms:

(A) There is a semi-detached unit at the east end of the north wing consisting of Room 11 and a series of surrounding unexcavated rooms. These are linked not only by their semi-detached position but also by a sealed doorway leading to the west from Room 11, by a bonded corner adjacent to Kiva I, and by the continuous east wall of Room 11 and the room to the north of it.

(B) Another group of rooms appears to have been the first to be added on to the nuclear unit on the south and east. This addition was made up of Rooms 14, 20, 23, 21, 17, 22 and 9. Rooms 9, 17 and 22 are linked by a continuous south wall and both Rooms 17 and 22 have west walls bonded into this south wall. From the character of the masonry this appears to have been an exterior wall at the time these rooms were built. Rooms 23, 20 and possibly 14 have a common east wall without any breaks or jogs in it between these rooms. Rooms 17 and 21 have a similar west wall which is bonded to the south wall of Room 17. Rooms 21, 23, 20 and 14 are abutted on to the nuclear unit directly. Rooms 17, 22, 21 and 23 are related to adjoining rooms of this unit not only by continuous walls and bonds but also by connecting vents and doorways.

(C) This group is comprised of Rooms 2, 8, 13 and 7. Rooms 2 and 8 are linked together by their east wall which has no gaps in it, and by their shared partition wall which is bonded to this east wall. The east wall of Rooms 2 and 8 forms the west wall of Room 7 and it abuts on to the south wall of Room 17. Room 13 is linked with Room 2 and with an earlier occupation of Room 8 by a continuous west wall. A change in the style of masonry where the south wall of Room 13 abuts on to the bonded southwest corner of Room 17 indicates that these rooms form a separate group. Rooms 7 and 8 and Rooms 8 and 13 are also related by connecting doorways.

(D) A fourth group of three rooms (Rooms 1, 4 and 6) probably represents the last stage in the expansion of the south wing. These rooms are not bonded together and we lack this definite evidence of their coeval construction. They are all abutted on to the same neatly constructed (formerly) exterior wall which forms their north wall, and they are thus all later than the group of rooms designated above as "B." They appear to be related by the unusual degree of similarity in their size, the style of masonry of which they were constructed and in the character of the abutments at the south end of their partition walls. These junctures lack any counterpart in other areas of the pueblo. The "T"-shaped doorway in Room 6 also lacks a counterpart in this pueblo. Room 6 was probably the first to be built of this group, then Room 4 and finally Room 1. Room 1 is the only room of the group with a bonded corner and this is the exterior corner. The symmetry of this group as a whole is comparable in a minor way to that of the nuclear unit and seems to confirm the contemporaneity of construction of the rooms of which it is composed.

SUMMARY AND INTERPRETATION

The Carter Ranch site consists of a block of about 39 dwelling rooms built in the form of a hollow square around a plaza containing a big "D"-shaped kiva, a large jug-shaped community(?) granary pit and a small platform kiva. A detached circular Great Kiva lies some ten meters northwest of the north wing. The rooms were generally constructed of a crude rubble masonry with walls about three meters on a side. A few walls of more advanced masonry types such as an inferior wide-banded type and a vertical slab-type were encountered. Roofs of typical pueblo construction consisted of one or more major beams with layers of poles, splints and earth above. With the exception of one "T"-shaped lateral doorway, entrance into the rooms from outside was probably by means of hatchways through the roof, but a number of rectangular doorways had been made through partition walls to provide communication between rooms.

Floors and walls were plastered with specially prepared adobe. Both rectangular firepits lined with stone slabs and "D"-shaped or circular firepits lined with adobe plaster were used. Ashpits, ventilators and in a few instances deflectors were employed with the firepits as part of the "air-conditioning" apparatus. Ashpits were similar to the firepits in construction, but smaller and shallower. The mouths of most ventilators were small openings similar to doorways. Other furnishings of rooms were bell-shaped storage pits, and occasional metate-bins, niches and benches.

Abutting walls and differences in masonry types indicate that the pueblo had not all been built at the same time, but had grown by stages. The original "L"-shaped unit had consisted of a group of rooms and the big kiva in the north wing and the rooms in the north part of the central section. The north, west and south plaza walls are incorporated into the dwelling unit, but the big kiva is actually a detached semi-subterranean structure like many Anasazi kivas. However, its position would indicate that it belongs with this nuclear unit.

After a certain lapse of time a second ell consisting of additional rooms in the central section and a row of rooms in the south wing were added. The condition of the terrain does not favor this location over one at the north end of the original unit. Possibly the choice was motivated by a desire to further enclose the plaza or to form a secondary courtyard.

The succeeding additions were simply extensions to the south wing. Most of the excavated rooms lacking firepits are in this south wing. Only two of the rooms in this wing have ventilators and there are other differences in details. There were no indications of a kiva in this courtyard.

Perhaps none was constructed and the two smaller kivas, the Great Kiva and quasi-ceremonial rooms sufficed for the functions of the community.

One of the more striking aspects of the ground plan of this pueblo is its orientation. Not only does the structure as a whole open with its wings to the east, but the interior features of the kivas and most of the rooms that have firepits and ventilators are also lined up in a west to east (actually 20 degrees south of east magnetic) trending row. Thus an axis bisecting the firepit, ashpit, deflector and ventilator extends toward the east.

This orientation differs, of course, from the customary south or southeasterly bearing of directional trends in Pueblo III sites of the Anasazi, and is one of the stronger indications that the architecture at the Carter Ranch inclined toward the Mogollon tradition rather than the Anasazi.

The interior furnishings of the rooms provide only weak indications in either direction. The presence of firepits in a majority of the excavated rooms appears to be a southern and possibly a Mogollon feature. Although firepits of both the rectangular stonelined type and the circular adobe-lined type occur in Anasazi dwelling rooms of the Pueblo II and Pueblo III periods, they appear to be present in a somewhat higher proportion of the rooms south of the San Juan district.

It also appears that ventilators constructed to furnish fresh air to the firepits of secular rooms are more frequent in the dwelling rooms of southern pueblos. The data on this point are unsatisfactory because the distinction between doors and the somewhat smaller window-like vents is seldom clear in the description.

Mindeleff (1891, p. 191) was probably the first to suggest that the "T"-shaped doorway may have resulted from a primary or temporary stage in the process of gradually sealing a rectangular doorway with masonry. In effect, the doorway was reduced to the function and size of a ventilator. It would be interesting to find out if there is a higher proportion of sealed "T"-shaped doorways out of the total number of doorways of this shape, than there is of rectangular doorways. Ordinarily the form of the seal in a rectangular doorway does not have the aspect of transforming it even temporarily into the "T"-shape (Rinaldo, 1959, p. 68; Martin, 1936, pl. XV; Pepper, 1920, fig. 150).

The history of mealing bins has been amply covered by Woodbury (1954, pp. 63–65). They seem to have come into use in Pueblo II and continue to be used today. Evidence for their use in Pueblo III times is well established but their infrequent occurrence at some sites remains to be explained. It is clear that not all flat metates were used in such bins because the number of such metates from any one site usually far exceeds the number of bins. Details of construction vary widely but generally there are two to four metate-bins placed in a corner so that the miller would face the firepit, and just far enough out from the wall for the grinder to kneel with her back to the wall, probably with her toes braced against the base of the wall.

Although mealing bins had been built in only four of the fooms (Rooms 4, 10, 18 and 22), kiva-like features such as firepits, ventilators, ashpits and deflectors(?) were present in several rooms (Rooms 3, 5, 7, 11, 12, 15, 16, 17). These seem analogous to the rooms which Stubbs (1953, pp. 31, 32) termed specialized rooms at Pindi Pueblo and to a lesser extent certain kiva-like rooms at Higgins Flat Pueblo (Martin *et al.*, 1956, pp. 44–46). But the distinction between rooms of this class and a room like the small platform kiva is a fine one and is justified primarily on the basis of the platform and the pilaster-like recessed post(s?)—a rather weak basis one must admit.

In spite of this fine distinction, there is no question that the big Kiva I functioned as a kiva. Even if the evidence for the ventilator is lacking (because of the collapse of the platform opposite the firepit), Kiva I has most of the other definitive kiva-like features: firepit, ashpit, banquette, pilasters, platform, partially subterranean placement, and shape and size distinctly different from the other rooms in the pueblo (Smiley, 1952 and Smith, 1952).

The use of three pilasters rather than the usual four, six or eight, has a parallel at Kiatuthlanna in Kiva B located in the Pueblo III structure (Roberts, 1931, p. 97). Kiva I also resembles this kiva in shape, in the form of the banquette, and in the large platform of the southeast side near the firepit. Although this platform is not as deep in the kiva at Kiatuthlanna, it resembles that in Kiva I, particularly in width. The arrangement of postholes between the north and south pilasters seem to be indicative of a flat roof rather than a cribbed roof which was suggested by charred timbers in the kiva at Kiatuthlanna. However, the ash-filled rectangular pit west of the firepit in Kiva I suggests the "trench" in a similar position in Kiva B. Only two kivas appeared to have been used at the same time at Kiatuthlanna and each is of a different type—one with pilasters and a sipapu, the other without. The difference in size, shape, lack of sipapu and other features between the small and big kivas at the Carter Ranch make these two scarcely comparable with each other. The kivas at Kiatuthlanna are more nearly the same size and shape. Furthermore, none of the dwelling rooms at Kiatuthlanna were furnished with the ventilator-firepit-deflector complex which gives so many at the Carter Ranch the aspect of having had a quasi-ceremonial use.

Although Kiva I seems directly comparable to Kiva B at Kiatuthlanna and very similar to Anasazi kivas located further to the north and east (in the Chaco district, for example), the Great Kiva at the Carter Ranch Site bears only a general resemblance to the Great Kivas of those northern districts and only in certain elements is it directly comparable. It contains almost as many characteristics typical of Great Kivas of the Reserve and Tularosa phases as it does those of the orthodox Chacoan Great Kivas (Vivian and Reiter, 1960, table II, p. 99). It contains such Chacoan features as the bench, masonry pillars for support of the roof, (of which the four primary ones are in a quadrilateral Chacoan arrangement), a semblance of a stone-lined vault, or vaults, and a roughly circular shape of floor plan; but it contains such Mogollon features as a sloping lateral entrance, a burned hearth zone (rather than a raised masonry fire-box or firepit), an east-west orientation, a floor about 1.5 meters deep, and an additional double-sized fifth pillar for support of the roof.

Before we excavated the entrance and the hearth area this super-ceremonial room (to borrow a term from Haury) appeared to be simply a "dilute" version of the Chacoan Great Kiva, but further excavation and study presented the alternative hypothesis that it is a regional variant of the generic Great Kiva concept, that is, the formal local manifestation of a widespread religious system. In order to understand this alternative it is necessary to review the typical characteristics of Great Kivas in the several neighboring regions: the Chaco, Forestdale, Point of Pines, Reserve and Vernon areas. (We refer only indirectly to the Ackmen-Lowry, Mesa Verde, Mimbres, Rio Grande, Jornada and Kayenta areas because they are too distant and, we suspect, only indirectly influential).

Chaco: Circular floor plan, bench completely encircles the floor, four seating pits for the main roof supports, paired stone masonry vaults, a raised firebox located between the two southern seating pits, a north to south orientation, a northern antechamber, entrance by a stairway, a subterranean location of some depth (2.0 meters or more), free-standing walls of stone masonry.

Great Kivas located in areas where the associated culture is Chacoan, such as those at Lowry Ruin and Aztec Ruin, differ in the use of masonry pillars rather than large wooden timbers based in seating pits, and ladders rather than stairways for entrance; also at Lowry, a firepit rather than a raised firebox. (Hewett, 1936, pp. 76–99; Martin, 1936, pp. 46–53, 1939, pp. 350–356; Morris, 1921, pp. 115–138, 1939, pp. 82–84; Peckham, 1958, pp. 161–163; Roberts, 1929, pp. 73–81, 1932, pp. 86–98; Vivian and Reiter, 1960.)

Forestdale: Circular floor plan, bench encircles floor except for ventilator or pole and stone stairway, a four-post roof support; orientation is generally southeast, the walls of the later structures are of stone, earlier they are of clay or bedrock; the location is subterranean and up to 1.75 meters deep (the average is shallower). Firepits and grooves are noted for the earlier examples; a rectangular masonry altar-like structure for the latest, which is rectangular, located in the plaza, and roofed only with a portico over the bench. (Baldwin, 1939a, pp. 17–18; Haury, 1940, pp. 43–47; 1950b, pp. 29–39; Haury and Sayles, 1947, pp. 21–22.)

Point of Pines: Rectangular floor plan (the earliest is roughly circular); shallower than the Forestdale Great Kivas (average depth, about 1.5 meters). Walls of later structures are of stone masonry, the earlier ones of clay; a bench is present at Dry Prong but not at the earlier sites; entrance is by means of a sloping lateral entryway or a passageway between rooms (in the latest sites); orientation is to the east; for support of the roof there are two or three rather irregular rows of posts; pits possibly used as resonators are more characteristic than grooves, although grooves are present on many sites; the hearth consists of a burned area not specially enclosed. (Breternitz, 1959, p. 18; Olson, 1960, pp. 185–204; Wheat, 1954, pp. 58–64.)

Reserve: Rectangular floor plan (the earlier ones are bean-shaped); subterranean location, but relatively shallow (average depth less than 1.5 meters); a bench is present in only one example and is possibly not a true bench; a long ramp type of entrance was provided; orientation is to the east or slightly south of east; support for the roof consists of two or three rather irregular rows of posts; grooves between the large posts are characteristic; pits, which may have served as resonators, are occasionally found. One relatively late example is circular and possibly may have had a stepped entrance. The latest example is of the plaza type and was roofed in a fashion much like the earlier structures, but lacks the bench, and "altar" found at Kinishba. (Bluhm, 1957a, pp. 15–19, 25–27; Martin and Rinaldo, 1940, pp. 14–17, 1947, pp. 304–305, 1950a, p. 284; Martin, Rinaldo and Antevs, 1949, pp. 86–89; Martin, Rinaldo and Barter, 1957, pp. 13–22, 126–129; Nesbitt, 1938, pp. 30–31; Rinaldo, 1959, pp. 181, 282–283.)

Vernon: Floor plan is roughly circular (the latest is rectangular); the location is subterranean but is not as deep as the Chacoan Great Kivas; walls of the later kivas are of stone masonry, the earlier ones are of clay or gravel; a bench completely encircles the floor area except at the entrance (it is absent in the earlier examples); entrance is by means of a sloping lateral entryway; orientation is to the east or the south of east;

the roof is supported by three rows of posts or two rows of pillars and a double-sized single pillar at the back; crude stone-lined pits or vaults are characteristic; grooves between posts are present in the earliest of the three excavated Great Kivas; the hearth consists of a burned patch of the floor and is not specially enclosed. (Martin, Rinaldo and Longacre, 1961a, pp. 23–29; Martin, *et al.*, 1962, pp. 52–60, 64–68, 220–221.)

It is evident from this review that there are regional expressions of the Great Kiva concept and that the differences between these local manifestations are often of a minor nature, such as the degree of emphasis put on grooves or vaults, two rows of posts in a quadrilateral arrangement or three rows of posts in a parallel order. In fact, the magnitude of these distinctions is sometimes not as great as that between two such structures in the same region—the early Great Kiva at the Sawmill Site (Bluhm, 1957a, pp. 15–19), and that at Starkweather (Nesbitt, 1938, pp. 30–31), for example. The similarities in the rectangular Great Kivas with lateral ramp-type entrances have been thoroughly explored by Olson (1960), as have those of the Chacoan Great Kivas by Vivian and Reiter (1960). Similarities in earlier Mogollon ceremonial architecture that transcend the regional ("branch") differences have also been noted by Wheat (1955, pp. 56–62). It is therefore interesting to observe that whereas in most regions traits of either the Chacoan or the Reserve-Tularosa types of Great Kiva predominate in any one structure, in the Vernon area they are often combined. These may be "dilute" often crude versions of Chacoan features, nevertheless, they may be recognized as features that appear more often in the Chacoan Great Kivas than in kivas of the Reserve and Tularosa Phases.

The combination of the two traditions in one structure, as found at the Carter Ranch Site, Hooper Ranch Pueblo and the Mineral Creek Site, suggests the possibility that although regional differences (i.e., Forestdale as compared with Reserve) can be recognized as well as differences of greater magnitude (the Chacoan Great Kivas as compared with the Great Kivas of the Reserve and Tularosa Phases, for example), the two styles of features must have been deemed congruous enough to put in juxtaposition in one structure and used in the ceremonial context in much the same way that they normally functioned.

Cushing (1896, p. 364) observed that although Zuni ceremonies are performed in a rectangular room, the action is better adapted to a circular structure, and he suggested that the earlier kivas must have been circular. There is now considerable archaeological evidence to support Cushing's hypothesis, and it seems possible that other attributes of kivas besides their shape were not as closely tied into the ceremonial functioning of the structure as one might assume. The position of many Great Kivas, set apart as they are from the contiguous secular rooms, may have been symbolic of the general ceremonial nature of the kiva rather than essential to the functioning of a particular aspect of the ceremonial or religious system. On the other hand, such specialized features as vaults, "resonators," crypts, niches and lateral entrances must have been associated with particular aspects of the ceremonies.

The Great Kiva at the Carter Ranch Site seems to be neither a "dilute" version of the Chacoan development, nor of the development characteristic of the Reserve and Tularosa Phases. Rather, it seems to be a special local development in the Vernon area which combined elements of various local manifestations in a characteristic way. This congruent combination of otherwise disparate features within each of a series of structures in the Vernon area suggests that these Great Kivas were manifestations of a religious system that had spread at this period (ca. A.D. 1150) over a very wide area.

On the whole, the arrangement of the structure with its north and south wings, central section and kivas in the plaza, is essentially a "front facing" layout (Reed, 1956 *in* Willey). As such it is more like the San Juan–Chaco sites such as Pueblo Bonito (Judd, 1954), Aztec (Morris, 1921) and Lowry (Martin, 1936), than it is like Kinishba (Cummings, 1940), Foote Canyon (Rinaldo, 1959) or Four Mile Ruin (Haury and Hargrave, 1931). Roberts (1931, p. 112) compared the structure at Kiatuthlanna in a similar fashion to San Juan ruins, rather than Little Colorado ruins with the reservation that practically nothing was known of the small pueblos in the Little Colorado area. Without drawing any definite conclusions and with very few additional examples at our disposal, it would appear to be at least partly a matter of chronology wherein the "front facing" layout is associated with Pueblo III villages and the earlier polychromes (St. Johns Polychrome, Querino Polychrome), if any, while the enclosed plaza layout is associated with the later polychrome types.

Thus, in spite of the fact that occasional forms of the architecture, such as the banquette and pilasters in the kiva and the "T"-shaped doorway in Room 6, have a marked resemblance to similar structures more popular among the Anasazi, the general character of the architecture and the details of wall construction compare more closely to those of the Mogollon.

II. Burials and Mortuary Customs

By John B. Rinaldo
Associate Curator, Archaeology

Over thirty burials or parts of human skeletons were encountered during the excavations. These included six infants, three older children or adolescents, thirteen adult females and fourteen adult males. The majority of these were found in or below the heavy trash layers east of the pueblo and outside the plaza wall, but they were not all clustered in what could be termed a community burial ground. Actually, they were found in other areas of the site also. Several were found in a low trash mound around the "ramada" north of the pueblo (see p. 48), two in the fill of Kiva I, one in a lower-story room and one outside the west wall of the pueblo. Many of the burials appeared to be in groups, as if certain areas of the trash were favored, and in a few instances, later burials had been made above earlier ones in these areas. This superposition of burials along with other evidence indicates that interments were made sporadically over a period of several years, rather than during a short period of time.

Burials were usually placed in pits excavated in the trash. In some instances these pits were also excavated a slight depth in the red clay below the refuse. Four were found in the upper levels 20 cm. or less below the present surface, six interments had been made 40 to 60 cm. below the surface and eighteen 60 to 110 cm. below. A very few were in the fill of rooms. Scattered human bones including fragments of the mandible, the sacrum, vertebrae and skull were found throughout the site, both in the rooms and in the refuse dumps—frequently in areas where no other "burials" occurred, but occasionally near other burials, as if older burials had been displaced in the process of excavating new graves. A streak of red paint on a human mandible found below the upper floor in Room 10 suggests the possibility that some of these fragments may have been trophies of war.

Fig. 25. Flexed Burial 2 from small refuse mound north of pueblo. Arrow 30 cm. long points magnetic north.

Bodies were placed either on the back (13) or the side (12), more frequently on the right side (9) than on the left (3), and usually with the legs folded up toward the body (fig. 25). Very few were tightly flexed and none was extended. One individual had been placed in the ventral position, and still another was apparently a secondary burial with the upper and lower torso interred separately. These had been placed with the lower torso on the back a short distance away from the upper body which was face down (in the ventral position). In general, a position on the back seemed to be favored.

The most common form of orientation was with the head toward the south (15 instances); eight were with the head to the east, four toward the north and one toward the southwest (an infant).

Pigments and coloured objects were associated with some burials but there was no definite indication that a color-directional symbolism was intended. Hematite in the forms of powder or cylinders was associated with three of the burials, turquoise in lumps and pendants with two, and yellow limonite with one.

Twill plaited mats had been wrapped around five of the individuals, and a very few had been covered by some other means, such as a roof of sticks or a bowl inverted over the head. Fragmentary string aprons clothed two of the adult females.

Ornaments such as wristlets, necklaces, collars and pendants of shell, turquoise, red stone and jet were encountered on eight skeletons, only two of which were infants. Necklaces and the more elaborate ornaments were found with the females (2) and the infants, a few simple pendants and wristlets with the males (4 burials). Pottery vessels, usually a jar or a pitcher and two or three bowls (fig. 26), accompanied most burials (23 burials). McDonald Corrugated vessels were normally associated with males (7 out of 8 vessels). Charred corn was found with one individual, seeds with two others, and small animal bones in some of the bowls, but it

Fig. 26. Flexed Burial 3 from refuse dump east of pueblo showing associated pottery. Arrow 30 cm. long points magnetic north.

is uncertain whether these were really intended as offering of food. The corn and seeds occurred in quantity.

No burials were made beneath the floors of rooms. One burial had been placed on or near the floor but it was covered with trashy fill rather than a later floor. Two burials were made in Kiva 1 after it had been abandoned.

One burial was due to accident. This individual was apparently entrapped attempting to escape a fire in Room 10. He lay in an unnatural position, his skull, both legs and one arm had been broken, probably by the collapse of the roof, and most of his bones were carbonized.

Although a horizontal distance of less than a meter separated many of the burials, very few were encountered in positions and circumstances suggesting that the two individuals were buried at the same time in a single large grave. In one instance, a male, accompanied by unusually elaborate grave furniture—seven pottery vessels, a bone club, a bow guard, two shell pendants and a lump of turquoise, was interred close to a female with only a single pitcher; and, in another instance, two infants were buried together with a single group of pottery vessels and with one individual right on top of the other.

A specialized type of grooved bone awl, similar to those used for piercing the nasal septum in rites performed by the Zuni Shumaikoli fraternity (see p. 99), was found with three male burials. These individuals were each accompanied by three pottery vessels and wore bracelets, in one instance of turquoise pendants and in the others of shell beads and pendants. One of these individuals also had with him the paw of an animal, probably a badger (*Taxidea taxus,* right forefoot identified by D. Dwight Davis, Curator of Vertebrate Anatomy).

In summary, the data noted above may be reduced to the following generalities: Burials were made in pits excavated into the trash; normally the head was oriented toward the south; the body was placed on the back with the legs drawn up and the arms folded; most burials were accompanied by pottery vessels and other offerings were not unusual.

III. Artifacts

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The artifacts discussed below are those of stone, bone, shell and baked clay as well as a few of perishable materials. The details of particular artifacts are recorded in Archives of Archaeology No. 24 (Martin, *et al.*, in press). This chapter contains a synthesis and interpretation of this data with emphasis put on those aspects in which the specimens from this site appear to be significant.

The ultimate basis for both of these descriptions is a catalogue kept by Mr. David McQueen, Mr. John Saul, and myself. However, the summary, descriptions and interpretations are my sole responsibility. The materials used in the stone artifacts were identified by Dr. Bertram J. Woodland, Curator of Igneous and Metamorphic Petrology, and those in the shell artifacts by Dr. Fritz Haas, Curator Emeritus of Lower Invertebrates.

GROUND AND PECKED STONE

Manos (fig. 27).—All manos and metates were shaped to a certain extent by grinding and pecking. Some of their surfaces and edges were also dressed roughly by spalling, probably with a hammerstone, before they were pecked and ground. The edges of some manos and the edges and bottoms of some metates had only this sort of preliminary shaping, but the majority of the manos were shaped all over either through use, through pecking, or by spalling.

There were 326 manos recovered. Grinding surfaces ranged from convex to flat (fig. 27, *upper*). Convex surfaces were more frequent than flat, and manos with single grinding surfaces were one-fifth more frequent than those with two grinding surfaces, on opposite faces of the mano. Beveled manos (fig. 27, *lower*), that is, those with the grinding surfaces faceted into two planes on one surface, were almost as frequent as those with ordinary

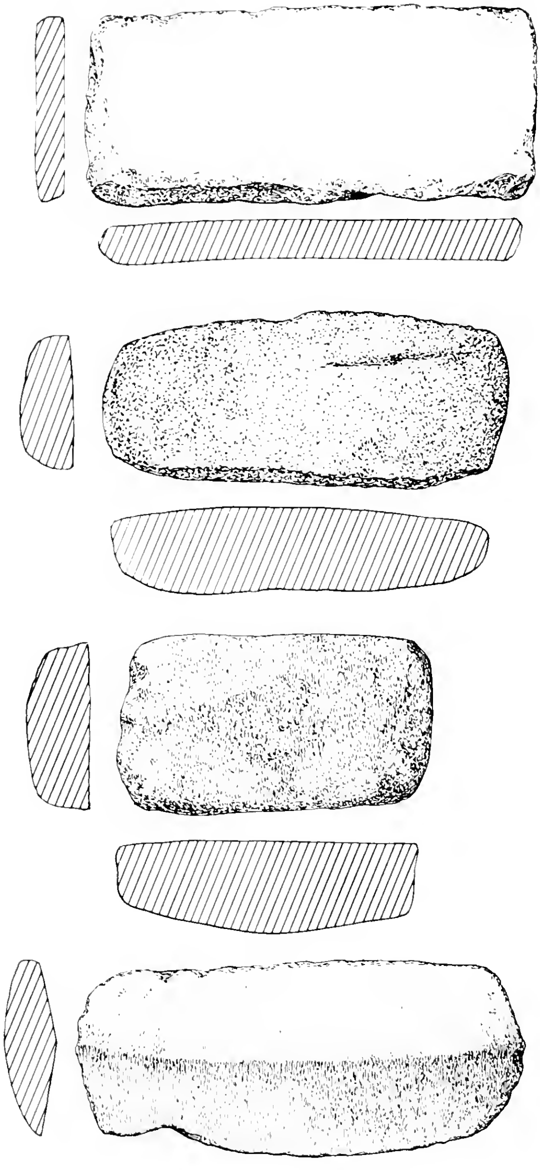


FIG. 27. Manos, showing progressive stages of wear from flat (upper) to beveled (lower). Length of lower specimen, 26.0 cm.

flat grinding surfaces. A large number of the convex grinding surfaces were in the process of becoming beveled. Many of the manos with beveled surfaces were used only until a short plane or facet was developed on the back side of the grinding surface (Bartlett, 1933, p. 16, fig. 8E).

The beveled manos and the thinner manos that had had prolonged use had their front corners ground off. When most of the manos were new they were rectangular in outline with rounded ends. Less than one-fourth of the over three hundred manos recovered were furnished with grips—i.e., depressions pecked in the sides or in the upper surfaces, or with their sides slightly incurved.

The majority of the manos were fragmentary, only about one-fourth (67) were complete. Yet it is quite certain that most of these were two-hand manos. Only twenty-five one-hand manos were recovered. The longest mano was only 29.1 cm. long, and the complete two-hand manos have an average length of 22.9 cm.

Although the majority of manos were broken, it appears that they may have been used and saved almost until the site was abandoned, as relatively few were found deeper than 40 cm. below the surface in the refuse and more manos were found in the rooms than in the trenches.

Manos were uncovered in direct association with four metates, including the two metates in the mealing bins (Room 10). Two hand manos of seven different classes, with surfaces of both coarse and fine texture, were found with these metates. Most of these manos had two grinding surfaces. In another instance a one-hand mano was in association with the only basin-type metate recovered on the site. The fourth example of association was also a one-hand mano in association with a trough-type metate located among the timbers of the roof. These milling tools apparently had been used on the roof.

The occurrence of so many long, rectangular-beveled manos might be taken as a rough indication that the pueblo was occupied between A.D. 1100 and 1300. This type of mano is found frequently in association with the polychrome pottery types, although it occurs earlier. But this distribution may also generally indicate that the site was probably occupied before A.D. 1300 because after that time much longer (up to 40 cm. long) manos occur (Woodbury, 1954, p. 70; Rinaldo, 1941, p. 59). While this is not a definite indication, it serves to corroborate other lines of evidence. Aside from their short length and possibly the angle at which the planes of the beveled grinding surfaces meet, there is nothing to distinguish these from historic Hopi (or Zuni?) manos.

Metates.—Both trough type (fig. 28, *left*), and flat (fig. 28, *right*), or slab-type metates were recovered, as well as one example much like the

Fig. 28. Three types of metates: left specimen with through trough; center specimen basin type; right specimen slab type. Length of right specimen, 41.0 cm.

basin type (fig. 28, *middle*). The examples of flat metates and trough metates are equal in number, but there are four unbroken examples of the former, and only one intact example of the latter. The widest and thickest specimens were the flat metates, these dimensions being 40 cm. and 12 cm. respectively. The longest specimen which has a trough closed at one end and a shelf beyond that is 52 cm. long. Twelve specimens of the trough type had the trough open at both ends.

Most of the metates were not carefully shaped. They appear to have been worked only sufficiently to make them useful tools. Surfaces were dressed only roughly.

Such a large proportion of both metates and manos was recovered in a fragmentary condition that it appears they may have been intentionally broken to prevent other people than their original owners from using them. It is true that most of them were made of friable sandstone, but the proportion of broken specimens is higher than on other sites where sandstone was also the most common material.

Almost half of the metates recovered came from the kiva fill and rooms near the kiva and the large granary pit. Furthermore, all types of metates are represented in the specimens from the vicinity of the kivas. This suggests that much of the corn was stored in the large granary pit rather than in the rooms (comparatively little was found in the burned rooms) but that it was ground into meal in the houses and in the plaza.

The relative scarcity of trough-type metates with one end open, as compared with through-trough metates and the flat or slab-type metates, is consistent with trends observed elsewhere in which the trough types are replaced gradually by the slab type (Roberts, 1932, p. 140; Morris, 1939, p. 133; Bartlett, 1933, p. 26; Woodbury, 1954, pp. 58–59; Rinaldo, 1959, p. 240).

Two slab or flat metates were found in enclosed bins in Room 10 (see p. 31). There were some indications of similar bins in three other rooms (Rooms 4, 18, 22), but the floors in which these bins were located had been abandoned when Room 10 was in use. The use of metates in bins began in the eleventh century (Pueblo II) and continued into historic times. (Woodbury, 1954, pp. 63–65; Mindeleff, V., 1891, p. 211; Stevenson, M., 1904, p. 292; Stevenson, J., 1883, pp. 321, 375–376, fig. 508; Bartlett, 1933, fig. 7). All of the historic Pueblo Indian metates are of the slab type.

Rubbing Stones (fig. 29, *left*).—A few of the rubbing stones had been shaped by grinding and pecking, but the majority had been shaped only through use. Whereas most of the manos were made of sandstone, many of the rubbing stones were made of several igneous and flinty materials, such as basalt, felsite, quartzite and chert. They range in length from

6.9 to 11.0 cm., in width from 4.3 to 8.5 cm., and in thickness from 1.5 to 5.8 cm. Ten out of the eleven specimens came from the rooms or kivas. Rubbing stones were relatively scarce on this site in comparison with the number of manos found. This proportion seems to be characteristic of the later sites in the upper Little Colorado drainage. They are somewhat more frequent on the earlier sites relative to the number of manos (Martin, Rinaldo and Longacre, 1961a, pp. 98–99).

In a general way the larger rubbing stones grade into the one-hand manos, whereas, the smaller ones are scarcely different from polishing stones. They are distinguished from one-hand manos on the arbitrary basis of size, by their polished rubbing surfaces, and by their general lack of intentional shaping. Polishing stones differ from rubbing stones primarily in size, being smaller, but also never exhibit the pecking marks seen on some rubbing stones. There was no direct evidence of their use. They may have been used to compact and polish the adobe floors.

Polishing Stones (fig. 29, *upper right*).—These are small rounded pebbles, some of which are oval in outline. All of them have one or more flat polished facets. They average 4.7 cm. in length, 3.9 cm. in width, and 2.2 cm. in thickness. They are all made of dense, fine-grained igneous stones, such as fine-grained basalt or felsite. Only three specimens out of the twenty collected came from the refuse dump. It is possible that some were passed over in the digging because they lacked facets and could not be distinguished from ordinary water-worn pebbles carried in from a gravel bar in Hay Hollow, a short distance from the site.

All of the painted pottery from this site was polished. The smudged interiors of McDonald Corrugated bowls are highly polished and probably represent diligent use of polishing stones such as these.

Polishing stones have no specialized characteristics to distinguish the prehistoric specimens from the historic Hopi or Zuni tools.

Pestles (fig. 30, *upper left*).—These stones, probably used for crushing materials, are like those used for rubbing or polishing in that they have been altered primarily by use. The fact that all are quite similar in shape and dimensions, however, suggests that certain forms and sizes of stones were selected.

These are thick massive stones, generally oval or oblong in outline with one or both ends worn and battered. They range in length from 12.5 to 25.3 cm., in width from 9.1 to 10.3 cm., and in thickness from 4.1 to 8.2 cm. All of them were found in rooms, but none in direct association with a mortar. Nor was there any paint adhering to their ends as there is in the cavities of the mortars.

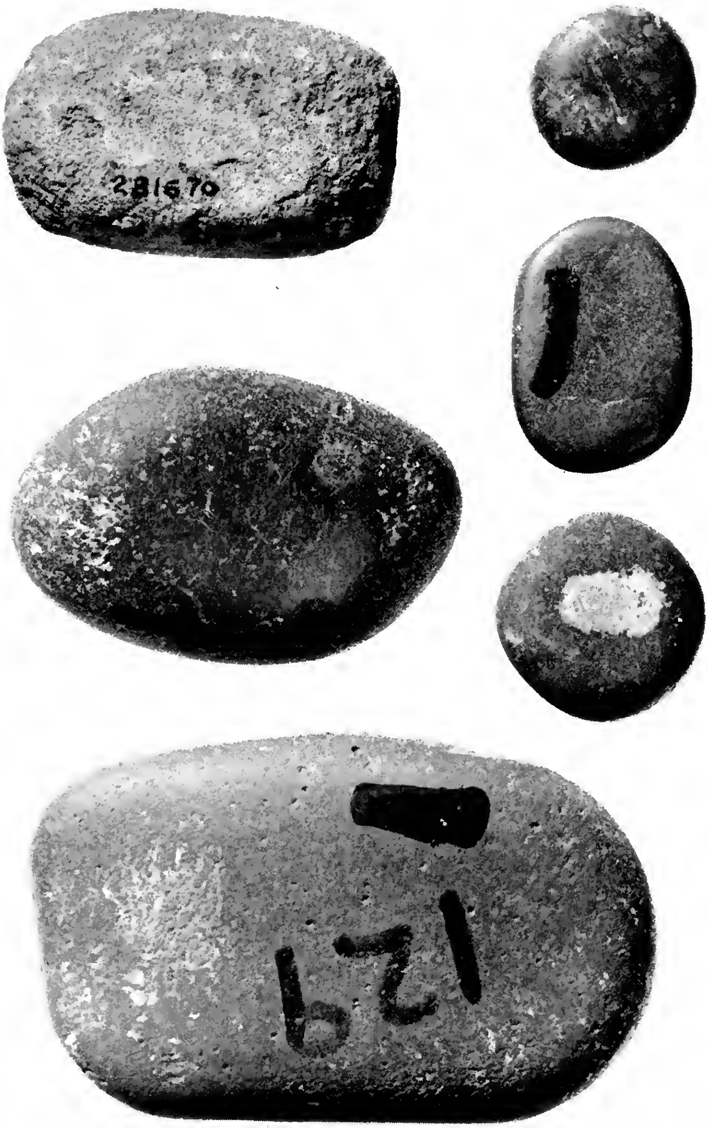


Fig. 29. Rubbing stones, left; polishing stones, upper right. Length of lower specimen, 11.0 cm.

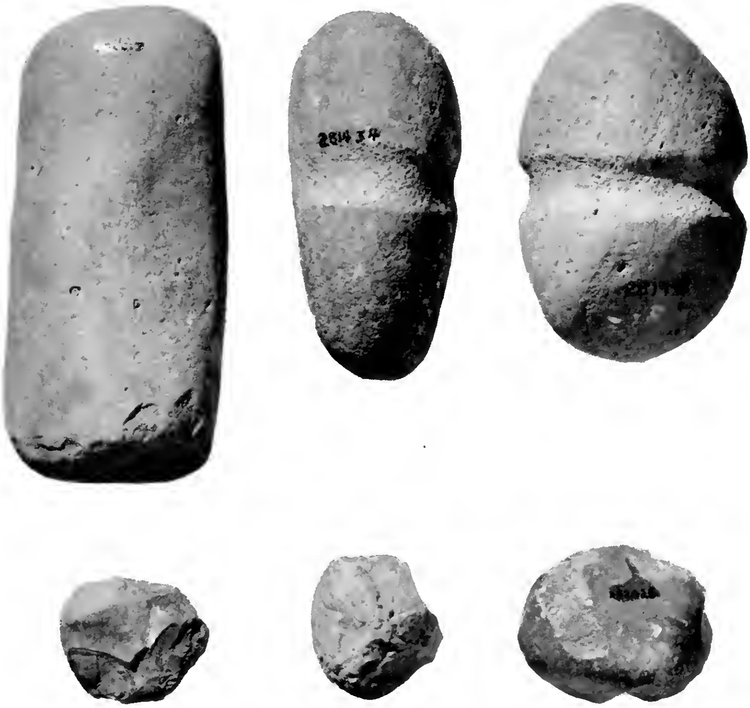


FIG. 30. Pestle, upper left; mauls, upper right; hammerstones, lower. Length of lower right specimen, 8.6 cm.

These resemble the pestles figured by James Stevenson (1883, figs. 353, 358), and described by Stephen (*in* Parsons, 1936, p. 882), but none is of the potato-masher type collected at Awatovi (Woodbury, 1954, pp. 95–96).

Mortars (fig. 31).—These objects with cavities for the crushing of materials have been called stone bowls, dishes and raised-border palettes. Generally, those with rough exterior surfaces and deeper cavities have been called mortars, and those with smoothly finished outer surfaces and shallow depressions bowls, dishes or palettes, but this is a somewhat arbitrary distinction.

Those from the Carter Ranch Site are thick slabs, irregular blocks or rounded cobbles with relatively shallow (0.4 to 2.5 cm. deep) cavities

FIG. 31. Mortars. Length of lower right specimen, 16.4 cm.

pecked into one of their broad surfaces. None of these specimens is symmetrical and well finished, but none is rough. One of them (fig. 31, *upper left*) has two cavities side by side, each stained with a different color of pigment.

These mortars are not large, they range in length from 8.3 to 27.5 cm., in width from 8.5 to 21.4 cm., and in thickness from 1.7 to 7.2 cm. Their cups range in diameter from 3.4 to 10.9 cm., and in depth from 0.4 to 2.6 cm.—only large enough to contain a small quantity of material, such as pigment. Traces of pigment are discernible in the cavities of several specimens. These mortars would not be suitable for crushing grain.

The present information on mortars from the Carter Ranch Site and other sites in the upper Little Colorado drainage indicates that rough block mortars with a shallow cup are more frequent in the later sites. Woodbury (1954, p. 113) has termed similar objects raised-border palettes.

Roberts (1932, pl. 54) illustrates a mortar with two cups, similar to the one described above, from the Village of the Great Kivas. Another is figured by J. Stevenson (1883, fig. 356) from Zuni, and similar objects were used by the Hopi. However, the Hopi tended to use shallower mortars or grinding slabs than the Zuni for grinding pigments (Judd, 1954, p. 285).

Hammerstones (fig. 30, *lower*).—Among the artifacts which are of frequent occurrence on most southwestern sites are battered and pitted pebbles of rough angular shapes, usually called either pecking stones or hammerstones. They are made of very hard, dense rock, often flinty in nature, such as chert. Those from the Carter Ranch Site range from 5.1 to 10.6 cm. in diameter.

Ten specimens are oval cobbles with one end pitted and spalled from use. Occasionally these smooth pebbles have pits in opposing sides for finger-holds.

Fig. 32. Axes, miscellaneous types. Length of lower right specimen, 10.9 cm.

Although they have frequently been uncovered on the floors of dwelling rooms, their associations have provided no clues as to their function. The use which is most frequently cited for them (on the basis of ethnographic data) is roughening the grinding surfaces of manos and metates, but they were probably tools of many purposes, such as shelling nuts, percussion-chipping flint and breaking bones for the marrow.

Small Metate-like Grinding Stones.—Only one of these was encountered. It is a small, thick slab, roughly trapezoidal in outline with the broad upper surface worn smooth and concave from grinding. The lower surface, sides and ends are rough. This specimen is 20.5 cm. long, 17.2 cm. wide, and 5.6 cm. thick. It is made of sandstone and represents a small version of a metate. The possibility has been suggested (Woodbury, 1954, p. 53) that these miniature metates were toys. A very few of the rubbing stones appear to have been used as miniature manos, and taken together these rubbing stones and the small metate present the possibility that they were children's toys (Curtis, 1922, p. 36).

Worked Slabs.—Very few complete rectangular worked slabs were recovered and most of them were less than 3 cm. thick. Generally, they were only rough-hewn or chipped along their edges to an outline, but occasionally one with smooth, straight edges was found.

The size of the nearly perfect specimens and their position in the fill of some of the rooms suggests that worked slabs were used for closing doorways, hatchways, and ventilator openings. However, in at least one instance (Room 3), this type of object was used as a deflector.

The horseshoe-shaped ring slabs (fig. 9) were used for framing the mouths of ventilator tunnels, and possibly as frames for hatchways. Two were found in place in ventilator tunnels, the other, a fragment, was found in roof fill. Those for the ventilator are not large, they are 35 and 40 cm. wide, and of about the same height. They are very similar to a ring slab located in the mouth of the ventilator to Kiva II at Hooper Ranch Pueblo (Martin, Rinaldo and Longacre, 1961a, fig. 29), and somewhat like a horseshoe-shaped slab in the mouth of the ventilator to Kiva I at the Village of the Great Kivas illustrated by Roberts (1932, pl. 13a). At Pinedale (Haury and Hargrave, 1931, pp. 56–59, fig. 14) a painted perforated slab was encountered.

The fragment that we assume comes from the frame for a hatchway is, of course, much larger (45.3 cm. long). This is similar to one from an excavated room at Kintyiel (Mindeleff, V., 1891, pp. 192–194, pl. C), although that was from a lateral doorway. One such frame for a doorway is mentioned for the historic Zuni (Stevenson, M. C., 1904, p. 350), and they are reported by Hodge as occurring at Hawikuh (1922, p. 6). Similar slabs have been reported from Table Rock Pueblo (Martin and Rinaldo, 1960b, p. 249), Hooper Ranch Pueblo (Martin, Rinaldo and Longacre, 1961a, p. 73), and sites near Springerville (Mindeleff, V., 1891, p. 193).

Axes (fig. 32).—The three-quarters grooved axe was more frequent at the Carter Ranch Site than the full-grooved type (fig. 32, *upper left*),—the proportion is six of the former to one of the latter. They are all of the short-bitted type and have a slight lip bordering the lower edge of the groove. On two of the specimens there is a well-defined secondary groove parallel to the lip but not extending as far around as the principal groove. One three-quarters grooved specimen has this lip or sharp ridge above the groove as well as below it.

Most of the axes also could be classified more easily as "tabular" in shape rather than "oval" (Roberts, F., 1932, p. 141), although with two exceptions they have short rounded spolls. The faces of two of the axes are polished.

The three-quarters grooved axe with short bit is apparently typical of the later Little Colorado ruins. They occurred at Kiatuthlanna in the Pueblo III rooms (Roberts, F., 1931, p. 156), at the Hooper Ranch Pueblo, and at the Village of the Great Kivas (Roberts, F., 1932, p. 141). The lip or ridge bordering the groove seems to be an important feature, although it does not occur on every specimen. This feature is important as a diagnostic of the Hohokam axes from the Snaketown through the Gila Butte Phases, but does not appear in subsequent phases (Gladwin, *et al.*, 1937, p. 115, fig. 44). Since this lip occurs both above and below the principal groove on many specimens, and is formed by a secondary groove, it seems unlikely that it is simply the result of thinning the blade as Cosgrove (1932, p. 41) has suggested, although this was the case on some specimens. This specialized feature also occurs sporadically elsewhere such as at sites in the Flagstaff area (Bartlett, 1934, p. 30), and at Awatovi (Woodbury, 1954, p. 29).

The full-grooved axe, tabular in shape and having a flat inner face or side, is very much like one of the three-quarters grooved axes. These axes range in length from 10.6 to 16.0 cm., in width from 6.1 to 10.4 cm., and in thickness from 3.6 to 7.0 cm. They are made of hard, dense rock, such as diabase or basalt.

The notched axe (fig. 32, *upper right*) is an unusual specimen and seems significant. It is notched by pecking and grinding about two-thirds the distance from the bit to the poll. There are rounded projections at the lower edge of each notch. The long narrow bit tapers both on the sides and the faces toward the edge of the bit which is dull and battered. This specimen is 23.3 cm. long, 10.2 cm. wide, 4.9 cm. thick, and is made of basalt. It was uncovered on the floor of a quasi-ceremonial room and may have had a ceremonial function.

Notched axes are a typical Anasazi trait. They are characteristic of the earlier periods and occur with greater frequency in sites of Basket Maker III and Pueblo I culture, but are by no means absent from later sites (Brew, 1946, pp. 237–239; Rinaldo, 1950, pp. 100–101). This particular implement is longer and narrower than most chopping tools of this type, but appears to fall within the general category. The bosses next to the notches are not common on this type of axe. Morris 1919, fig. 9,*c*) illustrates a tool with similar bosses. This suggests the possibility that these bosses are allied in conception and function to the lipping or ridges which border the grooves on the contemporary axes, since such projections are absent on the earlier tools of this type.

Mauls (fig. 30, *upper right*).—Only three mauls were found, and one is a grooved fragment. Of the two perfect specimens, one is full-grooved and the other three-quarters grooved; both are made of felsite. The three-quarters grooved specimen is 16.4 cm. long, 7.5 cm. wide, and 7.0 cm. thick. It has been shaped so as to flatten the inner face which lacks the groove.

The full-grooved maul is slightly shorter and over a centimeter thicker than the other. It has not been intentionally shaped beyond the groove pecked around the middle.

The distinction between worn-out axes used as mauls and genuine three-quarters grooved mauls is not clear in the literature and not always apparent in the actual specimens. However, mauls of this type have a southern distribution except on the late pueblo sites such as Awatovi.

The full-grooved type had a long life and a very wide distribution throughout the Anasazi and Mogollon regions of the Southwest. In the Mogollon culture both types of mauls occur with some frequency, whereas axes are rare until the advent of masonry surface dwellings.

The three-quarters grooved axe and maul appear to have a southern and western distribution (Rinaldo, 1959, p. 246). A large proportion of the axes from the Pueblo IV and V levels at Awatovi were of this type (Woodbury, 1954, table 3) and they are present in the collections made by Hodge at Hawikuh (personal observation). They occur rarely, if at all, among the artifacts excavated from the historic pueblo ruins in the Rio Grande area (Wendorf, 1953, pp. 73, 75).

Arrow-Shaft Tools.—These objects are of the design termed "arrow-shaft straightener" by Kidder (1932, pp. 76–80). They are made of dense materials, such as basalt or a fine-grained limestone, and have pol-

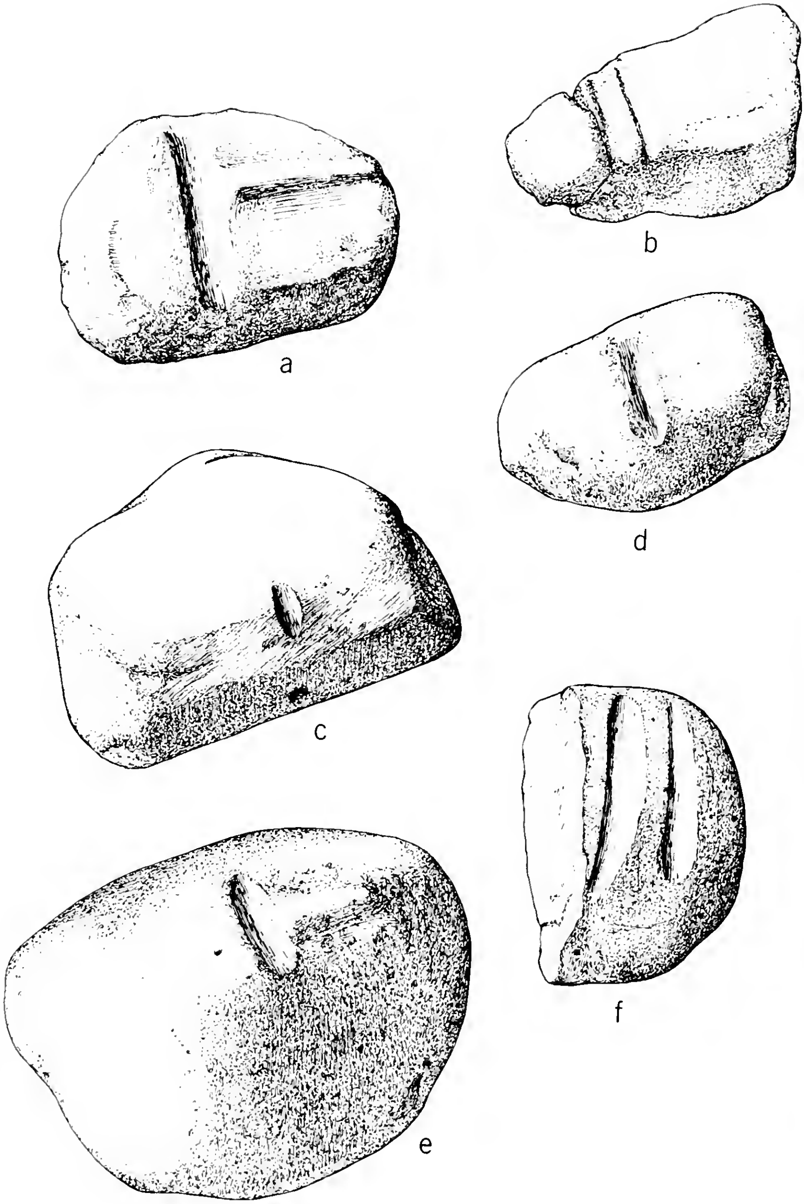


FIG. 33. Arrow shaft tools. Length of *e*, 14.6 cm.

ished grooves. There is one significant exception, a specimen of vesicular basalt, but the groove of this tool is also polished.

These tools are of three types: (1) a "transverse type" (ten specimens) in which the groove crosses the broad surface of the implement at right angles to the long axis (fig. 33, *d*); (2) naturally-shaped pebbles that are in the form of a truncated triangle in cross section and with a single polished groove across this ridge (fig. 33, *c*), termed "truncated triangular type" (thirteen specimens); (3) a "ridged type" (fig. 33, *a*) with artificially-shaped broad upper and lower surfaces, having a ridge perpendicular to the middle of a polished transverse groove (four specimens).

The use of this tool for straightening arrow shafts of reed has been tested in experiments (Cosner, 1951, pp. 146–147). In these experiments only the groove was used to straighten the reed and reduce the size of the joints. For making arrow shafts Cosner (ibid) says, "No other treatment would be necessary or even desirable." However, these tools frequently have some form of ridge, either the top of the truncated triangle or the artificially shaped ridge, or projecting crests (Kidder, 1932, p. 79; Hibben, 1938, p. 136). Obviously, these additional features were used for bending the reeds—the ridges, crests or other projections being used as fulcrums.

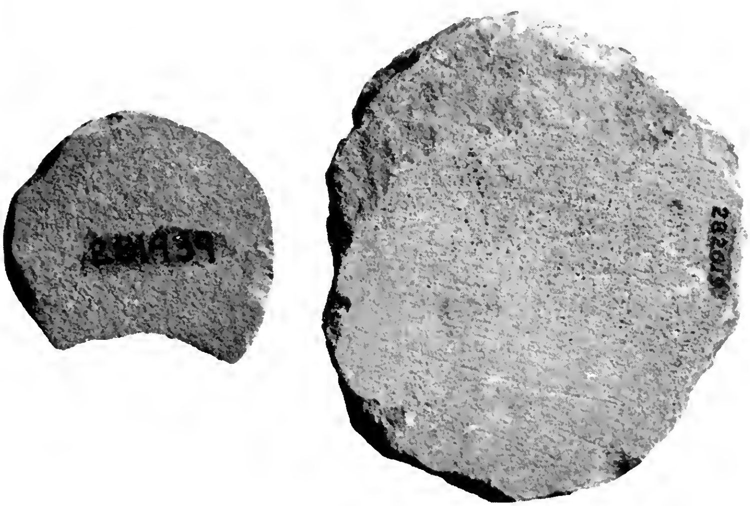


Fig. 34. Pot covers. Diameter of left specimen, 5.4 cm.

The distribution of the three types of arrow-shaft tools suggests a possible typological sequence from the transverse type through the truncated-triangular to the ridged type. Additional evidence for this possible sequence is represented in two truncated-triangular specimens from Carter Ranch that also have a ridge carved at the top of the specimen (fig. 33, *e*), and in another specimen of the simple transverse type which has the outline of a ridge incised in its broad surface, thus combining all three types in three specimens, providing concrete evidence of their relationship, and linking them together in this possible sequence.

The presence of a few fragmentary specimens with the "T"-shaped ridge at Awatovi in Pueblo V rooms (Woodbury, 1954, p. 107, fig. 22, *f, g, h*), suggests that this developmental series carried through into the historic period, although similar tools with the ridge formed parallel to the groove are more frequent on that site. That the simple-transverse type of arrow-shaft tool may have been used by the Zuni also is indicated by a specimen from a site near Hawikuh (Hodge, 1923, p. 31).

Simple-Grooved Abrader (fig. 33, *b*).—Only one specimen of this type was recovered. It is a small block of coarse-grained sandstone. Two deep, narrow grooves cross one end of the flat surface and a broad, tapering groove crosses the edge of the opposite wide surface. It is 9.5 cm. long, 6.1 cm. wide, and 3.2 cm. thick. The grooves are 0.4 cm. and 2.6 cm. wide.

This general type of tool has been found most frequently in late sites of the Upper Gila, Little Colorado, and Rio Grande districts, although it does occur occasionally to the north. Over a hundred of these tools were found at Awatovi (Woodbury, 1954, table 3) and fifty-five at Pecos (Kidder, 1932, p. 82). However, there is no data on their occurrence at Hawikuh.

Stone Disks (fig. 34).—Eight roughly circular slabs of sandstone were recovered from the rooms. They are all relatively thin and range in thickness from 0.8 to 2.7 cm. There are four larger specimens which average 19.2 cm. in diameter and the others average 8.0 cm. in diameter.

These are rare-to-absent on Mogollon sites such as the SU Site (Martin, 1943, p. 222), but are fairly frequent on some Anasazi sites (Judd, 1954, p. 127). Their use as jar lids has been indicated in several instances (Morris, 1939, p. 131; O'Bryan, 1950, p. 84), but they have also been found covering holes in the floor of rooms or kivas, such as the sipapu (Rinaldo *in* Martin, 1939, p. 387; Roberts, 1932, p. 144; Martin, Rinaldo and Bluhm, 1954, p. 116). They occurred in the mouths of storage pits at the Carter Ranch (Room 7) and are also said to have been used by the historic Zuni in games (Culin, 1907, pp. 382, 726, figs. 500, 950).

Fig. 35. Medicine cylinders, stone pendants, stone disks and tinklers. Length of lower specimen, 8.9 cm.

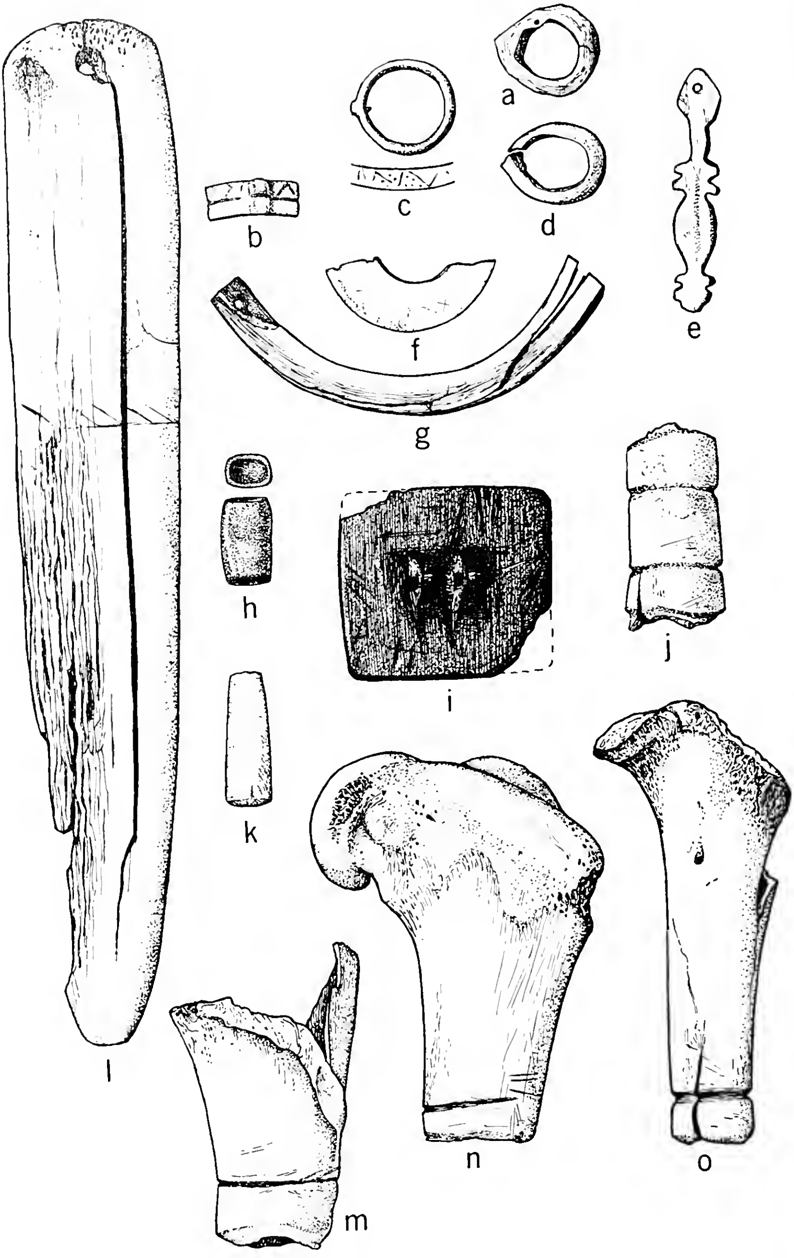


FIG. 36. Bow guard, bone rings, jet button, miscellaneous pendants and ring material. Length of *o*, 9.7 cm.

Only one was recovered from a Pueblo V provenience at Awatovi (Woodbury, 1954, p. 179). They were probably used by both Hopi and Zuni in historic times.

Medicine Cylinders (fig. 35, *upper left*).—These are small cylindrical objects of polished stone and should not be confused with the larger objects of vesicular basalt. These smaller objects range in length from 4.0 to 8.9 cm. (average, 5.4 cm.), and in diameter from 0.7 to 3.0 cm. (average, 1.3 cm.). They are made of hematite or chert and three specimens out of the five are dark red. One specimen was found with a burial which had been thoroughly disturbed and the remaining bones completely disarticulated. The other cylinders came from the rooms.

Like many other cylinders from the northern part of the Southwest the two of hematite have longitudinal facets. An idea suggested (but later withdrawn) by Morris (1919, p. 27) was that these facets were made in the process of using them as sources of red pigment. Judd (1954, p. 287) was informed by one of his Zuni workmen that they were used for magical purposes in hunting deer. The presence of these same longitudinal facets on one of our specimens of gray chert seems to argue against their use as sources of pigment, and they are frequently made of unlikely materials for this purpose (Woodbury, 1954, p. 183). McGregor (1941, pp. 204–209) has termed them nose plugs, although the straight or tapered stone cylinders have never been found in place on the nose in the numerous graves where they accompanied burials.

A similar object of siliceous hematite (fig. 36, *h*) is slightly curved, has a flat bottom and a small cavity in each end, is 1.7 cm. long, 1.1 cm. wide, and 1.8 cm. thick. Objects of this size and shape were also classified by McGregor (ibid) as nose plugs. This object and a highly-polished, colorful tablet of petrified wood were found near the pelvis and wrists of Burial 21. These did not appear to have been attached to a part of the costume and the idea was suggested that they were fetishes or part of a charm kit. The use of nose plugs by the historic Zuni is reported by Mrs. Stevenson (1904, p. 532).

Pipe (fig. 37, *a*).—One complete pipe and the fragment of a bowl from another were recovered. The complete specimen is 5.9 cm. long and of sub-conical shape; a hole has been bored through from both ends. Two etched lines encircle the pipe about one-third the length from the stem end. The material of the fragmentary bowl, vesicular basalt, is typical of Mogollon pipes and rare in Anasazi sites, where most pipes are of pottery or of fine-grained stone such as travertine, limestone, and argillite.

The contemporary Hopi use a "cloud blower" type of pipes in their ceremonies (Parsons, 1936, p. 683, fig. 369; Woodbury, 1954, pp. 174–

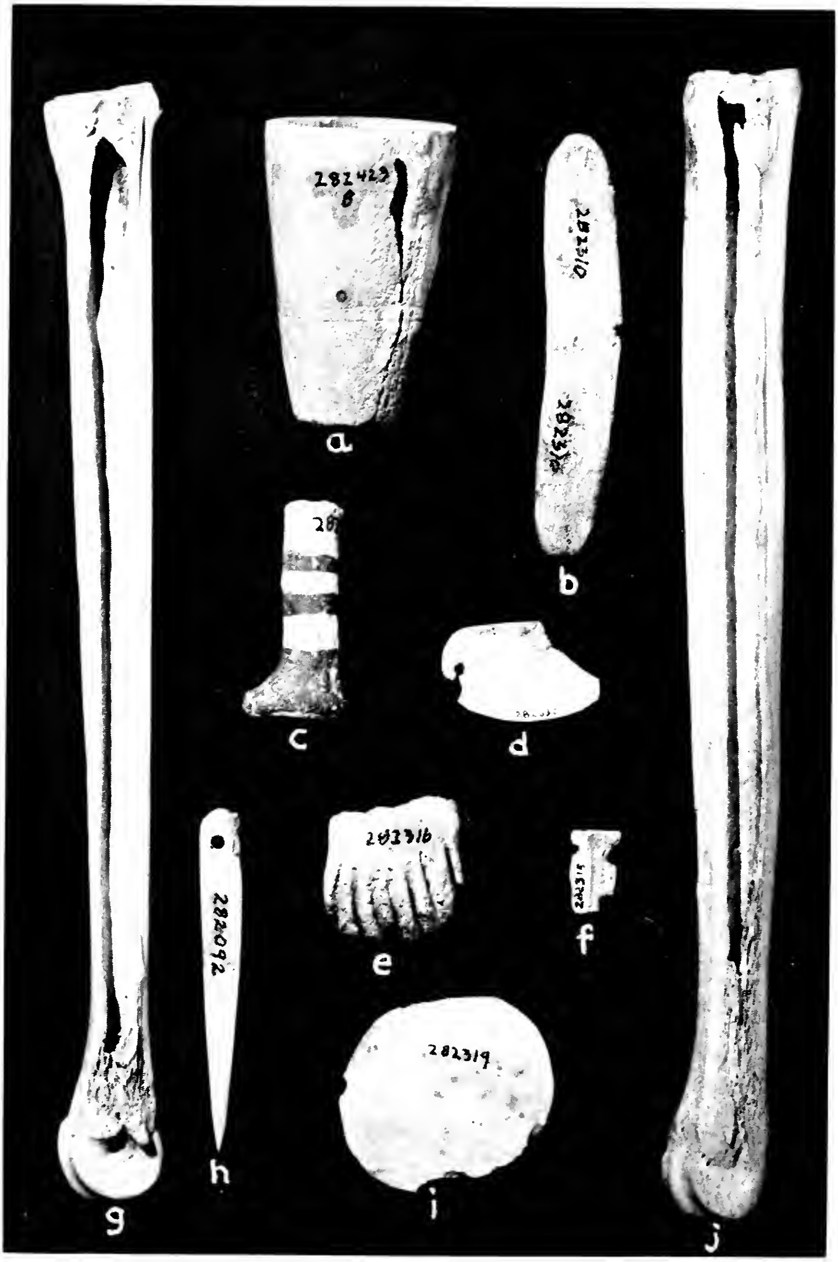


FIG. 37. Beamers (*g, j*), pipe (*a*), bone flaker (*b*), foot effigies (*c, e*), cut shell pendants (*d, f*), needle (*h*), bone disc (*i*). Length of *j*, 23.0 cm.

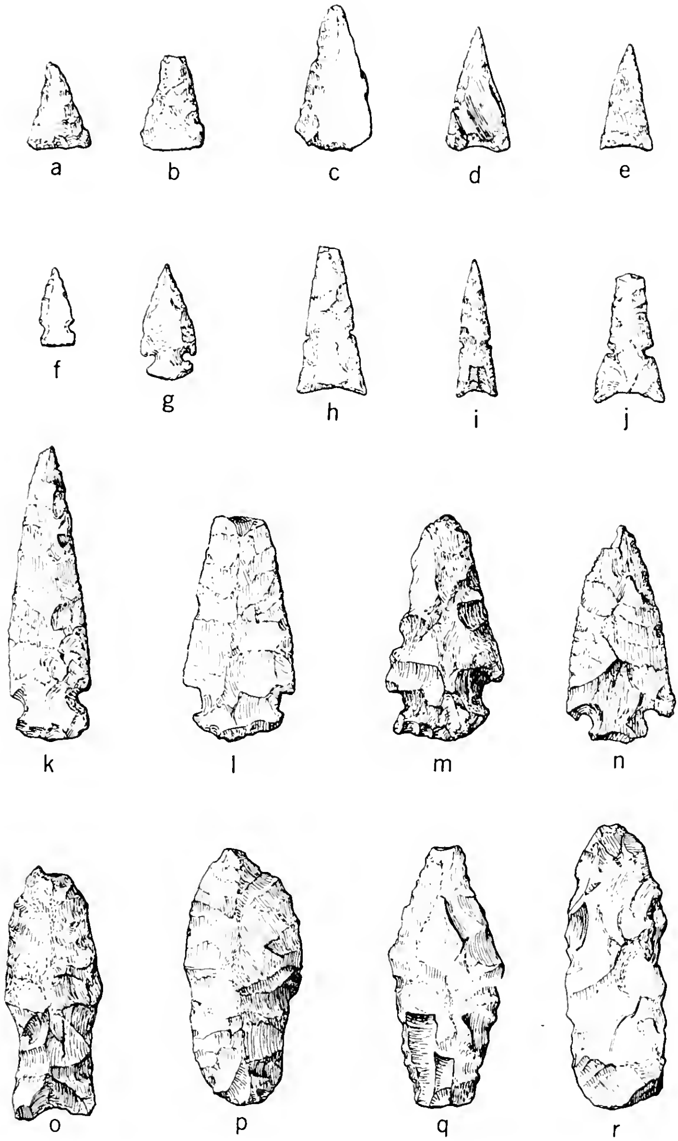


FIG. 38. Projectile points, miscellaneous types. Length of *r*, 6.0 cm.

175). Among the Zuni the use of reed cigarettes is reported (Stevenson, M., 1904, p. 434). The distribution of tubular pipes and reed cigarettes in the south and of elbow pipes, conical pipes and elaborately carved pipes generally to the north seems to suggest a difference in the concept of the use of these types of objects—the cloud blower for smoke to be blown *through* among some groups (Hopi), cigarettes and tubular pipes(?) to inhale smoke *from* among others (Zuni).

CHIPPED STONE

Projectile Points.—There are fifty-six small triangular projectile points (fig. 38) in the collection from Carter Ranch and twenty-three larger projectile points and blades. The small points are 2.1 to 4.4 cm. long, and the larger ones are 3.6 to 6.2 cm. long. The smaller points fit more easily into classes than the larger ones, and there is also relative uniformity within the categories of smaller points. Furthermore, at least five out of the fourteen larger specimens (fig. 38, *o–r*) are quite similar to certain well-recognized earlier patterns of projectile points (e.g., stemmed, indented base), and appear to have been picked up by the Indians from early sites. One of these (fig. 38, *p*) has been re-worked into a graver and two smaller points into scrapers.

The smaller projectile points appear to be typical of this site and are probably the "native" point. Over half of these have a concave base (fig. 38, *d*, *e*, *h–j*) and nineteen of them have shallow lateral notches placed relatively high, that is, about half the distance from the point to the base. Small, triangular, lateral-notched projectile points are usually diagnostic of sites later than A.D. 900 in the central part of the Southwest. There are some slight indications that this variant with the notch placed somewhat high may be diagnostic of later sites. Similar points have been found at Canyon Creek (Haury, 1934, p. 122, pl. 73), at Site W:10:51, Point of Pines (Wendorf, 1950, p. 69, fig. 32, *e*), and at Cordova Cave (Martin *et al.*, 1952, fig. 48, *i*).

A number of similar points were found in historic levels at Awatovi (Woodbury, 1954, p. 124, fig. 25, *h*, *i*) but they are not as common there as a point resembling the Toyah point of Texas (Suhm, Krieger and Jelks, 1954, p. 508, pl. 133, D, E). There are some specimens of our concave-base, high-notched variant in the collection from Pecos (Kidder, 1932, p. 20, fig. 4, *l*, *t*), and from Pindi (Stubbs and Stallings, 1953, pl. 17v), but their frequency at these later sites has not been noted. The lateral notched points from the Carter Ranch and Kidder's type 3a found both at Pecos and Pindi would probably all fit into the type Krieger designates as Harrell Points (op. cit., p. 500, pl. 129, D–F). Hodge (1920, fig. 33)

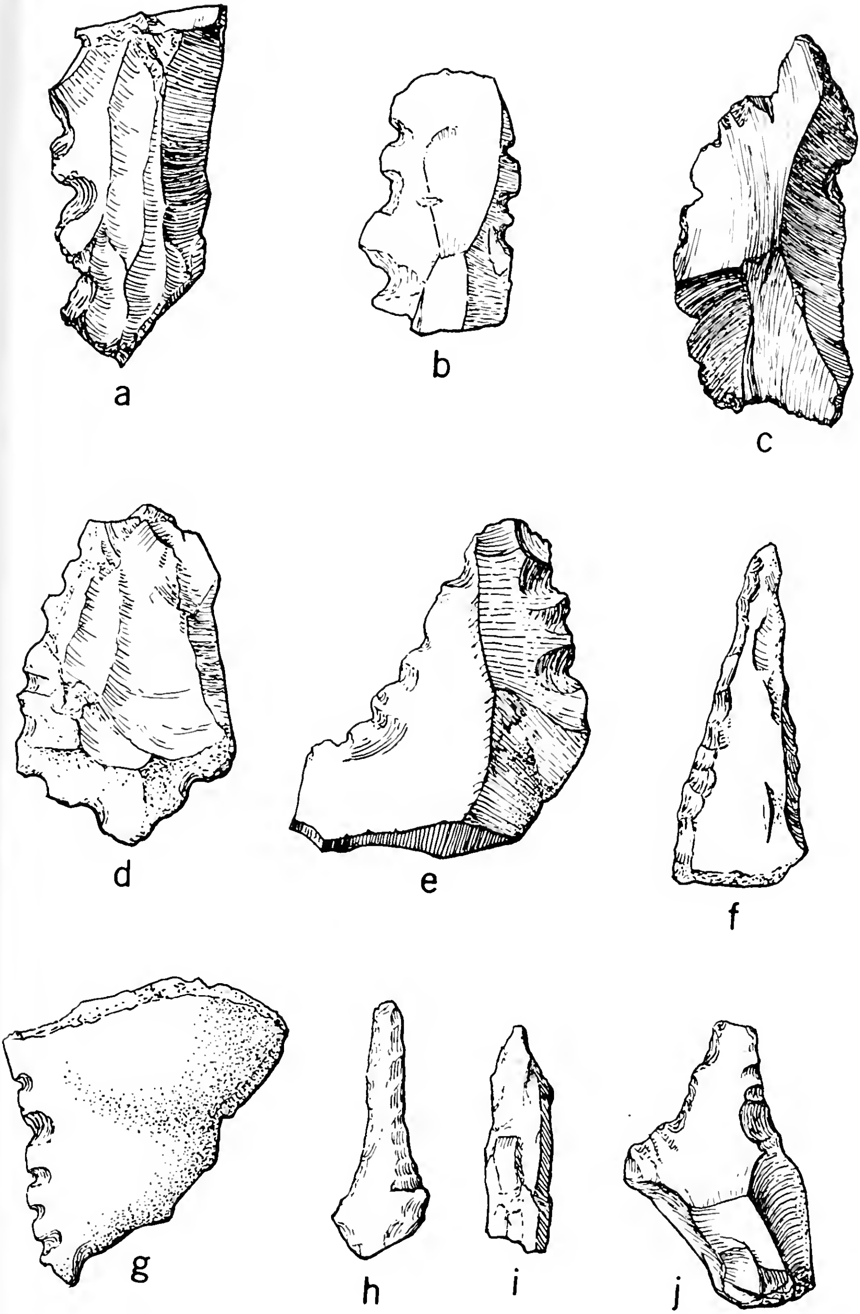


FIG. 39. Chipped stone saws and drills. Length of *g*, 4.7 cm.

illustrates a bone arrow point of roughly this pattern from Hawikuh. Some of the chipped stone points from Hawikuh are also of this pattern (personal notes).

Drills (fig. 39, *f*, *h–j*).—These are small implements from 3.0 to 5.6 cm. long, 0.8 to 2.5 cm. wide, and 0.5 to 1.2 cm. thick. They vary considerably in the amount of work put on them. Three of the eight specimens recovered are little more than sharpened flakes chipped to a point by pressure chipping (fig. 39, *i*). Two of the drills have broad bases (fig. 39, *i*), three, flanged bases (fig. 39, *h*) and the others taper gradually to their points (fig. 39, *f*).

No definite conclusions can be drawn from this meager data. Drills are usually scarce on Southwestern sites relative to projectile points and the Carter Ranch Site is no exception. They seem to bear out the theory that the drills with abruptly widening flanged bases are generally late. This type occurred at Awatovi (Woodbury, 1954, p. 133), at Hawikuh (personal notes), and also at the historic Rio Grande sites (Kidder, 1932, fig. 9, *f*, *g*, fig. 11, *g–j*; Stubbs and Stallings, 1953, pl. 17; Lambert, 1954, pl. XXXIII).

There are numerous instances in the literature in which these or similar objects are hafted as drills (Morris, 1919, p. 34, fig. 19, *c*; Pepper, 1920, p. 299, fig. 126; Kidder and Guernsey, 1919, p. 127, fig. 149; Martin, 1934, pp. 94–97).

Saws (fig. 39, *a–g*).—Thirty-eight thin flakes were recovered having one or more edges deeply indented by evenly spaced chipping which forms a saw-toothed margin. Two of these specimens have tang-like projections, possibly for hafting. These saws range in length from 2.0 to 5.4 cm., in width from 1.7 to 4.5 cm., and in thickness from 0.2 to 1.0 cm. Two-thirds of them came from the rooms and one-third from the refuse dump. All of them are made of chert.

The exact geographical and cultural distribution of these implements remains to be determined. They range in form from well-finished tools with a whole series of evenly-spaced denticles along one edge and a tang at one end, to raw flakes distinguished only by two notches in one margin. Similar objects have been termed "notched flakes," "serrate scrapers" and "unshaped saw-toothed flakes." They have been recovered throughout the Southwest from the Turner Ranch Site of the Fremont culture in Utah (Wormington, 1955, p. 54), south to Wet Leggett Pueblo in the Reserve area (Martin and Rinaldo, 1950b, p. 484). Their distribution in time ranges (in the Southwest) from Los Pinos Phase (Eddy, 1961, p. 72) possibly up to historic times. Woodbury (1954, p. 129) describes "two flakes not meant to be hafted, although the serrate edges might have made this possible." Also, Hodge (1920, p. 73), in a discussion of the manufacture of bone implements at Hawikuh, states they were "sawed with an edged stone." Their use for working bone was also indicated by a cache at Foote Canyon Pueblo (Rinaldo, 1959, p. 277) which included a saw and material for making bone rings. However, it has also been suggested by Breternitz (1957, p. 80) that these flakes were used to clean plant fibers in the manufacture of cordage, and to cut plant materials (Dittert, Hester and Eddy, 1961, p. 176).

Gravers.—Four of these perforator-like implements were found, as well as a number of knives made from flakes with one pointed end that may

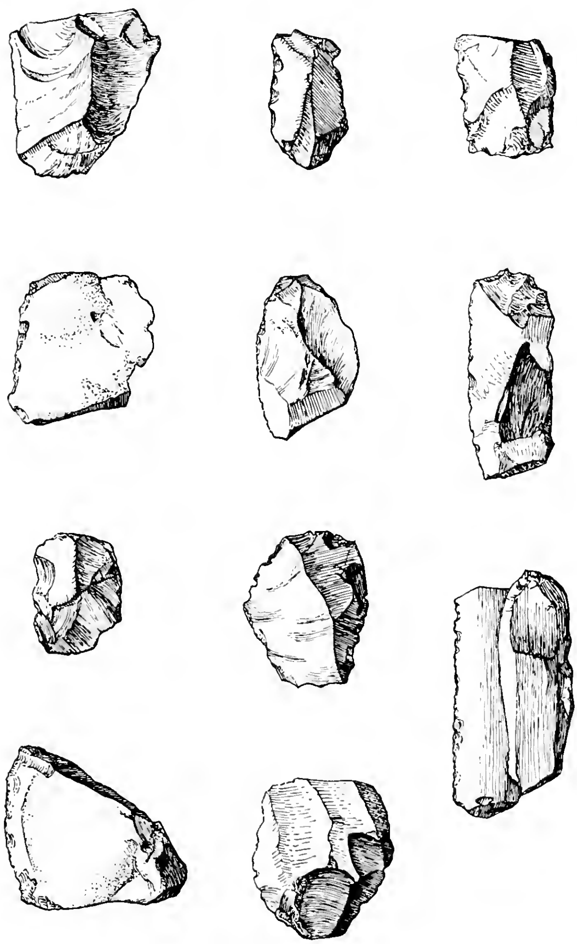


FIG. 40. Flake knives. Length of lower left specimen, 5.7 cm.

have been used for a similar purpose, but which do not show the characteristic retouch on the points. These gravers are made from thick flakes that have been shaped at one end by chipping from the convex surface to produce a pointed tip. These four specimens range in length from 2.54 to 4.71 cm., in width from 1.1 to 4.25 cm., and in thickness from 0.5 to 1.2 cm., and are made of chert.

Tools such as these have been noted from the Forestdale (Haury, 1940, p. 109; Haury and Sayles, 1947, p. 73), Black River (Wheat, 1954, p. 153) and Pine Lawn areas (Martin *et al.*, 1952, p. 182) Bluhm, 1957a, p. 49), but are rare in the Vernon area although engraved bone is not lacking (Martin *et al.*, 1962, p. 140). They may have been used as a form of drill or perforator, as Longacre has suggested (ibid, fig. 70).

Flake Knives (fig. 40).—These simple flake tools were one of the most numerous of stone artifacts recovered (over 300 specimens), yet most of them are merely utilized flakes. Most of these are made of a mottled red and gray chert, a few are of chalcedony, felsite and diabase. They range in length from 1.5 to 7.2 cm. (average, 3.7 cm.), in width from 1.2 to 5.2 cm. (average, 2.3 cm.), and in thickness from 0.2 to 1.5 cm. (average, 0.6 cm.). They occurred in both the refuse and the rooms (including the kivas).

Some of these so-called knives may be simply the by-product of making tools out of chert; but the recovery of a few from a charred basket on the floor of Room 10, and a few more with burials, tends to strengthen our belief that they were tools that were used frequently although in a "rough" form.

These utilized flakes are found on most Southwestern sites, and apparently continued in use up into historic times. They occurred at Awatovi (Woodbury, 1954, p. 138) and in the historic Rio Grande pueblos such as Pecos (Kidder, 1932, pp. 42–44), and Pa-ako (Lambert, 1954, p. 142).

Scrapers (figs. 41, 42).—These are also simple flake tools, although they tend to be better finished than the knives. Even the small scrapers are generally a little larger than the knives. The average specimen is 4.6 cm. long and 1.3 cm. thick. They were distinguished from the flake knives on the basis of secondary chipping at a steep angle along one or more edges. They are made of somewhat coarser stone—felsite, quartzite and fine-grained basalt as well as chert (295 specimens).

There are fourteen specimens over 6.3 cm. long, 5.2 cm. wide, and 2.0 cm. thick, assigned to a category termed "large scrapers," (fig. 42, *a-c*). These are thinner than the choppers or the scraper-planes.

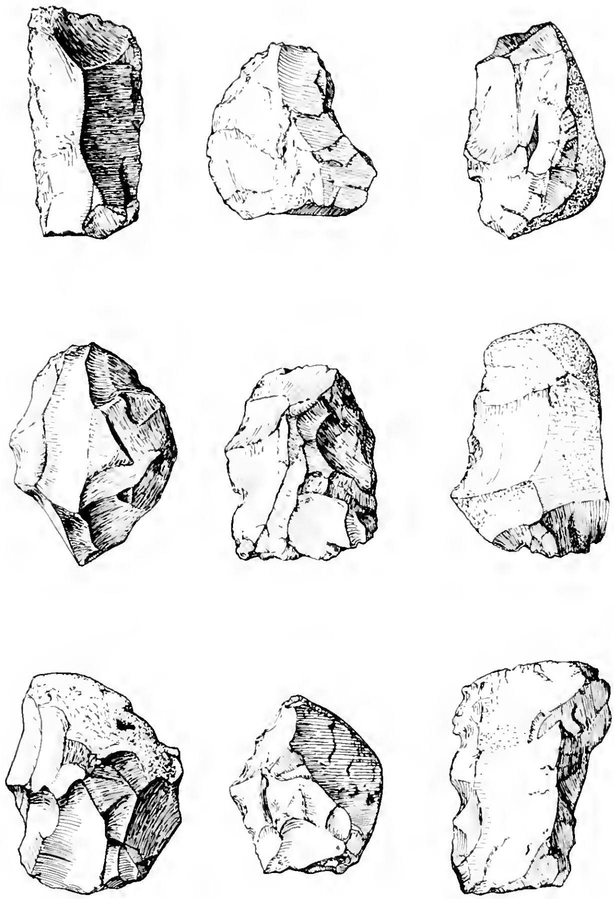


FIG. 41. Small scrapers. Length of lower right specimen, 6.0 cm.

Generally, rough scrapers have a distribution similar to that of the utilized flake knives.

Choppers (fig. 42, *g–l*).—Two types of these corelike implements were recovered: (1) a uniface type with the margin sharpened by flaking from one surface and (2) a biface type with the edge sharpened by flaking from opposite surfaces. These implements are as large as 11.0 cm. long, 7.5 cm. wide, and 5.2 cm. thick. Frequently a rounded portion of the natural crust of the stone was left intact as a smooth place to grasp the tool. The uniface type of chopper is similar to the scraper-plane in that both are planoconvex in cross section, but the scraper-planes are on the

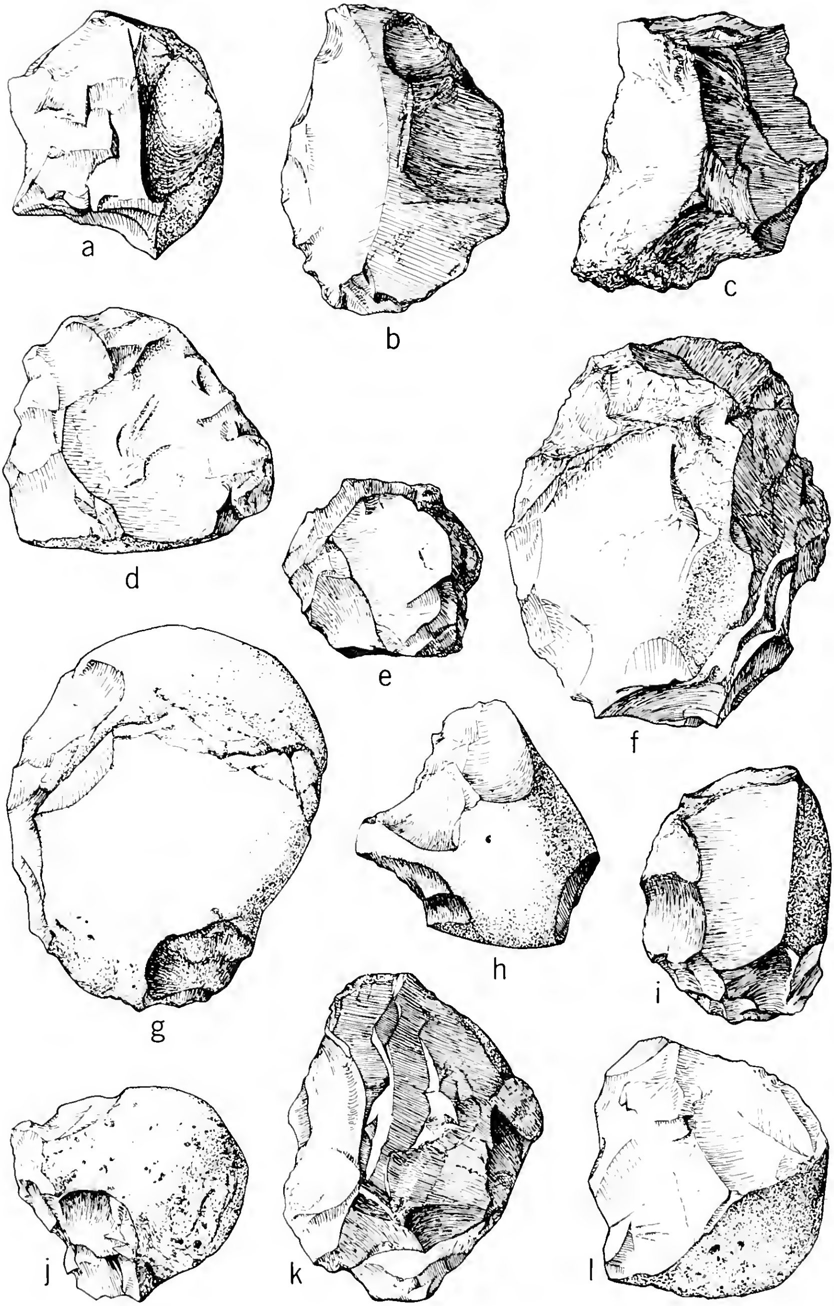


FIG. 42. Large scrapers, scraper-planes and choppers. Length of *l*, 7.9 cm.

average smaller and thinner and the sharp edge is chipped at a somewhat steeper angle.

The choppers are made of the same materials as the scrapers (quartzite, felsite and chert), but a smaller proportion of the choppers are made of chert than scrapers. Most of the choppers are from the rooms or kivas, only four specimens out of fifty-four came from the refuse dump.

These implements are usually present in Mogollon sites and have been reported from several Anasazi sites. One specimen was recovered from a Pueblo V context at Awatovi (Woodbury, 1954, p. 135), but they are not reported for the Zuni.

Scraper-planes (fig. 42, *d–f*).—These are thick angular implements much like the uniface choppers (see above). They range in length from 5.6 to 10.8 cm., in width from 4.1 to 9.3 cm., and in thickness from 1.8 to 3.8 cm. They were made of chert, with exception of two specimens made of petrified wood. Five of these tools came from rooms, three from the dump.

They have been reported from few, if any, sites of the Pueblo III period and their presence here at the Carter Ranch seems an anomaly.

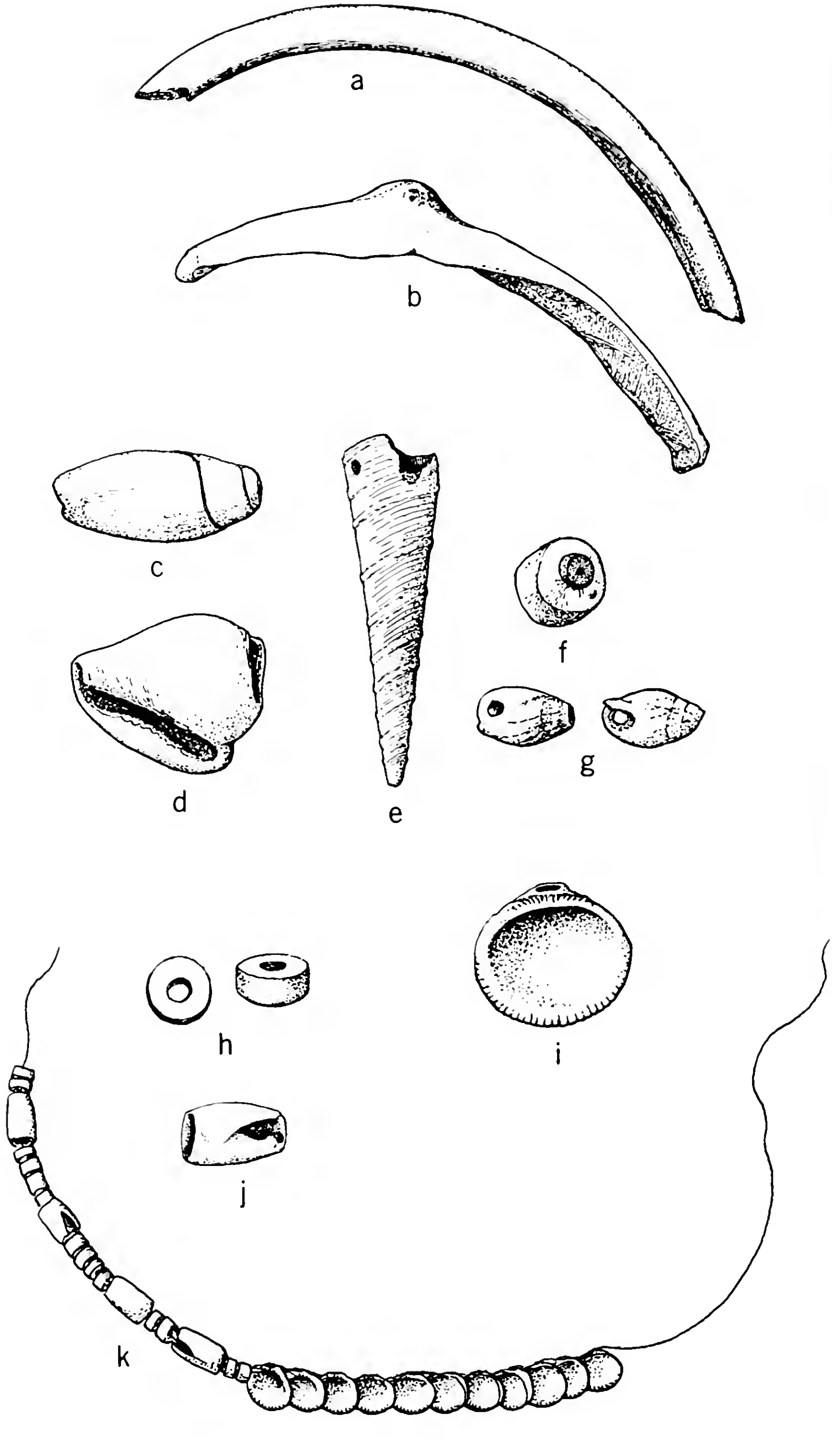
ORNAMENTS

The various kinds of beads and pendants came primarily from the burials in the refuse dump.

Small Disk Beads (fig. 43, *h*).—These symmetrical minute circular beads were the most common type numerically and by occurrence. They were found with six burials in positions suggesting their use in strings as necklaces (2), as wristlets or bracelets (5), and as pelvic ornaments (2). These beads are made of jet, turquoise, an unidentified red stone, and dentalium shell and are 3 to 8 mm. in diameter and 1 to 3. mm thick. Specimens were also found in the fill of Rooms 8, 12, 18 and 19.

Cylindrical Beads.—These are all of white material, such as shell or stone. They occurred in combination with the small disk beads and are 2 to 3 mm. in diameter, which is about the average diameter of the disk beads, and range from 2 to 5 mm. in length. They were found with Burials 17 and 23 in Trench D, and in Room 18.

Whole Shell Beads and Pendants (fig. 43, *c–e*, *g*, *i*, *k*).—A number of beads and pendants were made of small shells that had not been modified beyond making a single perforation or other minor alteration. Some of the shells used in this way were Olivella, Turritella, small Glycymeris and some unidentified minute gastropods. None of these various beads are over 3.5 cm. in greatest dimension. They were found almost ex-


a
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clusively with burials. One was found in Room 3 fill, and another in the fill of Room 18.

Cut Shell (fig. 37, *d, f*).—Two small fragments of cut shell, one with a small triangular hole cut through a triangular piece and the other rectangular in outline with square notches cut in one end, were recovered from the refuse deposit and from the ashy fill in Room 18. These and an oval pendant are of clam shell. Specimens of cut shell such as these are rare in the upper Little Colorado and more frequent in southern Arizona.

Tubular Beads (fig. 44, *c, d*).—A series of bone tubes and fragments were found on the floor of Room 21 and in the ashes of the firepit in Room 10. These are 3.4 to 6.0 cm. long and 0.7 to 1.8 cm. in diameter. Their actual use is unknown.

Bone Pendants.—There are four objects, each of different form. The only thing they have in common is the material from which they were made. One (fig. 44, *h*) is of tabular form, 9.2 cm. long, 2.7 cm. wide and 0.3 cm. thick. One end is broader and cut off square, the other end is broken; the surfaces are polished. It came from the floor of Room 16.

Another object (fig. 36, *f*) is a fragment that appears to have been annular in shape. It is a thin, broad semi-circle with an indication of a perforation at one end. One surface is polished. This object was about 3.5 cm. in diameter and 1 mm. thick.

A third bone pendant (fig. 36, *e*), or object containing a hole for suspension, has a long narrow form which suggests a zoomorphic origin. At one end is a lozenge-shaped spatulate "head" containing a small hole, below this and at the lower end there are eight protuberances in two sets which possibly represent legs. The lower tip (opposite the "head") is broken off but the present length is 5.2 cm. It was found in the fill of Room 7. The design is somewhat reminiscent of certain Pueblo prayer sticks in its long narrow form and the bead-like matched protuberances. It could also be compared with certain shell pendants found in the Mimbres ruins (Cosgrove, 1932, pl. 74 b) said to represent lizards.

The fourth is a small, flat, oval slip of bone with a hole through one projecting ring-like end. It is 1.7 cm. long and came from Room 17.

Perforated Tooth (fig. 36, *g*).—A long tusk-like incisor, possibly a beaver incisor, is perforated near one end. It is 8.4 cm. long and 0.8 cm. wide.

Bone Rings and Ring Material (fig. 36, *a–d, j, m–o*).—Thirteen of these annular ornaments were recovered, most of them from the rooms and Kiva I, only one with a burial (No. 23). Its position with this burial was that of

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FIG. 43. Bracelet fragments and miscellaneous shell beads and pendants; arrangement of beads associated with Burial 6. Length of *a*, 5.8 cm.

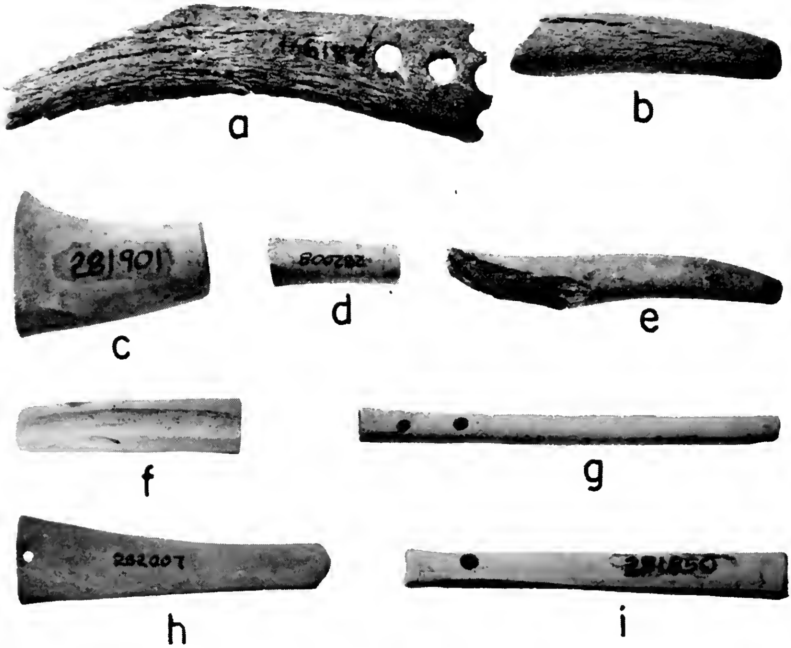

FIG. 44. Antler wrench, flakers, bone tubes, bone pendant and whistles. Length of *i*, 11.3 cm.

the central piece of a necklace rather than as a finger ring. We are not aware of any found on the fingers of burials, although they have sometimes been designated as finger rings on the basis of size (Judd, 1954, p. 106; Martin, Rinaldo and Longacre, 1961a, p. 82).

Hodge (1920, p. 145) refers to two specimens found at Hawikuh and says "it is not unlikely that they are merely unusually large and narrow beads." Further possible corroboration of their use as beads is the presence of a projection carved from the side of at least two specimens (fig. 36, *c*) which is apparently meant to resemble the umbo or beak of a small glycymeris shell from which rings were sometimes made (Haury, 1945, p. 156, pl. 72).

These objects were cut from the shafts of hollow leg bones of several different animals, both adult and young. The rings range in outside diameter from 1.8 to 2.3 cm., in width from 0.3 to 1.1 cm., and in thickness from 0.2 to 0.4 cm.

Forty shafts of bone were recovered from which these rings had been cut, or which were grooved to cut additional rings (fig. 36, *j*, *m–o*). The diameter of these shafts corresponds well to the outside diameter of the rings. For the most part, bone rings have a distribution south of the San Juan area. They occurred at Pueblo Bonito (Judd, 1954, p. 106) and at Tseh Tso (Hibben *in* Brand, Hawley and Hibben, *et al.*, 1937, p. 93) and at sites south of the Chaco district, but rarely, if at all, in the Mesa Verde or Kayenta districts.

Bow Guard (fig. 36, *l*).—This is a long spatulate section of limb bone, concave-convex in cross section that tapers from the broader rounded end to the spatulate narrow end. There is a hole drilled through near the broad end. The convex surface of this object is decorated with an incised line that is fringed with short lines meeting it at an oblique angle. This line crosses the short dimension at a point about one-third the distance from the broad end to the spatulate end. The object, which resembles a bull-roarer in shape, is 22.2 cm. long, 3.6 cm. wide, and 1.0 cm. thick and is called a bow guard because it was found on the left forearm of a male burial (No. 9). The sharp spatulate lower end of the object and the groove and hollow in the concave surface are features which it has in common with some bone objects termed "end scrapers" or "fleshers," (Rinaldo *in* Martin, 1939, p. 424, fig. 122), and it may have been used for multiple purposes.

The objects that accompanied this individual (a jar, bowls, a pitcher, turritella shell pendants, a large bone club, a lump of turquoise) seem to indicate that he had been an important figure in the pueblo.

Shell Bracelets (fig. 43, *a*, *b*).—Only six fragments of arm bands were recovered. These are thin curved sections of shell from the bivalve Glycymeris. Two of the specimens are perforated through the beak of the shell. These fragments are about 4.0 cm. long and 0.6 cm. thick. One specimen came from the Kiva I fill.

Shell bracelets have been found frequently on burials in other sites in the Southwest, particularly in the Mimbres area (Bradfield, 1931, pp. 58–59; Cosgrove, 1932, pp. 65–66). Many of them have been found on the left forearm indicating their possible use as bow guards, although their occurrence on the right arm, in other positions on the body, and with the burials of infants and children suggests some other use as well.

They occur most frequently in the southern parts of the Southwest and it is indicated that they were traded into this area from the Gulf of California.

Miscellaneous Stone Pendants.—There are fourteen tabular pendants, a cylindrical pendant, and one grooved pendant. The tabular pendants (fig. 35, *upper right*) are perforated near one end, the fragmentary cylindrical pendant (fig. 36, *k*) has the broken lower half of a hole through one end, and the grooved pendant has a knob at one end with a groove beneath it, apparently for a suspension cord.

These are all small objects, 4.4 cm. long or less. Eleven roughly rectangular turquoise pendants found with a burial are one centimeter long. An oval tabular pendant is quite crude and rough, the other objects are polished.

Bird Effigy.—A small black stone effigy representing a bird which was found in the stratigraphy column of the refuse deposit (Trench J) seems possibly significant. It is in the typical form described by Cushing (1883, pl. VIII), Pepper (1920, fig. 50), Bartlett (1932, fig. 1) and Haury (1945, fig. 85). Like these others it is depicted with wings folded and incisions on the tail to represent feathers. Unfortunately the base is broken off, so that the hole drilled through the body for suspension is missing on this specimen. Its color, black, is not typical, red, gray and blue being more common. The chronological distribution of these effigies ranges from the Pine Lawn Phase (Martin and Rinaldo, 1947, fig. 124) up to the historic period (Cushing, 1883). Cushing describes these bird fetishes as having been suspended with cotton cords from the rafters of the council room during a ceremony held shortly before or after the New Year. Eagles, falcons and the ground owl are represented, the eagles each of a different color symbolic of a cardinal direction.

Jet Button (fig. 36, *i*).—Objects such as this one have a scattered distribution north of the Carter Ranch. This button is rectangular, and apparently contained disk beads inlaid in each of the corners. On the bottom surface are two raised, perforated arches located near the center. It is 4.6 cm. long, 4.1 cm. wide, and 0.4 cm. thick, and was found inside a black-on-white bowl on the level (20 cm.) below Burial 23. A white disk bead remained in one of the corners.

These lignite ornaments show a certain amount of variation in detail. Most common are the circular disk-types such as that reported by Kidder and Guernsey (1919, p. 151, pl. 62, *k*), from Cave 1, Kinboko. However, there are several examples of the rectangular type, some bearing inlays like ours (Pepper, 1920, p. 186, pl. I; Fewkes, 1904, pp. 87–88, fig. 44; Morris, 1939, p. 141, pl. 174,*b*).

Stone Tablets (fig. 35, *lower*).—These tabular slivers of stone (mostly petrified wood) are in some specimens polished and in others merely worn, as if subjected to considerable handling. They are for the most part unaltered, although obviously selected for their general rectangular shape and size which is about 7.9 cm. long, 1.3 cm. wide, and 0.6 cm. thick.

One of them was found near the pelvis with Burial 21 (fig. 35, *lower*), two more have notches chipped in the edges near one end. These instances seem to corroborate the hypothesis that they were used as a kind of tinkler, as when they are "rattled against each other they give a high-pitched tinkle" (Woodbury, 1954, pp. 192–193). Woodbury, citing Voth (1903, p. 337, note 3) conjectures that these slivers of stone were used as rattles, tied to the fringes of a belt or on a stick. When tied pendant from a cord and allowed to rattle freely together the specimens from the Carter Ranch give off a ringing sound.

These specimens are smaller than the "pun-ku" or kiva bells of the Rio Grande pueblos (Lambert, 1954, pp. 132–133).

The position of at least one of these objects with a burial at Carter Ranch seems to indicate that they were saved not merely as raw material, but were considered of some value in themselves.

Small Stone "Medicine" Disks (fig. 35, *middle row*).—Four small, circular pieces of sandstone and sandy limestone, nicely finished with surfaces worked fairly smooth and the broad surfaces ground flat, are termed "medicine disks" after Stubbs and Stallings (1953, p. 122), and after certain objects "found in medicine bags and tied on to fetishes of modern date from Zuni" (ibid). The specimens from the Carter Ranch are 2.4 to 3.8 cm. in diameter and 0.3 to 1.2 cm. in thickness. An object about twice this size, but still too small for a jar lid, found in a "ceremonial" cache at Table Rock (Martin and Rinaldo, 1960b, pp. 172, 230) seems to add confirmation to the imputed "ceremonial" function of these objects.

WORKED BONE

Bone Whistles or Flutes (fig. 44, *g*, *i*).—Three medium-long sections of hollow, long bones that have their ends cut off square and ground smooth were recovered. They are pierced with one or two holes near one end. One specimen is 12.2 cm. long and 1.0 cm. in diameter and has two holes; the other specimens have only one hole. Two are from room-fill and the other is from the fill in Kiva I.

The data on this type of artifact are meager, but most of them are from sites occupied after A.D. 1100 or later, and with very few exceptions north of the Mogollon Rim. They are apparently familiar items in both Zuni and Hopi culture. Both F. Roberts' (1932, p. 138) and Hodge's (1920, p. 128) Zuni workmen exhibited familiarity with their use, and Voth (1901, pp. 79–80) cites their use among the Hopi in the Oraibi Powamu ceremony.

Bone Awls (fig. 45).—Pointed bone tools were relatively abundant at the Carter Ranch Site (120 specimens recovered), and all of the principal

FIG. 45. Bone spatula and bone awls, miscellaneous types. Length of lowest specimen, 17.7 cm.

types normally found in the Southwest are present. By far the most numerous are those made from splinters or split long bones with the end opposite the point broken off jaggedly.

Other types, such as with the head of the bone intact (12) except for splitting (14), the head of the bone removed and squared off (10), and a specialized type of grooved awl or awl with a hollowed-out shaft (11), number from ten to twelve specimens each. Awls made from ribs are represented by two specimens, and thin bone awls made from long bones split in quarters by six specimens. It appears that most of the awls are made from deer and antelope bone, although smaller mammals, such as rabbits, and birds, such as the turkey, may have furnished material.

Seventy-seven specimens came from the rooms, many on the floors; thirty specimens from the trenches, including eight associated with burials; and thirteen from Kiva I, about equally divided between floor and fill. Two were associated with infant burials and six with adults.

The grooved bone awls (fig. 46) are particularly interesting. These are made of metatarsals which have not been split. The shaft is hollowed-out for two-thirds the length above the point and a hole at the base of the intercondylar groove (at the head of the bone) has been cleared out to meet a gutter-like opening and groove below the condyle on the opposite surface from the cavity. This gutter-like groove twists along the bone to the tip. The condyle is partly worked down and carved in two instances into a disk-like form. Four of these bone awls were associated with adult male burials, two fragments were recovered from Kiva I (one from the floor, and the other from the fill), and three fragments and two complete specimens from room fill. Two of these were from store-rooms in the south wing, two from adjoining rooms with round firepits in the north, and one from a room with a rectangular firepit in the south wing. Most of the intact grooved awls are about 22.0 cm. long.

It is possible that these are a special kind of weaving tool or that they are related to the awls with heads carved to represent Shumaikoli masks or mountain sheep from Hawikuh discussed by Hodge (1920, pp. 93–97, figs. 20, 21), the decorated bone awls described by the Cosgroves (1932, p. 57, pl. 59) from the Swartz ruin, and by Fewkes (1904, p. 94, fig. 53). The resemblance is in the hollowed-out shafts and in the carved condyles. The find-spots of the Carter Ranch specimens, the unusually elaborate work spent on them, and their generalized likeness to the decorated awls cited above seem to indicate that they must have had a special function.

One needle (fig. 37, *h*), made from a mere splinter of hollow bone 6.9 cm. long, was recovered. The small eye through the blunt end is circular and was drilled through from one surface.

FIG. 46. Grooved bone awls. Length of left specimen, 26.0 cm.

Bone Tablet (fig. 44, *f*).—This object resembles one which Fewkes (1904, p. 95, fig. 57) illustrates and describes as a "stick used by stick swallower, from Chevlon," and some figured by Hodge (1920, pl. XXXVI) which he calls "tablet-like forms." The tablet from the Carter Ranch Site is made from a leg bone. It is concave on one side and convex on the other and tapers slightly at the edges toward a thin sharp end; the opposite end is ground off square. There is a series of thin lines across the convex surface toward the square, blunt end. It is 6.7 cm. long, 1.5 cm. wide, and 0.4 cm. thick, and was found on the floor of Room 7. This tablet is larger and probably not as deeply concave as the half-tubes Hodge (ibid, p. 130, fig. 38) illustrates as whistles. However, the incised lines may have been intended to hold bindings, rather than functioning as decoration.

Spatula (fig. 45, *upper*).—A fragment of split long bone has one end which was cut, ground and polished to the shape of a spatula. It is 16.7 cm. long and was recovered from the trenching through refuse. It is narrower and thinner than similar items termed fleshers elsewhere (Rinaldo *in* Martin, 1939, p. 424, fig. 122).

Bone Disc (fig. 37, *i*).—A plain, thin bone disc, 4.3 cm. in diameter, is similar to specimens from Chevlon (Fewkes, 1904, p. 95), Table Rock Pueblo (Martin and Rinaldo, 1960b, p. 230) and Pecos (Kidder, 1932, p. 240). The specimen from the Carter Ranch does not have the hole through the center present on these others, and it is not heavy enough to have been used as a spindle whorl, as it has been assumed the larger discs were.

Bone Flaker (fig. 37, *b*).—A small oblong piece of bone has rounded ends, one of which has been worn to a beveled shape and blunted by use. This specimen is 8.4 cm. long and 1.4 cm. wide. It is a little larger than similar tools reported from Tularosa and Cordova Caves (Martin *et al.*, 1952, p. 188) and from Broken Roof Cave (Guernsey, 1931, p. 73), but it is believed to belong to the same class of objects because of the likeness in form and material.

Beamers (fig. 37, *g*, *j*).—Two mammal leg-bones had been split, the interior cleaned out so as to produce a deep groove, and the surface contiguous to the groove along the middle of the shaft ground off on a slight bevel so as to produce a sharp cutting edge. This beveled surface retains some polished areas as if it had been subjected to prolonged use. These implements are termed "beamers" after similar tools used in the Woodland area in historic times to dress buckskin (Wissler, 1941, p. 65) and which have been recovered occasionally in prehistoric sites of the Plains area (Wedel, 1959, p. 547). A few of these implements have been reported from the Southwest, one from the Mesa Verde (Fewkes, 1911, pl. 34) and a variant from the San Francisco River drainage (Hough, 1914, p. 35, fig. 69).

ANTLER

Wrench (fig. 44, *a*).—This tool is a fragment with two holes intact and three more indicated by arcs of their edges. The holes are 0.9 cm. in diameter. As it is now, this object is a section of antler with the spongy portion gone leaving a hollow concave shell. It came from the trench through Kiva I. Similar tools have been recovered from other late Mogollon Pueblo sites. Wrenches recovered from Anasazi sites are generally of bone or the horns of mountain sheep.

Flakers (fig. 44, *b*, *e*).—Portions of antler tines with the tips beveled in one or two distinct facets were relatively abundant. Some of these may not be artifacts. They range in length from 6.9 to 15.7 cm. and were recovered from the fill and floors of rooms and fill of Kiva I. They have been reported from only a scattered series of sites in the Mogollon area, but would almost certainly have a wider distribution were it not so difficult to distinguish the naturally beveled objects from the artifacts.

OBJECTS OF CLAY, OTHER THAN POTTERY

Effigies (fig. 47, *upper left*).—These are all small (less than 5.0 cm. long) zoomorphic effigies. Two are animal heads, one of which is still attached to the rim of a bowl, the other, although much cruder in execution, suggests something similar. A smaller animal painted in black-on-white is almost certainly part of a handle for a pitcher (Martin and Willis, 1940, pl. 81, fig. 7). It is equally certain that the two fragmentary quadrupeds crudely molded from a lump of raw clay fired to a reddish-brown were never parts of pottery vessels. The plain effigies are generally similar to the one from Higgins Flat Pueblo (Martin *et al.*, 1956, pp. 120–121, fig. 65). They seem to be less common in the late prehistoric pueblos of the upper Little Colorado than they are in the villages of similar age in the Upper Gila. Similar objects have been recovered in the Rio Grande district at Pindi (Stubbs and Stallings, 1953, p. 92, pl. 14 *a*, *b*), Pa-ako (Lambert, 1954, p. 116, fig. 51), and Pecos (Kidder, 1932, pp. 125–129, fig. 101). Although they have been recovered from the floors of rooms (Martin *et al.*, 1956, fig. 68) and in one instance with a burial (Martin, Rinaldo and Antevs, 1949, p. 178), there have been no definite indications as to their use. The majority of them have been found in refuse in a broken condition suggesting intentional damage.

FIG. 47. Animal effigy, miniature ladle fragments and miscellaneous types of worked sherds. Diameter of lower right specimen, 3.9 cm.

Miniature Ladles and Bowls (fig. 47, *upper right*).—These ladles are all of the "bowl and solid handle" variety and are crudely formed and executed. The eight specimens found are thick, rough, and are not slipped, polished or painted. Two of them are 4.7 cm. long and a third 4.4 cm. long (the others are fragments). One came from the Kiva floor, but had no associations to indicate its use. The others came from the trench outside Room 3 and the fill inside the same room.

The essentially crude and unfinished nature of both the animal effigies and the miniature vessels suggests that they may have been related in function. Kidder (1932, p. 137) and Hough (1914, p. 119) have suggested that these were small cult objects. Kidder (loc. cit.) conceived of them as children's toys. Bartlett (1934, p. 53) and Hough (loc. cit.) cite their use by the modern Hopi as offerings in springs and at clay pits.

Foot Effigies (fig. 37, *c*, *e*).—Two effigies of feet were found in the Great Kiva. One of these is of black-on-white pottery and almost certainly is a fragment from a human effigy jar, such as those found at Pueblo Bonito (Judd, 1954, pp. 223–224; Pepper, 1906, pp. 320–334), Aztec (Morris, 1919, p. 83) and in the Mesa Verde cultural province (Brainerd, 1949, pp. 121–124). The leg of this specimen is solid, the ankle and the upper surface of the foot are painted in black and two black stripes encircle the calf. The total length of the specimen is 4.33 cm.

The other ceramic foot is of plain "pinch" pottery and has eight toes, or claws. This object is a rounded form somewhat like an animal's paw. The ceramic effigy of a foot found by Bluhm near the Great Kiva at the Sawmill Site (Bluhm, 1957a, p. 64, fig. 26, *c*) is similar to the one from the Carter Ranch. As mentioned below (p. 105), stone effigies of feet were recovered from Tularosa Cave, and another is illustrated from a small ruin near Point of Pines (Wendorf, 1950, fig. 29, *f*). The resemblance is somewhat closer to this latter specimen. The foot effigies of black-on-white pottery found by Judd at Pueblo Bonito (1954, pp. 221–222) seem at least to have a generic similarity. The use of bear paws on Zuni altars observed by Mrs. Stevenson (1904) and of animal figures on Hopi and Zuni altars (Stephen, 1936; Stevenson, M., 1904) seem related, notwithstanding the difference in materials.

Worked Sherds (fig. 47, *lower middle*).—Fragments of pottery were worked into a variety of shapes by rubbing their edges smooth, drilling holes through them and by notching one end. These have been arbitarily grouped as follows: disk-shaped (72); disks perforated through the center (14); oval and circular shapes with hole drilled near one edge (5); large, concave, oval spoons notched at one end (31); ovals, triangles and odd shapes (26); fragments with one worked edge (46).

Worked sherds were fairly abundant—over 200 were recovered. The disks and the spoons are the most common shapes in the collection. With very few exceptions they were recovered from rooms. Many were recovered from the fill in Room 12 and from Kiva I. They were made from black-on-white, corrugated, black-on-red, polychrome and plain wares, in that order of frequency, and all the principal pottery types were used.

The uses of these worked potsherds are problematical. The disks and ovals have often been cited as having been used as gaming pieces (Culin, 1907, p. 799). The disks with holes through the center have been called spindle whorls although there is some basis to doubt their use as such (Kent, 1957, p. 473). The use of two pottery disks enclosing a leaf as a whistle was described by Hough (1919, p. 295, fig. 48). The oval and disk-shaped sherds with a hole drilled through near one end or edge seem to have been pendants. Large, generally oval sherds are frequently concave and the curved, broader end is worn on the convex side. Two specimens are even worn to knife-like edges. Haury has suggested (1940, p. 119, fig. 443; 1945, p. 121) that these are scraping spoons for smoothing pottery, as scrapers of gourd-rind are used today.

The sherds notched at one end are the most puzzling. One specimen was found with Burial 3, the others were recovered from Trench B, through the refuse dump, the trash fill of Room 3, and the floor of Room 19. Three of them have closely-spaced, pointed teeth (fig. 47, *middle*) and two have a series of notches which form a series of blunt-ended projections. The remaining edges on only two of the sherds were rubbed smooth. Broadly similar objects are reported by Sayles (1945, p. 15, pl. XII, *b*) from the Cave Creek Village, by W. Smith (1952, p. 148, fig. 49, *d*) from Site N.A. 618 in the Big Hawk Valley, and by Ekholm (1944, p. 470, fig. 48, *e–h*) from Huasteca. The specimens from the Carter Ranch resemble more closely certain notched bones reported by Hodge (1920, pp. 140–141, pl. XLV, *d*) from Hawikuh. They do not show wear between the teeth and it seems improbable that they were used as weaving combs. Although they have a vague likeness to the stone effigies of feet from Tularosa Cave (Martin *et al.*, 1952, p. 146, fig. 44) and the Sawmill Site (Bluhm, 1957a, p. 64, fig. 26, *c*), there are far too many projections or teeth on the Carter Ranch specimens to represent toes, and it seems unlikely that they are related.

ARTIFACTS OF PERISHABLE MATERIALS

Fragments of two twined baskets or mats, four coiled baskets, one twill ring basket, ten twill plaited mats, two string aprons, one small fragment of plain weave cloth (over-one-under-one), two square knots, and a few pieces of Z-twist cordage were recovered. These are for the most part too fragmentary, charred and fragile to offer more than a tentative description.

The twined material may represent fragments of baskets or, more likely, mats. These are made of strips from yucca(?) leaves twined on a thin twig or rod foundation (over-one-under-one weave). Fragments of a similar basketry were found in the upper levels of Cordova Cave (Martin *et al.*, 1952, pp. 314–316, fig. 121), but twined over-two-under-two. They are somewhat different from the twined rush mats described from Bc. 50–51, Chaco Canyon (Tschopik *in* Kluckholn and Reiter, 1939, pp. 94–95) in which the twined elements (cords) are widely spaced and the foundation elements closely spaced.

The single coiled basket which could be more accurately described than the badly deteriorated specimens is coiled with a simple non-interlocking stitch on a bundle foundation. This appears to be like specimens reported by Morris and Burgh (1941, p. 10, fig. 3, *e*) from Basket Maker III. In technique it is also somewhat like a basket reported from the Sierra Ancha (Haury, 1934, p. 74, pl. LI). It is also like certain Hopi coiled plaques (Morris and Burgh, 1941, p. 10). Two miniature baskets made in this technique came from Tularosa Cave (Bluhm *in* Martin *et al.*, 1952, p. 310, fig. 117).

The only definite piece of twilled basketry came from Room 10, where it was apparently used to catch flour in the mealing bin. It is woven in an over-three-under-three pattern and had ornamental braid at the rim next to the osier rim. This type of basket is more important in Pueblo III than in the earlier periods in Anasazi culture (Morris and Burgh, 1941, p. 20), but continued in use into historic times. They also appear in the Mogollon culture in the late phases (Bluhm *in* Martin *et al.*, 1952, p. 251).

Twilled mats were more numerous from the Carter Ranch Site. Ten fragments were recovered mostly of over-three-under-three or over-two-under-two weave. Five burials were covered with these mats and the others had been used on the floors of rooms. All of these were either burned to charcoal or badly decayed so it is impossible to state definitely the specific form of yucca leaves from which they were woven. No traces of the selvage were uncovered. Mats such as these are most numerous in the late periods of both Anasazi and Mogollon cultures (Martin *et al.*, 1952, p. 254; 1954, p. 176; 1956, p. 134).

Traces of string aprons were found on two burials. These had been colored red. They consist of strings pendant from a woven band. String aprons have a sporadic distribution through the Southwest. They have been recovered from Basket Maker II and III sites (Kidder and Guernsey, 1919, p. 157), from Ventana Cave (Haury, 1950a, p. 429), from Canyon Creek (Haury, 1934, pp. 63–64), and from Tularosa Cave (Martin *et al.*, 1952, p. 255). All of these consist of strings, but there is little uniformity in the manner of attachment of the strings to the upper portion of the garment or waistcord. They have been found either in general refuse or associated with female burials. Apparently they were not an item of men's clothing.

The remaining artifacts of perishable material are two charred square knots and a few pieces of Z-twisted cord formed of strips of yucca leaf. This is the predominant form of knot found in the Southwest (Martin *et al.*, 1952, pp. 212–213) and also of cordage (ibid, p. 211).

The coiled and twilled baskets and the plaited mats, then, are comparable to types that are more numerous during the later periods in Southwestern prehistory and tend to corroborate a late date for the site. The string aprons, the knots and the cordage are of little use for this purpose, although the aprons are significant in filling out the data concerning what these people wore for clothing.

GENERAL SUMMARY AND CONJECTURES

The artifacts from the Carter Ranch Site confirmed certain concepts we have had about their manufacture, their uses, the chronological and spatial distributions of the various types, the general affiliations of the culture and the sources of influence upon it, and its contribution to the historic cultures. At the same time, a small number of discoveries were made which throw a new light on some of these ideas.

Manufacture.—A larger proportion of chipped stone artifacts (815 specimens) such as projectile points, drills, saws, knives, scrapers and choppers were found at the Carter Ranch Site than of those shaped by other techniques. About half as many (434 specimens) were recovered that had been shaped by grinding and pecking such as manos, rubbing stones, mortars, metates and mauls. There were relatively few artifacts from the Carter Ranch Site that were polished (61 specimens). These include axes, arrow-shaft tools, medicine cylinders, pendants, beads and tablets. These proportions represent a somewhat higher number of chipped implements than might be expected on a late pueblo site, but the other techniques represented, as well as the number of bone and shell artifacts are more consistent with those represented on other late Mogollon pueblos.

On the whole, the stone artifacts are not well finished. A relatively large number of the artifacts were shaped only so far as to make them useful. For example, ridges and grooves were fashioned on the arrow-shaft tools and the margins of choppers and scrapers were flaked to a sharp edge, but the other surfaces of these artifacts were left in a rough or natural state. Of course, objects that had been shaped into "blanks" before use, such as manos, or that had been shaped on all their surfaces and edges, such as axes, pendants and projectile points, were more numerous here than on earlier sites, but were not particularly abundant. At the other extreme "rough" stone artifacts, such as pestles, rubbing stones and polishing stones, that are merely stones that were selected as being of a suitable size and shape, and were modified by use, are in a decided minority.

In general, the small extent to which these objects were altered beyond that amount strictly necessary for some practical intent suggests a conservative approach in this regard. The objects that were probably obtained through trade, such as shell and turquoise ornaments, and a few special bone objects such as the bow guard and the grooved awls, are virtually the only stone, bone and shell artifacts that were decorated or shaped as "art" objects to be appealing to the eye. The aesthetic impulses of the inhabitants seem to have been expressed chiefly in pottery and textile design and possibly in architecture.

Uses.—The recovery of manos in association with metates, of ring slabs framing the mouths of ventilators, of stone disks as covers for pits, pigments in the cups of mortars, pendants strung as bracelets and worked slabs used as doors and deflectors serve primarily to corroborate information from other sites. The definite use of a bone ring as a bead is perhaps new. The association of a bow guard on the left wrist of one wealthy individual and of grooved awls with another seem of potential significance but the suggested designation of such individuals as members of an ancestral "Shumaikoli fraternity" seems entirely too speculative and unfounded.

The distribution of metates close to the large granary pit seems to indicate its use by the community and may perhaps be a pattern peculiar to this particular pueblo. The high proportion of fragmentary manos and metates suggesting intentional breaking has been observed in other localities.

Trends.—The proportions of the various types of artifacts found, when compared with those from earlier and later sites, tend to validate observations made previously, such as a trend toward the use of longer manos than on earlier sites. Other developments apparent in the material are toward an increase in through-trough metates and slab metates as compared with those with the trough open at one end only, an increasing scarcity of rubbing stones and an increasing number of grooved axes as compared with notched axes.

Relative Temporal Placement.—Within limits, the recovery of certain types of artifacts such as numerous beveled manos, flat metates in bins, three-quarters grooved axes of the "Little Colorado" variety, small triangular projectile points with concave bases and with lateral notches placed high, truncate-triangular arrow-shaft tools, and antler wrenches tend to place this site as Late Mogollon Pueblo.

Affiliations.—Most of the objects compare favorably with those described and illustrated by the Stevensons, Stephen, Cushing, Hodge, Voth and Woodbury from historic Western Pueblos—Zuni and Hopi. There are differences, of course, but taking into consideration the separation in space and time involved, they are perhaps to be expected.

On the whole, more of the similarities seem to be with Zuni culture. A hazardous guess would indicate ring slabs, deep mortars and mortars with double cavities, grooved bone awls, the "Little Colorado" variety of three-quarters grooved axe and possibly the small tubular pipe as being more Zuni than Hopi, but our knowledge of both historic and protohistoric Zuni and Hopi material culture seems inadequate at this stage. In this connection one deals not only with the known close resemblance of the two cultures but with the influence of known migrations of Zuni to Second Mesa, Hopi, and of Hopi east to Sandia Pueblo, and constant trade and intermarriage as well.

The occurrence here of the three-quarters grooved axe, polychrome red pottery, polished smudged bowl interiors, polished brown pottery, occipital deformation and at least one (small) rectangular kiva seem to indicate that the prehistoric affiliations of this pueblo were Mogollon. Yet, northern influence, if not something more direct such as trade, is indicated by a full grooved axe, a lignite button, the stone disks used as pit covers, and probably the bone whistles. The shell ornaments and the nose plug may represent something equivalent from the south.

However, more characteristic of the Late Mogollon Pueblos are elements such as the three-quarters grooved axe, the antler wrench, the truncate-triangular arrow-shaft tool, the small clay animal effigies and the basketry coiled on a bundle foundation. Furthermore, elements such as the choppers, scraper-planes, one-hand manos and the basin metate are artifacts that continued in use from the pre-pottery stages in the area.

IV. The Ceramic Analysis

By William A. Longacre
Research Assistant, Department of Anthropology

The excavations at the Carter Ranch Site during the summer of 1961 produced 33,995 sherds and nearly 100 whole or restorable vessels. As a large segment of this ceramic sample consisted of what we had been calling Snowflake Black-on-White, we had an opportunity to make a detailed analysis of the type, both in terms of design and technology.

This chapter is primarily descriptive. The exciting inferences from the associations and frequencies of pottery types based on a statistical analysis aided by a Univac computer are reported in full in Chapter V. Inferences of a sociological nature from the distribution of design motifs are given in Chapter VI.

This chapter will examine Snowflake Black-on-White as a ceramic type. My aim will be to make the reader familiar with this black-on-white pottery appearing in the upper drainage of the Little Colorado River in profusion by A.D. 1000. I have discerned three varieties of the type which will be discussed in full. I shall rely primarily upon design style set within what Watson Smith (1962) calls a "School" as a frame for my description.

SNOWFLAKE BLACK-ON-WHITE

Background

Snowflake Black-on-White was first named by Gladwin (1934, p. 22) and described by Colton (1941, pp. 62–63). The naming of the type and later description were based upon sherds collected by surface survey carried out by Gila Pueblo and upon purchased collections of whole vessels from the Snowflake area.

W. and H. S. Gladwin (1934, p. 23) place the type in the Salado Branch with direct style affinities to Roosevelt Black-on-White. They also note an affinity of Snowflake Black-on-White to Reserve Black-on-White (*op. cit.*, p. 19).

Colton (1941, p. 63), in his description of Snowflake Black-on-White, also notes a similarity to Reserve Black-on-White. Relying on a comparison of the paint, he suggests that Snowflake may be relegated to a variety of Reserve as more work is done.

Colton's description of the type is only roughly accurate. Any attempt to identify Snowflake Black-on-White using his description would be severely limited. His characterization of decoration is too general, and his description of tempering materials would not hold for any of the more than 10,000 sherds of Snowflake Black-on-White recovered by us in 1961.

Design Style

Rather than make a concrete type-description of Snowflake Black-on-White, I want to concentrate on design—the Snowflake Style of decoration. After studying the analysis of the ceramics from Awatovi done by Watson Smith and his conclusions concerning ceramic schools (1962), I feel that the usefulness of such an approach warrants its quick adoption. As Smith points out, however, this does not replace the type-variety taxonomy, but augments it. He writes (1962, p. 1174) that the School concept ". . . is not to destroy or confuse a helpful taxonomy of types and varieties, but rather to sharpen the focus of these very entities by explicitly recognizing that they cannot be stretched or distorted to embrace every possible variation or combination of factors. The alternative is to attempt to create finite categories for each of these almost literally innumerable variations, and that can lead to only one end—whom the Gods would destroy they first make mad."

Snowflake Black-on-White with its varieties fits well within what may be called the Snowflake Ceramic School. In the Snowflake area, as at Awatovi, variations were encountered that established taxonomy could not cover. Relationships exist that would be readily apparent such as those that pertain to Show Low Black-on-Red. Leaving the description of the Snowflake School for a later date when more detailed work is completed, I will concentrate upon Snowflake Black-on-White as a first step, stressing style and utilizing technology when demonstrably critical to the analysis.

Stylistically, Snowflake Black-on-White is a blend of several art traditions. At its base, the type is characterized by what we call the Snowflake Style. This consists of various solid elements, the most common being stepped frets. Various kinds of these fret motifs encompass about 40% of the designs on the type. These motifs (fig. 60) occur most fre-

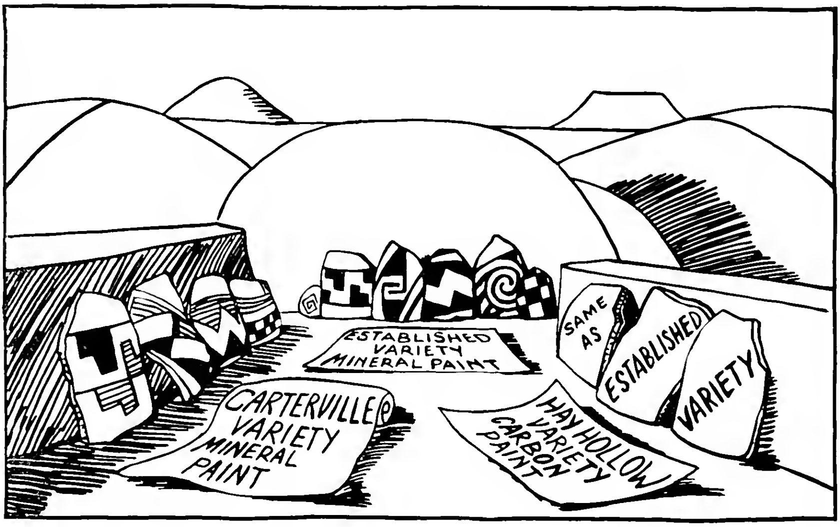

FIG. 48. The varieties of the Snowflake Black-on-White type.

quently enclosed within a frame of broad lines forming either a series of squares or triangles. They also occur in panels or bands. Other solids include opposed triangles (10%), broad lines or stripes (15%), gridded figures such as "checkerboards" (10%), and others (10%).

Again speaking stylistically, this art tradition, the Snowflake Style, is distinctive in "feel" to the Snowflake region. But in it one can see stylistic affinities to the Kayenta area to the north. Similarities in such things as particular motifs of design, some design lay-outs and vessel forms suggest a detectable stylistic influence from the north. This artistic influence is not strong enough to mask the originality of the Snowflake Style, but rather it blends with it and becomes obscured.

In addition to the stylistic influences from the north, one can see a strong impact from the east and south. Here the stylistic influence is much clearer. I am speaking of the appearance of hatchured motifs (roughly 15% of the elements) in the type. These designs are dramatically foreign to the style. Rather, they seem to represent an acceptance on the part of the local artists of a non-local art, evidently the Mogollon art tradition reflected in Reserve and Tularosa Black-on-Whites.

The type, Snowflake Black-on-White, then is characterized by various solid elements showing subtle stylistic influence from the Kayenta area to the north. Less subtle influence from the Mogollon area is discerned in the hatchured motifs that occur in the type. It is interesting to note

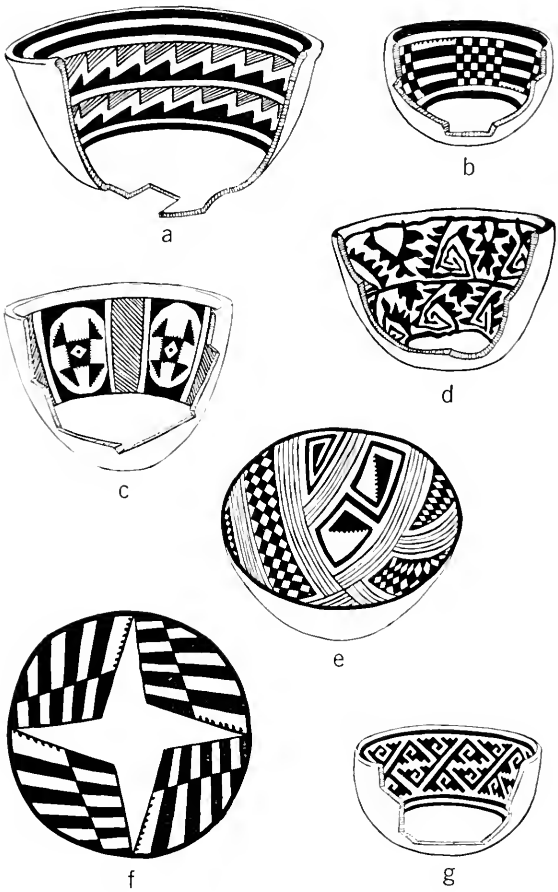

FIG. 49. Bowls, Snowflake Black-on-White: Carterville Variety, *a, c, e;* Snowflake Variety, *b, d, f* (reconstructed from a sherd), *g*.

that although Mogollon hatchuring is utilized as an artistic technique, it is done so within the limits of the solid motifs in form; the hatchured swirls that are so common in Tularosa Black-on-White are conspicuously absent from Snowflake Black-on-White.

VARIETIES

Wheat, Gifford, and Wasley (1958, pp. 35–38) suggest that the variety should reflect either regional, temporal, or sociological factors. None of these factors has been discovered for the varieties of Snowflake Black-on-White which have been isolated. Their validity has been demonstrated functionally, a neglected dimension in the original scheme (Ibid.) with potential for anthropological inference (Chapter V). Useful inferences of a sociological nature are possible from several levels beneath that of the variety (Chapter VI).

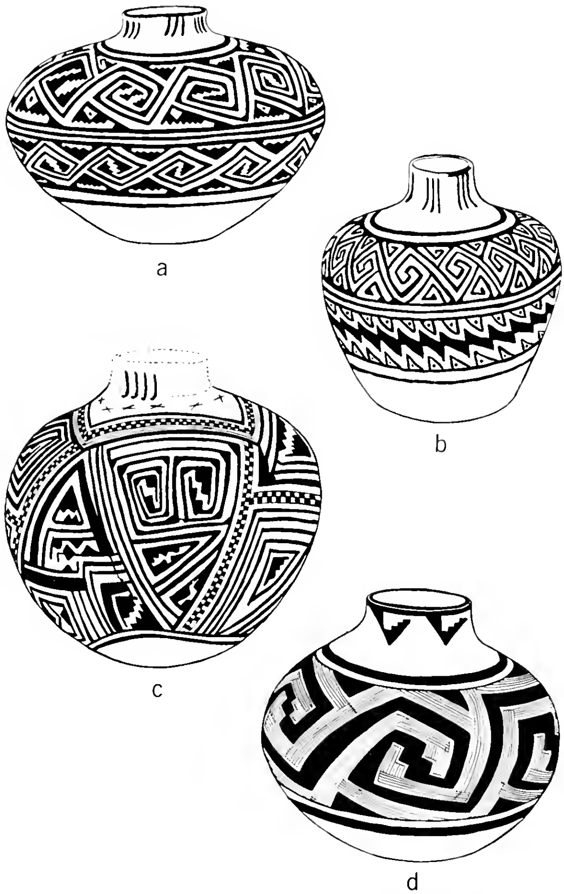

FIG. 50. Jars, Snowflake Black-on-White: Snowflake Variety, *a, b, c;* Carterville Variety, *d.*

We can segregate three varieties of the type Snowflake Black-on-White. First there is the Established Variety after Phillips (1958) (Established Type of Wheat, Gifford, and Wasley, 1958) described above as the Snowflake Style. It has a mineral paint and is characterized by solid motifs. We label this variety Snowflake Black-on-White, Snowflake Variety. Its

FIG. 51. Snowflake Black-on-White, Snowflake Variety: jar, *a;* duck effigy, *b.*

validity has been demonstrated functionally (Chapter V). Two additional varieties have been demonstrated.

One variety was segregated in terms of design style. The style shows Mogollon stylistic influence in the appearance of hatchured motifs. This is Snowflake Black-on-White, Carterville Variety. It is locally made and is a functionally discrete entity (Chapter V). No temporal significance has as yet been ascribed, and no sociological implications as a variety have been demonstrated. It has a mineral paint.

FIG. 52. Snowflake Black-on-White, Snowflake Variety: jar, *a;* pitcher, *b.*

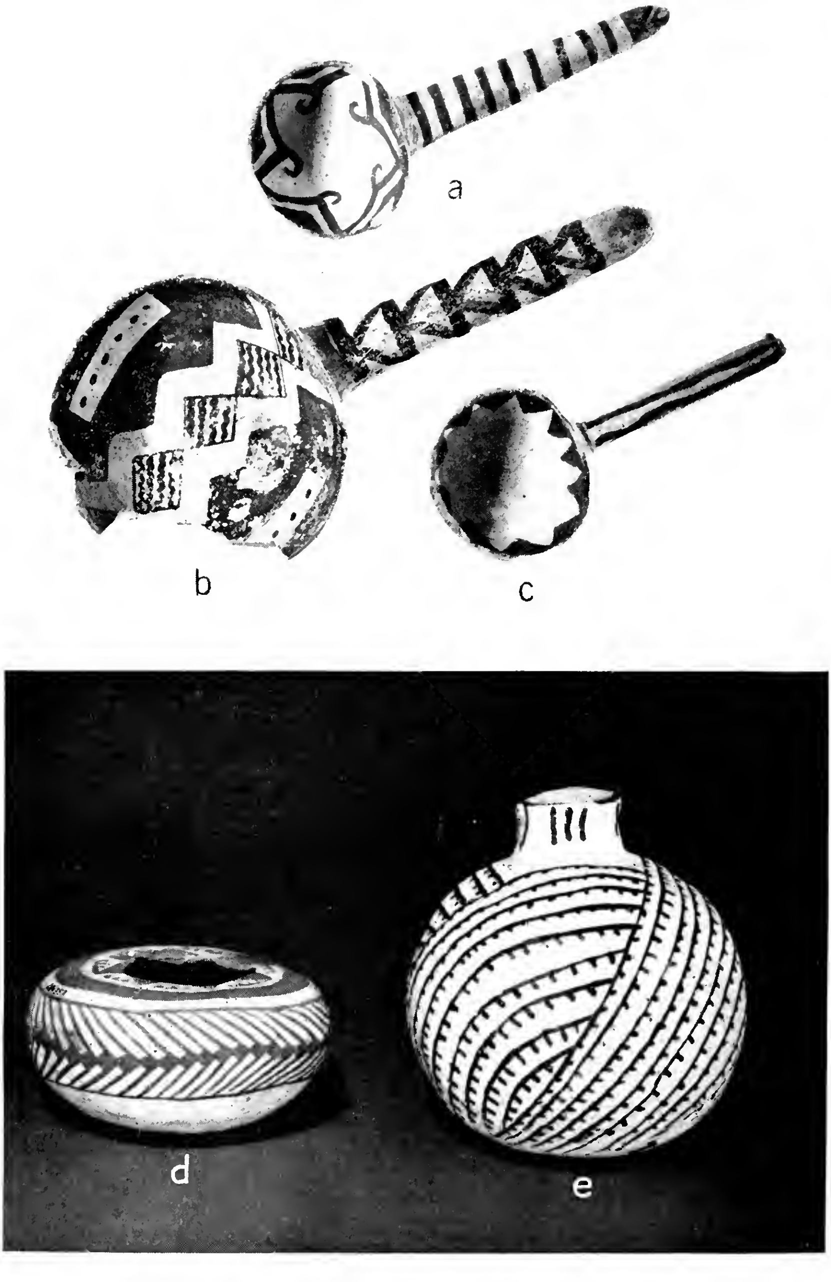

FIG. 53. Snowflake Black-on-White, Snowflake Variety: ladles, *a*, *b*, *c*; jars, *d*, *e*.

The other variety, Snowflake Black-on-White, Hay Hollow Variety, is primarily defined on the basis of technology rather than style. This is a locally made organic paint variety of the type. Stylistically, it is indistinguishable from the Established Variety both in terms of form and frequency. No hatchured motifs appear. This variety, too, is demonstrated functionally (Chapter V).

In summary, the Established Variety (Snowflake Black-on-White, Snowflake Variety) is characterized by solid elements and a mineral paint. Two other varieties have been demonstrated functionally: (1) Carterville Variety, defined stylistically as composed of hatchured motifs

FIG. 54. Pitchers, Snowflake Black-on-White, Snowflake Variety, *a*, *b*, *c*, *d*.

with a mineral paint and demonstrated as a functionally discrete entity, but having no demonstrable regional, temporal, or sociological significance at this time, (2) Hay Hollow Variety, defined technologically as having an organic paint, indistinguishable stylistically from the Established Variety with no demonstrable regional, sociological, or temporal implications at this writing (fig. 48).

Twenty sherds recovered in the vicinity of the Carter Ranch were submitted to Mr. James Porter, Southern Illinois University, for petro-

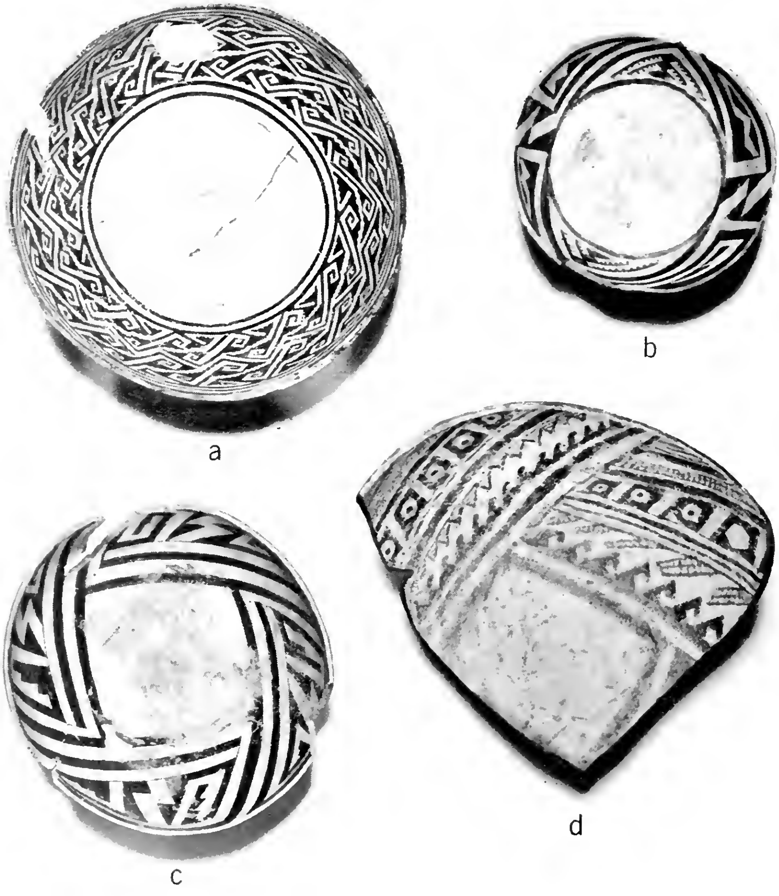

Fig. 55. Bowls, Snowflake Black-on-White: Snowflake Variety, *a*, *b*, *c;* Hay Hollow Variety, *d* (portion of bowl).

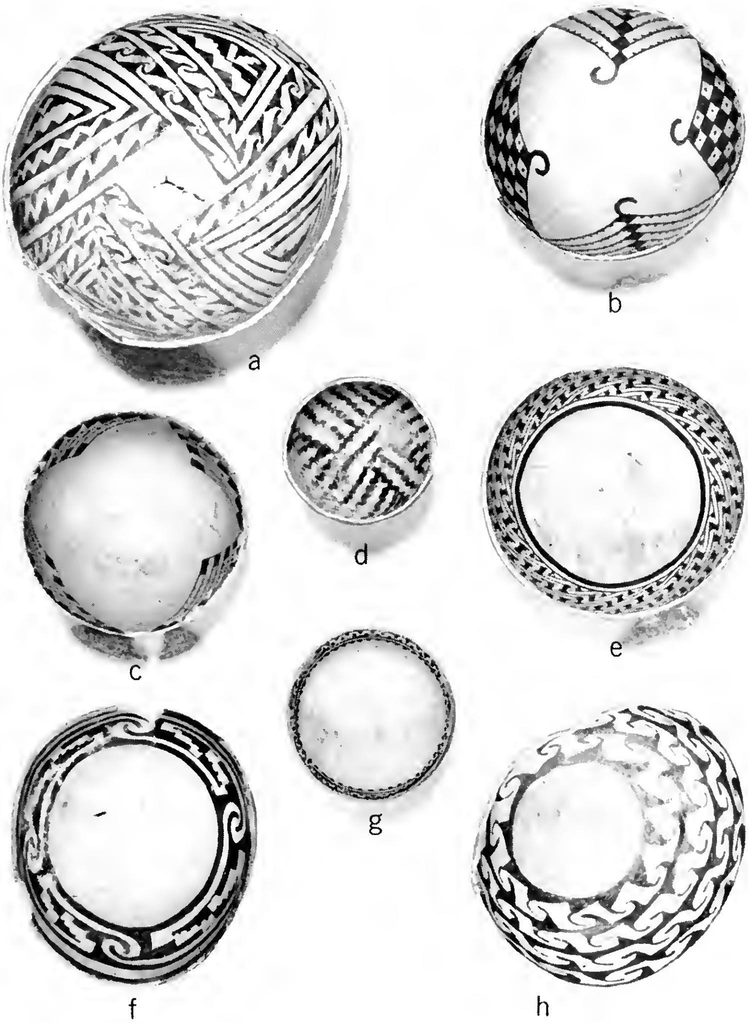

Fig. 56. Bowls, Snowflake Black-on-White: Hay Hollow Variety, *a;* Snowflake Variety, *b, c, d, e, f, g, h.*

graphic examination. In addition, the writer made microscopic examination of several hundred more with a binocular microscope.

Briefly, these analyses indicated that all the sherds examined were tempered with sherds and that they were all composed of the same paste (kind of clay). This holds true for the Established Variety of Snowflake Black-on-White as well as for the two other varieties. Sherd tempering also characterizes Show Low Black-on-Red and St. Johns Polychrome from the Carter Ranch Site although sand was occasionally used. Sherd temper was also found in the two thin sections of St. Johns Polychrome recovered from Hooper Ranch Pueblo (Martin, Rinaldo and Longacre, 1961a, pp. 128–133).

Snowflake Black-on-White and its varieties occur as four forms: bowls, pitchers, ladles and effigy vessels. Bowls are most common, followed closely by pitchers; a few effigy vessels were found. No effigy handles

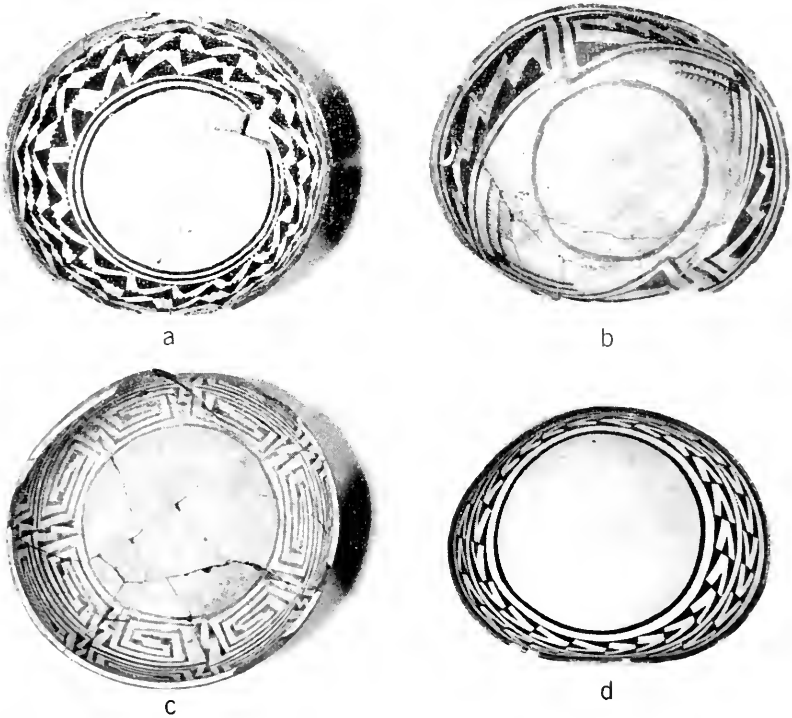

Fig. 57. Bowls, Snowflake Black-on-White: Snowflake Variety, *a*, *b*, *d;* Hay Hollow Variety, *c*.

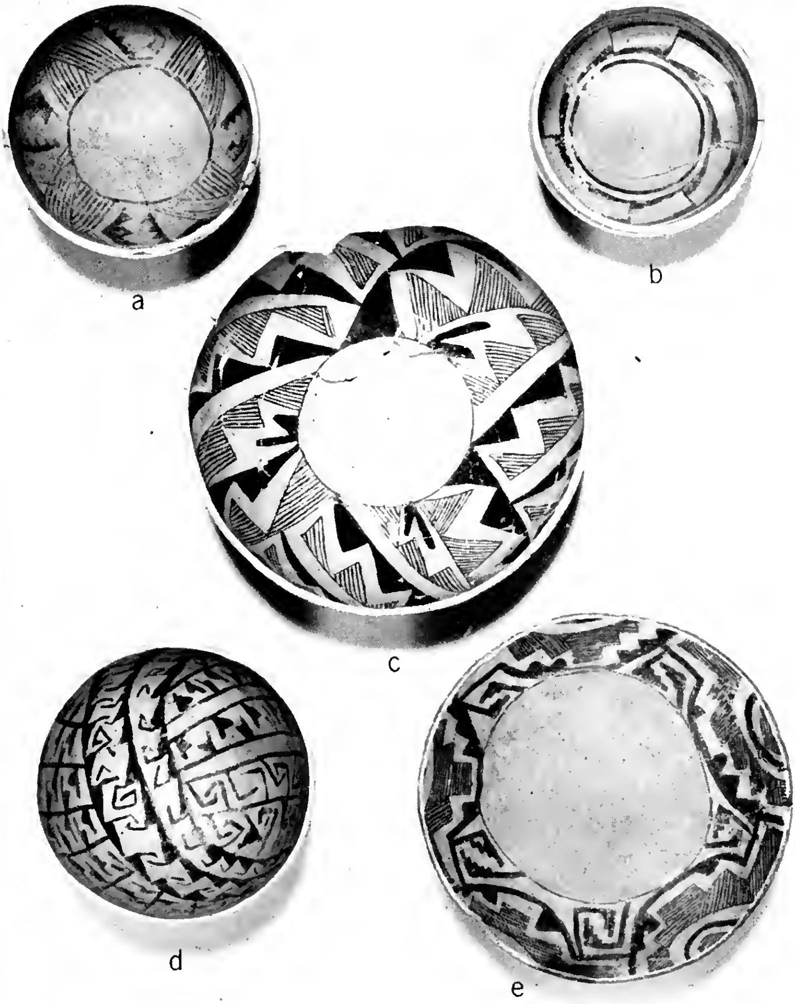

FIG. 58. Bowls: Show Low Black-on-Red, *a*, *b*, *d*; Wingate Black-on-Red, *c*. Plate, St. Johns Polychrome, *e*.

were found on pitchers. About 65% of the necks of pitchers had some form of broad line design pendant from the rim.

SHOW LOW BLACK-ON-RED

Next to Snowflake Black-on-White, Show Low Black-on-Red was the most common decorated type at the Carter Ranch Site. More detailed remarks must await further study, but some observations can be reported.

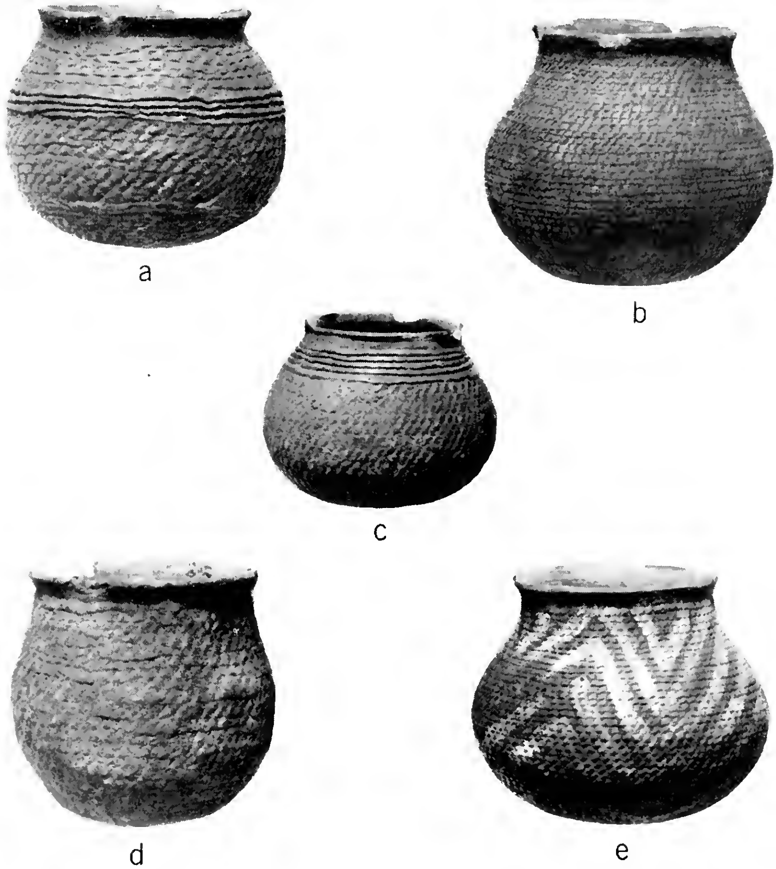

FIG. 59. Jars: Brown Patterned Corrugated, *a, c;* Brown Indented Corrugated, *b, d;* McDonald Indented Corrugated, *e*.

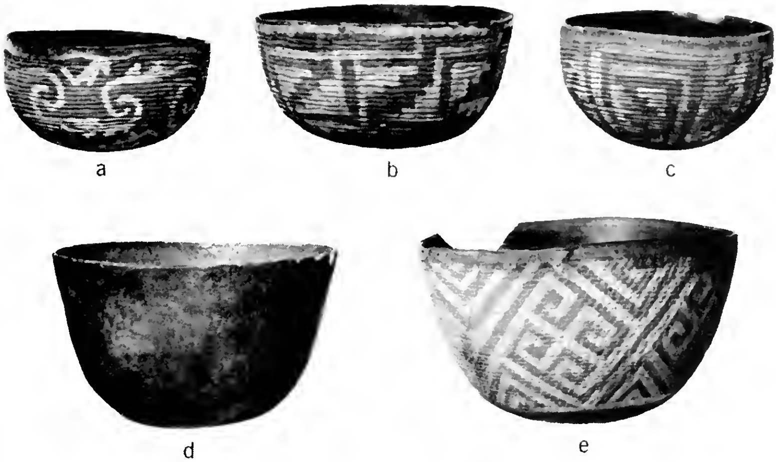

FIG. 60. Bowls: McDonald Corrugated, *a, b, c;* Alma Plain (?), *d;* McDonald Indented Corrugated, *e*.

Stylistically it appears to mirror Snowflake Black-on-White. As in Snowflake, both carbon and mineral paint were used. It has a paste that fires brown, but petrographically it is similar to the paste used in Snowflake Black-on-White. It is primarily sherd tempered, but sand temper was occasionally utilized. Its validity as a type has been demonstrated functionally (Chapter V). No temporal, regional, or sociological inferences can be made now. Forms for the type are limited to bowls and ladles.

LIST OF POTTERY TYPES

Painted Types

(Figs. 49–58)

Gila Black-on-Red (Haury, 1945, p. 65)

Houck Polychrome (Roberts, 1932, pp. 111–112)

Kiatuthlanna Black-on-White (Gladwin, 1945, pp. 41–42; Roberts, 1931, pp. 130–149)

Pinedale Black-on-Red (Colton and Hargrave, 1937, p. 106)

Querino Polychrome (Colton and Hargrave, 1937, pp. 121–122; Hawley, 1936, p. 44; Roberts, 1932, p. 111)

Red Mesa Black-on-White (Gladwin, 1945, pp. 56–57; Martin and Willis, 1940, pls. 66–67)

Reserve Black-on-White (Nesbitt, 1938; Martin and Rinaldo, 1950a, pp. 502–503)

St. Johns Polychrome (Gladwin, W. and H. S., 1931, pp. 36–40; Hawley, 1936, p. 49; Martin and Willis, 1940, pls. 97–101; Martin, Rinaldo and Longacre, 1961a, pp. 128–137)

Show Low Black-on-Red (Colton and Hargrave, 1937, p. 78; Haury and Hargrave, 1931, p. 27)

Snowflake Black-on-White (Colton, 1941, p. 62; see also pp. 110-122, this paper)

Springerville Polychrome (Danson, 1957, p. 93)

Tularosa Black-on-White (Gladwin, W. and H. S., 1931, pp. 32–35; Hawley, 1936, pp. 46–47; Kidder, 1924, p. 98; Nesbitt, 1938, p. 139; Rinaldo and Bluhm, 1956, pp. 177–184)

Wingate Black-on-Red (Gladwin, W. and H. S., 1931, pp. 29–31; Gladwin, 1945, pp. 71–73; Martin and Willis, 1940, pls. 89–96)

Textured Types

(Figs. 59, 60)

Brown textured types equivalent to types described by Rinaldo and Bluhm, 1956, pp. 155–173

Alma Neck Banded (Haury, 1936, pp. 35–36)

Kana-a Gray (Hawley, 1936, p. 25; Colton and Hargrave, 1937, p. 195)

Tularosa Fillet Rim (Gladwin, W. and H. S., 1934, p. 18; Kidder, 1924, p. 98; Martin *et al.*, 1952, p. 65; Wendorf, 1950, p. 121)

Plain Types

(Fig. 60, *d*)

Alma Plain (Gladwin, W. and H. S., 1934, p. 18; Haury, 1936, p. 32; Hawley, 1936, p. 104; Martin and Rinaldo, 1947, pp. 362–368; Nesbitt, 1938, p. 137)

San Francisco Red (Haury, 1936, pp. 28–31; Martin, 1943, p. 240; Martin and Rinaldo, 1940, pp. 80–81; 1947, pp. 364–368)

Lino Gray (Hargrave, 1932, p. 11; Hawley, 1936, p. 21; Colton and Hargrave, 1937, p. 191)

Forestdale Smudged (Haury, 1940, p. 73)

Woodruff Smudged (Mera, 1934, p. 6; Hawley, 1936, p. 25; Colton and Hargrave, 1937, p. 59)

CARTER RANCH SITE

SHERD TOTALS

	NO.
Gila Black-on-Red	84
Houck Polychrome	4
Kiatuthlanna Black-on-White	44
Pinedale Black-on-Red	6
Querino Polychrome	22
Red Mesa Black-on-White	358
Reserve Black-on-White	199
St. Johns Black-on-Red	146
St. Johns Polychrome	334
Show Low Black-on-Red	1,067
Snowflake Black-on-White, Snowflake Variety	8,366
Snowflake Black-on-White, Carterville Variety	1,348
Snowflake Black-on-White, Hay Hollow Variety	699
Springerville Polychrome	30
Tularosa Black-on-White	148
White Mountain Red Ware	311
Wingate Black-on-Red	298
Indeterminate Black-on-Red	143
Indeterminate Black-on-White	4,735
Indeterminate Red Ware	72
Indeterminate Polychrome	12
Indeterminate White-on-Red	2
Brown Plain Corrugated	694
Brown Plain Corrugated, Smudged Interior	398
Brown Indented Corrugated	9,035
Brown Indented Corrugated, Smudged Interior	1,729
Brown Incised Corrugated	5
Brown Patterned Corrugated	1,092
Brown Patterned Corrugated, Smudged Interior	66
McDonald Plain Corrugated	365
McDonald Indented Corrugated	746
McDonald Patterned Corrugated	92
Brown Punched Corrugated	3
Red Indented Corrugated, Smudged Interior	28
Gray Plain Corrugated	60
Gray Indented Corrugated	277
Gray Patterned Corrugated	4
Alma Neck Banded	1
Kana-a Gray	1
Tularosa Fillet Rim	1
Indeterminate Textured	262
Alma Plain	434
San Francisco Red	30
San Francisco Red, Smudged Interior	2
Lino Gray	22
Lino Smudged	1
Forestdale Smudged	141
Woodruff Smudged	72
Indeterminate Plain Ware	6
Total Sherds	33,995

V. Statistical Analysis of Carter Ranch Pottery

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Department of Anthropology
University of Chicago

Sherd samples were collected from a great number of provenience units at the Carter Ranch site. We were asked to analyze this material, and to discover if any differences existed between provenience units at the site.

In problems of this nature it is important to understand what accounts for differences between samples. There are only three possible causes for these differences, when the samples have been drawn from undisturbed cultural stata, so that differences in the nature of the geological processes forming the strata are either not present or immaterial in the study. Samples may vary because of real functional and/or temporal differences between their parent populations, or they may vary because of sampling error with respect to populations that do not really differ.

Many archaeological studies in the past have ignored the effect of sampling error as a causal factor in inter-sample variation, and, moreover, have relegated possible functional differences between provenience units and parent populations to a minor role in the explanation of such variation. The major cause of inter-sample variation has been most frequently assumed to be temporal change in the popularity of artifact types. This is the underlying assumption in such analytical techniques as the "Ford" type of seriation (Ford, 1951) and the Robinson-Brainerd seriation technique (Robinson, 1951; Brainerd, 1951). Neither of those two methods allows for the existence of sampling error, and neither makes any provision for the effect of functional differences in producing variation between samples.

An explanation of sample variation cannot assume which of the three possible causal factors mentioned above is of primary importance. We must be able to isolate the contribution of each of the three factors to that variation, and demonstrate which of them, either singly or in combination, satisfactorily accounts for this variation (Duncan, Cuzzort and Duncan, 1961, p. 106).

We have sought to explain differences and similarities between the Carter Ranch samples by models derived from regression analysis, which measures the behavior of one variable (in this case, sherd frequency of one type) to other variables (sherd frequencies of other types). Such models satisfy the requirements set forth in the above paragraph. It is statistically proper to formulate hypotheses concerning the cause of sample differences and similarities on the basis of correlations of frequencies derived from a regression analysis, and to check those hypotheses by means of other correlations, provided only that the same data used to formulate hypotheses are not used to test them (Duncan, Cuzzort and Duncan, 1961, p. 106). The correlation coefficients derived from regression analysis enable us to make precise statements as to the probability that observed relationships may or may not be explicable in terms of sampling error. We employed chi-square (χ^2) tests to establish whether samples we suspected, were, on the basis of the regression analysis, actually different. This was useful, as will be seen below, in isolating groups of houses and areas in which much the same cultural activities must have been carried on.

A factor in our choice of tests was the availability of the Univac computer at the Operations Analysis Laboratory at the University of Chicago. The use of Univac permitted us to perform, systematically, regressions of frequencies of all types of pottery from all utilized provenience units, against all other types in all combinations. These regressions showed us which pottery types were "behaving" together. Chi-square tests were run to determine which provenience units were different with respect to pottery contents. Needless to say, the form of analysis we undertook would have been utterly impractical without the use of Univac. As an example, 50 chi-square problems were calculated for us by Univac in less than 2 minutes. These calculations alone would have required over 18 man hours of computation. A total of over 1000 problems was run by Univac, producing among other things, much more statistical data than we can possibly analyze.

SAMPLE SIZE DATA AND EXPLANATION OF TABLES

There were more pottery types recovered at Carter Ranch than we have utilized in this study. We selected fourteen types which were represented in quantity. Table 1 lists and numbers the pottery types we were able to utilize. For the writers' convenience, we will often refer to the types by their numbers shown in that table. However, when detailed discussion of the relationships of a single type must be undertaken, the type name will be employed also, to ease the reader's task.

Tables 2 and 3 list, by type, sherd frequencies used in the calculations which follow. The totals will occasionally not match from calculation to calculation, since for some problems it was necessary to eliminate from consideration all sherds of indeterminate type, while in others the nature of the calculation was such that the indeterminate sherds had to be included. In each case where this was so, it will be mentioned.

The authors have no intention of presenting an explanation here of the statistical tests employed. Such explanation may be found in Walker and Lev (1953); Duncan, Cuzzort and Duncan (1961) and in Arkin and Colton (1950). However, some explanation of the meaning of the values we have tabulated will be presented so that the non-statistician can understand them with little mathematical background.

The pairs of regression coefficients given in the tables are expressions of the relationship of two variables, x and y, for example. Independent variables, the x's in the regression formula, will be found horizontally in the tables, and dependent variables, the y's to be explained as functions of x, will be listed vertically. Each regression formula is of the following form: $Y=a+bX$. When graphed, this formula will produce a straight line. We cannot demonstrate that any of our regressions would be better expressed as curvilinear relationships.

Normally, if one wanted to estimate an unknown value of Y and one had only the variable Y to use in the estimation, the best estimate that could be given would be the mean of the known values. If, however, there are also values of the variable X and the relationship between X and Y is known, then given a known value of X for an unknown Y, the best estimate for unknown Y is afforded by the regression formula. The correlation coefficient "r" may be thought of as a measure of the degree of accuracy with which a value of Y can be predicted given a value of X. When r is zero, the value of one variable cannot be predicted knowing the value of the other. When r is $+1$ or -1 perfect prediction is possible. A positive r means X increases as Y increases. A negative r means X increases as Y decreases. We have no negative r's except in the case of the study of the relationship of sherd frequency and increasing distance south on the site (see below).

Tables 10, 11, 12, 15 show the chi-square (χ^2) values for calculations undertaken below. These values are measures of discrepancy between an observed number of sherds and an expected number based on the hypothesis that there are no differences between the samples. The larger the value of chi-square, the larger the discrepancy is.

Levels of significance "α" are the probabilities of expected occurrence of a statistic of given size by sampling error alone. An α value of .05 would be read "the value of the statistic concerned (χ^2 for example) would only be expected to be this large on the basis of sampling error alone 5 times in a hundred." Sampling error is, of course, the discrepancy between a sample and the population from which it was drawn.

Only the primary data of sherd frequencies, provenience units, the values of chi-square, the values of the regression and correlation coefficients and levels of significance are given in this paper. Anyone desiring further statistical data pertinent to this report may obtain them by writing to Chicago Natural History Museum.

CONSTELLATIONS OF POTTERY TYPES

The first series of calculations run by Univac included three separate correlation problems. The first problem was run to determine which pottery types were exhibiting associated behavior on floors. The frequencies of each of 12 pottery types in 18 floor and sub-floor samples from 12 structures were compared with each of the other 11 types. The second problem was run to determine if types whose frequencies are correlated in floor samples also exhibit related behavior in the fills. The frequencies of each of 14 pottery types in the fills of 10 structures were compared with each of the other 13 types. The third problem was calculated to determine whether relationships exist between samples in floors and samples in the fills of the same buildings. The frequencies of each of 14 pottery types in the fills of 7 structures were compared with each of the same 14 types on the floors of the same 7 structures. The correlation and regression coefficients of the first 2 problems, and levels of significance of the correlation coefficients are shown in tables 4 and 5.

It is apparent from these tables that within the fills and within the floors, there are some pottery types that are highly correlated with each other and others that are not correlated within the .05 level of probability. From these basic data it was possible to draw up four lists of pottery types whose frequencies are so highly correlated in all utilized floor samples that sampling error alone would not be expected to explain the appearance of such related behavior as often as 5 times out of 100. These groups of types are mutually exclusive and exhaustive on the basis of the correlations. In other words, when types 1 and 3 correlate with each other and with 4, and when type 2 likewise correlates with 3 and 4, but not with 1, two such groups of types are established: 1, 3, 4 and 2, 3, 4.

We therefore postulate as our first hypothesis that there are 4 constellations of pottery types at the Carter Ranch Site which either were temporally or "functionally" different, or both (see table 7):

(1) Types 1, 3, 4, 9, 10

(2) Types 2, 4, 7, 10, 11

(3) Types 1, 2, 4, 6, 8, 9, 10, 11

(4) Types 2, 4, 5, 6, 8, 9, 10, 11

The "bases" of these constellations cannot be elucidated from the coefficients alone, and the only factor contributing to the correlations that can be isolated is sampling error. If the differences between groups are found to be functional, it is not assumed that these groups would each have been used for one sole purpose. It is possible that each group might contain two or more units of pottery types which were functionally specific, but which correlated with each other because the activities in which the constellation as a whole were used took place on the same floors. Also, one must not assume, merely because the types in each constellation are correlated, that fragments of each and every type will always be found associated on the same floor. The vagaries of breakage and differences in housekeeping make this impossible. It must also be stressed that sherds of any type may be found on a floor with other types of sherds, and still not be correlated with the appearance of those other types. Such sherds may have been brought into the house for reasons unconnected with any functional activity in which the other types of pottery were being employed.

In the case of constellations 3 and 4, the only difference lies in the replacement of type 1 in group 3 by type 5 in group 4. This shows the possibility that types 1 and 5 are equivalent in the activities which utilize groups 3 and 4. For example, in the routine of daily living Snowflake Black-on-White, Hay Hollow Variety, bowls may have been used for the same purpose as Snowflake Black-on-White, Carterville Variety, bowls, and a family which utilized the one might have had no need, opportunity or desire to utilize the other type.

It is also striking that constellation 1 consists of types which are largely made in the shape of bowls, whereas the other groups include types which appear as ollas and pitchers as well. This seems to argue that the difference between group 1 and groups 2, 3 and 4 is more likely to be functional than temporal. Groups 3 and 4 look less functionally specialized than groups 1 and 2 in the sense that groups 3 and 4 include the majority of the types considered in this study, with an assemblage that includes narrow-mouthed jars, wide-mouthed jars, and bowls.

Group 2 may be fortuitous. Type 7 is only correlated with types 2, 4, 10, and 11. But, it is not correlated highly even with these, so that only approximately 25% of the variation in 7 may be explained as associated with variation in the other 4 types. Large numbers of sherds of type 7 appear on floors only in room 5 and the Kiva, and significantly, it is these two rooms that have graves in which type 7 pottery is included. It seems possible that type 7, Brown Plain Corrugated, Smudged Interior, is a mortuary type. If this type were removed from group 2, the group would collapse, and its other members would be assigned to groups 3 and 4. However, since the group shows correlations between and among its units that would be expected to occur on the basis of sampling error alone less than 5 times in 100, we are inclined to leave the group as it stands, and consider the whole group as belonging, perhaps, to a mortuary complex, especially characterized by the appearance of type 7 pottery. This complex, if such it is, must also have utilized large amounts of types 11 and 2, and lesser amounts of the other types. (See the examination of Room 5).

To determine whether the same correlated behavior observable in floor samples is also observable in fill samples, we calculated Problem 2 (see table 5). Table 5 shows the regression and correlation coefficients derived from this analysis, which include two additional pottery types for which frequencies were too low for meaningful interpretation on most floors. By means of Fisher's Z_r test (Walker and Lev, 1953, pp. 255–256) we then examined the hypothesis that the correlation coefficients are the same in the floors as in the fills for types which were correlated in both provenience groups. Table 6 shows Z values and associated degrees of probability for this test. There were 29 such correlated pairs of types common to both floors and fills. Of their correlation coefficients, all but 4 were so similar that simple sampling error by itself could have produced the differences between them more often than five percent of the time. The four correlations which were more different from what could reasonably be expected solely on the basis of sampling error are the correlations between types 1 and 4 (Snowflake Black-on-White, Hay Hollow Variety, and Show Low Black-on-Red), types 6 and 8 (Brown Plain Corrugated and Brown Indented Corrugated), types 8 and 10 (Brown Indented Corrugated and McDonald Corrugated Indented) and types 8 and 11 (Brown Indented Corrugated and Patterned Corrugated). The correlation coefficients pertaining to the last pair were so different that sampling error alone could be expected to produce them in samples from the same population less than once in a thousand cases.

The tables (4 and 5) also show that in 23 cases there are correlations in the fill that do not occur on floors, and vice versa. To ensure that this difference between provenience units really exists, and is not a function of the differential in degrees of freedom in the two sets of regression calculations, we compared the magnitude of the insignificant correlation coefficients with the magnitude of their significant counterparts from the other samples. Although a statement of probability is not deemed necessary here concerning these magnitudes, since the insignificant coefficients were not used in analysis, it was obvious by inspection that there was a great discrepancy (between .20 and .25) in size of coefficients in all cases save two—the relationship between types 7 and 4 and that between types 7 and 10. Only in these two cases is it likely that sampling error alone would account for the discrepancy.

There are a total of 66 possible correlations in common between the floor and fill samples. Of these, there are 23 cases of significant correlations in the fills but not on the floors, or vice versa. In 29 cases, there are significant correlations in both fills and floors, 25 of these paired correlations being no more different than could be expected solely on the basis of sampling error. In 14 cases, correlations in both floors and fills are insignificant. Thus in 43 out of 66 cases we find the same trends either for or against correlated behavior between pottery types in both the floor and the fill data. This demonstrates that the trends in correlation of types in floor samples carry over largely into the fill samples, while it also reveals some striking differences between samples from floors and fills.

Table 7, column A shows the hypothetical pottery constellations established by considering only the floor samples, and column B of the same table shows the types in each constellation, the inter-relationships of which have been affirmed by the data derived from fills. It is interesting to note that differences in the groups from floors as compared to the groups from fills are all in brown ware categories, and not in the painted ware contents of the samples. If the differences between samples from floors and samples from fills were largely or entirely temporal, we should expect differential associations of types of painted pottery as well, since a widely held tenet of Southwestern Archaeology is that painted types are the more sensitive temporal indicators.

Problem 3 was next run to determine if behavior of types on any given floor was related to behavior of the same and other types in fill samples from the same structure. The correlation coefficients and regression coefficients for this series of problems are shown in table 8. Only pottery type 11 (Patterned Corrugated) in the fills, exhibited any relationship in frequency to any type on the floors. That type was found to vary in direct relationship to types 2, 3, 4, 10, 11, and 13 on the floors. All the correlation coefficients of these regression relationships are too large to have been expected by chance as often as five times in one hundred. The fact that variation in the sherd frequencies of only one type in the fills is related to variation in sherd frequencies on floors indicates that the fill samples have not accumulated under the same cultural conditions that account for the association of artifacts on their respective floors. These large differences can be accounted for by either functional differences between fill areas (as might occur in intentional filling of abandoned houses) or temporal differences between the deposition of floor and fill samples. In this case time is probably not a large factor, since as we have seen above, the correlations of frequencies within the fills and correlations of frequencies within the floors have more in common than the hypothesis of gross temporal difference would allow us to postulate.

An explanation for the "behavior" of type 11 sherds in the fills is difficult to derive. Although this type on floors is not correlated with type 3 in floor samples, it is, in the floor-to-fill comparison. It is also correlated with type 3 in the within-fill comparison. Aside from this factor, however, type 11 in the fill is associated with types on the floors which belong to floor "constellations" of pottery which include type 11.

The highest correlation is that of type 11 on the floors with the same type in the fills. In order to account for this behavior we may postulate that while the room was being occupied type 11 was being placed both on the floor and the roof of the same structure. The collapse of the roof would then have placed frequencies of type 11 in the fills that were correlated with frequencies of other types on the floors. Whether the function of this type in both locations was the same is immaterial. Possibly it was used for roof storage or drying some perishable material.

ANOMALOUS FLOOR SAMPLES

Samples from some structures "fit" the regression lines of certain types of pottery poorly. This situation was seldom encountered but did influence our thinking about room typology. A list of such anomalies follows.

Kiva 1 floor.—This entire sample is large, but the fréquencies of 7 pottery types were much larger than they were expected to be with respect to four other types. Types 2, 5, 6, 8, 9, 10 and 11 were unexpectedly high with respect to the regression formulae calculated on the basis of the frequencies of types 1, 3, 4 and 9. Type 4 was high with respect to type 3. This may be due to greater utilization of the former group of types and type 4 than the latter group in Kiva ceremony. It is interesting to note that in terms of pot shapes this large group of types appears rather functionally diversified.

Room 5 floor.—This is our second largest sample. However, again the magnitude of sherd frequencies is disproportionately allotted among the pottery types. Type 7 is extremely high, and types 1, 2, 4, 10 and 11 also show unexpectedly large frequencies in comparison with types 5, 6 and 8. As mentioned above, it is suspected that some of the above types may be involved in ceremonial activities, since type 7 pottery is reported to have been found with burials on this floor.

Room 2 floor.—This sample lacks types 1, 3, 7 and 10, and there are larger quantities of type 9 than would be expected on the basis of frequencies of types 2, 4, 8 and 10.

Room 3 floor.—On the floor of Room 3, types 3 and 4 are missing. There are relatively great amounts of types 2 and 6 with respect to types 8 and 11. Type 1 is unusually high with respect to types 2, 3, 4, 6, 8, 9, 10 and 11. Types 9 and 10 are also quite high, however.

ANOMALOUS POTTERY TYPES

Silver Creek Corrugated is never correlated significantly with any other type of pottery on the floors that we have considered at the Carter Ranch. This strongly suggests that Silver Creek is not a pottery type in the sense that the other types are. We do not venture to suggest reasons for the peculiar behavior of Silver Creek. However, two possibilities for such an explanation are obvious. One is that the type is a random variant of another type, or is so difficult to distinguish as a type that the classifier randomly assigns sherds to it. The other is that it includes a number of types which are behaving in dissimilar fashions.

FUNCTIONAL DIFFERENCES BETWEEN ROOMS AND MIDDENS

Since it is apparent that there are real differences in the frequencies of pottery types within the pueblo, it is appropriate to ask questions of the data that will isolate possible functional differences between provenience units. We should like to know how much of the variation can be explained solely as a result of the association of the pottery with different types of structures and different types of deposit. To answer this a preliminary typology of four structure types was set up principally on the basis of the presence and kind of floor features. Type A consists of those rooms with square floor pits, type B of those rooms with no floor feature, type C of those rooms with round-orificed features, and type D includes the Great Kiva and small platform Kiva, which are architecturally different from the other structures (see Table 9). Rooms of each type except D occurred in every part of the site and cross-cut what were apparently contemporary architectural units, so that there is every reason to expect that different functions of those room types may be contributing factors in the differences between pottery type frequencies.

Having thus ordered the rooms into four classes, we ran chi-square problems to test the hypothesis that the sherd samples in the various rooms could have been drawn at random from a single homogeneous population. From the correlations among the 14 pottery types from floor samples, we made a preliminary grouping of pottery types whose "behavior" with respect to other types was nearly identical. These groups of pottery types were the following: types 5, 6, 13; types 2, 4; and types 1, 8, 9. In addition, several types which exhibited few similarities in pattern of correlation were also grouped in hopes that significant χ^2s would point the way for further analysis with respect to those types. This group included types 3, 7, 10, 11, 14. Lastly, in hope that so doing would limit necessary reanalysis, we established two further groups, types 4, 9, 6, 11 and types 2, 8, 5, which cross-cut our previous categories. Each room type was run against each other with respect to each of these groups and the first three pottery groups were run against each other. Lastly each pottery type in the other groups was run against each other type in its group.

An explanation is necessary of our reasons for establishing the χ^2 problems in the above fashion. First of all, to have set up a χ^2 problem considering the proportion of each pottery type in each house type would have been ideal, but would have required 546 separate chi-square problems using 2 by 2 matrices. Even with the aid of the Univac the time required for the purely mechanical process of transferring the data from our sheet to IBM cards would have made the running of so many chi-square problems impractical. Therefore, in the time available to us it was impossible to refine our χ^2 analysis to the point we desired, and we were forced to attempt to establish categories of types on the basis of our guesswork as to where such real categories were to be found. Further, a clerical error in the transfer of sherd counts has made it impossible to give a probability statement concerning the following results, which nevertheless are confirmed by other independent tests. These results are: (1) The sherd samples of types 5, 6, 13, 2, 4, 1, 8, 9 in room type C are not likely to have been derived from the same population as the same samples on floors of type D. (2) The samples of types 7, 14, 11, 10, 3 on Type B and Type C floors were probably not drawn from the same population. (3) The sherd samples of types 2, 8, 5 on Types B and C floors show different characteristics than samples of the same type from type D rooms, and B differs from A. (4) Samples of sherds of types 4, 9, 6 and 11 from rooms of type C differ from B, on this basis B differs from A, and B and C both differ from the Kiva.

The results of the χ^2 test which were not involved in the error are as follows: The sherd sample of types 5, 6, 13, 2, 4, 1, 8, 9 on room type A floors would not be expected to have come from the same population as the sherds in the same group on Kiva floors as often as one time in one hundred. The Kiva floor sample of sherd types 2, 8, 5 would not be expected to have been derived from the population of which the comparable sample on floors of type A was part as often as one time in one hundred. The chi-square test run on the group of types 4, 9, 6, 11 in type A and Kiva samples shows that these samples would not be expected to have been drawn from the same population as often as five times in one hundred. However, we would expect to draw two samples as different as the samples of types 7, 14, 11, 10 and 3 from type A rooms and the Kivas from the same population more than 1 out of 2 times. Although two sherds too many were included in the sample of types 3, 7, 10, 11, 14 from type C houses, adjustment of the chi-square test is unnecessary since the chi-square values are so large in the C–A, C–D room comparisons. In neither case would we expect the sample from type C rooms to have been derived from a population including samples from type A and type D rooms as often as one time in one thousand, and in both cases, adjustment of the chi-square test would not alter this result.

The results of the previous set of chi-square tests, although not in all cases conclusive, were suggestive of further hypotheses to be tested. One of these was the possibility that the proportions of unpainted ware and painted ware in the floor samples would disclose further characteristics by means of which differences between house types could be distinguished. To test this hypothesis, we ran 15 more chi-square tests by calculator. In this case our null hypothesis was that there is no difference in proportions of painted and unpainted pottery as determined from sherd counts in floor samples grouped by room type. Whereas we had not considered indeterminate types of sherds previously, this series of tests used all sherds, since for this purpose knowledge of exact type is unimportant.

We considered all floor samples from each room in six different room types. (The 4 previous types were further subdivided on the basis of apparent homogeneity or dissimilarity of floor samples within each floor feature type to refine our typology.) The relationships discovered in this fashion are shown in Table 10.

In order of relative proportions of unpainted ware from high to low we have the following distinct groups:

(1) Those with absolutely greater proportions of brown wares: types A_1 and B, with the highest brown ware proportions, and type C_1.

(2) Those with absolutely greater proportions of painted ware: types C_2, D and type A_2, which had the lowest brown ware proportion.

These results demonstrate that it is in the rooms closest to the Kiva that we find the highest proportion of painted to unpainted ware, since the three rooms of type A_2 are the closest to the Kiva, and room 5 (making up room type C_2), is next closest.

Thus, we have demonstrated that at the Carter Ranch Site, four room types can be established on the basis of architectural considerations and floor features. These four room types exhibit differences greater than would be expected (with respect to pottery frequency) if they had only architectural validity, and were not functionally or temporally different as well. Further, it is possible to establish subtypes in type A and type C rooms based on the relative quantities of painted and unpainted wares, but it is not possible to subdivide type B rooms on this basis. Although types A_1 and B rooms are similar in this respect, as are types C_2 and D rooms, the existence of type A and type C rooms as units for certain purposes is not negated by these findings since that unity is based on a different set of considerations. Rather, the unity of those types seems to a large extent confirmed, for if it did not exist, we would have expected much greater realignments between rooms of diverse architectural type than are actually observable. More than simply architectural types, they seem likely to be functional types, for did they and their associated ceramic contents merely reflect temporal differences we would not expect the room types to occur scattered over the site.

Rooms are not the only distinguishable class of provenience unit that is a potential contributor to the variation in sherd frequencies on the site. Tests were made on selected parts of each of the trench areas near the pueblo (A, B, C, D and G, see fig. 1), in order to reveal differences between the trenches themselves and the trenches and total room sample. Chi-square tests were employed in the same way with the same pottery breakdown as the previous analysis of the varying proportions of painted and plain wares in the rooms. Each trench area was represented by five adjacent squares located along a transect perpendicular to the downward slope of the ground away from the pueblo (viz., trench A, squares 1–5; trench B, squares 1–5; trench C, squares 8, 8L1, 8L2, 9L1, 9L2; trench D, squares 1–5; and trench G, squares 1–5). A comparison of the selected samples of each trench area with the total room floor sample reveals those trench samples that differ from the room sample. We would expect to draw the samples of trenches A and C from the same population as the rooms only once in one thousand times, and trenches B and D from the room sample only once in one hundred times. This was the only set of tests in which differential deposition might alter our results. Results are shown in Table 11.

This test, however, does not isolate the potential differences between the trenches or between particular types of house floor samples that can contribute to these likenesses and dissimilarities. In order to help isolate these differences, the trench samples were compared with each other. It was found that trench A contrasted at .001 level (see table 12) with all other trenches and that the other trenches could all readily have come from the same population. Since it is the trench A sample that differs from the other samples, one can infer that at least part of the western midden of the pueblo, which is represented by trench A, is really different from middens on the east side, represented by the other samples. The difference lies in the absolute preponderance of plain wares in trench A. This difference is one that takes on more significance when it is recalled that adjoining structures contain an absolute preponderance of painted wares (see above). Sherds from nearby houses do not seem to have been dumped at random in the trench A area throughout its period of use, but may have been dumped elsewhere.

AREAL DIFFERENCES WITHIN THE PUEBLO

In order to determine if there was a real difference between the frequencies of pottery types from the north end and the south end of the site, we produced a multiple correlation and regression problem which compared all pottery types in each of five rooms, to a scale of distance increasing toward the south end of the site. This scale was constructed as follows: Each room was assigned a number, from 1 to 8, in accordance with its distance from room 5 which was assigned number 1. To adjust this scale for differential floor areas in each room, so that a large room at point 2 would not be given the same weight as a small room at point 3, a series of correction factors was constructed. Each position number was corrected by multiplying the number of the house at that position by a figure which represents the ratio of the area of the house at that position to the area of the smallest house, number 4. See table 13 for the identification, position, correction factor and adjusted "areal position" of each floor.

The correlation and regression coefficients for each of the problems thus established are shown in table 14. None of the multiple regressions exhibits a significant correlation coefficient. The regressions of single pottery types produced some correlation coefficients which were significant. Types 2, 3, 4, 6, 7 and 10 increase in frequency to the north. The correlation coefficient size is significant at the .05 level, that is, random sampling error would be expected to produce such increases only once in 20 times. We call attention to the fact that, although the correlation coefficients of the other 8 single types are not significant, there is a clearly observable trend in the fact that 12 of the 14 correlation coefficients have negative signs—that is, 12 of the 14 types show some increase from south to north on the site. This would be expected on the basis of chance alone only once in 2000 observations. The significance of this finding would seem to be that, regardless of floor area, sherd numbers on floors increase to the north in all but two pottery types. This suggests to us a longer occupation of the rooms to the north end of the site than of those to the south. In the fact that Snowflake Black-on-White, Carterville Variety, and Reserve Black-on-White decrease to the north, we believe we have our only hint of possible temporal differences in pottery type frequency on the site. Perhaps the south rooms of the site were constructed somewhat before the northerly rooms, and occupation was longer in the northern rooms than the southern. We do not know if this is borne out by the existence of subfloor midden deposits in the northern portion of the site and their absence in the southern part of the site, or not.

TEMPORAL DIFFERENCES

The variation observed in the sherd frequencies at the Carter Ranch Site has hitherto been accounted for largely in terms of functional differences or sampling error. The temporal factor, which is the favorite in archaeological explanation, cannot be surely isolated with the problems and data at hand. This does not mean that there is potentially no temporal difference; it is only that we have failed to isolate it, and this probably because its magnitude is relatively small.

The closest situation to temporal difference at this site is the contrast in the upper two levels and lower levels of trenches A, B and D (see table 15). However, the change in level is not in the same direction in the three cases. Whereas plain ware increases in trenches A and B, it decreases in trench D, thereby robbing this example of much of its temporal import. Passing to a consideration of the two rooms (4 and 10) which have adequate samples from two superimposed floors, we have found that the proportion of painted to plain wares behaves differently in each sequence of floor samples. In room 4 the differences could be accounted for by sampling error 4 out of 5 times, whereas in room 10 the difference would be expected on the basis of sampling error alone in less than one out of twenty cases. In room 10 the change in floor samples is in the direction of even more painted ware on the floors so that this difference does not invalidate house groupings established earlier.

CAUSES OF INTER-SAMPLE VARIATION AT THE CARTER RANCH SITE

A. Temporal

At the Carter Ranch Site we have only a weak case for temporal differences causing sample variation. The data we have do not, we feel, permit us to make any statements about the relative temporal order of rooms or areas within the site other than that there is a possible temporal difference in the period of construction and occupation from the south to the north end of the site.

Further, from the samples considered there is no indication that the occupation at the Carter Ranch Site is multiple or interrupted, since either a multiphase occupation or the abandonment of the site for a long period of time would have resulted in samples from each period or each occupation exhibiting consistent differences from samples from other occupation. Since this is not the case, we believe that the occupation represented by our samples is a single occupation.

We do have some strong evidence against a mainly temporal hypothesis for sample variation at the site. If the differences at the Carter Ranch between sherd frequencies on floors were mainly temporal, we would expect to find the frequency of some types in some samples consistently higher than expected by the regression formulae, and the other samples of those types consistently lower. (For example, if a pottery type is increasing in frequency through time while another type remains the same, "late" rooms should have higher frequencies of the first type than expected by the regression formula, even though no correlation might be shown.) We have graphs of our residuals in all the regression calculations and can observe no alignments of any systematic sort. Therefore, we believe that the analytical units at the Carter Ranch Site represent a relatively short occupation, or at least one during which temporal difference between samples is subordinate to functional difference. The patterns of graphed residuals also seem to negate the possibility of multiple or interrupted occupations at Carter Ranch. And lastly, we found in connection with the first three problems that the difference between floor and fill constellations of sherds falls in the unpainted categories, and that the correlation coefficients in 43 out of 66 cases show the same pattern of linked or non-linked types in floors compared with fills. Altogether these four points argue that the temporal difference between samples at Carter Ranch is relatively minor.

B. Functional

At the Carter Ranch, we have demonstrated that there are four constellations of pottery types that may have been used for functionally diverse purposes. We have shown that four room types established on the basis of floor features, are distinguishable in frequencies of pottery from their floors. This suggests that different cultural activities were taking place in each type of room.

We have questioned the validity of Silver Creek Corrugated as a type in the sense that eleven other types in our sample are valid. We have also pointed out the possibility of a ceremonial or mortuary complex utilizing certain pottery types.

We discovered functional differences in the deposition of midden materials in five discrete areas. We cannot demonstrate any consistent temporal differences in the frequency of unpainted and painted wares in these five trenches. These findings may, however, be complicated by differential geological deposition.

We have discovered that the largest frequencies of painted pottery are found in the Kiva and four rooms closest to it. If this were due to temporal causes operating uniformly at the site, it is hard to see why Trench A does not show a painted ware increase through time. However, we have indicated, but not demonstrated, the possibility that the occupation of the Carter Ranch began later and lasted longer in its northern portion than in its southern.

Temporal differences between samples at the Carter Ranch Site are certainly not demonstrated, and postulated temporal differences are in some cases contradicted by the evidence. In any case, such differences seem to be of minor importance in comparison with functional and areal differences at the Carter Ranch Site.

The effects of sampling error have been dealt with in the body of the text.

Conclusions

With the completion of this study certain general conclusions stand out that have important implications for future research. It is universally recognized that all archaeological associations involving artifacts, structures, and general contexts are an integral part and a necessary condition to archaeological inference. However, the important and vital role to archaeological inference of statistical discovery of archaeological associations is not thoroughly appreciated. Simply because such associations are not visible or readily apparent does not mean that they do not exist. Nor does the fact that statements are conditioned by probability lessen their validity or usefulness. Rather, it should be realized that statements of probability are potentially very important; this potentiality is realized only when they fit within a well-designed problem in which as many of the contributing variables as possible are controlled. The most important means of controlling these variables is to plan the excavation to fit both the problem attacked and the analytical methods employed.

The fact should be stressed that Univac is not a magician. To utilize it efficiently, an excavator must plan far ahead. He must formulate specific questions which he hopes to answer with his excavation, choose appropriate tests that are suitable to the answering of those questions and that are amenable to Univac processing. He then must conduct his excavation in a manner that will allow his recovered data to be used in those tests. It is extremely impractical and inefficient in both machine and human time to attempt to run all possible combinations and permutations of archaeologically recovered data in a search for just a few significant correlations. The "programming" of the data and problems alone, before any Univac analysis can be done, is a formidable task, since to calculate problems based on all possible combinations and permutations of archaeological data the machine must be "fed" all of those combinations and permutations in a form it can "digest." In addition, since many more questions can be asked and answered by using Univac, increasing amounts of time and money must be allotted to the analysis phase of archaeological research.

In such analyses as we have performed above, it is desirable to utilize data from all the associations between artifact categories. In fact, if this analysis were extended to all artifact categories, even more powerful conclusions could be made that would lead to sound cultural interpretation. As it is, our analysis, which exposes functional differences and similarities between samples, can only pose questions about the cultural significance of these relationships.

The major result of this work, however, is the demonstration that it is improper to compare data from a given provenience at one site to data from a given provenience at another site without regard for possible functional differences between the provenience units. As it has been perfectly evident at the Carter Ranch Site, such a site is not homogeneous from one area to another. And due regard must be paid to not only the sampling procedure but also the functional differences between provenience units. It is entirely possible, under conditions outlined in the immediately preceding paragraphs, to isolate the effects of time, functional differences, and sampling error as causative factors in the production of intersample differences. An isolation of these factors is necessary to the complete description and interpretation of any body of archaeological data.

Note

We must thank Dr. Robert L. Graves, Associate Director of the Operations Analysis Laboratory, and Mr. Allan B. Addleman, Chief Engineer, Univac, for freely placing the facilities of the Operations Analysis Laboratory at our disposal. Without the assistance and advice of Mr. Bennet Fox, Research Assistant in the Department of Statistics, we would not have been able to program or to understand the Univac analysis of our data.

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Table 1.—LIST OF POTTERY TYPES AND TYPE NUMBERS USED IN UNIVAC ANAYSIS

Type No.	Name
1	Snowflake Black-on-White, Hay Hollow Variety
2	Snowflake Black-on-White, Snowflake Variety
3	St. Johns Black-on-Red
4	Show Low Black-on-Red
5	Snowflake Black-on-White, Carterville Variety
6	Brown Plain Corrugated
7	Brown Plain Corrugated, smudged interior
8	Brown Indented Corrugated
9	Brown Indented Corrugated, smudged interior
10	McDonald Corrugated Indented
11	Patterned Corrugated
12	Silver Creek Corrugated
13	Red Mesa Black-on-White
14	Reserve Black-on-White

Table 2.—SHERD FREQUENCIES OF 14 TYPES OF POTTERY IN FLOOR SAMPLES, SAMPLES BELOW FLOORS AND FILLS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Room 2, floor	0	8	0	1	2	0	0	10	23	0	3	4	0	0
2, below floor	8	0	20	57	0	2	1	39	22	6	0	0	0	1
3, floor	11	110	0	0	5	6	1	22	4	3	7	1	3	4
4, floor 1	0	30	2	12	12	3	0	65	11	2	9	24	0	0
4, floor 2	0	42	0	3	14	1	0	102	2	1	12	0	5	2
4, below floor 2	0	23	0	1	7	1	0	6	1	1	1	3	0	0
5, floor	7	188	7	39	9	6	30	152	14	10	29	0	4	0
Kiva 1, floor	11	390	10	72	68	41	7	559	67	22	67	0	30	6
Platform Kiva, floor	0	4	0	0	0	0	0	1	0	0	0	0	0	0
Room 7, below floor	1	8	0	1	4	0	1	10	1	0	2	2	0	0
8, below floor	0	29	0	4	2	0	0	9	3	5	3	0	0	0
10, floor 1	6	29	0	4	3	0	0	9	0	1	1	0	2	0
10, below floor 1	2	22	0	1	3	0	0	10	6	1	4	0	2	0
10, floor 2	1	41	0	5	9	0	0	22	0	4	2	0	1	0
11, floor	1	15	0	0	3	0	1	13	1	1	1	0	0	0
12, floor	0	43	1	3	5	1	0	72	1	3	17	1	20	1
12, Ash pit bel. fl.	0	11	0	0	27	0	0	10	0	0	1	0	3	5
15, floor 2	3	40	1	0	4	0	0	100	2	4	17	0	0	0
Room 2, fill	0	8	0	5	3	3	3	7	2	0	1	1	0	0
3, fill	11	188	5	42	21	12	6	140	43	36	10	8	7	3
4, fill	2	11	0	3	1	0	0	1	0	4	1	1	1	0
5, fill	7	93	10	9	4	6	4	215	17	13	35	7	1	1
Kiva 1, fill (part)	1	64	1	0	12	1	1	126	7	1	38	1	2	2
Room 7, fill	19	285	11	40	46	17	9	461	21	53	34	12	4	6
8, fill	2	122	5	5	12	28	4	247	16	12	21	0	14	3
11, fill	3	51	0	3	4	4	5	29	3	2	6	0	1	2
12, fill	17	312	9	60	58	80	8	551	55	22	27	5	20	5
15, fill	15	92	9	45	19	68	28	176	25	19	22	1	5	0

Table 3.—FREQUENCIES OF PAINTED AND UNPAINTED WARES BY HOUSE TYPES, TRENCHES

	Painted	Unpainted
Type A_1 Houses (total)	246	400
Type A_2 Houses	357	110
Type B Houses	36	56
Type C_1 Houses	110	122
Type C_2 Houses	324	258
Type D Houses	1129	843
Trench A, levels 1 and 2	316	339
Trench A, below levels 1 and 2	131	101
Trench B, level 1	445	334
Trench B, below level 1	255	133
Trench C, levels 1 and 2	614	429
Trench C, below levels 1 and 2	686	438
Trench D, levels 1 and 2	353	204
Trench D, below levels 1 and 2	370	275
Trench G, level 1	128	106
Trench G, below level 1	207	154

TABLE 4.—CORRELATION (r) AND REGRESSION COEFFICIENTS FROM FREQUENCIES OF EACH OF 12 TYPES OF POTTERY IN 18 FLOOR AND SUBFLOOR SAMPLES RUN AGAINST EACH OF

Dependent Variables		Independent Variables					
		1	2	3	4	5	6
1	r		.6810	.5913	.6796		.6280
	α		<.01	<.01	<.01		<.01
	A		1.2050	1.8177	1.4352		1.9610
	b		.0284	.4459	.1240		.2574
2	r	.6810			.7202	.8276	.9417
	α	<.01			<.01	<.01	<.01
	A	11.0715			21.8223	9.0132	25.9892
	b	16.3473			3.1537	4.9196	9.2655
3	r	.5913			.8897		
	α	<.01			<.01		
	A	.0561			−.1495		
	b	.7841			.2152		
4	r	.6796	.7202	.8897		.6080	.7563
	α	<.01	<.01	<.01		<.01	<.01
	A	.7234	1.8388	2.9011		3.1620	5.5184
	b	3.7251	.1645	3.6776		.8253	1.6995
5	r		.8276		.6080		.9026
	α		<.01		<.01		<.01
	A		1.8427		4.7821		4.7701
	b		.1392		.4479		1.4941
6	r	.6280	.9417		.7563	.9026	
	α	<.01	<.01		<.01	<.01	
	A	−.9520	−2.1038		−.4073	−1.9733	
	b	1.5321	.0957		.3366	.5453	
7	r		.5394		.4876		
	α		<.05		<.05		
	A		−.0559		.4625		
	b		.0407		.1610		
8	r	.5476	.9361		.7619	.8908	.9590
	α	<.05	<.01		<.01	<.01	<.01
	A	15.9558	−6.7498		15.4306	−4.4738	23.2169
	b	18.1137	1.2899		4.5973	7.2968	13.0016
9	r	.5769	.8091	.6054	.8432	.7755	.9049
	α	<.05	<.01	<.01	<.01	<.01	<.01
	A	2.0066	.7635	4.4695	1.5914	.9549	3.5705
	b	2.3898	.1396	1.8914	.6372	.7955	1.5366
10	r	.6692	.9314	.5869	.8647	.7721	.9112
	α	<.01	<.01	<.01	<.01	<.01	<.01
	A	1.0011	.5555	2.1975	1.1589	1.0225	1.8503
	b	.9016	.0523	.5962	.2125	.2576	.5032
11	r	.5409	.9503		.7046	.8288	.9133
	α	<.05	<.01		<.01	<.01	<.01
	A	3.4275	.3629		3.7710	1.4151	4.5206
	b	2.2413	.1641		.5326	.8504	1.5513
12	r						
	α						
	A						
	b						

THE OTHER TYPES. SAMPLES FROM FIRST 18 PROVENIENCE UNITS OF TABLE 2

Dependent Variables		Independent Variables					
		7	8	9	10	11	12
1	r		.5476	.5769	.6692	.5409	
	α		<.05	<.05	<.01	<.05	
	A		1.7194	1.6110	1.0672	1.5570	
	b		.0166	.1392	.4967	.1305	
2	r	.5394	.9361	.8091	.9314	.9503	
	α	<.05	<.01	<.01	<.01	<.01	
	A	41.0926	11.6856	16.2375	-1.6119	3.5624	
	b	7.1545	.6793	4.6881	16.5940	.5050	
3	r			.6054	.5869		
	α			<.01	<.01		
	A			.5766	.2239		
	b			.1938	.5777		
4	r	.4876	.7619	.8432	.8647	.7046	
	α	<.05	<.01	<.01	<.01	<.01	
	A	7.9136	2.7828	1.4849	-1.2313	2.1638	
	b	1.4770	.1263	1.1156	3.5182	.9321	
5	r		.8908	.7755	.7721	.8288	
	α		<.01	<.01	<.01	<.01	
	A		2.5162	3.1984	1.6045	1.9360	
	b		.1088	.7559	2.3144	.8077	
6	r		.9590	.9049	.9112	.9133	
	α		<.01	<.01	<.01	<.01	
	A		-1.3696	-1.2884	-2.4776	-1.8688	
	b		.0707	.5329	1.6500	.5377	
7	r				.4972	.4817	
	α				<.01	<.05	
	A				-.0970	.2209	
	b				.6679	.2104	
8	r			.8739	.9260	.9758	
	α			<.01	<.01	<.01	
	A			6.0314	-13.5522	-8.8818	
	b			6.9774	22.7334	7.7890	
9	r		.8739		.8561	.8118	
	α		<.01		<.01	<.01	
	A		1.4137		-.5821	.8418	
	b		.1095		2.6325	.8116	
10	r	.4972	.9260	.8561		.9132	
	α	<.05	<.01	<.01		<.01	
	A	2.7123	1.0181	1.1118		.6524	
	b	.3702	.0377	.2784		.2969	
11	r	.4817	.9758	.8118	.9132		
	α	<.05	<.01	<.01	<.01		
	A	7.2655	1.5535	2.6503	-.2090		
	b	1.1030	.1222	.8120	2.8088		
12	r						
	α						
	A						
	b						

TABLE 5.—CORRELATION COEFFICIENTS (r), REGRESSION COEFFICIENTS (A AND B) AND PROBABILITY LEVELS OF CORRELATION COEFFICIENTS (α) FOR FREQUENCIES OF 14 POTTERY

Dependent Variables (Pottery Types)		Independent Variables (Pottery Type Nos.)						
		1	2	3	4	5	6	7
1	r		.8444	.8432	.9290	.8483	.6706	
	α		<.01	<.01	<.01	<.01	<.05	
	A		.6888	.9609	1.4335	1.9989	4.0251	
	b		.0572	.1348	.2956	.3167	.1678	
2	r	.8444		.7334	.8177	.9509		
	α	<.01		<.05	<.01	<.01		
	A	26.6031		36.0511	41.1629	28.2388		
	b	12.4671		17.3098	3.8414	5.2423		
3	r	.8432	.7334		.7032	.6551		
	α	<.01	<.05		<.05	<.05		
	A	.9379	1.1898		2.0325	2.2456		
	b	.5275	.0311		.1400	.1530		
4	r	.9290	.8177	.7032		.8509	.7829	
	α	<.01	<.01	<.05		<.01	<.01	
	A	-1.2825	-.1390	3.5370		3.2267	7.7156	
	b	2.9198	-.1741	3.5326		.9985	.6157	
5	r	.8483	.9509	.6551	.8509		.6800	
	α	<.01	<.01	<.05	<.01		<.05	
	A	.5067	-3.1466	3.9783	2.6282		8.0199	
	b	2.2719	.1725	2.8043	.7251		.4557	
6	r	.6706			.7829	.6800		.6992
	α	<.05			<.01	<.05		<.05
	A	1.2668			.7977	3.6384		4.6397
	b	2.6796			.9954	1.0145		2.5383
7	r						.6992	
	α						<.05	
	A						2.5821	
	b						.1926	
8	r	.7864	.9330	.8033	.7175	.9218	.6488	
	α	<.01	<.01	<.01	<.05	<.01	<.05	
	A	39.9913	-3.4142	30.6261	71.1597	36.3961	104.0951	
	b	20.1700	1.6208	32.9348	5.8557	8.8280	4.1646	
9	r	.7557	.8309	.6461	.8922	.7874	.7214	
	α	<.05	<.01	<.05	<.01	<.01	<.05	
	A	4.2616	1.5449	5.9109	3.7601	5.5868	8.9552	
	b	1.9011	.1416	2.5978	.7141	.7396	.4541	
10	r	.8448	.8181	.7333	.7306	.7129		
	α	<.01	<.01	<.05	<.05	<.05		
	A	.7279	.0421	2.2598	4.4778	4.8032		
	b	2.0094	.1318	2.7880	.5529	.6332		
11	r			.6628				
	α			<.05				
	A			9.0924				
	b			2.0815				
12	r	.7392	.7235	.6897				
	α	<.05	<.05	<.05				
	A	.4748	.1351	.4207				
	b	.4059	.0283	.6359				
13	r		.6609				.6778	
	α		<.05				<.05	
	A		.2316				1.7323	
	b		.0430				.1720	
14	r							
	α							
	A							
	b							

TYPES IN FILL SAMPLES FROM TEN STRUCTURES (ROOMS 2, 3, 4, 5, 7, 8, 11, 12 AND 15, AND THE GREAT KIVA

Dependent Variables (Pottery Types)		Independent Variables (Pottery Type Nos.)						
		8	9	10	11	12	13	14
1	r	.7864	.7557	.8448		.7392		
	α	<.01	<.05	<.01		<.05		
	A	1.7125	2.0222	1.9463		3.3082		
	b	.0307	.3004	.3552		1.2199		
2	r	.9330	.8309	.8181		.7235	.6609	
	α	<.01	<.01	<.01		<.05	<.05	
	A	17.7063	30.4310	40.3282		55.9309	60.5718	
	b	.5371	4.8767	5.0785		18.5192	11.2778	
3	r	.8033	.6461	.7333	.6628	.6897		
	α	<.01	<.05	<.05	<.05	<.05		
	A	1.1733	1.9632	1.8752	.8840	2.3069		
	b	.0196	.1607	.1929	.2111	.7481		
4	r	.7175	.8922	.7306				
	α	<.05	<.01	<.05				
	A	4.0294	.1317	5.5604				
	b	.0879	1.1147	.9654				
5	r	.9218	.7874	.7129				
	α	<.01	<.01	<.05				
	A	.7976	2.1552	4.9954				
	b	.0962	.8383	.8028				
6	r	.6488	.7214				.6778	
	α	<.05	<.05				<.05	
	A	2.1581	.2427				3.7099	
	b	.1011	1.1459				3.3073	
7	r							
	α							
	A							
	b							
8	r		.7281	.6711	.6510		.7462	
	α		<.05	<.05	<.05		<.05	
	A		54.9950	78.0614	29.5688		83.5042	
	b		7.4235	7.2370	8.4990		20.3265	
9	r	.7281					.7607	
	α	<.05					<.05	
	A	4.9544					7.2310	
	b	.0714					2.1216	
10	r	.6711				.9324		.7292
	α	<.05				<.01		<.05
	A	4.0458				3.1765		4.1582
	b	.0622				3.6176		6.6899
11	r	.6510						
	α	<.05						
	A	9.7618						
	b	.0499						
12	r			.9324				.7311
	α			<.01				<.05
	A			.1536				.1519
	b			.2127				1.5823
13	r	.7462	.7607					
	α	<.05	<.05					
	A	.4877	.2364					
	b	.0257	.2785					
14	r			.7292		.7311		
	α			<.05		<.05		
	A			.5123		.7596		
	b			.0795		.2890		

Table 6.—Z VALUES AND LEVELS OF SIGNIFICANCE, TO TEST THE HYPOTHESIS THAT CORRELATION COEFFICIENTS OF TWO POTTERY TYPES IN FLOORS AND THE SAME TWO TYPES IN FILLS ARE EQUAL

Type	1	2	3	4	5	6	8
1 z							
α							
2 z	.90						
α	.1841						
3 z	1.20						
α	.1151						
4 z	1.79	.52	-1.20				
α	.0367	.3015	.1151				
5 z		1.44		1.20			
α		.0749		.1151			
6 z	.15			.13	-1.44		
α	.4404			.4483	.0749		
8 z	.98	.06		-.22	.50	-2.53	
α	.1635	.4622		.4129	.3085	.0057	
9 z	.72	.15	.15	.44	.066	-1.29	.92
α	.2358	.4404	.4404	.3300	.4721	.0985	.1791
10 z	.94	-1.14	.57	-.83	-.31		-1.79
α	.1736	.1271	.2843	.2033	.3783		.0367
11 z							-3.10
α							.0010

Table 7.—POTTERY TYPE CONSTELLATIONS ON FLOORS AND THEIR COUNTERPARTS IN FILLS

No.	A. Floors	B. Floors and Fills
I	1, 3, 4, 9, 10	1, 3, 4, 10
II	2, 4, 7, 10, 11	2, 4, 10
III	1, 2, 4, 6, 8, 9, 10 11	1, 2, 4, 8, 10
IV	2, 4, 5, 6, 8, 9, 10, 11	2, 4, 5, 8, 10

Table 8.—CORRELATION COEFFICIENTS (r) OF FREQUENCIES OF TYPE 11 POTTERY IN FILLS OF SEVEN HOUSES (HOUSES 2, 3, 4, 5, 11 AND 12) WITH FREQUENCIES OF SIX TYPES OF POTTERY ON THE TOP FLOOR OF EACH HOUSE

Type	2	3	4	10	11	13
r	+.7935	+.8186	+.7739	+.8149	+.8345	+.7705
α	$<.05$	$<.05$	$<.05$	$<.05$	$<.05$	$<.05$

TABLE 9.—LIST OF HOUSES BY TYPE

Type	A_1	A_2	B	C_1	C_2	D
	4	3	2	11	5	Great Kiva (Kiva 1)
	9	10	6	12		Platform Kiva
	15	16	13			

Note: When there was more than one floor in a house, and when (comparing type to type) only one floor could be used in the calculations, floor 2 was used.

TABLE 10.—CHI-SQUARE TEST: PAINTED VERSUS PLAINWARE FREQUENCIES BY HOUSE TYPES. ALL SHERDS FROM ALL FLOORS INCLUDED

	House Type A_1	House Type A_2	House Type B	House Type C_1	House Type C_2
House Type A_2 (Rooms 3,10,16) χ^2 / α	160.7365 / <.001				
House Type B (Rooms 2,6,13) χ^2 / α	.0337 / >.80	51.8118 / <.001			
House Type C_1 (Rooms 11,12) χ^2 / α	6.1434 / <.02	58.9181 / <.001	1.8547 / <.10		
House Type C_2 (Room 5) χ^2 / α	38.1520 / <.001	49.0527 / <.001	8.6803 / <.01	4.5461 / <.05	
House Type D (Great and Platform Kivas) χ^2 / α	71.7397 / <.001	58.4734 / <.001	11.6970 / <.001	3.1129 / <.01	.4574 / >.30

TABLE 11.—CHI-SQUARE TEST: PAINTED VERSUS PLAINWARE FREQUENCIES IN TRENCHES COMPARED TO TOTAL ROOMS

	Trench A	Trench B	Trench C	Trench D	Trench G
χ^2	38.296	8.477	13.266	8.256	.300
α	<.001	<.01	<.001	<.01	<.50

TABLE 12.—CHI-SQUARE TEST TO SHOW THAT THE SHERD FREQUENCIES OF PAINTED AND UNPAINTED WARES ARE THE SAME IN ALL FIVE TRENCHES

χ^2	Total				
	A	B	C	D	G
A					
B	60.44 P<.001				
C	71.618 P<.001	.0000 P=1			
D	54.981 P<.001	.0070 P>.90	.0008 P>.90		
G	19.208 P<.001	2.109 P>.10	1.310 P>.20	2.332 P>.10	

TABLE 13.—LIST OF HOUSES, POSITIONS ON SITE (INCREASED TO SOUTH), AREAL CORRECTION FACTORS, AND CORRECTED POSITIONS (TEN HOUSES)

Position	House Number	Correction factor= area of house(s) in terms of house 4	Corrected position
1	5	2.11	2.1
2	12	2.55	5.1
3	15	2.14	6.4
4	unexc.	1.04	4.1
5	unexc. 13, 17	3.87	19.3
6	7, 8	3.20	19.2
7	2, 6	1.02	7.2
8	4	1.00	8.0

Table 14.—CORRELATION COEFFICIENTS (r) AND REGRESSION COEFFICIENTS (a and b) OF 14 POTTERY TYPES REGRESSED AGAINST THE CORRECTED POSITION OF THE FLOOR SAMPLES IN WHICH THEY WERE FOUND

Types	1	2	3	4	5	6	7
r	−.8324	−.8957	−.9410	−.8847	+.0127	−.8790	−.8860
α		<.05	<.05	<.05		<.05	<.05
a	.7007	7.6375	7.0862	6.8850	5.7181	7.0540	6.6750
b	−.6237	−.0292	−.7368	−.1223	−.0062	−.8087	−.1525

Types	8	9	10	11	12	13	14
r	−.6195	−.1444	−.9349	−.3739	−.3188	−.2181	+.4624
α			<.05				
a	8.1637	6.0469	7.7471	7.2833	5.3350	6.1138	5.0438
b	−.0276	−.0342	−.5520	−.0802	−.4250	−.0610	+1.1938

Table 15.—CHI-SQUARE TEST TO SHOW THAT THE RELATIVE FREQUENCIES OF PAINTED VERSUS UNPAINTED WARES ARE THE SAME IN THE UPPER LEVELS (1 AND 2) OF ANY TRENCH AS THEY ARE IN THE LOWER LEVELS

χ^2		Upper Levels				
		A	B	C	D	G
Lower Levels	A	4.642 P<.05				
	B		7.998 P<.01			
	C			.6746 P>.30		
	D				4.552 P<.02	
	G					.3918 P>.50

VI. Sociological Implications of the Ceramic Analysis

By William A. Longacre
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ACKNOWLEDGEMENTS

This project was carried out under the direction of Dr. Paul S. Martin, Chief Curator, Department of Anthropology, Chicago Natural History Museum. His many stimulating insights and encouragement throughout the study are deeply appreciated. I also express gratitude to: the late Robert Burgh, Constance Cronin, A. J. Jelinek, and Watson Smith.

Much of the data used in the analysis was obtained from the excavation of the Carter Ranch Site by the Museum's Southwest Expedition in 1961. The remainder came from surface survey and limited excavations carried out by Robert Bird and myself.

The analysis of the design elements was undertaken by Mr. and Mrs. Stevens Seaberg, Department of Art, Northwestern University. Their careful work and stimulation throughout the task proved to be invaluable.

Much of the field work and analysis that forms the basis for this report was carried out under the auspices of the National Science Foundation.

THE PROBLEM

The first demonstration of a correlation between changes in social organization and/or residence and the distribution of design attributes used in ceramic manufacture was made by Deetz (1960). To do this he utilized data from the historic period in the Plains.

Deetz carefully documented the gradual shift from a matrilineal, matrilocal social organization to one less rigid in matrilocality at an eighteenth century Arikara village, the Medicine Crow Site.

Using data recovered from the excavation of this three component site, Deetz was able to demonstrate a non-random distribution of stylistic attributes during the earliest occupation and an increasingly random sorting of these attributes through time. He explains this behavior in the form of an hypothesis: "The stylistic attributes of ceramics produced by a society characterized by matrilineal descent, matrilocal residence, and households composed of social units of greater complexity than the nuclear family will exhibit a high degree of association, forming a series of clusters, each of which is the result of having been passed, relatively intact, from mother to daughter . . . with the residence and/or descent pattern forming the channeling device. If these channeling devices are removed, through a change in descent and/or residence, clusters which were formerly possessed of a relatively low internal variation, and high intergroup variation, will exhibit an increase in internal variation with a corresponding decrease in intercluster variation." (op. cit., p. 2.)

Deetz uses a rim sherd sample in this study, utilizing nineteen attribute classes in his analysis. The analysis was made with the aid of an IBM Data Processing Computer.

Although I have several methodological criticisms, the study does demonstrate, I feel, a correlation between a matrilineal, matrilocal social organization and a non-random distribution of stylistic attributes in the ceramics. His historical documentation makes this study an excellent control for the one reported below.

Several methodological weaknesses in Deetz's study must be pointed out. First, nowhere in his report (op. cit.) does he cite his sample size, and since he uses relative frequencies rather than actual counts in his analysis, it is impossible to evaluate his sample. Second, he lumps data from each component, treating each as one unit of analysis. I would prefer to see these data analyzed within smaller cultural units, such as houses, in order to provide more rigid control.

The usefulness of the distribution of design elements as a tool for sociological interpretation in prehistory was first realized by Constance Cronin (Martin *et al.*, 1962, Chapter 3). Her problem was to determine stylistic similarities among several pottery types recovered from a series of excavated sites in the Vernon area. In the course of her analysis, based upon a detailed examination of design elements, she discovered that more similarities in style existed among the types found at any one village than existed within one type made at several villages (op. cit., p. 109).

This finding suggested that the generations of potters at a village tended to utilize a system of designs which through time was relatively conservative. It also indicated that this traditional usage of designs was probably a kin-based phenomenon.

Cronin's work (*op. cit.*) gave rise to my own interest in the possibility of reclaiming sociological information from a source that has been neglected. I hoped that a detailed analysis of designs would allow the delimitation of a series of social groupings from relatively larger to smaller aggregates. My task was to define geographical clusterings of elements of design and then to correlate these with kinship groupings as suggested from the ethnography of the Western Pueblos.

It was my assumption that the smaller and more closely tied the social group(s), the more details of design would be shared.

The data relative to the problem stated above were derived from the analysis of ceramic designs, especially the particular combinations of the elements of design in the decorative style produced in one area of the Southwest during one time period. The hypothesis that was tested is presented below. It is proposed as a basis for preliminary discussion of the ceramic traditions of variously-sized social aggregates from large to small.

THE HYPOTHESIS

The pottery type reflects a common ceramic tradition within relatively narrow geographic boundaries at a particular period of time. Types are defined on the basis of a distinct series of common attributes which are not shared with other similarly-sized ceramic groups. For the most part, design analysis constitutes the main method for distinguishing types in the Southwest.

Gifford (1960, p. 341) suggests that: "Types are summations of individual or small social group variation consistent with boundaries imposed by the interaction of the individuals on a societal level and determined by the operative value system present in any society." The socio-cultural milieu reflected by the spread and frequency of the type is the highest level of analysis that we will consider.

The level of analysis below that of the type concerns regional traditions of ceramics which have been differentiated. These sub-divisions of the type are named varieties (Wheat, Gifford, and Wasley, 1958). The geographic spread of a variety is less than the type of which it is a part. The variety probably reflects a common decorative tradition among the villages of a relatively small area (cf. Gifford, 1960, pp. 342–343). This shared tradition perhaps indicates a more intense contact among villages in the area, compared to those villages in the larger region producing pottery of the same type.

The conservative distribution of the variety suggests general agreement among the villages producing it as to what constitutes "accepted" design styles within the broader limits of the type. The distribution may also indicate a unit of villages, sharing a common geographic area, and perhaps linked together by a kin-based combination of religious and political ties.

The next level of analysis would be the pottery produced by a group of villages in a minute geographical area such as a single valley. Closer bonds might be created through more intimate contact among the villages of a single valley; this might be reflected in the pottery produced within the valley. There may be more similarities in shared elements of design among the pottery of these villages when compared to the ceramics of other villages in neighboring valleys.

Below this level of analysis would be the ceramics of the village. We may discover an accepted style of design common to a village within the broader sphere of the areal or "valley" tradition. If present, this village tradition would be based on intimate daily contact and would to some extent be kin-based.

The lowest analytical level that we will consider concerns the social groupings which form a village. If we assume a social system for the prehistoric peoples of the Anasazi and Mogollon area by A.D. 1000 similar to the Western Pueblos today, then, in general terms, a matrilineal clan system made up of matrilineages practicing matrilocal residence patterns would be the rule (Eggan, 1950). If we assume, further, that pottery making was a female occupation as it is today among these people, then we may be able to delimit still another and finer ceramic tradition within the village level. This would be the lineage style of decoration. The localized matrilineage would form the pottery-making unit. This tradition would therefore be kin-based. The art of pottery manufacture and decoration would be learned and passed down within the lineage frame. Preference for design-style, shapes, and possibly for temper might show statistically within this social grouping.

This hypothesis may be summed up as follows: Social demography and social organization are reflected in the material cultural system. In a matrilineal, matrilocal society, social demography may be mirrored in the ceramic art of female potters; the smaller and more closely tied the social aggregate, the more details of design would be shared. Augmented by clues from other aspects of the cultural system, differential relative frequencies of elements of design may suggest the delimitation of various social aggregates: (1), (2) larger social units such as the villages interacting in a relatively large area and producing pottery of the same variety or type, (3) groups of villages forming a unit through social interaction along kin-based, religious, and political lines, (4) the village as a social group, and (5) localized matrilineages or lineage segments forming a village.

FIELD WORK

To delimit the various ceramic traditions in our hypothesis: the lineage tradition, the village tradition, and the areal or "valley" tradition—three levels of analysis beneath the variety—a sensitive method must be developed with which to examine the products of the prehistoric potter. Design analysis must be made on several levels. In addition to a somewhat intuitive appraisal of the style of design, the decoration must be broken down into elements of design. Presence or absence of elements, relative frequencies of elements, and preferences for particular combinations of elements may provide the clues to identifying the various traditions. To obtain these data, sensitive field work providing adequate and random sampling within the geographical and social units proposed was mandatory.

To obtain the raw data on which to base our study, two types of field work were necessary. To isolate the lineage tradition, it was necessary to study the ceramics from at least one carefully excavated site with an excellent yield of painted pottery. To delimit other traditions a number of roughly contemporary sites within the same natural area (such as a single valley) had to be visited and large surface collections made. It was necessary to visit sites in other valleys and make surface collections to delimit the areal or "valley" tradition.

Pottery recovered from the excavated site provided data for the identification of the lineage tradition. Pottery from different parts of the ruin may reflect this tradition if the lineage(s) were localized since trash (including broken pottery) would tend to be thrown into the refuse closest to the living area. Nearby contemporary sites produced data to identify ceramic differences on the level of the village tradition. Pottery from sites in the same valley compared to the ceramics produced in neighboring valleys provided data for the delimitation of the areal or "valley" tradition.

In order to test the hypothesis indicated above, it was decided to concentrate field operations within a long and relatively narrow valley east of Snowflake, Arizona. This decision was made for several reasons. Our survey file (Martin, *et al.*, 1960; Martin, *et al.*, 1961a) indicated that within this valley were a number of roughly contemporary sites dating about A.D. 1100. Just east and north of this valley were several other valleys in which we had recorded sites from the same time period. It appeared to be an ideal situation to test the hypothesis.

To augment the data recovered from the Carter Ranch Site, an intensive archaeological survey on foot of the entire valley was undertaken. A large and random collection of artifacts and pottery was taken from each

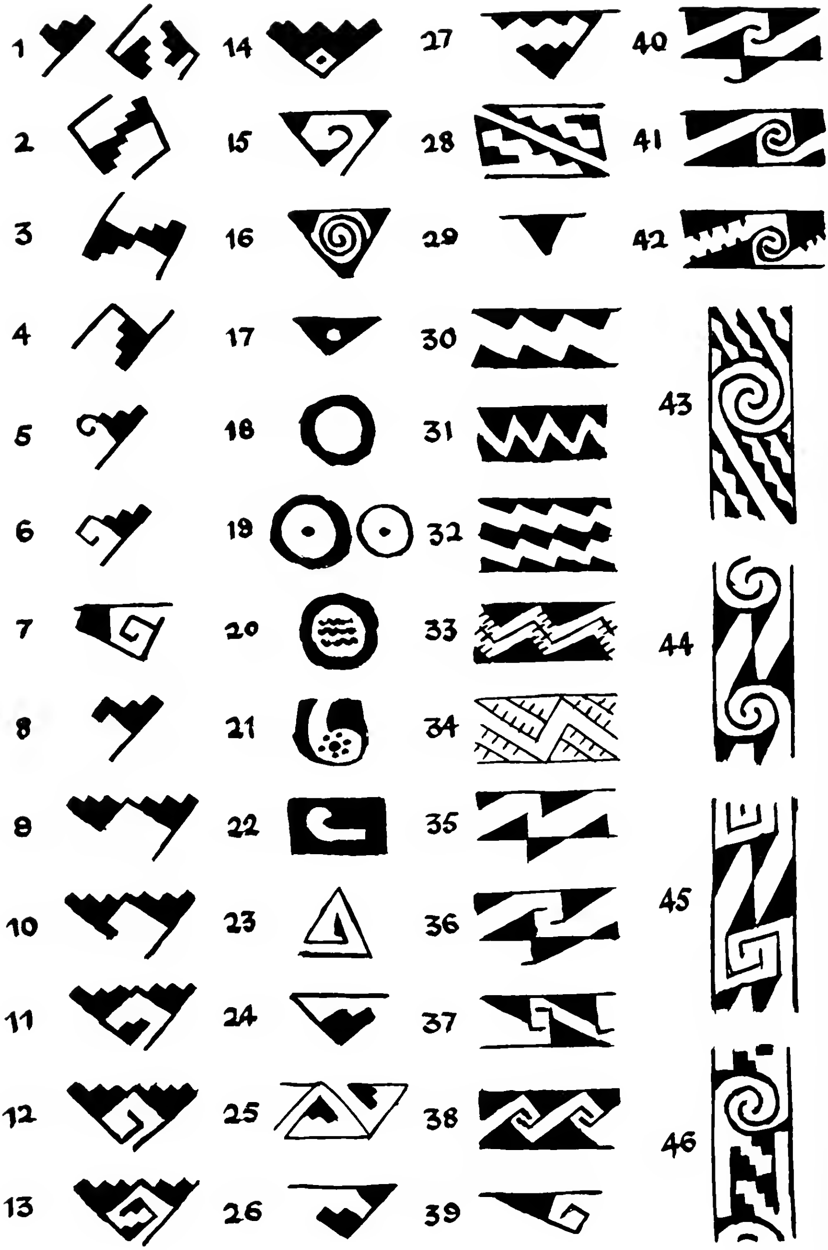

FIG. 61. Elements of design from the Black-on-White ceramics.

Design elements in figs. 61–64 are numbered for convenience in future comparative studies.

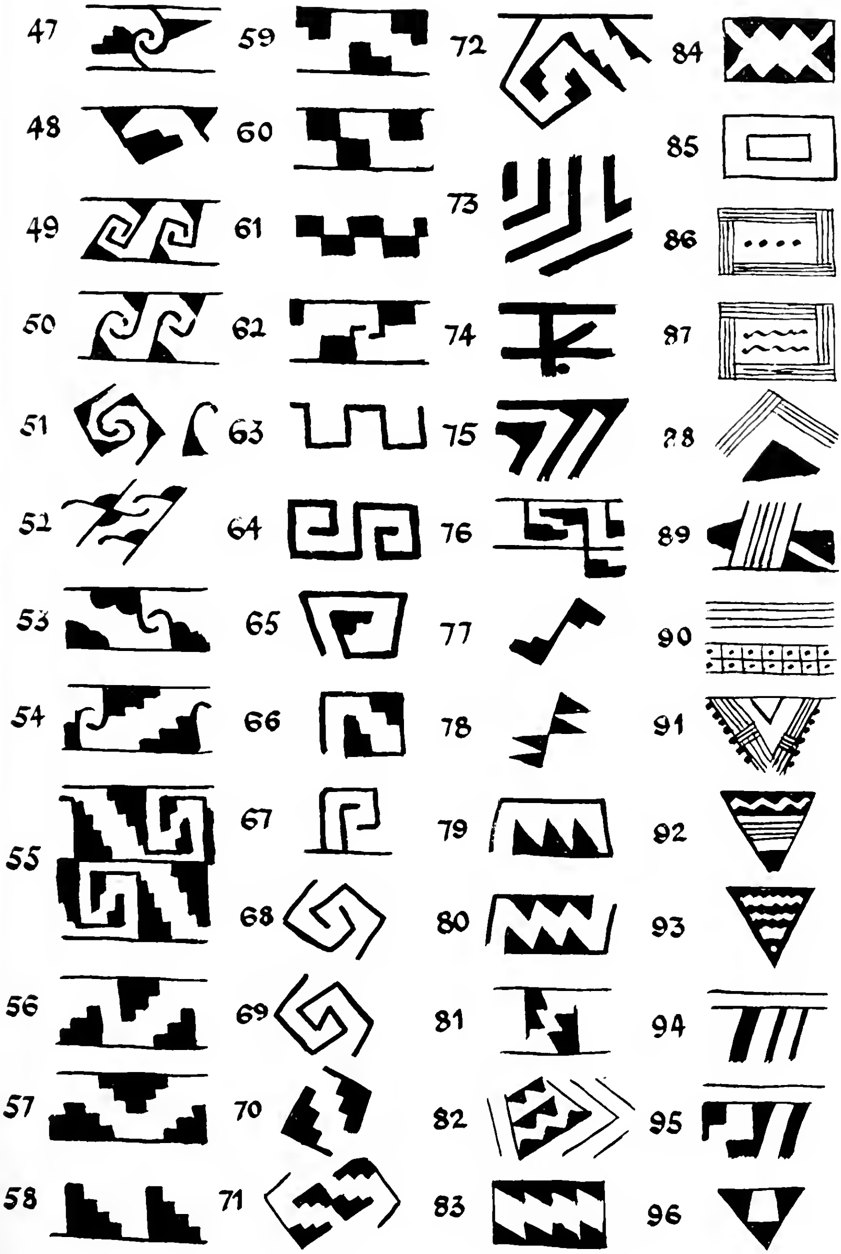

Fig. 62. Elements of design from the Black-on-White ceramics.

site. Valleys to the north and east were also surveyed. These data augmented with collections from survey work in previous seasons provided our surface sample for the analysis.

On the basis of field analysis, one site (LS-211) was selected for partial excavation. It is a five-room pueblo with an associated trash midden located about three miles west of the Carter Ranch Site in the main valley. Field analysis of the surface collection indicated that this site was contempoarary with the Carter Ranch Site. For this reason as well as its proximity to the main site, it was decided to take an excavated sample to act as a control. The trash area was extensively trenched and one room was excavated. Work was concentrated in the midden as our interest was in a large ceramic sample.

All pottery from both the surface collections and the excavations was washed and classified in the field, bagged according to location and sent to the Museum for analysis.

THE ANALYSIS

The first step in the analysis was to cull the usable sample of pottery from the more than 15,000 decorated sherds from the excavated and surface collected samples. It was decided to utilize only black-on-white sherds and only those sherds which had at least one complete element of design. With this selection in mind, all the sherds were sorted and the sample of black-on-white sherds was taken, consisting primarily of Snowflake Black-on-White.

A simple numerical code was designed to cover all cultural units and stratigraphic positioning for the excavated sample; each sherd was stamped with its coded location. The surface sample was stamped with survey site numbers.

When this sorting was complete, a total sample of 6,415 black-on-white sherds was usable for analysis. This sample consisted of 4,160 from the Carter Ranch Site, 303 from LS-211, and 1,952 from the surface collections. Surface collections of fewer than 30 usable sherds were discarded.

The next step in the analysis was to define the elements of design used on the black-on-white pottery. It was decided to work first with the smallest units of design and to combine units later if statistically relevant. For an artistic analysis, Shepard (1948, pp. 211, 291–292) has suggested that the use of design elements proves to be of little value, if not misleading. A design analysis of pottery should be made in terms of units of decoration such as bands or panels. For our analysis, however, we hoped to define elements that would not be consciously selected from an artistic point of view. Rather, we hoped to isolate the smallest units or elements of design that would be non-consciously selected based upon learning patterns within the social frame. The elements were defined from the sherds, the list growing as we progressed in the analysis. They are illustrated in figures 61 to 64.

The sherds were sorted by element and by location. The frequency of element occurrence by cultural unit for the excavated samples was recorded. Frequency of elements by site was recorded for the survey collections. The excavated samples were combined to permit overall site element frequencies from LS-211 and the Carter Ranch Site.

A site map of the Carter Ranch Site was reproduced and the distribution of each element in terms of relative frequencies per cultural unit at the site was plotted. In addition, at the Seabergs' suggestion, similar elements were grouped and the distribution of these groupings was plotted for the excavated and surface samples.

The distribution maps for the groups of elements and selected "sensitive" elements at the Carter Ranch Site, as well as the relative frequencies of elements and element groups for each site analyzed in this study are published (Martin, *et al.*, 1964). The sherds, the complete distribution maps and detailed recording of element distribution by level and square for the Carter Ranch Site are available for study at the Department of Anthropology, Chicago Natural History Museum.

ETHNOGRAPHIC BACKGROUND

Localized matrilineages or lineage segments are well documented in both recent and older ethnographic reports. A description of this pattern for the Western Pueblos, both in terms of sociology and demography, is given by Eggan (1950, pp. 299–300), Roberts (1956), Stevenson (1904, pp. 305, 427), Mindeleff (1900), and Donaldson (1893, pp. 47, 128).

One excellent study has been made of pueblo ceramics. This is the well-known ethnography by Bunzel (1929) in which much data pertinent to our analysis is recorded.

Bunzel discusses the origins of ceramic designs and the operation of the lineage or lineage segment in passing these designs from generation to generation. She writes (1929, p. 54): "The great source of decorative ideas is, of course, tradition. This has frequently been reported about primitive art, and present evidence strengthens this conclusion. All women state that they learned from their mothers not only the techniques of pottery making, but also the particular designs and style of decoration

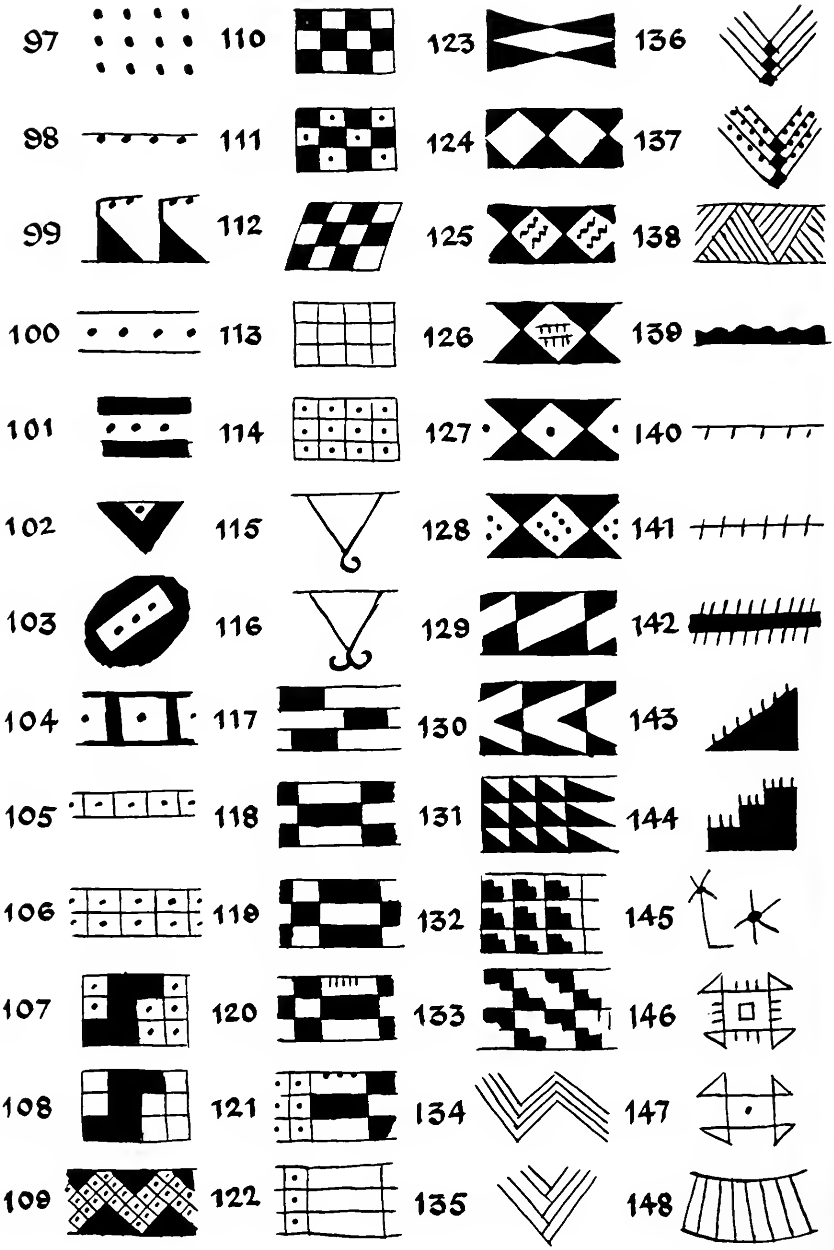

FIG. 63. Elements of design from the Black-on-White ceramics.

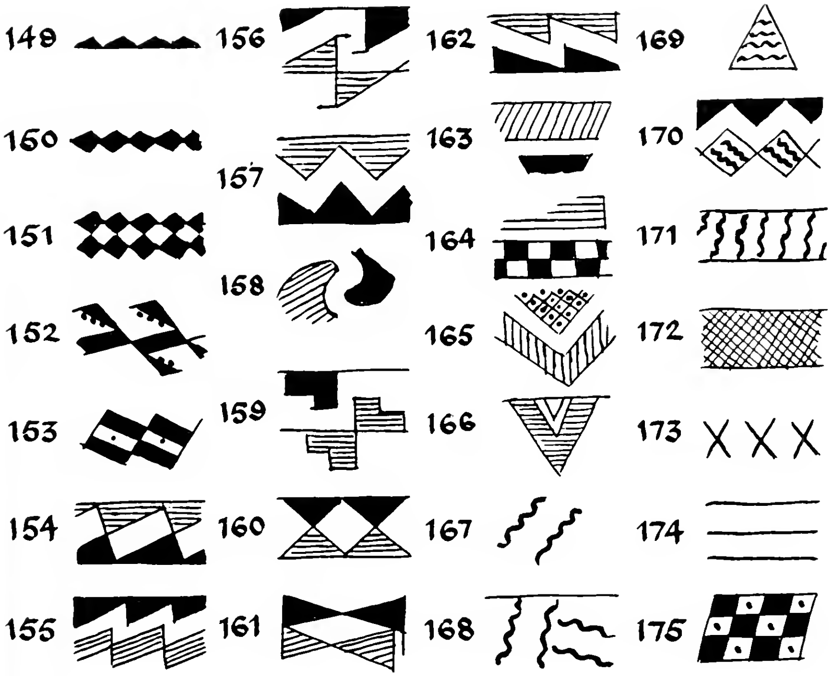

FIG. 64. Elements of design from the Black-on-White ceramics.

which they use. Where they have learned designs from other sources as well, they generally express a preference for the 'old designs,' always meaning by this the designs used by their mothers."

Also that: "The impression of uniformity in the vessels of any village is based on rather elusive traits. It is, in one sense, more apparent than real." (*op. cit.*, p. 8)

Bunzel also discusses what I have called the village ceramic tradition. She was able to delimit village ceramic traditions within types (*op. cit.*, p. 4; pp. 86–87).

RESULTS AND CONCLUSIONS

The overall results may be summed up by stating that on all levels of analysis there is a definite non-random distribution of elements and element groups. There is a probability of about one in a million for this distribution to occur with such consistancy as a result of chance alone. There must be factors operative in this distribution other than random sorting.

When the distribution maps of elements and groups of elements for the Carter Ranch Site were completed, a two-fold pattern emerged (figs. 65–67). Roughly 60 per cent of the elements showed a pan-village distribution, that is, there were no clusterings apparent for these elements. Those particular elements were utilized in ceramic decoration with approximately the same frequency in all parts of the village.

For the remaining elements, however, quite a different pattern emerged. Definite clustering was noted for these "sensitive" elements. When a cluster occurred at one end of the site, the element occurred in a low frequency at the other. When these clusters were correlated, two "cluster areas" were suggested for the site. These areas were the rough north half and south half of the pueblo.

Correlating with the clustering of design elements were data from the architectural analysis and the statistical analysis of the pottery type distributions. The analysis of the building sequence of rooms suggests that there were two major construction areas at the site. These correlated with the element "cluster areas." This building sequence indicated that there were two areas of construction which, as each expanded by the addition of new rooms, formed the rectangular pueblo (Chap. 1). Ethnographically, we know that it is this very pattern which characterizes the construction of new rooms in the Western Pueblos in historic times. As daughters marry, the localized matrilineage maintains its spatial corporateness by adding rooms to the original household to accommodate the increase in the number of individual members (Eggan, 1950, pp. 297–299).

The correlation between pottery types and room features (Chap. 5) suggests a series of functionally specific room types which combined as structural units to form the pueblo. This residential pattern is also characteristic of Western Pueblo localized lineage or lineage segment demography.

In all, the evidence points to the occupation of this pueblo by two localized lineages or lineage segments. Design element clustering correlates with the areas of the site which appear to have been occupied by localized descent groups. The non-random occurrence of the elements can be best explained by returning to the original hypothesis: that there are strong indications that the Carter Ranch Site was occupied by two matrilineal descent groups, practising matrilocal residence.

When we examined the element distribution by village, we noted that no two villages were identical in the relative frequency of the various elements or element groups. This finding added support to our suggestion of a village ceramic tradition. We do note, however, that the relative frequencies of elements were more similar for some groups of sites than for others.

To explain this fact we must turn to the spatial distribution of the sites in our analysis. In terms of element frequencies by site, the sites in the rough southeastern half of the main valley were more similar to one another than to those in the northwestern half. This correlated with the presence of two Great Kivas in the valley. One Great Kiva was at the Carter Ranch Site in the approximate center of the southeastern half of the valley; the other was at LS-228 in the northwestern half.

I have suggested elsewhere (p. 209) that the presence of Great Kivas reflects ritual supports for multi-community solidarity, probably with economic overtones. The element distributions add weight to this suggestion.

Sites in the main valley when compared to sites in other valleys were more similar in relative frequency of design element occurrence. The internal similarity in terms of relative frequencies of design elements held true for all valleys investigated in this study. This finding suggests the presence of an areal or "valley" tradition.

When the sherds from the Carter Ranch Site were submitted to a petrographic analysis, no paste or temper differences were found. This indicated that, at least in this area, pottery varied little technologically in terms of which group of women produced it. Upon analysis of sherds from a number of sites, both in the main valley and in other valleys, the same lack of technological difference was noted. Sherds made in a valley twenty miles distant from the Carter Ranch Site could not be distinguished petrographically.

These findings indicate the value of utilizing a detailed design element analysis to get at sociological information that might otherwise be missed. This approach has ramifications for the Type-Variety analysis of ceramics as used in the Southwest. The obvious conclusion is that this typological system is incomplete. If I had utilized the Type-Variety method, the correlations discussed in this chapter would certainly have been missed. It has now been demonstrated that beneath the level of the variety, there are a series of levels that lend themselves with profit to detailed analysis.

The analysis of design elements reported above has demonstrated three style traditions subordinate to the variety: (1) the areal or "valley" tradition, (2) the village tradition, and (3) the lineage tradition.

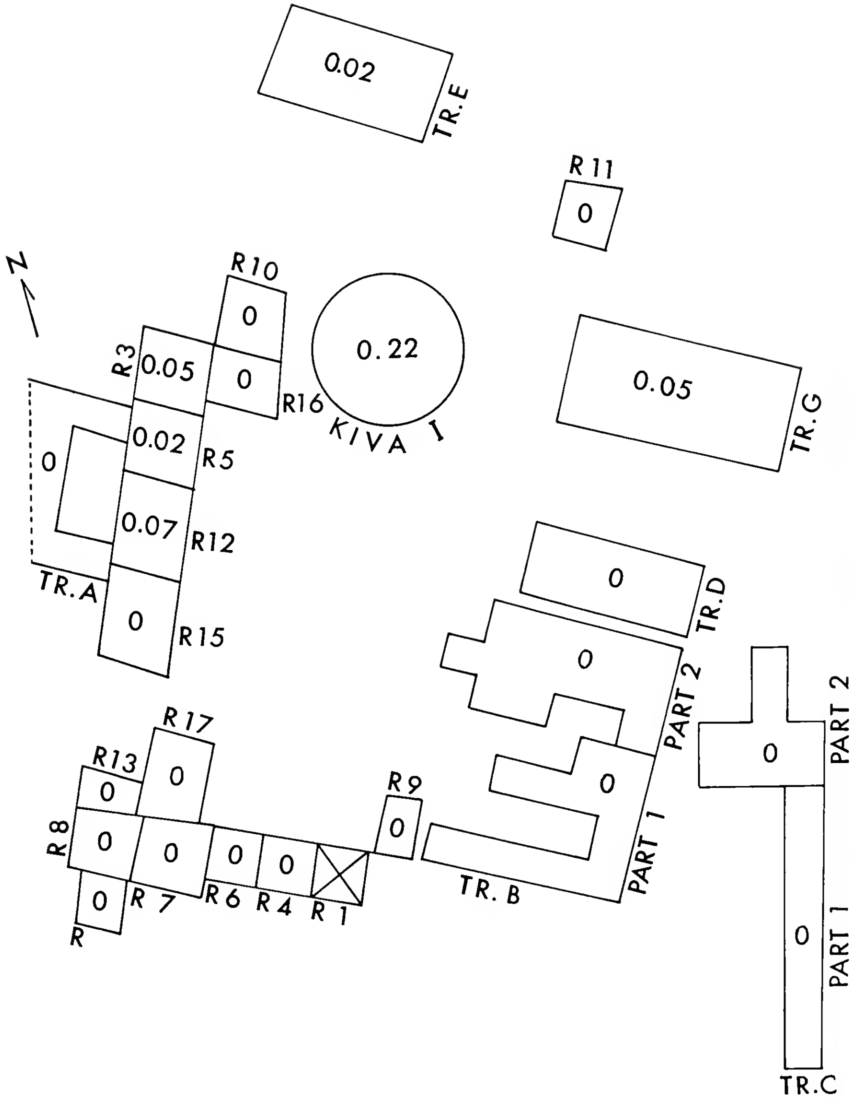

FIG. 65. Distribution in relative frequency of element no. 38.

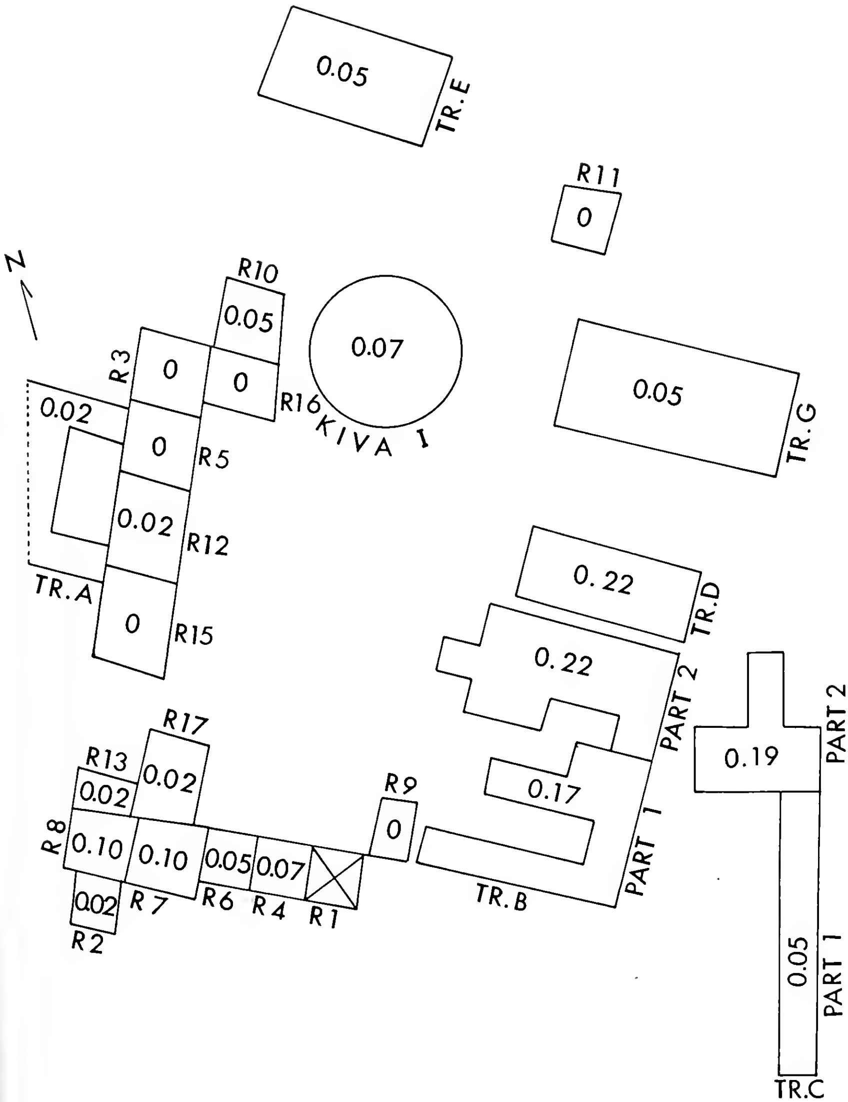

FIG. 66. Distribution in relative frequency of element no. 98.

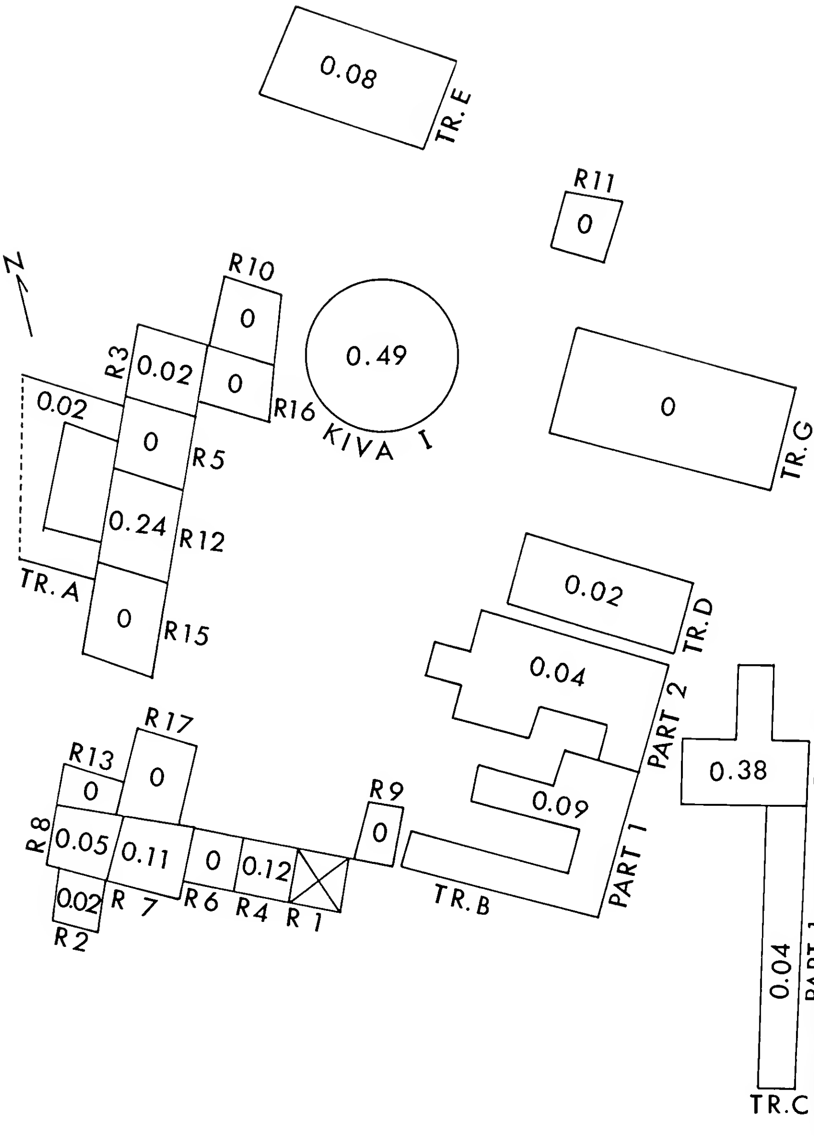

FIG. 67. Distribution in relative frequency of elements nos. 1–7.

VII. Paleoecology of Laguna Salada[1]

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ACKNOWLEDGMENTS

The writer wishes to express his gratitude to the various people who aided him during the course of this study, particularly Dr. Paul S. Martin of Chicago Natural History Museum and Dr. Paul S. Martin of the Geochronology Laboratories, University of Arizona, under whose National Science Foundation grants this research was made possible.

The investigator would like to thank Mr. Maurice E. Cooley of the United States Geological Survey, Ground Water Branch and Mr. Robert J. Drake, Department of Zoology, The University of British Columbia, for their donation of time and experience in the investigation and report on the geology and invertebrates from the sediments of Laguna Salada.

Acknowledgment must also be made to Dr. John Rinaldo of Chicago Natural History Museum and the many local people of the Vernon area who aided the writer in the collection of samples.

Thanks are also due Drs. Jane Gray and Kankichi Sohma of the Geochronology Laboratories for aid in the determinations of some of the critical pollen types.

Gratitude must be expressed to Dr. Charles T. Mason, Jr. and to many of the above people for their helpful suggestions and criticisms throughout the course of the actual research and in the preparation of the manuscript.

INTRODUCTION

As a result of the expanding knowledge of cultural history revealed to us by archaeologists, there has been initiated an intensive program to establish the environment of the prehistoric peoples of the semi-arid Southwest. One phase of this program is the establishment of a chronol-

[1]Contribution No. 58, Program in Geochronology, University of Arizona, Tucson.

ogy of vegetative change, or migration based on pollen records obtained from dated archaeological sites. While such sites afford an excellent opportunity of establishing a well-dated and useful chronology, the information regarding regional paleoecology may be ambiguous or misleading due to micro-environmental alterations resulting from economic and cultural activities of man as well as peculiar ecological conditions of the site during and after occupation. To place prehistoric man within his proper ecological frame work, it is then necessary to investigate areas other than sites of occupation in order to obtain an understanding of man's macro-environment.

Preliminary pollen chronologies have been prepared for northern and southern Arizona and extend back in time several thousand years; however, the northern Arizona pollen chronology (Schoenwetter, 1962) is based almost entirely on archaeological sites and is incomplete beyond 350 A.D. The purpose of this study was to extend the northern Arizona pollen chronology back into the late-pluvial period and to reveal post pluvial environmental history relatively uncontaminated by the activities of man.

PROCEDURE

The site chosen for study was a seasonally shallow, occasionally dry lake, Laguna Salada, located at an elevation of approximately 6,300 feet, between Show Low and St. Johns, immediately east of the ghost town of Floy (fig. 68). The present basin of Laguna Salada is approximately 0.8 square miles in area and receives water from a number of small springs and arroyos. Until recent years it contained a more or less permanent body of water in which fishing was possible.

In the walls of one of the larger arroyos ("West Arroyo", fig. 68), which enters the basin from the northwest, are exposed lake sediments deposited during a period when the lake was considerably deeper and covered a wider area. A series of 54 sediment samples from the banks of this arroyo and about 50 feet upstream from old bridge abutments was collected during the summer of 1960 by Mr. James Schoenwetter of the Department of Anthropology, Southern Illinois University. Following the collecting techniques outlined by Schoenwetter (1960), additional samples were obtained from this arroyo, several terrace levels and sand dunes on the shore of the lake, the center of the lake, and from a nearby cattle tank.

A careful field survey of the sediments exposed in the arroyo, the various terraces, and the sediments of the lake was made to clarify their

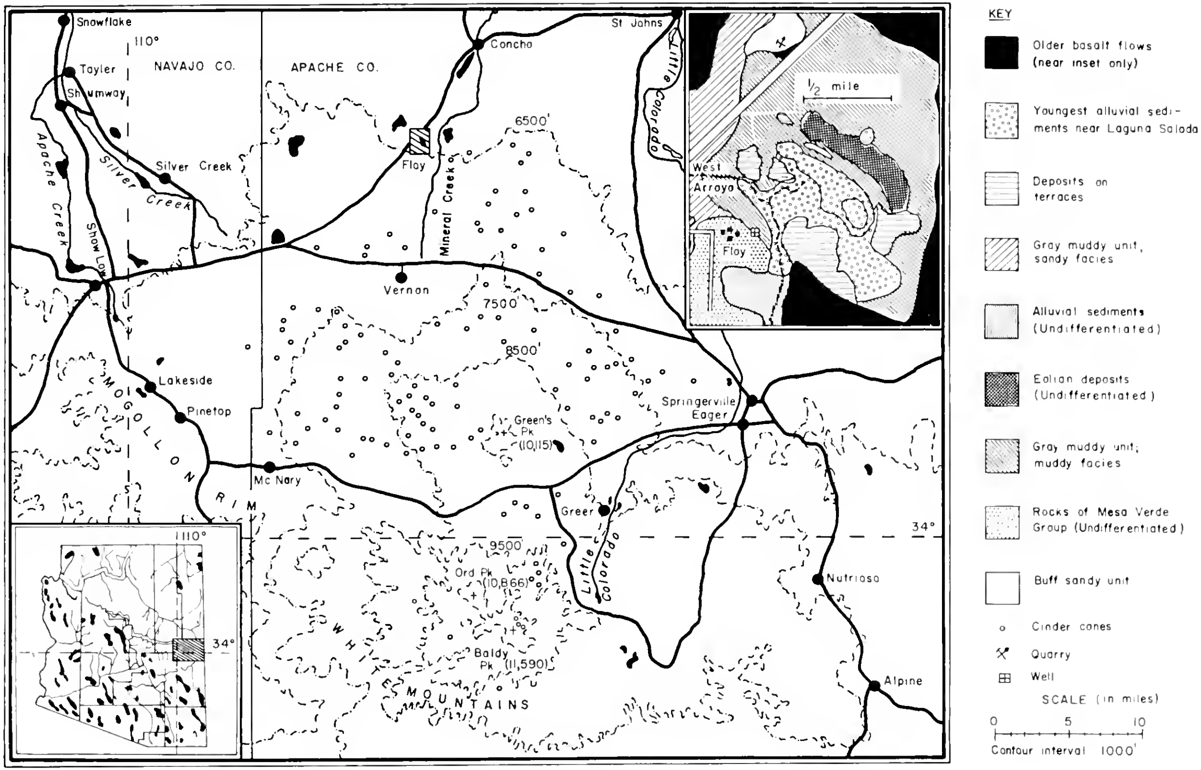

FIG. 68. Map of the White Mountains-Mogollon Rim area showing the location of the ghost town of Floy and nearby Laguna Salada.

relationship. This study was made by Mr. Maurice E. Cooley, of the Ground Water Division of the United States Geological Survey, University of Arizona, who also helped me in the collection of pollen C_{14} and gastropod samples from the arroyo. These samples were located in the near vicinity of the long series of samples collected by Schoenwetter. The gastropods were determined by Mr. Robert J. Drake, Department of Zoology, the University of British Columbia. The C_{14} samples were analyzed by the University of Arizona Geochemistry Laboratory.

Pollen was extracted from the sediment samples by Mr. Bernard C. Arms, Laboratory Technician, Geochronology Laboratories, University of Arizona. Following removal of the coarser material by panning or swirl techniques (Funkhouser and Evitt, 1959), the samples were prepared for pollen analysis by boiling HF and HCl for removal of silicates and carbonates and in 10% KOH and acetolysis solution for removal of humic acid and cellulose according to a schedule suggested by Faegri and Iverson (1950). Where necessary, the samples were also treated with NaClO for removal of lignin (Hoffmeister, 1960).

The residue was mounted on microscope slides in glycerin, stained with basic fuchsin, and covered with a No. 0 cover slip. These preparations were examined with a Zeiss binocular microscope utilizing a 12.5x ocular and 40x objective. Due to the great overabundance of various aquatic flowering plants in addition to numerous fungal, algal, bryophyte, and pteridophyte spores in some levels, 250 pollen grains of flowering plants generally considered to be nonaquatic were tabulated for each sample, but at the same time all other microfossils were also recorded. In some instances this necessitated counting more than one slide and also resulted in highly variable numbers of total microfossils counted. The relative abundance of non-aquatic flowering plants was calculated on the basis of 250 grains, and the percentages of aquatic flowering plants were determined on the basis of total flowering plant pollen. The relative abundance of other microfossils was determined on the basis of all microfossils (including pollen).

PRESENT CLIMATE

There are no weather records for the Laguna Salada area; but based on long-term United States Weather Bureau records compiled by W. D. Sellers (1960) from the nearby towns of Show Low, Springerville, and St. Johns, it can be stated that the climate of this area may be characterized by seasonal, meager, undependable, and variable rainfall (10–20 inches), as well as extreme diurnal and seasonal temperature ranges (15–25° F.

daily variation and as much between seasonal means). In this region the greatest amount of precipitation occurs in the form of torrential thunderstorms during the summer months when the mean temperature is approximately 70° F. The remainder of the precipitation falls primarily in the form of snow or rain during the winter months when the mean temperature is approximately 33° F.

LOCAL VEGETATION

Although classified by some workers as pinyon pine-juniper woodland (Nichol, 1952) and by others as grassland (Humphrey, 1955), the Laguna Salada is actually transitional between the two, and perhaps is best described by the term Savana-Woodland coined by Danserau (1957). Due to extensive volcanism, this region is vegetationally heterogeneous as a result of great edaphic variability in soils developed from ash, cinder, and lava or older sedimentary formations protruding through these rocks and soils of volcanic origin. On the ash and cinder areas, or the relatively deep soil developed from them, extensive grasslands have become established. The grasslands in the Laguna Salada area are composed chiefly of wheat grass (*Agropyron smithii*), grama (*Bouteloua* spp.), muhly (*Muhlenbergia* spp.), three-awn (*Aristida* spp.), and galleta (*Hilaria jamesii*); but in the vicinity of the alkaline, barren lake basin saltgrass (*Distichlis stricta*) and alkali-sacaton (*Sporobolus airoides*) also become abundant. Interspersed with the grasses (Gramineae) are many herbs belonging to the sunflower family (Compositae) such as snakeweed (*Gutierrezia* spp.), pingue (*Hymenoxys* spp.), fleabane (*Erigeron* spp.), goldenweed (*Haplopappus* spp.), paperflower (*Psilostrophe* spp.), zinnia, and aster. In sandy or gravelly soils, shrubs such as sagebrush (*Artemisia* spp.), mormon tea (*Ephedra* spp.), and saltbush (*Atriplex* spp.) occur with the grasses, while on the finer textured, more alkaline soils greasewood (*Sarcobatus vermiculatus*) and shadscale and chamiso (*Atriplex confertifolia* and *canescens*) are of more frequent occurrence.

On the more shallow soils or bare rock outcrops shrubs such as Apache plume (*Fallugia paradoxa*), cliffrose (*Cowania mexicana*), service-berry (*Amelanchier* spp.), black-brush (*Coleogyne ramosissima*), mountain-mahogany (*Cercocarpus* spp.), fernbush (*Chamaebatiaria millefolium*), barberry (*Berberis fremontii*), antelope-brush (*Pursia tridentata*), and squawbush (*Rhus trilobata*) are of frequent occurrence. These shrubs are generally associated with and frequently dominated by juniper (*Juniperus osteosperma*) or pinyon pine (*Pinus edulis*). Oak (*Quercus gambelii*) may also be present but usually in rather limited stands.

In the fine-textured, moist soils bordering the few permanent springs, seeps, creeks, and lakes, a distinctive assemblage of herbaceous species occurs in association with willow (*Salix* spp.), seep-willow (*Baccharis* spp.), and occasional tamarisk which has escaped from cultivation. The herbaceous species which are most conspicuous in such moist habitats consist of grasses, sedges, rushes, various species of the genera *Rumex* and *Polygonum* (Polygonaceae), and numerous representatives of the goosefoot family (Chenopodiaceae).

At Laguna Salada there is a conspicuous change in the composition of the vegetation with increasing distance from the center of the barren lake basin. The vegetation immediately surrounding the lake and nearby springs or seeps is composed predominately of representatives of the genus *Amaranthus* and various species of the Chenopodiaceae ("Cheno-Ams" of Martin, Schoenwetter, and Arms, 1961). There is a transition from vegetation dominated by "Cheno-Ams" to vegetation composed primarily of grasses with sedges and representatives of the Polygonaceae in the more moist areas. On the sedimentary rock outcrops ringing the basin, dense stands of junipers and other shrubs are most frequent, but a short distance away, on rocks of volcanic origin, pinyon pine also occurs. At slightly higher elevations on north-facing slopes of several of the nearby cinder cones, the juniper-pinyon pine complex is replaced by yellow pine forest (*P. ponderosa*). Other conifers such as fir (*Abies* spp.), spruce (*Picea* spp.), and Douglas fir (*Pseudotsuga menzesii* var. *glauca*) do not occur naturally any nearer than the White Mountains, which are less than twenty miles away. *Picea engelmannii* is frequently cultivated in the nearby towns of Show Low, Springerville, St. Johns, Vernon, and Concho which ring this site, the latter two being less than 15 miles from Laguna Salada.

THE MODERN POLLEN RAIN

The pollen trapped in any particular sediment reflects the vegetation in or near the depositional environment, excluding such types as might be transported to that site by wind or water. Thus, if one has determined how the pollen types of the modern flora are represented in the modern pollen rain, it is possible to evaluate the significance of changes in the relative abundance of these pollen types in a fossil flora.

Samples of the modern pollen rain may be obtained in various ways, but in the semi-arid Southwest, one of the most convenient traps of modern pollen is provided by open cattle tanks (Martin, Schoenwetter, and Arms, 1961). On the northwestern shore of Laguna Salada there is a spring which has been diverted into an open cattle tank, around which there is a swampy area with abundant grasses, sedges, members of the Polygonaceae, and numerous "Cheno-Ams." Pollen from the sediments at the bottom of this cattle tank reflect the type of vegetation observed in the immediate vicinity of the site of collection (fig. 69).

It is also possible to obtain a sample of the modern pollen rain from the surface of the ground, and soil-surface samples were obtained from the lower terraces, while in the process of sampling these terraces to a depth of approximately one meter. It was interesting to note that these terraces proved to be sterile except for the surface samples; however, this is not too surprising since the sediments appear to represent near-shore deposits that are likely to have been subject to frequent desiccation due to fluctuating lake level and, hence, the pollen in them could have been easily oxidized. The interpretation of the surface sediments is more difficult since the two samples differ significantly from one another. Both sites of sampling are considerably drier than the swampy cattle tank location, and the vegetation around them consists primarily of grasses. At soil-surface-collection-site No. 1, sedges were also plentiful and the soil was relatively sandy, while at soil-surface-collection-site No. 2, the soil appeared to be more of a clay loam. At the latter location several small arroyos were found and the surface of the ground showed evidence of erosion. Since the relative abundance of the various pollen types recovered from this latter site shows little resemblance to that recovered from the cattle tank, the pollen is best interpreted as being fossil and originating perhaps from pollen yielding sediments exposed not far away. The pollen recovered from the site with more sandy soil with sedges and grass shows close correlation in the relative abundance of the various pollen types with the plants which are growing in the immediate vicinity and does not differ too greatly from that recovered in the cattle tank and so can be interpreted as being modern. The drier site No. 1 differs from the cattle tank site in that the relative abundance of "Cheno-Am" and Compositae is about equal as shown by the pollen record (fig. 69). The low relative abundance of grass and the high abundance of fungal spores are probably related to the smutted condition of the grass growing at this site. Juniper, oak, Ephedra, and pine seem to be about equally represented at both sites, and their low relative abundance reflects their scarcity in the near vicinity. If anything, pine is somewhat over-represented and juniper is somewhat under-represented.

CENTRAL LAKE SEDIMENTS OF MODERN LAGUNA SALADA

The pollen profile (fig. 69) has been divided into four pollen zones on the basis of the relative abundance of the various pollen types. The sediments from the center of the lake, which are composed chiefly of mud, have been designated "Zone I" since they have been deposited most recently. In fact, deposition of sediments containing pollen is apparently continuing since the uppermost sediments from the lake contain pollen that is nearly identical to that of the modern pollen traps in the relative abundance of the various pollen types.

The pollen record obtained from the center of the lake is essentially uniform to a depth of about two meters. Pollen Zone I may be characterized by well-preserved and apparently nonredeposited pollen with low relative abundance of arboreal species and high relative abundance of nonarboreal species. This Zone generally has higher percentages of pine pollen and slightly lower percentages of "Cheno-Am" pollen than is recovered in surface samples from the shore of the lake; however, the lowest sediment samples in the lake contained "Cheno-Am" pollen in about the same relative abundance as that of the modern pollen rain. Pollen Zone I is further distinguished by the recovery of pollen of ditch grass (probably *Ruppia maritima* L.) and of milfoil (probably *Myriophyllum spicatum* L.). Pollen of *Myriophyllum* has been recorded only once before in the Southwest in sediments from Deadman Lake in the Chuska Mountains in northwestern New Mexico (Bent, 1960). Pollen of *Ruppia* has not previously been recovered from lake sediments in southwestern United States, although it has been recorded in coastal lake sediments from northern California, Oregon, and Washington (Heusser, 1960).

NEAR-SHORE DEPOSITS OF ANCIENT LAGUNA SALADA

Two distinct sedimentary units are exposed in West Arroyo and the lower unit, which is composed of buff-colored sands and gravels, proved to be sterile of pollen except for a calichified soil zone of undetermined age (fig. 69). The upper sedimentary unit, which is composed of gray clay and mud with lenses of silt, sand, and fine gravel, was very polliniferous. The remaining pollen zones refer to pollen extracted from the sediments of this unit, which thins and pinches out against an ancient shore some distance upstream in the arroyo.

Pollen Zone II is characterized by an increasing relative abundance of nonarboreal pollen, particularly of the "Cheno-Ams" and decreasing percentages of arboreal pollen such as pine and spruce (fig. 69). The sediments of this zone contain a pollen record which differs from that recovered from modern pollen traps in higher percentages of "Cheno-Ams," lower percentages of grass, and slightly higher levels of arboreal pollen except for the uppermost samples which in one instance produced less pine pollen than is recovered in the modern pollen rain. Except for the uppermost sediments of Pollen Zone II and the lowermost sediments of Pollen Zone I, which contain similar relative abundance of the various pollen types, Zone II may be distinguished from Zone I by higher percentages of "Cheno-Am" and the scarcity of pollen from aquatic flowering plants, particularly that of *Ruppia*.

Pollen Zone III is characterized by increased relative abundance of arboreal pollen with nonarboreal pollen about equal to it (fig. 69). While "Cheno-Am" pollen appears in increasing percentages, the dominant nonarboreal pollen is that of the Compositae. Pollen of aquatic flowering plants is present in these levels but not as abundant as Pollen Zone IV nor as scarce as in Pollen Zone II. Pollen of the grass family shows a slight increase in this zone.

Pollen Zone IV is characterized by high relative abundance of arboreal pollen and of aquatic flowering plants, but terrestrial flowering plants such as Compositae and "Cheno-Ams" are present only in relatively low percentages. This zone is further subdivided on the basis of the relative abundance of spruce, fir, and Douglas fir which achieve percentages of 10 to 24 per cent in subzone IVb, while in subzones IVa and IVc, their relative abundance is generally less than five per cent. Pine is present in relatively high percentages throughout Zone IV (usually 60 to 70 per cent), but in subzone IVc the percentage of pine declines to levels as low as 50 per cent. Pollen Zone IV is further characterized by the predominance of short-spined, wind-pollinated Compositae pollen, while in all other zones the long-spined, insect-pollinated types of Compositae pollen occur in equal or greater relative abundance than the short-spined pollen type. It is noteworthy that pollen of sagebrush or wormwood (*Artemisia* spp.) which is frequently encountered in other pluvial records from the Southwest is relatively scarce in the pollen record from Laguna Salada.

SHORE DEPOSITS

Two shore deposits were sampled to determine, if possible, their relationship to the lake and near-shore sediments. On the eastern shore of the lake there are rather extensive aeolian dust or sand dunes from which surface samples were taken. The pollen extracted from these samples appears to be very similar to that obtained from the near-shore sediments of Pollen Zone IV, but the pollen grains are very poorly preserved (fig. 69). The pollen grains of pine in particular show about 50 per cent breakage in the sand dunes, while in the near-shore sediments the breakage rarely exceeds 30 per cent, suggesting that pollen is reworked from Zone IV rather than deposited at the time of dune formation.

In addition to the aeolian deposits, sediments believed to be fluvial which fill a channel dissected by the same arroyo from which the lacustrine near-shore sediments of Pollen Zones II through IV were taken, also were sampled (fig. 69). The small channel from which the so-called fluvial samples were taken is located very near the ancient shore of the lake, and, of course, the sediments filling it may in part be lacustrine; but in any event, they differ from the nearby lacustrine sediments in being coarser textured and lighter colored. It is believed that they represent a facies change of the near-shore lacustrine sediments, having been deposited in running rather than still water (Cooley, personal communication). Two samples from the fluvial sediments yielded a pollen record which differs from Pollen Zone IV of the nearby lacustrine samples only in the presence of sedge pollen and the absence of *Myriophyllum* pollen. With some understanding of the associated stratigraphy, these differences can be explained as the result of changes of local vegetation associated with transition between lentic, lotic, and terrestrial environments. Pollen of *Myriophyllum*, for example, is most abundant in the permanent deep water of the lake as evidenced by the near-shore pollen, but its pollen is rare or absent in the putative fluvial deposits since this plant grows only in permanent, quiet water. Sedges tend to be somewhat more abundant around the margins of lakes and streams but do not extend far out into the permanent water, and this, too, is suggested by comparison of the pollen from the fluvial and lacustrine sediments exposed in West Arroyo since sedges are slightly more abundant in the putative fluvial sediments.

DATING

There are two C_{14} dates available for the Laguna Salada area, but they can be related only indirectly to the pollen diagram since the material on which they are based was not collected in association with the pollen samples obtained from West Arroyo in 1960. A date of 5300 ± 160 B.C. (A-256) was obtained on richly organic sediments exposed in the upper portion of the gray mud unit in West Arroyo at a depth of about one meter and 10–20 cm. above a conspicuous light-gray, sandy, silt layer with a little gravel in it. This sample was taken near the point of collection of the pollen samples obtained during 1960 about 50 feet upstream from some old crumbling bridge abutments. Lithological analysis of the sediment from which the 1960 pollen samples were removed shows that a similar gray, sandy, silt layer is found at a depth of slightly more than one meter. Comparison of the pollen obtained from the long series of pollen samples from West Arroyo and from the C_{14} samples shows very similar relative abundance of the various pollen types at depths of 60 and 100 cm.

TABLE 16.—COMPARISON OF THE 60 CM. AND 100 CM. LEVELS OF THE POLLEN PROFILE FROM WEST ARROYO WITH TWO POLLEN COUNTS FROM THE SAME SAMPLE ON WHICH A C_{14} DATE (A-256) WAS OBTAINED

		"West Arroyo" 60 cm. level	C_{14} sample (A-256)	C_{14} sample (A-256)	"West Arroyo" 100 cm. level
≠	*Pinus*	28%	28.4%	25.6%	30.4%
≠	*Picea*	0	0	0	.8%
≠	*Juniperus*	2.8%	3.2%	3.2%	4.4%
≠	*Quercus*	.8%	1.6%	1.6%	.4%
≠	*Ephedra*	1.2%	.8%	1.2%	.8%
≠	Gramineae	13.6%	8.8%	10.8%	12.0%
≠	"Cheno-Ams"	17.6%	30.4%	27.6%	32.8%
≠	Compositae	34.0%	24.4%	29.8%	18.0%
	Low spine	12.8%	10.8%	15.2%	7.6%
	High spine	21.2%	13.6%	14.6%	10.4%
≠	Leguminosae	.4%	.4%	.4%	.4%
≠	Euphorbiaceae	.4%	.4%	.4%	.4%
≠	Cruciferae	0	.8%	.8%	.4%
≠	*Kallestromia*	0	0	0	.4%
+	Cyperaceae	1.2%	6.2%	2.7%	3.8%
+	*Myriophyllum*	1.6%	.4%	0	.8%
+	Unknowns	0	1.2%	1.2%	.4%
*	Algae				
	Botryococcus	.4%	.4%	.6%	.4%
	Pediastrum	0	.4%	.3%	0
	Synura	0	1.2%	.9%	1.9%
*	Spores				
	Pteridophytes	.4%	.4%	.4%	.4%
	Bryophytes	0	.4%	.4%	.4%
	Fungi	0	4.0%	1.5%	.7%
	Σ Pollen	257	270	288	263
	Σ count	259	287	315	271

≠ % calculated on bases of 250 pollen grains of nonaquatic flowering plants.

\+ % calculated on bases of total pollen (including nonaquatic flowering plants).

* % calculated on bases of total count (including nonflowering plants).

The sediment sample from which this C_{14} date was obtained contained many rootlets which were methodically removed from the sample prior to processing. The date of 5300±160 B.C. is probably correct, but the possibility exists that all of the rootlets may not have been removed and if this is so, then the 5300 date should be somewhat older. As it stands, however, this date is in close agreement with dates for the initiation of the Hypsithermal in western North America which generally range about 6000 B.C.

Another C_{14} date of 1550±60 B.C. (GRO-1614) was obtained on charcoal removed from a pre-pottery camp site hearth at a depth of two to eight inches in sediment similar to that of the gray mud unit exposed in "West Arroyo." Comparison of the pollen contained in the archaeological site (Schoenwetter, 1962) and in the upper sediments of the nearshore deposit exposed in "West Arroyo" shows similar relative abundance of the various pollen types. Unfortunately, the date is applicable only to the archaeological material, but it does give a terminal date before which deposition of sediment had stopped at this site.

PALEOENVIRONMENT OF THE LAGUNA SALADA REGION

The Laguna Salada region is of interest because the sediments from this area contain pollen disclosing the vegetational history of the major arboreal elements which have been important in the recognition of the paleoecological effects of Pleistocene climatic change.

The series of vegetational changes discernible in the sequence of samples from the Laguna Salada area (fig. 69) are similar to those observed in the pluvial-post pluvial records elsewhere in Arizona (Hevly and Martin, 1961; Martin, Sabels, and Shutler, Jr., 1961) and adjacent states (Bent, 1960; Clisby and Sears, 1956; Roosma, 1958; Wendorf, 1961). It must be remembered that these studies have all been done at different elevations and latitudes; hence, the species involved and their relative abundance as indicated by pollen percentages differ, but nonetheless reveal the same pattern.

This pattern, which is generally interpreted as a pluvial-post-pluvial sequence, is characterized in the early stages by relatively high abundance of pollen of species from vegetation zones found presently at a higher elevation. While the abundance of these species is initially high, it declines rapidly to levels similar to that of the modern pollen rain.

As in various sediments sampled elsewhere in southwestern United States, the more recent sediments of Laguna Salada (Pollen Zone I) contain a pollen record that is very similar to the modern pollen rain and, hence, reflect an environment that was more or less similar to the present. However, there are minor differences between the modern pollen rain and the pollen of the central lake sediments, such as the occurrence of pollen of *Myriophyllum* and *Ruppia*. The presence of these plants, due to their requirement of permanent water several feet deep for survival, indicates that sometime during the period of deposition of the central lake sediments, the climate of the Laguna Salada area was sufficiently different from the present for the establishment and maintenance of a permanent body of water. The halolimnetic *Ruppia* has no further ecological significance despite its occurrence in extremely arid portions of southern Arizona (Hevly, 1962), since it occurs up to elevations of 7000 feet throughout the Northern Hemisphere (Harrington, 1954; Mason, 1957).

Having ascertained from palynological evidence the previous existence of the lake, it is also possible to learn something concerning changes in lake level from the "Cheno-Ams" which today ring the lake, competing most successfully in saline habitats with some moisture, frequently in habitats which other species are unable to exploit, due to high content of soluble salts (for a more complete description of this phenomena, see Shantz, 1925). As long as salt concentrations remain tolerable, it is to be expected that this ring of "Cheno-Ams" about the lake will move in response to fluctuating lake level, either moving toward or away from the center of the lake with lowering or rising lake level, respectively. Changes, then, in the relative abundance of "Cheno-Am" pollen in lacustrine sediments reflect only the advance and retreat of the lake margins or increases or decreases of salinity—in other words, the stability of the shoreline. This is borne out in the diagram, since where "Cheno-Ams" are in great abundance aquatics all but disappear, except for sedge which grows under a wide range of environmental conditions. The converse is also true as shown by sediments in which *Ruppia* and/or *Myriophyllum* are abundant and "Cheno-Ams" are present in reduced relative abundance.

It is possible to interpret the minor fluctuations observed in the relative abundance of various pollen types from Pollen Zone I as the result of minor variations in the climatic pattern such as a shift from a predominately summer rain pattern to a climate dominated by winter rains. Such a hypothesis was advanced to explain pollen profiles from southern Arizona (Martin, Schoenwetter, and Arms, 1961) and it has been suggested that shifts between two such climatic patterns occur along a "tension zone" in northern Arizona at elevations of about 7000 feet (Glock, Argerter, and Smith, 1961). Seasonal growth studies of Arizona pines have shown that stem elongation and pollination occur in late spring in response to favorable soil temperature and moisture, the moisture being derived from winter precipitation since there is little rain from April to July (Little, 1938; Pearson, 1950). Winter precipitation is presently essentially negligible near Laguna Salada; hence the increased relative abundance of pine reflected by increased pine pollen would suggest increased winter precipitation.

It is also possible that human activities may be related to fluctuating pollen percentages, particularly those near the top of Pollen Zone I. The recent decline of pine percentages may be related to lumbering and clearing of land or agricultural purposes initially undertaken by Mormon pioneers in the late 19th century. Earlier increase in relative abundance of pine possibly is related to regeneration under more favorable climatic conditions following cessation of gathering of firewood and construction timbers by indigenous peoples in the late 14th century, when a sharp decline in population occurred. The recent expansion of juniper into the grasslands, noted both in northern and southern Arizona, is also discernible in the pollen record and, as suggested by other workers, is probably related to agricultural practices, but may also be climatically controlled, at least in part (Nichol, 1952; Humphrey, 1958). It is interesting to note in this regard that arroyo cutting, which is often blamed on changing climate and/or poor grazing practices of domestic animals, is thought to have begun about the same time that juniper and other shrubs began to expand into the grasslands; namely, about the end of the 19th century (Bryan, 1925; Hastings, 1958–1959; Humphrey, 1958).

It is possible the lowermost sediments sampled from Modern Laguna Salada may actually correspond to the uppermost sediments of Ancient Laguna Salada exposed in "West Arroyo"; however, it is equally possible that there is a time gap of several thousand years during which the basin of Modern Laguna Salada was excavated and the dunes on the eastern shore were formed. Classically, deflation and dune formation are considered to have occurred under arid conditions; however, the dunes on the eastern shore of Laguna Salada are active under the semiarid climate of today, suggesting that dune formation may have occurred intermittently during the past several thousand years under a climate not too dissimilar to the present.

Pollen Zones II and III fall into the time period generally referred to as the Altithermal (5500–2000 B.C.) or Hypsithermal (7500–0 B.C.), postglacial periods generally conceived to have been warmer and drier than the present at high latitudes and under humid environments (Antevs, 1955; Deevey and Flint, 1957). Palynologically, this time period is recognized in northwestern North America by maxima of Gramineae, Chenopodiaceae, and Compositae (Antevs, 1955; Heusser, 1960); however, in pollen profiles from Arizona (including Laguna Salada) there is as yet no evidence that this period was either warmer or drier than the present, since maxima of these families continue up till the present.

While there is no palynological evidence from Laguna Salada of a Hypsithermal that was warmer or drier than the present, there is nonetheless evidence of the initiation of an important climatic change from that inferred from the pollen of the preceding Pollen Zone IV. This change is apparently one of increasing aridity during which spruce, fir, and pine have retreated from the margin of Ancient Laguna Salada up into the mountains, surviving there in refugia. Evidence of increased aridity is also afforded by the aquatic plants which decline in relative abundance and are replaced by "Cheno-Ams" as the lake margin moves inward. Despite evidence of increased aridity in comparison to Pollen Zone IV, climatic conditions at least within portions of Pollen Zones II and III appear to have been more moist and cooler than the present.

Pollen Zone IV with its great abundance of arboreal elements differs, of course, greatly from the modern record, and it is to be expected that the environmental conditions also were significantly different. It would appear that spruce, fir, and pine descended to the margin of Ancient Laguna Salada, under cooler and more moist climatic conditions than the present. Pollen Zone IVb possibly represents the Wisconsin maximum.

The interpretation of climate from a pollen record rests on the ecological significance of various groups of plants. Spruce and fir grow naturally today at considerably higher and more moist sites (8,100–11,000 feet, except in cool, moist canyons where they may descend to quite low elevations along the Mogollon Rim). They are easily grown under cultivation in nearby Show Low, Snowflake, and Springerville; however, their pollen is not presently carried this short distance to the modern pollen traps on the margin of Laguna Salada.

In the Santa Catalina Mountains of southern Arizona, where fir and Douglas fir grow mixed with pine, less than five per cent fir and Douglas fir pollen is recovered from the soil under trees at an elevation of about 8000 feet. In southern Arizona this suggested an elevational vegetational depression of 3000 to 4000 feet to get comparable percentages of fossil pollen of fir and spruce in Willcox Playa at an elevation of 4135 feet (Hevly and Martin, 1961). However, in northern Arizona only 2000–3000-foot vegetation displacement is necessary to account for the percentages observed in Pollen Zone IV. This, of course, does not preclude the possibility of greater displacement.

The existence of a body of water coincident with the zonal vegetational depression of spruce, fir, and pine is demonstrated by the occurrence of abundant pollen of *Myriophyllum* and various algal types such as *Botryococcus* and *Pediastrum*. It is difficult to interpret the significance of the abundance of *Botryococcus* and *Pediastrum* other than to say they, like the moluscan remains, indicate the presence of a body of water (fig. 69). *Botryococcus* is usually found in eutrophic, hard, fresh water lakes (rarely in semipermanent pools) and in northern Arizona it is reported from elevations in excess of 6,500 feet from lakes and permanent pools with continuous inflow (Fritsch, 1951; Prescott, 1951; Smith, 1933; Taylor and Colton, 1928). *Pediastrum* is usually found in semipermanent or permanent pools or ditches and also fresh water lakes, but in northern Arizona is known only from permanent or semipermanent pools below 6000 feet elevation (Smith, 1933; Taylor and Colton, 1928).

The conditions under which permanent bodies of water of considerable size could have become established during Pleistocene time have been estimated by Antevs (1954) on geological evidence and by Leopold (1951) on climatic evidence, who estimate for the Lake Estancia region of New Mexico an increase in precipitation of about nine inches and a decrease in temperature of 5–16.2° F. (January and July means, respectively). These estimates are based on the lowering of the snow line by about 1,500 feet. A somewhat greater snow line depression has been indicated for the White Mountains by Melton (1961), and it might be reasonably assumed that climatic conditions during the Pleistocene were somewhat more severe at Laguna Salada.

SUMMARY

1. A comparison of modern pollen rain with pollen profiles obtained from lake and arroyo sections at Laguna Salada discloses a long period of climatic change from a humid, cool, pluvial climate inferred from comparatively high percentages of spruce, fir, and pine to a warm arid climate similar to the present, represented by pollen profiles more or less similar to the modern pollen rain.

2. The pluvial-post-pluvial pollen record obtained at Laguna Salada is similar to that detected in Arizona and adjoining states but is a longer record than has been previously recorded in the southwestern United States.

3. Two C_{14} dates of 1550 ± 60 B.C. and 5300 ± 160 B.C. may be related indirectly to this climatic change. The period of time spanned by these dates is approximately that suggested for the Altithermal, but no evidence is found to suggest that the climate was either warmer or drier than the present.

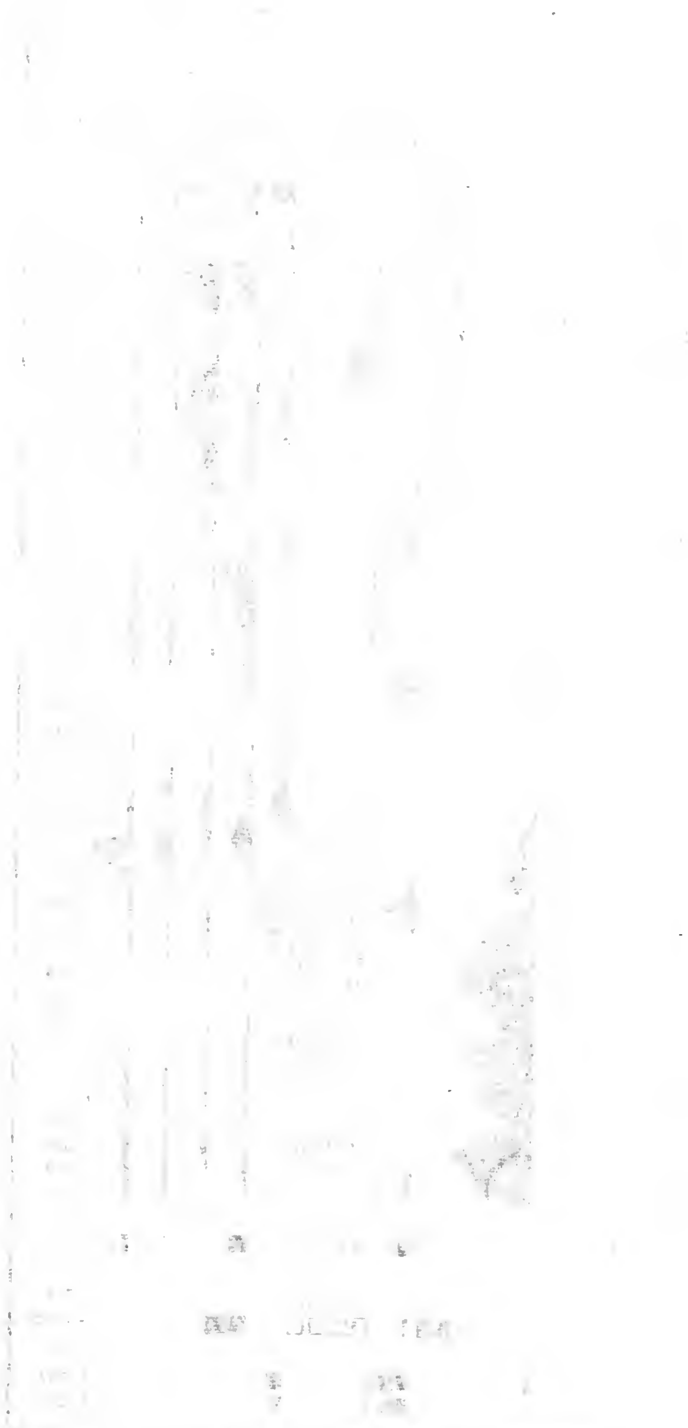

Fig. 6

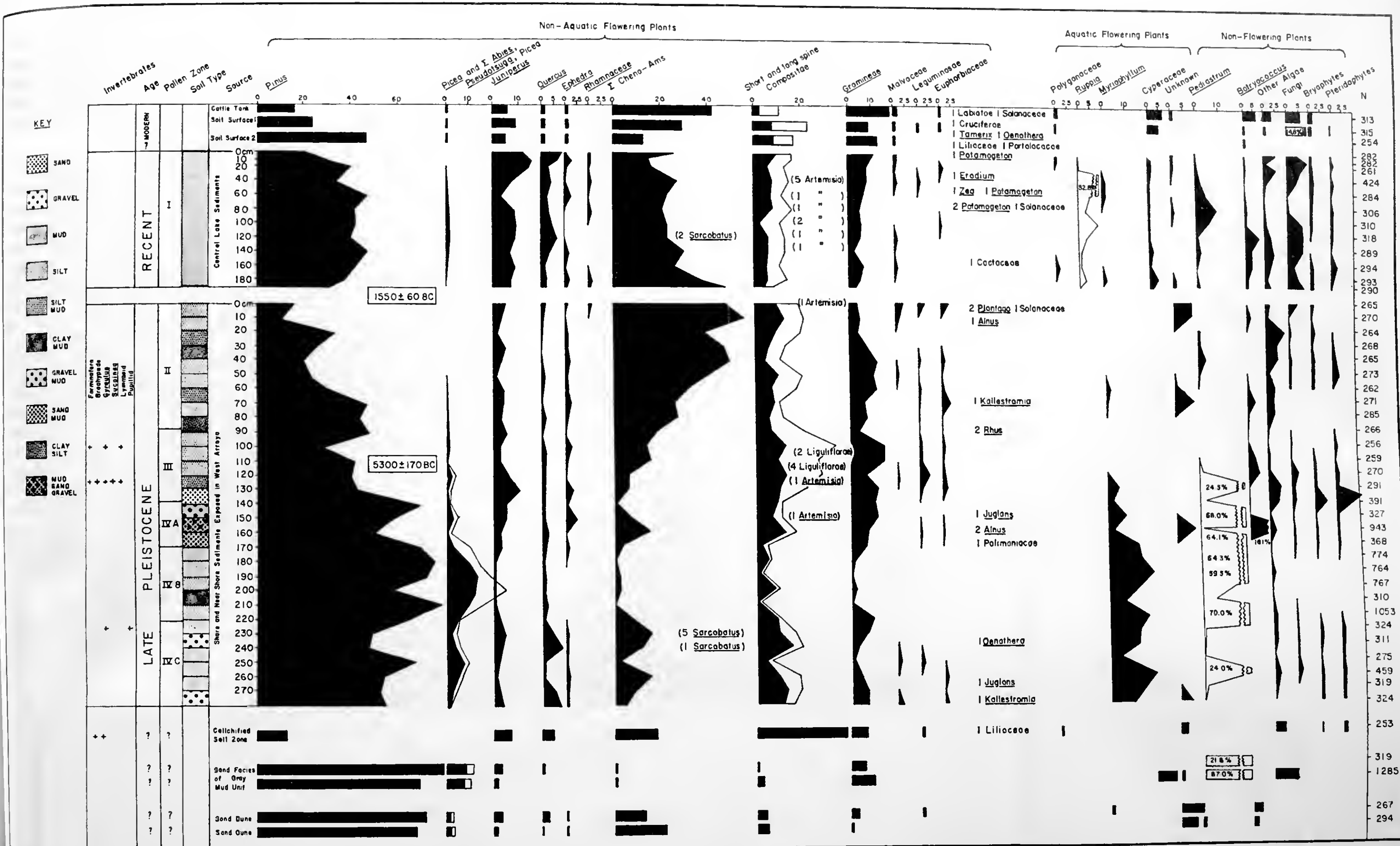

Fig. 69. Pollen diagrams of recent lake sediments of modern Laguna Salada and shore and near-shore deposits of Ancient Laguna Salada correlated with data on invertebrate remains and type of sediment. Invertebrate determinations by Drake (1962).

4. It is suggested that minor fluctuations of various pollen types in recent lake sediment may be related to minor shifts of climatic pattern dominated by either winter or summer rain. It is also suggested that these variations of pollen percentages may be due, at least in part, to the activities of man.

POST SCRIPT

Pollen studies of sediments from Laguna Salada have been continued since the above was written and have been the subject of the author's dissertation entitled, "Pollen Analysis of Lacustrine and Archaeological Sediments from the Colorado Plateau," submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the Department of Botany, University of Arizona 1964. These studies substantiate the initial conclusions reported here and provide additional data, some of which relate to the preceramic site on the beach of Laguna Salada. This site occurs on erosional remanents, whose persistence may be related to the concentration of prehistoric activity and accumulation of debris in the immediate area. Although deflation has removed some of the sediments of the final living surface, the site has several decimeters of depth and the pollen record from these sediments is dominated by non-arboreal pollen, particularly of Cheno-Ams with little if any algae or pollen grains of aquatic plants (Schoenwetter, 1962). This would suggest that the site was occupied during a low stand of the lake under conditions similar to the present. If so, the lake would not have served as a source of water or fish for the prehistoric aborigines as the small size, shallow depth and probably ephemeral existence would have resulted in accumulations of salts. Furthermore, permanent sources of fresh water were probably present in nearby streams just as they are today. It may be suggested that the prehistoric aborigines were attracted to the lake margins not by water or fish but by the abundance of Cheno-Ams whose seeds may have been a seasonally important food source. Seeds of this plant group are small but produced in large quantities and easily gathered, and their abundance in pueblo ruins of the vicinity attests to their utilization in more recent times.

VIII. Geology and Depositional Environment of Laguna Salada, Arizona [1]

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INTRODUCTION

Laguna Salada, an ephemeral lake, occupies a small interior-drained basin in the northern part of the White Mountains volcanic field, Arizona. It is near the abandoned settlement of Floy along U. S. Highway 666, about 18 miles northeast of Show Low and 11 miles southwest of Concho (fig. 70). Laguna Salada is at an altitude of 6300 feet in an ecotone between grassland and pinyon-juniper woodland.

Geologic work near Laguna Salada was chiefly by reconnaissance until World War II, after which geologic investigation of the Colorado Plateau was accelerated by the search for uranium ore and ground-water supplies. The principal geologic work in the Laguna Salada area was by personnel of the U. S. Geological Survey, and is contained in a preliminary report of central Apache County (Akers, 1962). The present investigation of the geology of the Laguna Salada area consisted of fieldwork by the authors in August, 1961. At this time, the alluvial deposits and some of the volcanic flows were mapped, the stratigraphy of the alluvial units was studied, and the positions of the pollen profiles and archaeological sites in the geological sequence were determined. The erosional and depositional events are summarized in Table 17.

REGIONAL GEOLOGIC SETTING

Laguna Salada and the adjoining area are on the broad Mogollon slope, in which the strata dip gently northeastward from the Mogol-

[1] Publication authorized by the Director, U. S. Geological Survey. Contribution No. 75. Program in Geochronology, University of Arizona, Tucson.

TABLE 17.—CORRELATION AND AGE OF THE DEPOSITIONAL AND EROSIONAL EVENTS IN THE LAGUNA SALADA AREA, ARIZONA

Period	Age	Radiocarbon dates and Christian calendar years	Geologic events along Little Colorado River	Geologic events in Laguna Salada area
QUATERNARY	Late Recent	1962	Deposition	Laguna Salada dry; dry lakebed provides material for increased eolian activity.
		1935		Formation of low terraces and deposits (Qs) around present Laguna Salada; multiple terrace levels indicate fluctuation of shorelines; lake probably dry intermittently; amount of wind erosion controlled by extent of lake.
		1550 B.C. (Radiocarbon)		Erosion with lowering of lake to essentially the present level; beginning of modern Laguna Salada; formation of lower terrace.
				Deposition of sediments (Qt_1) that cap the lower terrace.
	?		Erosion	Erosion; formation of higher terrace; deposition of some eolian sediments.
	Early Recent			Deposition of sediments (Qt_2) that cap the higher terrace.
				Erosion; terminated through drainage, ancestral Laguna Salada and the deposition of the gray muddy unit; depression of present Laguna Salada which is believed to have been caused by vigorous eolian activity; formed the bulk of the dunes (Qd) northeast of the lake.
	Middle and late Pleistocene	(5300 B.C. (Radiocarbon)	Wupatki cycle of erosion	Deposition of gray muddy unit in ancestral Laguna Salada.
				Deposition of buff sandy unit behind the lava barrier; the unit probably represents multiple periods of deposition.
	Late Pliocene and early Pleistocene		Black Point cycle of erosion	Drainage blocked and diverted by younger basalt flows (Qb).
				Erosion; shallow canyon was formed across older basalt flows northeast of Laguna Salada.
? TERTIARY				Eruptions that produced older basalt flows (QTb); these flows outline valley which is occupied by Laguna Salada.
				Deposition of older gravel (QTg) by generally northward-flowing streams.
				Major unconformity; stripping of younger units of Mesaverde Group and overlying sediments.
CRETACEOUS				Deposition of the Mesaverde Group, undifferentiated.

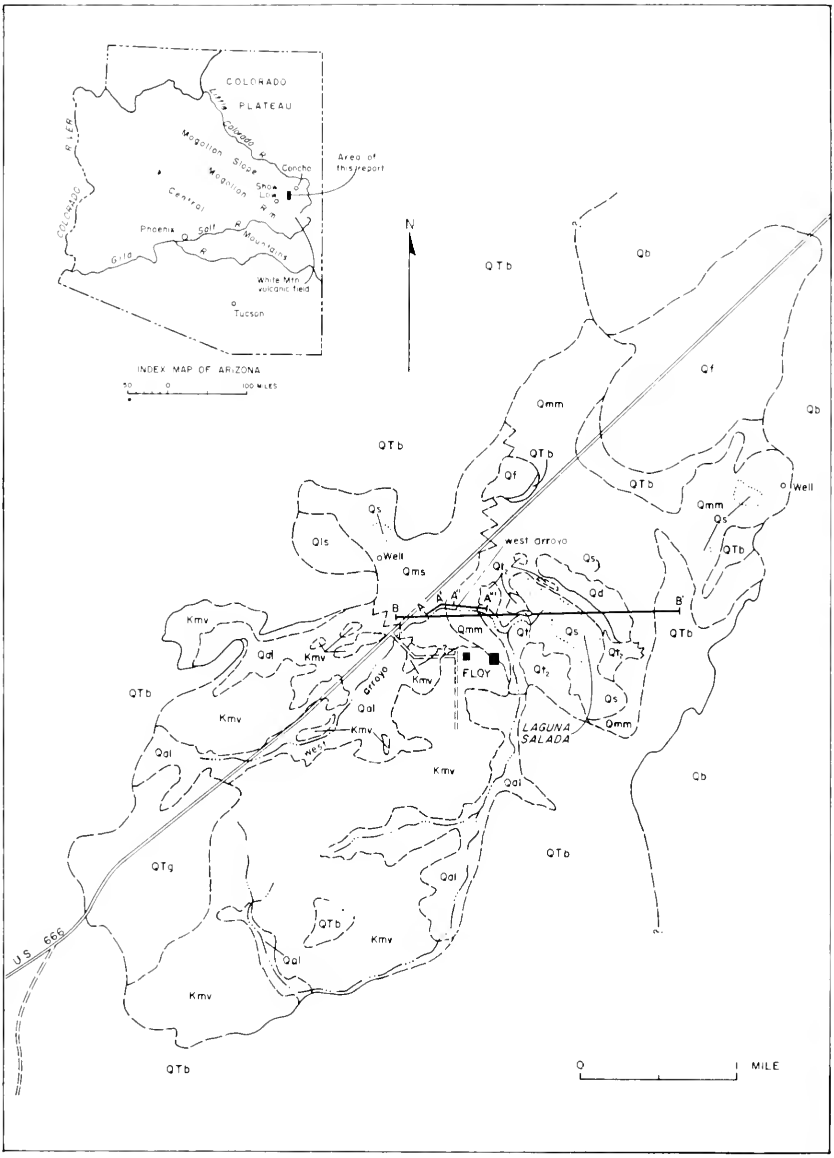

FIG. 70. Geologic map of the Laguna Salada area, Arizona, showing the locations of the sections.

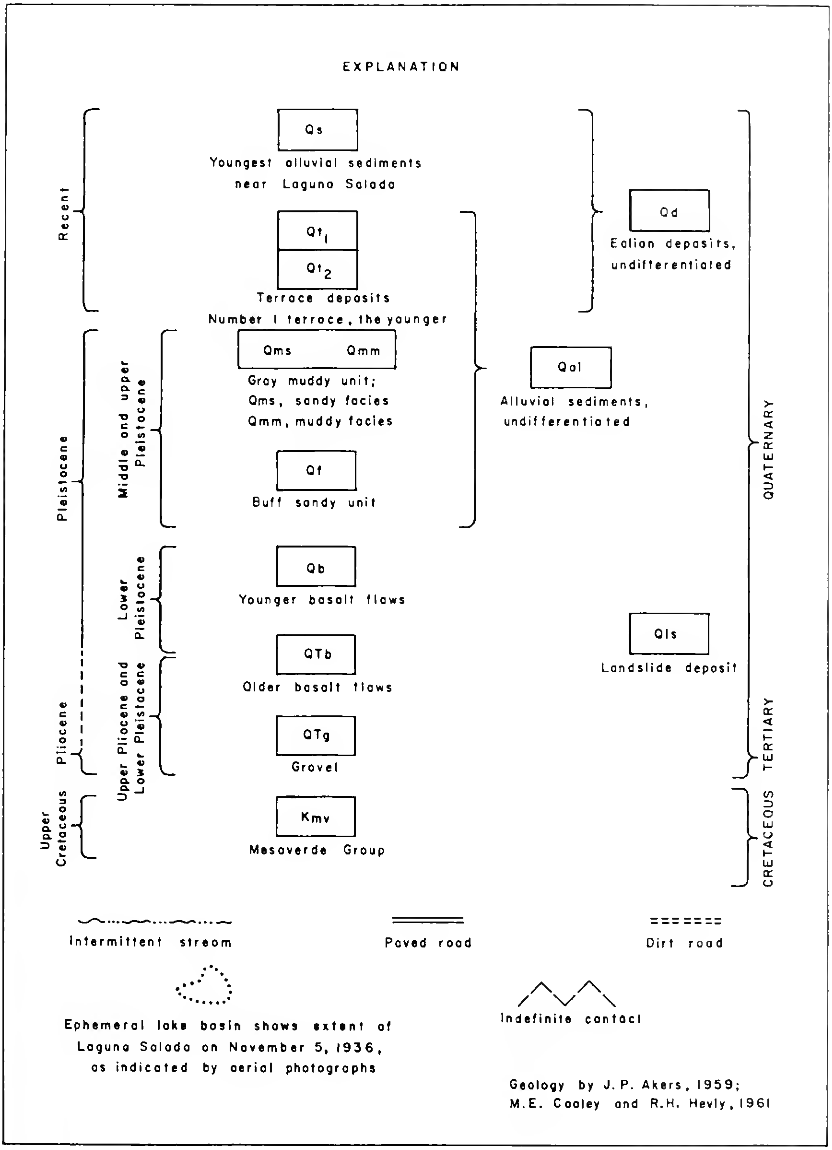

FIG. 70 (*continued.*) Explanation of Symbols.

lon Rim, the southern boundary of the Colorado Plateau, to the Little Colorado River. The whole region, except for small areas of interior basins such as Laguna Salada, is drained by the Little Colorado River. The only sedimentary rocks cropping out in the area are buff, chiefly fine-grained sandstone and shale of Late Cretaceous age. Volcanic rocks, chiefly basalt flows of late Tertiary and Quaternary age, surround Laguna Salada and cover an extensive region in this part of Apache County. At Laguna Salada, the volcanic rocks overlie erosion surfaces cut on the Cretaceous rocks, but northward near Concho the Cretaceous rocks are beveled and the volcanic rocks lie on the Chinle Formation of Late Triassic age. In many places, lava flows dammed the valley and alluvial materials accumulated behind the lava barriers. The lavas, encircling Laguna Salada, are from vents to the south and east. Generally, in this part of the White Mountains volcanic field, the lavas flowed northward and northwestward to the ancestral Little Colorado River.

The Little Colorado River was the main control of erosion and sedimentation in most of northeastern Arizona during late Tertiary and Quaternary time (Cooley and Akers, 1961). Several terrace levels, representing two broad cycles of erosion and recording the entrenchment of the Little Colorado River system, have been mapped throughout most of northeastern Arizona. The higher, older levels are referred to as the Black Point surfaces, named by Gregory (1917), and the lower, younger levels are the Wupatki surfaces, named by Childs (1948). The Black Point surfaces, on the basis of meager fossil evidence, are believed to be of late Pliocene and early Pleistocene age and the Wupatki surfaces are of middle and late Pleistocene age.

The older lava flows (TQb) in the Laguna Salada area spread out on erosion surfaces that can be traced into the main part of the Black Point surfaces near the Little Colorado River. The oldest alluvial deposit (TQg) in the area probably was laid down during the Black Point cycle of erosion. The younger lavas (Qb) flowed down valleys which were cut on the older volcanic rocks and which probably were excavated no later than the early part of the Wupatki cycle of erosion.

GEOLOGY OF THE LAGUNA SALADA AREA

Events Not Related to Formation of Laguna Salada

The oldest post-Cretaceous unit near Laguna Salada is the gravel (TQg) that crops out in the southern part of the area (fig. 70). The gravel is composed principally of subangular to rounded pebbles and cobbles consisting of quartzite, chert, granite, and other types derived from the Central Mountains of Arizona, which are south of the Mogollon Rim. This material probably is redeposited from the coarse deposits of Tertiary age commonly referred to as the "rim gravel," the name being derived from their proximity to the Mogollon Rim. The age of the gravel near Laguna Salada is late Pliocene to early Pleistocene and its deposition is an event associated with the early part of the Black Point cycle of erosion.

The deposition of the oldest gravel (TQg) was terminated by erosion that formed the drainage courses that were followed by the early basalt flows (TQb). Reconstruction of the drainage patterns, on the basis of trends of the early basalt flows, indicates that streams near Laguna Salada flowed generally northward. In good exposures, these lavas show prominent joints, which trend northwestward. Near Concho, one of these flows was offset by a small normal fault (Akers, 1962). The younger lavas (Qb) show only slight effects of structural movement. Evidences of diversion of streams by the older basalt flows have been masked largely by succeeding volcanism, alluvial deposition, and erosion. The older basalt flows (TQb), which have been dissected rather severely by erosion, overlie early Black Point surfaces and are considered to be late Pliocene and early Pleistocene in age.

South of the lake, the ancestral stream flowing through the Laguna Salada area appears to have occupied a valley carved between two older basalt flows. North of the lake, this stream crossed an older basalt flow (TQb), which is still exposed to the east of the lake (fig. 70). It carved a fairly narrow but shallow canyon in the area half a mile to a mile northeast of Laguna Salada and seems to have flowed northeastward.

Events Related to the Formation of the Ancestral Laguna Salada

The younger basalt flows (Qb) dammed the old northeast-flowing drainage and diverted it northwestward from Laguna Salada (fig. 70). The younger basalt flows are on surfaces correlated with either late Black Point or early Wupatki surfaces and are early to middle Pleistocene in age. Alluvial material was deposited behind the lava dam and covered the area now occupied by Laguna Salada. The log of a water well, drilled near the landslide deposits a mile west of the lake, showed 120 feet of alluvium overlying 50 feet of basalt (J. P. Akers, oral communication, 1961). Another water well, drilled about a mile northeast of Laguna Salada, penetrated only the upper 68 feet of the alluvium. On the basis of the well data, the maximum thickness of the alluvium in the Laguna Salada area probably is not more than 200 feet. The bulk of this alluvium is referred to in this report as the buff sandy unit (Qf). The buff sandy unit is overlain by the gray muddy unit and deposits of Recent age.

Buff Sandy Unit.—The buff sandy unit is the oldest alluvial unit exposed at Laguna Salada. It is a light-brown, pale-yellowish-brown to moderate-yellowish-brown fluvial deposit, composed of mixtures of materials ranging from clay to gravel. Silty sand is the chief lithologic type. The sand particles are composed of quartz and volcanic materials and are angular to subrounded. Much of the sand is from the nearby rocks of the Mesaverde Group. The gravel consists of sandstone from the Mesaverde rocks, volcanic fragments, and quartzite redeposited from the older gravels (TQg) exposed in the southern part of the area. Fossil mollusks, including *Ostrea*, eroded from the nearby rocks (Mesaverde) of Cretaceous age, are found within the unit.

Bedding of the buff sandy unit is thin to very thick and is lenticular. The unit is horizontal and crossbedded. The crossbeds are generally medium scale, although some are large scale, and they are chiefly of the trough type. However, well-defined channels are rare. Most of the crossbeds merge laterally into units containing flat beds or into sediments displaying little or no bedding features.

A soil is present on the top of the buff sandy unit in exposures in the West Arroyo (fig. 71). It may represent a residual accumulation of material after the main part of the unit was deposited. The unit also contains a buried caliche zone half a foot to a foot thick. The caliche and soil zones suggest that the buff sandy unit was laid down during several periods of deposition.

Sediments, similar to the buff sandy unit along the West Arroyo, overlie older lava flows (TQb) and are exposed as low terraces north and northwest of the lake. Lag gravel, composed of sandstone pebbles eroded from the Mesaverde rocks, was found on the top of the older lavas (TQb) northeast of the lake. The buff sandy unit, on the basis of the present exposure, must have been deposited throughout the Laguna Salada area in a broad valley formed between the younger flows (Qb) to the east, and the older flows (TQb) and the Mesaverde rocks to the west.

The buff sandy unit cannot be dated specifically, but it probably represents deposition that may have occurred chiefly during the Wupatki cycle of erosion of middle and late Pleistocene age.

Gray Muddy Unit.—Erosion terminated the deposition of the buff sandy unit and formed the depression occupied by the ancestral Laguna Salada. The gray muddy unit was deposited within this depression. This unit overlies the buff sandy unit and its uppermost level of deposition is the

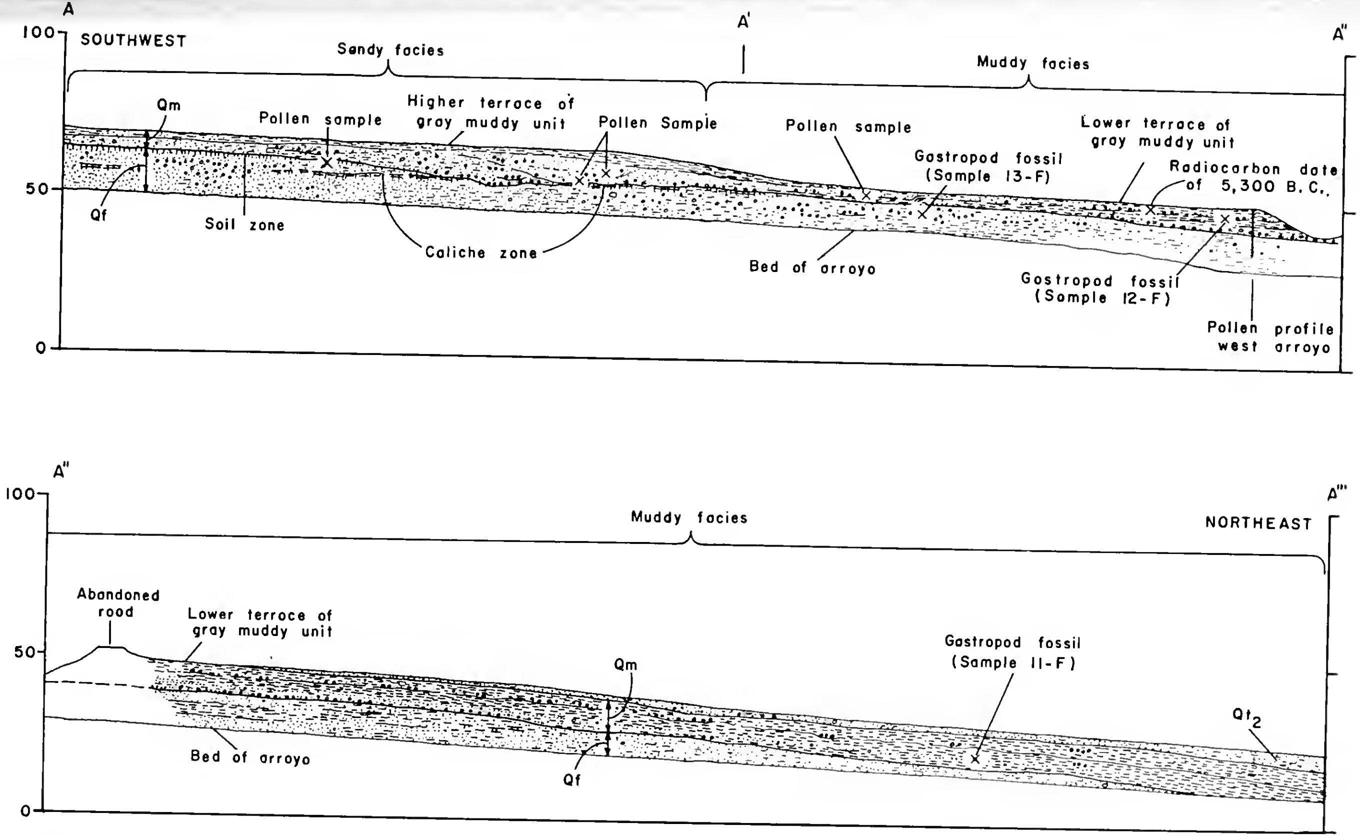

FIG. 71. Section along the West Arroyo showing the stratigraphy of the buff-sandy unit, the gray-muddy unit, and the deposit on the higher terrace.

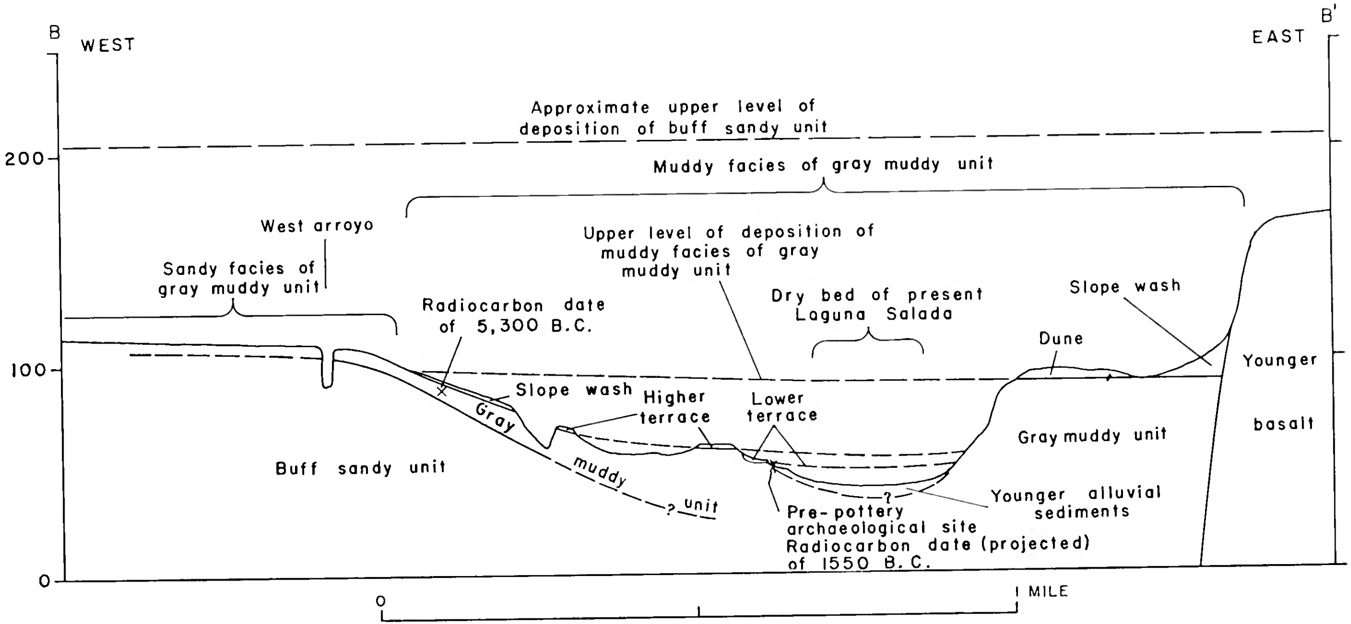

FIG. 72. Section showing alluvial deposits and terraces associated with the formation of the present Laguna Salada.

level of a persistent terrace formed from this unit around the western and northern shores of the present Laguna Salada. A few isolated remnants of the terrace are along the east and south sides.

The gray muddy unit consists of two facies: (1) the lacustrine muddy facies, which makes up most of the unit; and (2) the fluvial sandy facies present only southwest of Laguna Salada. The muddy facies consists of thin and thick beds of medium-gray to brownish-gray clay, mud, and silt. The medium-gray layers contain abundant finely divided carbonaceous material. Beds within the unit are horizontal where exposed near the present lake, but dip gently eastward to the lake in the West Arroyo.

In the West Arroyo, mud and silt beds of the gray muddy unit thin and wedge out westward for a distance of about 1000 feet (fig. 71). Part of the wedging out is due to intertonguing of these beds with sandy silt, silty sand, and pebble silt beds of the sandy facies. One light-brownish-gray thin silty sand bed that contains a few channels filled with pebbles forms a prominent horizon in the middle part of the exposure. This bed tongues out eastward into mud and silt beds about 800 feet east of the pollen profile (section A-A″, fig. 71) taken in the West Arroyo. Westward it thickens and appears to grade laterally into the buff sandy facies (fig. 71). The thinning and tonguing out of the beds and the channeling indicate instability of the depositional environment. This also is reflected in the pollen record of the uppermost three feet of the gray muddy unit by declining relative abundance of arboreal and aquatic pollen species coincident with an increase of nonarboreal elements, such as Compositae and Chenopodiaceae.

A lateral transition in lithology occurs within the gray muddy unit exposed in the West Arroyo. Buff silt and silty sand of the sandy facies of the gray muddy unit replace the beds of the muddy facies (figs. 70, 71). The transition takes place at a change in slope between the terraces formed from sediments of the gray muddy unit (figs. 71, 72). The higher terrace level is believed to be the uppermost limit of deposition of the sandy facies. Sediments of the sandy facies were carried in by streams and deposited along the southwestern flank of the ancestral Laguna Salada. The lower terrace may be a physiographic feature associated with the shoreline and open water of the youngest stage of the ancestral Laguna Salada. Large bedding planes in the sandy facies dip northeastward and indicate fluctuation of the shoreline (fig. 71), and the sandy facies in this area probably represents material reworked and redeposited by wave action associated with advances and retreats of the ancestral lake. To the south the sediments of the sandy facies show no effects of reworking by transgressions of the ancestral Laguna Salada.

Deposits of the sandy facies of the gray muddy unit are similar to those composing the buff sandy unit (see p. 194). However, the sandy facies is slightly less consolidated, shows less calcification, and displays better defined bedding features. Crossbeds of medium to large scale, dipping at medium and low angles, and channels, are common in the unit.

The gray muddy unit is believed to have been deposited in latest Pleistocene time and represents the last event in this area that was associated with the Wupatki cycle of erosion. A radiocarbon date of about 5300 B.C., determined by the Geochronology Laboratories, University of Arizona (P. E. Damon, written communication, 1962, sample A-256), was obtained from a medium-gray mud bed near the top of the gray muddy unit (fig. 71). The radiocarbon date confirms the antiquity of the unit, and also suggests that Pleistocene sedimentation in the northern part of the White Mountains area (altitude about 6,500 feet) may be younger than 5000 B.C., if there is a sufficient amount of time represented in the deposition of the uppermost beds of the gray muddy unit (fig. 71).

Events Related to the Formation of the Present Laguna Salada

The depression occupied by the present Laguna Salada is cut entirely on the gray muddy unit and is bounded by the terrace formed from this unit. During the deposition of the gray muddy unit, streams gradually filled or nearly filled the depression occupied by the ancestral Laguna Salada and flowed out of the area to the northwest. About 5000 B.C., environmental conditions must have changed radically, and caused the ancestral Laguna Salada to dry up intermittently and to terminate through-flowing drainage in the area. A belt of dust dunes (Qd), composed of material eroded from the gray muddy unit and paralleling the northeast side of Laguna Salada, is strong evidence that the depression was formed as a result of wind erosion. The depression of Laguna Salada is about 30 feet deep and was formed by at least three periods of cutting (fig. 72), as indicated by two prominent terraces five and ten feet above the present lake bed. These terraces are capped by one to two feet of sediments, which probably represent levels at which cutting was stabilized for a considerable period of time.

The sediments that are the capping layer on the terraces are similar in lithology and consist principally of brownish-gray sandy silt and silty sand. They are very thin and thin bedded, although bedding features are lacking in many deposits. Silty and sandy sediments grade laterally into coarser material composed of sand and gravel along the southwestern side where most of the ephemeral streams enter the depression. The modern sediments and younger sediments (Qs) bordering Laguna Salada are similar in composition to sediments capping the terraces. Some of these younger sediments locally show small-scale primary slumpage features.

The age and relations with the cultural remains of the cutting of the depression of Laguna Salada and of sediments on the terraces are difficult to determine specifically from the available field information. Distribution of stone tools and projectile points probably of a pre-ceramic date along the east side of Laguna Salada suggests occupation may have been during the time of deposition of sediments on the higher terrace, ten feet above the present lake bed, and was during the period of cutting that followed the deposition of sediments. The stone material was found in several areas along the east side of the lake between five and ten feet above the present lake bed, and between the levels of the higher and the lower terraces. The firepits at a pre-pottery archaeological site (Martin and Rinaldo, 1960a, p. 115) are between two and three feet below the projected level of the lower terrace. A radiocarbon date of 1550 B.C. (P. S. Martin, written communication, 1962) was determined from a charcoal found associated with one of the firepits excavated at this site. However, all the material at this site, with the exception of the firepits, is present as a lag gravel on several low ridges, and the land surface on which the occupation occurred has been eroded away. This land surface would be higher than the level of the lower terrace. In summary, the geological events associated with the formation of the higher and lower terraces may equate approximately with post-early man pre-pottery occupation in the southern part of the Colorado Plateau.

Several rather indistinct terraces or wave-cut benches lying below the lower terrace surround the dry lake bed of Laguna Salada. The sediments on these wave-cut benches are similar to sediments on the higher and lower terraces and are at least two feet thick. The formation of these indistinct terraces probably took place chiefly during the declining stages of the lake before it dried up in about the middle of the 20th century. The extent of Laguna Salada, indicated by aerial photographs taken on November 5, 1936, is outlined in Figure 70. The lake at that time extended beyond some of the present terrace levels; as a result of heavy precipitation during the winter of 1961–62, the lake was filled temporarily and covered these lowermost terraces. The cutting of five feet or more below the level of the lower terrace must have occurred since the Pine Lawn Phase occupation, but repeated fluctuations of the lake have obscured the relationships of the terracing, the deposits on the terraces, and the deposits beneath the present dry lake bed.

Samples of the sediments underlying the present lake bed of Laguna Salada were taken to a depth of six feet for pollen analysis. The lower $5\frac{1}{2}$ feet consists of brownish-gray and black clay, mud, and silt, and the remaining upper half-foot consists of brownish-gray mud. The samples below a half-foot effervesced and gave off hydrogen sulfide gas when dilute hydrochloric acid was applied. At a depth of about $1\frac{1}{2}$ feet, a sample contained remains of grass or narrow leaves of reeds. The presence of these remains suggests that Laguna Salada at the time these plants were alive may have been dry or nearly dry. The upper half-foot of sediments probably represents modern deposition, but there is not enough information available to determine the age and relationships of the interval between a half-foot and six feet. These sediments may be material brought into Laguna Salada and laid down during the past several centuries; they may be material formed chiefly in place by reworking of the gray muddy unit; or they may be material brought in and combined with the material reworked from the gray muddy unit.

The cutting of the present depression of Laguna Salada probably resulted from a change in the depositional environment caused by a regional change in climate. There is considerable contrast between the sediments of the gray muddy unit of late Pleistocene age and the sediments of Recent age, which cap the terraces within the depression, and the material deposited in the depression by modern streams. The gray muddy unit contains a relatively high percentage of carbonaceous material, but all younger sediments, with the possible exception of the sediments underlying the present dry lake bottom, contain little or no carbonaceous material. Environmental change is also indicated by the dust dunes on the lee side (prevailing southwest winds) of the lake. Wind erosion would have been more active in the Laguna Salada area when the lake was dry or was of small areal extent. Thus, dust dunes, the lack of carbonaceous material of the Recent sediments, and the inferred intermittent drying up of the lake indicate an environment which must have been controlled by a climate much drier than that occurring during the deposition of the gray muddy unit in late Pleistocene time, and one which generally was similar to, but possibly drier than, the present climate of the area. Supporting evidence for a climatic change is suggested by differences in the pollen sampled throughout the Laguna Salada area. Pine and spruce, reflecting a cooler, wetter environment, are more common in the pollen from the gray muddy unit. Compositae, Chenopodiaceae, and others, suggesting more unstable, possibly warmer drier environments, are the main pollen types recorded from all sediments of Recent age that were sampled.

IX. A Synthesis of Upper Little Colorado Prehistory, Eastern Arizona

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ACKNOWLEDGEMENTS

This chapter is an attempt to synthesize approximately 3000 years of cultural history in the upper reaches of the Little Colorado River in Eastern Arizona. This area of the Southwest was virtually unknown, archaeologically, until Chicago Natural History Museum's Southwest Expedition moved to Vernon, in the heart of the region, to begin systematic investigations in 1956.

Under the direction of Paul S. Martin, assisted by John B. Rinaldo, the expedition first undertook a limited survey of the area followed by a series of excavations. A decision to expand the surface reconnaissance of the Little Colorado drainage led to an intensive surface survey and excavation program initiated in the summer of 1959. The survey which Dr. Rinaldo began in 1956 was expanded by myself during the summers of 1959, 1960, and 1961. During these years the Museum continued excavation of a series of key sites. The combined data from the archaeological survey and the excavations are the basis for this paper.

I have benefitted from discussions with many people in the preparation of this paper. I acknowledge and thank: Drs. Robert M. Adams, Lewis R. Binford, Fred Eggan, Paul S. Martin, and John B. Rinaldo.

Much of the field work which forms the basis for this report was made possible by two grants (1960 and 1961) awarded to Chicago Natural History Museum by the National Science Foundation. I wish to thank the Foundation for its interest and support.

INTRODUCTION

A discussion of the topographical and environmental setting of the area (fig. 73) has been presented elsewhere (Martin, Rinaldo, and Long-

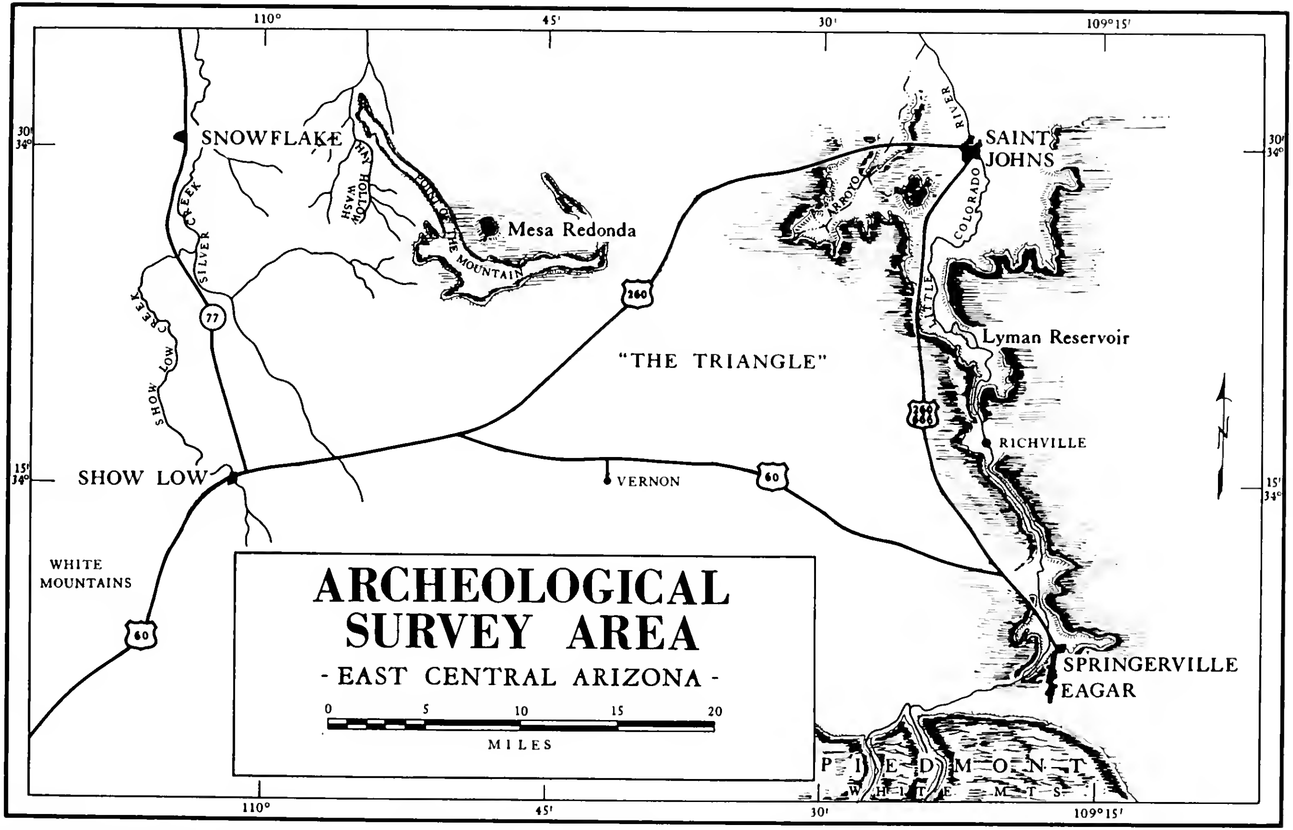

Fig. 73. Map showing area of archaeological survey, east-central Arizona.

acre 1961a, pp. 150–153) and will not be repeated here. Likewise, tables showing settlement numbers and locations within the region are published (Martin, *et al.*, 1962, pp. 151–154). Although the interpretative synthesis presented below is based upon these data, the tables will not be reproduced in this volume.

In these previous publications the chronological sequence was framed in terms of dated "pottery groups." In this chapter I will depart from this procedure to suggest a tentative listing of phases. These phases and the interpretative synthesis of the sequence as we know it thus far, represents a more complete analysis of the data. My aim is to present an interpretative synthesis of the area's prehistory highlighting changes in complexity and their possible explanation. A beginning was made (Martin, *et al.*, 1962, pp. 163–167) by attempting a synthesis of the non-ceramic portion of our sequence—corresponding to phases I and II in this chapter. The interested reader is referred to those pages as that portion of the synthesis will not be repeated here.

There follows a summary of the prehistoric occupation of this region from approximately 1500 B.C. to A.D. 1500. This summation consists of a tentative list of unnamed phases, each briefly characterized. This will be followed by an interpretative synthesis beginning with phase III as indicated above.

TENTATIVE AND UNNAMED PHASES

Phase I—Concho Complex.—Food Collectors. *Stone tools:* basin milling stones and pebble-type manos, numerous chipped stone tools including scrapers, planers, predominantly stemmed-indented-base projectile points, choppers, flake knives, drills, etc. *Settlement type:* small impermanent camps. No evidence of architecture. Settlement locations scattered, ranging from valley floor or lakeside camps to sheltered spots high on "tiers" on the sides of mesas. No clustering of sites was found. *Dates:* 1500 B.C. to ca. A.D. 300. *Excavated sites*: Beach Sites (Martin and Rinaldo, 1960a). (I recognize that the material here described as "Phase I" is not a true phase (Willey and Phillips, 1958, p. 22), but for reasons of symmetry and convenience, the Concho Complex will be referred to as "Phase I.")

Phase II—Incipient Agriculturalists.—Food collectors augmenting their diet with agriculture (corn, definitely; squash and beans, probably). Shallow pit-houses with associated storage pits. *Settlement type:* two to four houses with storage pit for each house. *Settlement pattern:* same locations as Concho Complex sites. Sites of this phase are sparse; no clustering of sites occurred. *Stone tools:* Many of the stone tools identical to those of earlier non-sedentary peoples: basin milling stones, pebble-type manos, chipped stone tools such as scrapers, knives, planers, and choppers. Tool differences: projectile points are predominantly notched forms. New tool: mortar and pestle. *Dates:* A.D. 300 to 500. *Excavated site:* Tumbleweed Canyon (Martin, *et al.*, 1962).

Phase III—Initial Sedentary Agriculturalists.—Deeper and larger pit-houses in villages of from one to five houses. Random arrangement of houses. Pottery first appears in this phase. *Pottery:* Lino Gray, Alma Plain, Kana-a Neck Banded, San Francisco Red, Alma Incised, Alma Neck Banded. In general, sites with Anasazi types of pottery (Tsegi Series: unpainted) are in the northern portion of the area; those with Mogollon types (Reserve Series: unpainted) are in the south. Most sites, however, have sherds of all types. *Settlement type:* small groups of pit-houses or a single pit-house close to land suitable for agriculture. *Settlement pattern:* new locations—locations of the pre-pottery sites (Phases I and II) not occupied. Sites of this phase located in valleys or overlooking valleys where well-watered and fertile flood plains are available. Sites are not clustered in this phase; they occur in a random pattern throughout the region. *Stone tools:* troughed metates, rectangular manos, notched projectile points. *Dates:* A.D. 500–700. *Excavated site:* one excavated pit-house (LS-199) from this phase.

Phase IV—Established Village Farming.—Relatively large pit-house villages of from five to fifteen houses. Pit-houses are large and deep with associated storage pits. Some have lateral entrances. *Settlement type:* large, unplanned villages with a random pattern of houses and pits. *Settlement pattern:* locations similar to those of Phase III, only settlement is much more dense. Many more locations were being utilized and each more intensively than during the previous phase. During this phase, settlements tend to occur in clusters. *Pottery:* Alma Plain, San Francisco Red, Woodruff Smudged, Forestdale Smudged, White Mound, Black-on-White, Kiatuthlanna Black-on-White, Red Mesa Black-on-White. *Stone tools:* in general, similar to preceding phase. *Dates:* A.D. 700–900. *Excavated site:* Site 30 (Martin and Rinaldo, 1960a).

Phase V—Beginnings of Planned Towns.—*Settlement type:* at first unplanned villages of surface rooms, eight to fifteen rooms per settlement. Site plan similar to that of Phase IV. Later, planned rectangular blocks of rooms, eight to twenty rooms per town. Non-habitational structures (kivas) appear. Earliest examples are rectangular and circular kivas and circular Great Kivas. *Settlement pattern:* initially groups of unplanned villages in a similar location to those of previous phases, but more numerous.

Later, planned towns appear, usually with one settlement having a Great Kiva, surrounded by other towns lacking such a structure. *Pottery:* Brown textured (e.g., Reserve Indented Corrugated), Reserve Black-on-White, Snowflake Black-on-White, Wingate Black-on-Red, Show Low Black-on-Red. *Stone tools:* diagnostic differences in stone tools among these later phases appear to be less obvious and crucial. This category will therefore be deleted in discussion of later phases for chronology. *Dates:* A.D. 900–1100. *Excavated sites:* Site 31 (Martin and Rinaldo, 1960a), Mineral Creek Site (Martin, Rinaldo, and Longacre, 1961a), Thode Ranch Site (Martin, *et al.*, 1962).

Phase VI—Established Towns—Beginnings of Convergence.—Large masonry pueblos, many with kivas, some with Great Kivas. *Settlement pattern and type:* similar to preceding phase; size of individual site is larger but there are fewer sites. Sites tend to be more numerous along major drainages such as the Little Colorado itself; fewer sites (compared to previous phase) located on minor tributaries. *Site size:* eight to forty rooms. *Pottery:* Brown textured, Tularosa Black-on-White, Houck and Querino Polychromes, St. Johns Polychrome (including Springerville Variety). *Dates:* A.D. 1100–1300. *Excavated sites:* Rim Valley Pueblo (Martin, *et al.*, 1962) and earlier occupation at Hooper Ranch Pueblo (Martin, Rinaldo, and Longacre, 1961a).

Phase VII—Large Towns—Full Convergence.—*Settlement pattern and type:* large towns of from 50 to 100 rooms each. Settlements few in number and restricted to the two major streams of the area, either in the Little Colorado Valley, or in the Silver Creek Valley. Each town has several kivas, and often a large plaza (evidently replacing the Great Kiva). One site in the Little Colorado Valley, Casa Malpais (Danson and Malde, 1950) is a true fortress-site, well fortified and approached with great difficulty. *Pottery:* Pinedale and Four Mile Polychromes, Heshotauthla Polychrome, Kwakina Polychrome, Kechipawan Polychrome, Pinnawa Glaze-on-White. *Dates:* A.D. 1300–1450. *Excavated sites:* upper occupation, Hooper Ranch Pueblo (Martin, Rinaldo, and Longacre, 1961a), and Table Rock Pueblo (Martin and Rinaldo, 1960b).

INTERPRETATIVE SYNTHESIS

As mentioned above, the detailed synthesis of Phases I and II (Concho Complex and Incipient Agriculturalists) has appeared elsewhere (Martin, *et al.*, 1962, pp. 163–167) and will not be repeated here.

The Desert Culture form of adaptation, locally expressed as the Concho Complex, apparently persisted in this area for more than 2000 years.

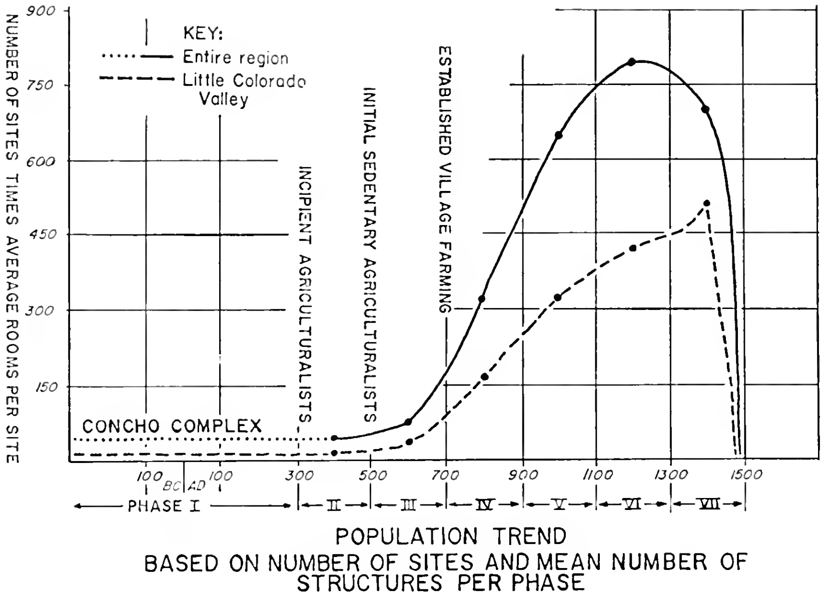

FIG. 74. Population trend based on number of sites and mean number of structures per phase.

The collecting livelihood of these people changed very little; styles may have changed in such things as chipped tools, but the economy remained more or less unaltered. Then, probably toward the beginning of the fourth century A.D., a change in complexity took place that was to alter this way of life that had enjoyed such antiquity.

This was the introduction of a foreign exploitive-adaptive subsistence system in the form of agriculture, preservation and storage techniques, and houses. At first, the peoples in this region used these new adaptive tools as an augmentation to their subsistence. For that reason we labeled this phase (II) one of Incipient Agriculturalists.

With the introduction of domesticated plants, the stage was set for a relatively rapid series of transformations. The introduction of agriculture has been called revolutionary by Childe (1957, pp. 19, 61). This term is applied because of the rapid population increase and far-reaching changes in both the cultural and social order that follow its introduction.

I have prepared a graph (fig. 74) presenting the general population trend. This was obtained by multiplying the number of sites by the mean number of rooms or houses per phase. These figures should reflect any demographic fluctuations present in the sequence.

The meaningful aspect of such a presentation lies in the shape of the curve rather than in any absolute value at any place on the curve. There is no evidence for a period of settlement relocation within any one phase. By this I mean the short occupation of a village by a group of people followed by the founding of a new settlement which is in turn abandoned. Such a pattern would distort the figures of site density per period of time. Most of the sites recorded by the survey were occupied over a long period of time as evidenced by the presence of several temporally different pottery types on each. In any case, there is no reason to assume that the relocation of sites would be confined to any particular period of time. Rather, if it is a factor in the distribution and numbers of recorded sites, the shape of the curve would remain the same; only the absolute values would be misleading. As this is the critical interpretative aspect of the figure, it is of relatively little importance where on the absolute scale the curve is placed.

The curve indicates a rapid and drastic population increase which begins somewhere before A.D. 700 and continues until some time after A.D. 1100. I will now examine the sequence during these years looking for changes in complexity that might help explain the plotted graph.

Initial Sedentary Agriculturalists

Phase III—A.D. 500–700

In the phase following the pre-pottery pit-house occupation of the region we note a drastic change in settlement pattern. Sites of this period occur within or overlooking river valleys. The ever-present need for water still was a factor in settlement location, but by this time a new factor appeared. This was the need for fertile and arable land for farming, present in the flood plains of the river valleys.

The initial appearance of adaptive techniques in the form of agriculture, storage and preservation techniques, and houses had taken place nearly 200 years before. But it was only by about A.D. 500 that the people of the region completely changed their way of life to employ the new techniques to their fullest.

Population was numerically about the same, small groups of people, probably in kin-based bands very similar to their ancestors'. In this period we see the establishment of a new exploitation of the same environment—a change from dominant collecting activities to dominant agriculture.

Contact with the outside is evidenced by the appearance of ceramics during this period. The two dominant types are stylistically associated with two distinct cultures: Alma Plain is the brown pottery made by Mogollon peoples in the intermountain valleys to the south and southeast; Lino Gray is associated with Anasazi groups to the north. The people in the northern part of the region under study made more of the gray pottery than the brown. Those in the southern portion made more brown than gray. There was intercourse, however, for small amounts of Lino Gray are found on almost all the southern sites as are small quantities of Alma Plain found on the more northern sites (cf. Martin, Rinaldo, and Longacre, 1961a, pp. 155–156).

The houses of this period are larger and deeper (if we can argue from surface indications) perhaps reflecting the increased stability as these beginning farmers became tied to their land.

The efficiency of these beginners may be questioned since the population remained quite stable for a long period of time (fig. 74). It was not until the following phase (IV) that we note a drastic increase in the population.

Established Village Farming
Phase IV—A.D. 700–900

There were now relatively large villages, some with as many as 12 or 15 pit-houses. The great increase in both the number of sites and the size of site would argue for an increasing population. The rapidity of this increase along with the location of these sites within or overlooking river valleys would argue for an increased efficiency in the exploitation of the environment through agriculture.

I would characterize this period as one of population growth within communities backed by productive and dependable agriculture forcing budding daughter communities to occupy other exploitable portions of the region. Under these conditions a change in social organization might be expected. I would expect the development of descent groups such as lineages and clans where there is a sedentary population with group splintering or segmentation. Here I am not referring to the "predatory segmentary lineage" type of organization proposed by Sahlins (1961).

Settlements of this period are characterized by random clusters of pit-houses (Martin and Rinaldo, 1960a, p. 55). The houses are round or nearly so, and most have lateral entrances (op. cit., pp. 35–56).

Black-on-White decorated pottery makes its appearance during this phase. White Mound, Kiatuthlanna, and Red Mesa Black-on-Whites are the most frequent decorated types. Along with these are found both brown and gray plain types such as Lino Gray, Alma Plain, San Francisco Red, and so on.

Beginnings of Planned Towns
Phase V—A.D. 900–1100

The initial portion of this period gives evidence of an innovation in architecture; the first above-ground pueblo architecture appears. Early in the phase unconnected rectangular surface rooms occur, making a village plan somewhat similar to that of the earlier pit-house villages i.e., a cluster of rooms (Martin, *et al.*, 1962, pp. 38–39; 217). Later, true pueblo architecture appears. It is during this phase, too, that the first religious architecture appears in the region. Kivas, associated among the historic peoples of the Southwest with unilineal descent groups such as clans, are found for the first time in the area.

Settlements were more numerous than in the preceding phase and also larger. This would indicate that a growing population continued to expand into unoccupied valleys.

Some of the larger communities have quite large ceremonial structures, the Great Kivas. These larger towns were surrounded by smaller communities lacking Great Kivas, and in many cases lacking any religious architecture at all.

This pattern of larger settlements with a Great Kiva, surrounded by small settlements lacking such would suggest a pattern of centralized community ritual. Some workers have even speculated on an organized priestly class or "incipient theocracy" from similar data (Vivian, 1959, p. 85). This arrangement is probably related to ritual supports underlying community integration rather than reflecting a priestly class system. The arrangement would probably have economic overtones in the periodic pooling of labor and other aspects of the economic pattern along the lines created by the corporate mechanisms of solidarity.

Established Towns—Beginning Convergence
Phase VI—A.D. 1100–1300

This phase is characterized by large masonry pueblos, many with kivas and some with Great Kivas. The settlement type is slightly different from that of the preceding phase (V) in that the sites are larger, on the whole, but they are fewer in number. Settlement pattern is also altered; the sites tend to be located on major streams, such as the Little Colorado itself, with fewer on minor tributaries. For these reasons, I have tentatively labeled this period one of beginning convergence.

Paleo-pollen analysis indicates a significant change in the rainfall pattern beginning about this time or earlier. This is not a climatic change since the annual amount of precipitation is unchanged. However, from a pattern of about equal winter-summer rainfall, the pattern changes to dominant summer rainfall in the form of heavy thunder-showers or, as they are known today, "gully washers." This type of rainfall pattern is probably responsible for arroyo cutting and the consequent lowering of the water table. It would probably make an agricultural existence precarious. I must stress that although this explanation is the most probable, it is not the only possible one (cf. Martin, *et al.*, 1962, chapter 8; chapter 7, this report).

It might be expected, then, to see people settling along major streams which would (and still do) flow all year. Agriculture as an adaptive technique was efficient enough by this time to sustain the increased population with less widespread land use.

I view the changes taking place during this period as not being changes in complexity because a similar social organization and economy for this phase and the previous one are suggested.

The last phase of our sequence (VII) does reflect changes in complexity which must be explained.

Large Towns—Full Convergence Phase VII—A.D. 1300–1450

During the final occupation period (roughly A.D. 1300 to 1450) all of the region is abandoned except for its two major stream valleys, the Little Colorado Valley and Silver Creek Valley. It is also at this time that the population clusters in very large pueblos. The towns are large, more than 50 rooms, and there are often two or more kivas at each. There seem to be no Great Kivas, but large town plazas appear to replace them. Thus, there is a change in both settlement pattern and type.

In the Little Colorado Valley there are ten sites of this period. All but one are non-defensive in nature. One, the most southern of all ten, is a true fortress, built high above the valley floor on the side of a mesa. Boulder walls and natural obstructions combine to create a formidable location to attack. This site, Casa Malpais (Danson and Malde, 1950), and the convergence of the regions' population into large communities seems best explained by defensive and offensive patterns of these people.

The presence of only one strongly fortified site would dismiss, I feel, the possibility of internal strife among the towns in the valley. This time period is given for the probable date for the Athabascan intrusion into the Southwest (Danson, 1957, pp. 111–118) although there is no archeological evidence for a date this early (Hester, 1962, pp. 98–102). Large towns would be a defense against the quick and deadly raids of small nomadic groups. Small isolated villages would be prime targets for this type of warfare.

The size of the settlement itself, however, would be no defense for the growing crops in their fields. The fields must have been extensive in order to feed such numbers of people. How then would they defend their crops which were their subsistence? Recalling the maxim: "The best defense is offense," we perhaps have an explanation for the fortress site of Casa Malpais.

If marauding raiders made life in the Valley difficult, one of the best ways to get rid of the threat was probably to go out and eliminate them —or at least drive them away. To do this would require a large amount of manpower. To take away the men from a town would invite attack. The best answer to this situation would seem to be a refuge site, easily defended, at which the "civilian" population could remain in relative safety until the threat could be eliminated.

At one of the last sites occupied in the Little Colorado Valley (Table Rock Pueblo) no concrete evidence was found to explain the abandonment of the area. We know this site was built sometime around 1300 and that it was left around 1400. We know, too, that in historic times this region was utilized by Apaches although the historic pueblos of the Hopi and Zuni maintained religious shrines in the region. The wholesale abandonment of large areas of the Southwest is one of the many unanswerable problems at this stage of our knowledge. We feel certain that groups such as the Apache had a great deal to do with it, but what role, if any, rainfall pattern changes, crop failures, and disease played, we frankly do not know.

CONCLUSIONS

The region described in this study is but a small tile in the mosaic that is Southwestern Prehistory. The Little Colorado area, however, is important to an understanding of general Southwestern archaeology for several reasons.

First, culturally and spatially, the area lies between the classic Anasazi tradition of the Colorado Plateau and the Mogollon mountain valleys to the south. It is a part of what Danson calls the "Transition Zone" (1957, pp. 101–102). The material culture of the peoples who occupied the region does reflect both Mogollon and Anasazi influence, but it is not the purpose of this chapter to discuss these aspects in detail. I would point out, however, that this appears to be an area of stylistic blending which at this time is not clearly understood. There seem to be important differences within the region at various periods as well as fluctuations in the degree of interaction between this region and either the Mogollon or Anasazi areas through time (Martin, Rinaldo, and Longacre, 1961a, Chapter 5). As this area ecologically lies between the intermountain valley systems to the south, and the plateau country to the north, the cultural adaptation to either of these ecographies would not be completely suitable for this area. Such a blending of culture as an adaptation to a transition zone should not come as a complete surprise. We hope that further investigations will help clarify our understanding of this situation as well as aid our understanding of culture as an adaptive system.

For my synthesis of the region's prehistory I have chosen to focus on process—changes in complexity as reflected in the archaeological evidence. To do this, I have relied primarily upon the archaeological surface survey as a tool to obtain data. Excavated data served to augment the study by providing a chronological frame and adding detailed information of the cultural adaptation within each phase.

But to form a typology of settlements, to obtain settlement loci information and settlement patterns through time, we must rely upon surface reconnaissance.

The information that the archaeological surface survey supplies can be most helpful in inferring changes in complexity within the sequence. I have attempted to demonstrate this in my analysis. Ideally, the next step would be to compare this sequence with those of adjacent areas in the Southwest and then, perhaps, to make cross-cultural comparisons with other regions as well. Unfortunately, the lack of published data—the critical processual data from archaeological survey—severely limits the potential of such a comparison.

Adjacent areas in the Southwest include: on the north, the middle drainage of the Little Colorado River; the regions to the west and east, north of the Mogollon Rim and mountains at the base of the Colorado Plateau; and the various mountain regions of the Mogollon development to the south.

The areas to the north and west of our region must be ignored due to the almost total lack of archaeological survey. Bartlett (1942) reports a non-ceramic lithic industry from seventy sites located in the valley of the Little Colorado River north of the region considered in this study. Until further work is done in this northern area resulting in a description of the assemblage, site typology, and settlement pattern, a comparison is unjustified.

The region to the east was surveyed by Danson (1957). His analysis of the data was directed toward different problems than my own. The data are published but the lack of certain descriptive classes makes the re-working of these data for comparison most difficult. I would initially have to interpolate site typologies and population data. This would be extremely difficult from the published data because we are presented with numbers of sites and not numbers of rooms or houses.

Bluhm (1957, p. 135) attempts to graph a population trend for the Little Colorado area from Danson's data with little success. She was forced from the nature of the data to use numbers of sites per period which would be misleading, especially for the late occupation.

For this reason I can say little by way of comparison with the prehistory of the region to the east.

This leaves us only the Mogollon areas to the south. Within the mountain region which seems to be the heartland of the Mogollon development, there has been a long-standing program of prehistoric investigations. In the area to the southwest near Forestdale, Arizona, the University of Arizona conducted field work in the 1930s. Unfortunately, there are no data published from archaeological surface survey and relatively little of excavated material. Directly south of our region, the Point of Pines area has been the scene of the University of Arizona's archaeological field school. Several excellent reports of excavated sites have appeared, but as yet no information from surface survey has been published.

This leaves only one other major Mogollon area, the Reserve–Pine Lawn Valley region to the southeast. Fortunately, there is comparable information published for this section, but there are limits imposed by the nature and reporting of the data.

First, this area was not occupied after ca. A.D. 1250, and second, only the agricultural, ceramic-bearing sites are considered in the publications containing comparable data (Bluhm, 1957, 1960). The former fact is in contrast to our region where occupation is noted to nearly A.D. 1500. This difference in itself is, of course, meaningful, but until we know the reasons for the abandonment of the Reserve area (cf. Danson, 1957, pp. 113–118; Bluhm, 1960, p. 544) and, indeed, the reasons for the abandonment of other areas of the Southwest including our own, this comparison is not as illuminating as might be suggested.

There are both parallel and contrasting data from the Reserve area compared to our own. Examining the information on site numbers and size of site of processually similar phases to our own, I am struck with the similar outline of population trends for the two areas, but note the absolute differences between them. For example, in the Pine Lawn Valley, only 61 sites are reported for the Reserve–Tularosa Phases (A.D. 1000–1250) (Bluhm, 1960, p. 542). For the Little Colorado region during the same period of time, 144 sites are recorded. Similarly, 16 sites are reported for the period A.D. 700–1000 (*Ibid.*) from the Pine Lawn area; 60 from the Little Colorado region. These differences can be best explained by the difference in size between the two regions. The size of site for each period in the Reserve area is approximately equal to or slightly smaller than the size of sites in the Little Colorado region. This pattern of numerical difference in site numbers is true for the earlier periods, also. When we examine the curve that these figures produce, however, the similarity in the shape of the curve compared to our own is striking (Bluhm, 1957, p. 135).

Agriculture does appear earlier in the Reserve area compared to the Little Colorado region. From the site size and number data, I can suggest that agriculture as an adaptive tool was not as productive in the Pine Lawn area as it was in the Little Colorado region.

Another similarity in cultural process between the two areas can be noted: there is a similar pattern of inter-community ritual supports as evidenced by the Great Kivas (Bluhm, 1960, p. 543).

Without comparable data from the rest of the Mogollon area, I feel a more detailed comparison is unjustified. Much of these data are recorded, but are unavailable in published form. This is true for other portions of the Southwest as well as for the Mogollon region.

My aim has been to indicate the value of this particular combination of data collection and inference. This aim will be realized if it spurs further efforts for data accumulation and publication for the Southwest and, hopefully, other regions as well.

GENERAL SUMMARY

I have examined changes in complexity in the cultural history of the peoples in a part of eastern Arizona. I began with small groups of non-sedentary peoples with an exploitative-adaptive economy based on collecting wild plant foods and hunting. The addition of agriculture to this way of life brought about far-reaching changes. It eventually allowed a much larger population to utilize the same region and made possible a sedentary existence. I examined changes in the material culture that reflect changes in social complexity such as the appearance of Great Kivas indicating the ritual supports for multi-settlement corporate solidarity. I suggested a change in social organization when budding daughter communities began to further exploit the region. The resultant new settlement pattern as well as the increased population was the result of an increased agricultural productivity. I followed the effects of agricultural and storage techniques as exploitative tools from their introduction to the abandonment of the region by pueblo peoples in the 15th century.

I do not claim that the history of cultural processes operative within the area is complete—there are undoubtedly many subtleties which are not even suspected as yet; it remains our task to find them and to structure research that will enable further investigation of the inferences advanced in the course of this analysis.

X. Summary

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INTRODUCTION

Carter Ranch Pueblo, located about nine miles east of the contemporary town of Snowflake, Arizona, was found by Longacre when surveying the area in 1960 (Martin, *et al.*, 1961). It consists of a block of dwelling rooms, approximately 39 in number, arranged in the form of a square "U," the open part of which may have been a plaza divided into two parts. The ruin appeared to be of modest size and could thus be dug in two seasons. A large trash midden bid fair to yield large numbers of sherds of a black-on-white pottery (Snowflake) that we were eager to know more about. Two large depressions, the only ones in the immediate area, aroused our curiosity and gave rise to the conjecture that this village may have been important ritually and economically. On the basis of our survey file, the site appeared to have been one of the latest towns to have been built in the area. The valley in which it stood also contained a number of smaller sites, probably contemporaneous with the Carter Ranch Pueblo; and if this were so, would be a favorable region for testing various hypotheses and for obtaining palynological samples.

For all these reasons and because no site of this period or sub-culture had ever been examined, we decided to make Carter Ranch Pueblo the center of our researches.

EXCAVATIONS

Rinaldo has given a detailed description of architectural details (Chap. 1). Here I shall mention only a few points that seem particularly significant. Twenty-nine units were dug, including 23 dwelling rooms; three kivas; one Great Kiva, a big lesser kiva (Kiva 1), and a smaller rectangular one. The evidence at hand suggests that the pueblo was erected on a knoll; was two stories high in the north or central section; and had consisted of a nucleus plus several additions. Access to the rooms was probably through roof hatchways since most of the doorways appeared to serve as connection passages between rooms. Only one exterior doorway was found and it had been walled up.

Some rooms contained no fire pits; others, square or rectangular ones; and others, round ones. This kind of grouping of rooms with or without fire pits made no particular impression on us until we received the results of the Univac analysis (Chap. 5). It is probable that these rooms are functionally different; and perhaps a lineage segment occupied a group of three adjacent rooms: one with no fire pit (sleeping or storage?); one with a round fire pit; and one with a rectangular one.

In the north end of the pueblo and adjoining the north wing is Kiva 1. The walls were in poor condition, and the east portion of the kiva could not be located.

Near Kiva I a small kiva was located. In shape, features and size, it resembled Kiva II at Hooper Ranch Pueblo (Martin, Rinaldo, and Longacre, 1961, p. 46).

To the north and west and separate from the pueblo unit stood the Great Kiva, excavated in 1962. The description of this structure is given in Chapter 1.

The general character of the architecture; the east facing plaza and ventilators; and details of wall construction compare, according to Rinaldo, more closely to those of the Mogollon tradition than to the Anasazi.

The artifacts of bone, stone, clay, and perishable materials have been described and discussed. On the whole, most of the objects compare favorably with those from Western Pueblos and more specifically with those from proto-historic Zuni.

Some of the traits indicate affiliations with the Mogollon culture; a few reflect Anasazi influences.

This is not surprising since Carter Ranch Site is in a transitional zone. The blending of traits may reflect a cultural adaptation of traits from two different ecological and cultural zones.

In the trash area on the eastern side of the Pueblo, 34 burials were found.

Cutler (Appendix) reports that three kinds of corn were grown and used at Carter Ranch Site: small cob flints, a medium-sized flint corn, and the Pima-Papago corn race. Squash (*cucurbita pepo*) and beans (perhaps lima, scarlet runner, or Jack beans) were cultivated. Portions of wild plants were also found in rooms of the pueblo: pinyon nuts; juniper seeds; Indian rice grass seeds; yucca pods, seeds and fibers; walnut shells; amaranth seeds; and *opuntia* fruit.

INFERENCES

For years I have sought methods of analysis that would yield inferences of any and every imaginable kind. The minutiae of our digs have always interested me; but I felt that being an archaeologist implied much more than just digging and innocuous, sterile reporting of details of architecture and artifacts. I longed to be able to find the explanations for what we dug up so that we might create a cultural history of the area. I wanted to reconstruct the actual social, religious and economic life of the people under investigation.

Fortunately, I have always been lucky enough to find colleagues who shared my interests and curiosity and who were willing to try out different methods of approach and to put forth conjectures based on careful analyses.

This report is especially enriched because of hypotheses advanced by colleagues who see things with a clear, fresh vision and who were willing to propose and try different theoretical approaches. Much of what has been done in the past is good; but we wanted to build on previous work and knowledge. We hoped to advance by doing careful quantitative work on materials and residues previously neglected or not sufficiently studied. Settlement patterns, size of population, geographic distribution of traits, fossil pollen, economy, exploitative adaptation, plant and animal remains, social organization, rituals and kivas, chronology, soils, artifacts—all of these items and more unmentioned, are grist for our mill. Many of these ingredients are amenable to statistical treatment and inference, provided statistically random samples are collected.

In the past, I have been careless in collecting samples, and have overlooked, for example, the possibility that analysis of interrelationships of pottery types might tell us whether temporal or functional differences were involved. I failed to recognize that statistical descriptions and comparisons could be strikingly helpful in discovering archaeological associations (not perceivable or apparent by the usual inspection of data), and thus in making inferences hitherto undreamed of. As Spaulding (in Application of Quantitative Methods in Archaeology, Viking Fund Publications, No. 28, edited by Robert F. Heizer and Sherburne F. Cook, 1960, p. 83) says: ". . . we are working on more detailed problems which require sharper discriminations . . . the current trend toward utilization of more elaborate and theoretically sophisticated quantitative methods is . . . an effort to discover and communicate subtle differences between closely related assemblages, so that the details can be inserted into the broad outline."

We are far from realizing our ideal goals—thank heaven—and we have not gathered data on all the items mentioned above. This is partly due to lack of funds and staff and partly from lack of awareness. But now that the scales have fallen from our eyes, we are undeceived and are conscious of shortcomings, and a beginning has been made. I am not satisfied, but I am exhilarated by the prospects.

As a prelude to what I hope will eventually become a fugue of many voices, I bring forward, in summary form, two illustrations of more sophisticated quantitative approaches.

The first is concerned with sociological implications that may be derived from ceramic analysis; and the second, with a Univac analysis of sherd frequencies.

CERAMIC ANALYSIS

Longacre (see Chap. 6) formulated his hypothesis as follows: The spatial distribution of kin groups and the outlines of social organization are reflected in the material items used in a cultural system. In a matrilineal, matrilocal society, social demography may be mirrored in the ceramic art of the female potters. Further, the smaller and more closely tied the social aggregate, the more details of design would be shared. Using all other possible clues from the cultural system, differential relative frequencies of elements of design may suggest the delimitation of various social aggregates, such as: 1. localized matrilineages or lineage segments within a village and forming the village; 2. the village as a social group; 3. groups of villages producing a larger unit or "alliance" coupled by means of social interaction along kin-based, religious and political lines; and 4. even larger social units or combinations made up of villages in a relatively large area all acting reciprocally each with the other and producing pottery of the same variety or type.

I shall mention here, most briefly, a few of the results of the study. In order to understand how these results were obtained, the reader must turn to Chapter 6.

The analysis indicates that there is a non-random distribution of pottery design elements on all levels, whether comparison was made within a village or within a valley. This fact alone showed that random sorting could not explain the groupings of pottery design elements.

1. I shall start with the basic or primary subdivisions that were observed within the Village and work upward. The non-random occurrence of design elements suggests that the pueblo was occupied by two or more localized lineage segments. Perhaps, Carter Ranch Site was occupied by at least two descent groups, practicing matrilocal residence.

2. When we examine the distribution of design elements, village by village, we note that no two villages enjoy precisely the same relative fre-

quencies of design elements or groups of elements. This suggests a ceramic tradition of villages—one step higher than the kin-based traditions within a village.

Within this grouping of village-ceramic-tradition, Longacre did find that the relative frequencies of design elements were more similar for some groups of villages than for others. He explains this by showing that there were two Great Kivas in the Valley. It is assumed that each Great Kiva reflected ritual supports for multi-community solidarity, probably with economic overtones. Each Great Kiva then acted as a pole and attracted several villages within its field and held them by means of the economic, ritual and political ties mentioned above. The villages within one field tended to share more similar relative frequencies of pottery design elements than would those in the other.

3. The next level upward is the valley or "areal" tradition. This is demonstrated by the presence of more similar relative frequencies of pottery design elements from all the villages in one valley when compared with frequencies from all villages in another valley.

Thus three pottery traditions, all subordinate to the variety, were detected: 1. lineage tradition; 2. the village tradition; and 3. the areal or valley tradition of pottery designs. If we had resorted only to the type-variety concept, these more sensitive sociological implications would have been missed.

UNIVAC ANALYSIS OF SHERDS

I shall not try to summarize in detail all the results of the Univac analysis. Chapter 5 by Freeman and Brown is a landmark in our work and perhaps in the archaeological work of the Southwest and, therefore, deserves careful reading.

Here, I shall mention a few of the results that impressed me most.

1. The major causes of inter-sample variation are: (a) sampling error; (b) temporal differences; (c) functional differences. An explanation of sample variation cannot assume that any one of the causal factors mentioned above is more important than the others. The explanation of sample variation must be able to set apart or isolate the contribution of each of the three factors to that variation and show that they satisfactorily account for that variation. Regression analyses were used to explain differences and similarities among our samples. Chi square tests were used to check samples that appeared, on the basis of regression analysis, to be different, and the tests established these differences beyond reasonable question.

2. Four constellations of pottery types appeared to be temporally or functionally different. It is more than likely that they are functionally different. One constellation consists largely of bowl shapes; whereas the other groups include ollas and pitchers. Smudged bowls may have been used as mortuary or ceremonial pottery. Patterned-Corrugated jars were probably used both within the rooms and on the roofs of houses. Two variations of Snowflake Black-on-White pottery that were functionally equivalent but discrete in usage, were isolated. That is, the two Varieties of Snowflake Black-on-White might have been used for the same purpose, but that when one variety was used for that specific purpose, the other variety was not.

3. It was demonstrated that four house types (with two sub-types) can be established on the basis of features (absence or presence of fire pit and shape of fire pit). These house types exhibit differences in pottery frequencies greater than would be expected unless these differences reflect temporal or functional differences. On the basis of further tests, it was decided that the temporal factor was insignificant. From a functional viewpoint, it is proper to suggest that different cultural activities took place in each type of house; or that a lineage segment occupied several adjoining rooms.

4. Temporal differences could not be surely isolated, perhaps because their magnitude is not great. It seems probable that the pueblo was occupied but once and for a relatively short time—perhaps a century.

SUMMARY OF THE PREHISTORY OF THE UPPER LITTLE COLORADO REGION

Archaeologists hold archaeological reconnaissance or survey in high esteem. It has many values and uses, all well known to and employed by members of the profession.

We have made good use of the data derived from Rinaldo's and Longacre's surveys; but here I shall mention only one important result—a synthesis of the prehistory of our area. The methods used in obtaining data for this cultural outline and the results are given in full in Chapter 9.

We have not named the phases and shall probably not do so until we have checked the suggested sequence by means of statistically random excavations. Here we use a numbered sequence. It must be clearly understood that the sequence given by Longacre is a tentative one and is based mostly on data from the surveys.

1. *Concho Complex—Food Collectors.*—The earliest occupation of the area is represented by artifacts and refuse from what is called the Concho

Complex—a taxonomic sub-division of the Desert Culture. (Since Longacre wrote his chapter, we have found two sites used by people with a Desert Culture as well as by people with a Folsom culture adaptation. Since these sites are yet to be systematically investigated, more cannot be said at this point.) A date of about 1550 B.C. (GRO 1614) was obtained from charcoal in a hearth. No pottery is associated with these camp sites, 32 of which have been found.

2. *Incipient Agriculturalists.*—At about A.D. 300 (GRO 2801) several new traits filtered into the area. The introduction of a foreign exploitative-adaptation subsistence system (agriculture, houses, and techniques for preservation and storage of foods) brought about irreversible changes in complexity that altered the Desert Complex way-of-life that had endured for two thousand years or more. A new pattern was ushered in, traces of which we can perceive among contemporary Pueblo Indians. It should be noted that the new patterning did not include ceramics, for at the five sites located and in the one we excavated (Tumbleweed Canyon Site) no pottery of any kind was found. Although pottery had been manufactured in the Pine Lawn area of New Mexico from at least 300 B.C. and in the Anasazi area to the north from about A.D. 400, pottery was late in reaching our area. The reason or reasons for this are at present not known, but we guess that its function was being suitably performed by baskets or bark containers.

At first, probably, the diet of collecting-hunting was merely augmented by corn and perhaps squash and beans. Pit-houses were shallow, crude, and appeared to have been constructed in a fumbling manner by novices. Associated with the houses were food storage pits. Settlements consisted of two to four houses built on valley floors and on sheltered spots high on benches on sides of mesas.

3. *Initial Sedentary Agriculturalists.*—Phase III, that lasted roughly, by estimate, from about A.D. 500–A.D. 700, is differentiated from the previous phase because of the appearance of ceramics and a noteworthy change in location of settlements. We conjecture that a good cooking receptacle was now really needed because agriculture produced foods that required the kind of cookery that only a fired clay container can produce. Change in location of settlements was probably brought about by the need for fertile, arable farming land. This type of location is found in flood plains of river valleys and near small streams. Although agriculture—a new adaptive technique—had been introduced several centuries earlier, the idea of depending almost entirely on farming had not really taken hold until about this time. The people changed their way of life then at about A.D. 500 in order to employ and enjoy to the fullest the new techniques.

Houses became larger and deeper as the farmers became increasingly tied to their lands. Kin-based bands, as in the previous phases, were probably the rule. Population increased slightly but not markedly. The pottery found in this phase represents two separate traditions: a brown ware from the Mogollon area to the south; and a gray ware from the Anasazi area to the north. From this time on, we can perceive, more and more, that this area was and continued to be a transition zone—an area where the influences from the two neighboring cultures—Mogollon and Anasazi—blended.

As we imagine it, the tempo of life was accelerated in all respects and perhaps especially in size of population. An estimate of population growth indicates that a rapid and dramatic increase may have begun toward the end of this phase or about A.D. 700 and continued until A.D. 1100 or thereabouts. It should be noted that migrations are not resorted to for explaining this jump in population. It seems more probable that an increased efficiency in the exploitation of the environment through agriculture is the more plausible explanation.

Seventeen sites of this phase have been found.

4. *Established Village Farming.*—The name for this phase, conjecturally dated at about A.D. 700 to A.D. 900, was suggested by the fact that during these centuries in our area more and larger villages were built with perhaps 12 to 15 pit-houses per village. Settlement type is characterized by random clusters of pit-houses that were round or roundish, some of which were provided with stubby eastern, lateral entrances. The increase in size of sites and in the number of them strongly suggests an expanding population. Further, since growth in general seems to have been rapid, it might be argued that the inhabitants made better use of the land and perhaps grew corn with low row numbers.

The growth in population brought about by a concomitation of circumstances forced established communities to splinter and new settlements to be founded by segments of the original populations in unoccupied but exploitable portions of the region.

Along with the Mogollon and Anasazi plain wares, such as occurred in the preceding phase, one finds the first black-on-white wares (Anasazi derived?).

It is assumed that at about this time a shift in the social organization took place—a shift from kin-based bands to matrilineal clans with matrilocal residence and ownership of property.

Sixty sites of this phase have been found.

5. *Beginnings of Planned Towns.*—An innovation in architecture marks the beginning of this period, for the first surface structures appear at this

time. Rooms were irregular in shape. The floors were semi-subterranean (20–40 cm. below the surface). Masonry was cautiously and clumsily used. The rooms, eight to fifteen in number, were clustered near to one another, as if the builders were trying to devise a practical village plan, but were not contiguous. Perhaps a space of 50 cm. separates each room from its neighbor.

Simultaneously or a little later, more daring fellows went a step farther. They constructed surface rooms but this time they used the radical idea of letting one wall serve two rooms. They had hit on the idea of building contiguous rooms and thus the idea of "pueblo" architecture—rectangular blocks of rooms with masonry walls—came into being. This innovation was probably borrowed from Anasazi neighbors. Pueblos of this type consisted of from eight to twenty rooms. These "planned" towns were usually located on knolls in the valley or on a bluff or edge of a mesa overlooking a valley.

It is during this phase that kivas first appear in the area.

We conjecture that matrilineal matrilocal groups continue. Since settlements are more numerous than in the preceding phase, the increase may be accounted for by the continued expansion of new settlements into unoccupied but fertile valleys. The pattern of larger communities provided with a Great Kiva surrounded by smaller settlements without a Great Kiva, suggests centralized rituals for more than one community.

Pottery reflects the changing styles of adjacent regions. Thus we are not surprised to find more developed black-on-white (such as Reserve and Snowflake) but also black-on-red wares (Show Low and Wingate). The unpainted textured wares are dominated by Mogollon brown corrugated types although some of the Anasazi type gray textured wares are associated with the brown textured types.

Eighty-five sites of this phase have been found.

6. *Established Towns—Beginnings of Convergence.*—This phase (1100–1300) differs from the preceding one in degree rather than substance. Towns are larger (80 to 90 rooms) although there are fewer of them. Many of the settlements possessed kivas and some of them, Great Kivas. Since smaller settlements were being abandoned and the people were tending to settle on two major streams, this period is called one of convergence. It is possible that a slight change in the pattern of rainfall made an agricultural existence precarious. At any rate, whatever the cause, the "inner" parts of the region under study were abandoned. Since agriculture as an adaptive technique was fairly efficient by this time, a larger population could be and was supported on fewer acres.

The social organization and economy for this phase were probably similar to those of the preceding phase.

The pottery was more decorated with more complicated and florid designs. The black-on-white pottery has more space devoted to designs and these are ornate and executed in a casual manner. Polychromes are more abundant.

Thirty-eight towns of this phase have been found.

7. *Large Towns—Full Convergence*, A.D. 1300–1450.—Just prior to the total abandonment of the area, we can perceive that the processes described for the preceding phase are quickened.

The region under study is completely depopulated except for a few sites built on banks of the Little Colorado River and Silver Creek. Both of these streams still flow today, but there are many fossil river beds.

The pueblos were large because the people were herded by circumstances into a relatively few clusters. Some towns possessed several kivas; and with one or two exceptions, plazas seem to have replaced Great Kivas. The social organization probably remained unchanged.

Ten towns of this phase have been found.

Finally, at or about A.D. 1450, the area was abandoned. The reason or reasons for this are unknown at the present time.

PALEOECOLOGY

Hevly and Cooley have contributed papers that manifest their skills to a high degree. Without their cooperation and their researches many of the adaptive processes of the culture under study would be incomprehensible. Seldom in the past have I had the stimulating pleasure of working with such able colleagues who have given liberally of their own time and efforts. More and more am I convinced of the fertility of interdisciplinary studies and cooperation. We have already published one such study on palynology by Schoenwetter (Martin *et al.*, 1962) and I am happy to say that it and those included herein are a prelude to others we envision.

A start has been made on one of the principal aims of Hevly's research. He hoped to obtain a pollen chronology for northern Arizona from late pluvial times to the recent in order to obtain a datable sequence that would be useful in interpreting the relative age of sites that cannot be dated by other means. He also hoped to find pollen from an area relatively uncontaminated by man in order to establish an undistorted environmental history of postpluvial times. This hope was only partly fulfilled.

Briefly, Hevly found that the profiles obtained from a nearby dessicated lake—Laguna Salada—indicate a long period of climatic change from a humid, cool, pluvial climate (at more than 6000 years ago) to a warm, arid climate that is similar to that which obtains today in eastern Arizona. The fluctuations of pollen types in Recent sediments may be related to minor shifts of climatic patterns and the variations in percentages in pollen found may be partly due to the activities of man. Thus, man's activities and consequent disturbances of floral balances are partly reflected in the samples we obtained. It was decided to drill the following season in the center of the old lake bottom to obtain a longer core that might represent ecological conditions not altered by man's activities. A core was obtained in 1962 but the analysis is not completed.

The origin of the sediments from which pollen samples were obtained and the dating of various depositional and erosional events in the Laguna Salada area were studied by Mr. Cooley and reported on herein. The dating of the lava flows, of the origin of the lake and of the alluvial beds in the arroyo are geologically placed and therefore contribute immeasurably to Hevly's work. Cooley demonstrates that the geological history of the Laguna Salada area is a complicated one. In Pleistocene times a stream flowed northeast through the Laguna Salada area. A basalt lava flow dammed the stream causing alluvial material to be deposited to a hundred or so feet in depth behind the lava dam and covered the area now occupied by Laguna Salada. During the time of deposition of the sediments, streams gradually filled or nearly filled the depression occupied by the ancestral Laguna Salada and flowed out of the area to the northwest. About 5000 B.C. environmental conditions changed, the ancestral lake dried up intermittently and the drainage to the northwest was terminated. During periods of heavy precipitation, a small body of water again forms as in the winter of 1961–62, but these intermittent lakes are of less size than in antiquity (before 5000 B.C.). Climatic change is thus suggested by the drying up of the lake, by wind erosion, and by the presence of dunes, the dust of which was scoured out of the lake depression by wind.

FINAL NOTE

Radiocarbon dates have been received from the Laboratory at the University of Groningen, Netherlands, courtesy of Dr. J. C. Vogel:

GrN-4111—Carter Ranch, room 15, earlier of two floors: A.D. 960±60.

GrN-4112—Carter Ranch, room 15, later of two floors: A.D. 1120±70.

GrN-4113—Carter Ranch, room 10, floor: A.D. 1110±70.

We tentatively estimate the life span of this pueblo to be from about A.D. 950 to A.D. 1150 or even A.D. 1200.

Appendix A

Plant Remains from the Carter Ranch Site

By Hugh C. Cutler

Curator of Useful Plants, Missouri Botanical Gardens

CORN

All of the corn from this site was carbonized. There were some ears with grains but most of the specimens were fragments of cobs. It is not possible to distinguish color and grain texture in carbonized material, but accurate comparisons of structure can be made with material from other sites and from living Indians, and the kinds of corn roughly classified. Cob characters have been utilized in many studies and are relatively stable (Anderson and Cutler, 1942; Cutler, 1960; Mangelsdorf and Lister, 1956; Nickerson, 1953; Wellhausen, Roberts, Hernandez and Mangelsdorf, 1952). Two characters which I have found most useful are the number of rows of grains and the width of the cupule. A cupule is the cob cavity associated with a pair of spikelets and their pair of grains. It is a reliable measure of the size of a cob which can be obtained even when only small cob fragments are available. The size, shape and thickness of the lower glumes were studied in the Carter Ranch Site and helped to define the kinds of corn.

The corn from this site falls into three overlapping groups which are outlined in the diagram in figure 75, *a*. Small Cob Flints are the most ancient kinds of corn in the Southwest and, probably, over most of the United States and Mexico. The two modern Small Cob races, Reventador and Chapalote, are difficult to separate precisely. They are still grown in northern Mexico and may still be grown by the Papago of southern Arizona, although the last collection I have seen was made in 1913. Some of the extremes of hard flints grown by the Pueblo Indians of Arizona and, less frequently, of New Mexico, might be considered as part of the Small Cob Flint corn group. The variability of the specimens from Carter Ranch suggests that there has been considerable mixture with other

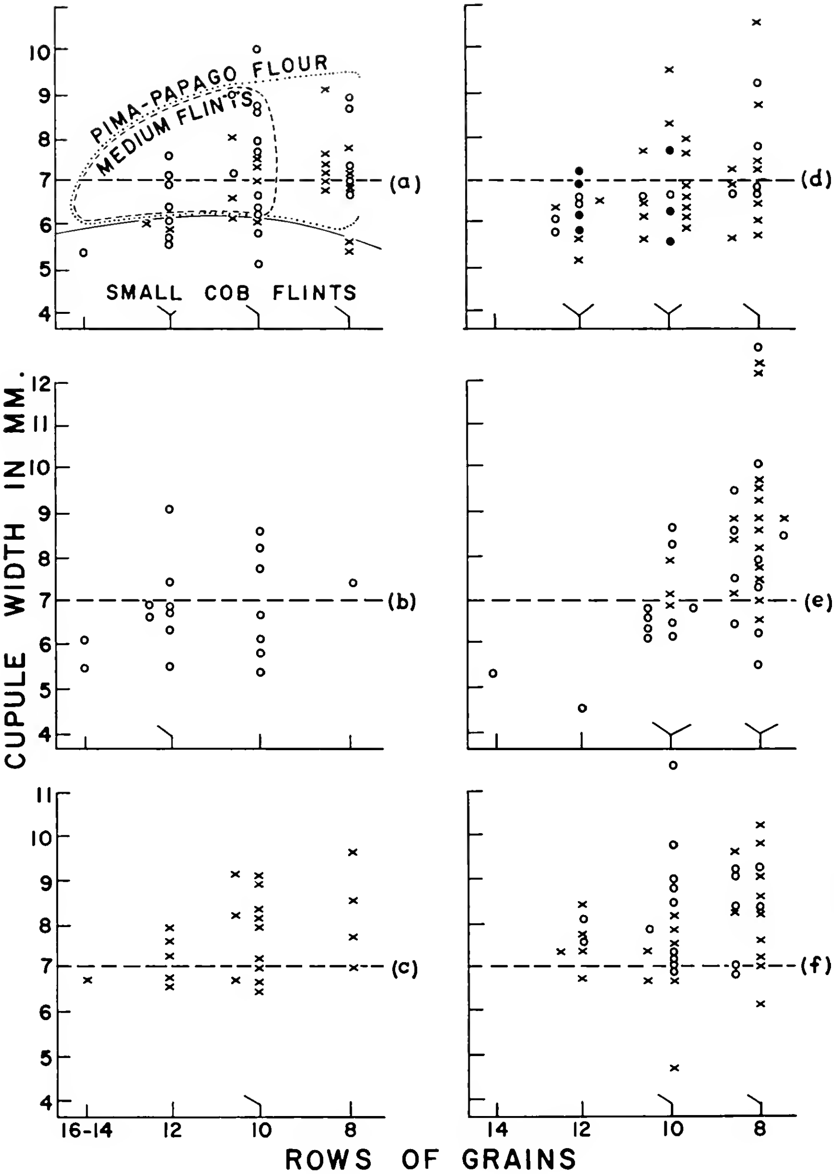

FIG. 75. Diagrams of number of rows of grains and cupule width of corn cobs. All cupule width figures for Carter Ranch Pueblo carbonized corn have been increased by 0.7 mm. to allow for shrinkage of carbonized corn. *a*, Carter Ranch Pueblo, room 8, below floor, indicated by O; room 8, fill, indicated by X. *b*, Carter Ranch Pueblo, room 12, floor, indicated by O. *c*, Carter Ranch Pueblo, cobs from jug-shaped

kinds of corn, especially with the Pima-Papago race (Anderson and Cutler, 1942; Carter and Anderson, 1945), but that some of this would still be within the races we call Reventador and Chapalote, and probably was planted as a distinct kind.

A second major group of corn from Carter Ranch was a medium-sized flint corn, similar to some common yellow and white flints of the Papago Indians, and probably identical to the yellow and white flints which made up about two-thirds of the loose kernels from some Pueblo II-III sites like one on the northeastern slopes of Navajo Mountain, Arizona (Cutler, notes on collections of the Glen Canyon Project of the Museum of Northern Arizona). This kind of corn is still grown by all the Pueblos. Of it Whiting (1939) remarks for Hopi corn, "Once a popular type of corn. With changing economic conditions it has now practically disappeared." This is a bit extreme, because it is still readily found and I have seen and collected it at most Pueblos on casual visits. A major crop even as late as historic times, hard yellow flint corn is now one of the least important kinds grown by the Pueblos.

The medium-sized flints are a mixed race, resulting from hybridization of flour corns like Pima-Papago and Harinoso de Ocho (Cutler, 1960) with the Small Cob Flints. This group has been given the name Onaveño by Wellhausen, Roberts, Hernandez and Mangelsdorf (1952) based on studies of specimens from Sonora, Mexico. There often are forms of Onaveño with larger cupules and cobs, flatter grains, and characteristics of the glumes which suggest mixtures with dent corns. There is very little evidence of these in the Carter Ranch material, even in the latest occupation when it might be logical to expect considerable infiltration of large-cobbed dent corn from the eastern Pueblos.

It is practically impossible to separate the medium-sized flints from the flour Pima-Papago corn race by cobs alone. Since good examples of Small Cob Corn, with small cobs and 12–14 rows of grains, are present at Carter Ranch Pueblo, it is likely that some cobs which fall within the range of the Pima-Papago race but approach Small Cob Corn in having more rows of grains and slightly narrower cupules and lower glumes than the mode for Pima-Papago must be considered as the intermediate, medium-sized flint race, Onaveño.

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pit in Kiva I floor, indicated by X. This probably represents the final occupation of the Pueblo, the most recent corn. *d*, Hooper Ranch Pueblo (about A.D. 1200–1375), room 10A, bin in southeast corner, indicated by solid O; room 10A, floor, indicated by open O; cobs from other rooms indicated by X. *e*, Hinkle Park Cliff Dwelling (about A.D. 1100–1200), trash area B, level 2, indicated by X; level 4, indicated by O. *f*, Cosper Cliff Dwelling (about A.D. 1300), room A, level 2, indicated by X; level 3, indicated by O.

The third major kind of corn from Carter Ranch is the Pima-Papago corn race, the most widespread of the races of the Southwest at the time the site was occupied, and today, when it is grown in northern Mexico and throughout the Southwest. In the Pueblo region and among the Navajos and Apaches, the slightly dented Pueblo race dominates and the Pima-Papago race is of minor importance.

Before A.D. 700 most of the corn in the Southwest had more rows of grains than at present, but increasing amounts of germ-plasm from the Harinoso de Ocho race reduced the row number quickly and slightly increased the cob size. This change is best seen in the corn from Tularosa Cave, New Mexico, where a large and significant collection made it possible to establish the first long sequence which defined periods of radical change in corn types (Martin *et al.*, 1952).

Table 18.—NUMBER OF COB FRAGMENTS OF EACH ROW NUMBER FOUND IN EACH ROOM, TRENCH OR KIVA OF THE CARTER RANCH SITE

Provenience	Rows of Grains				
	8	10	12	14	16
Room 2					
floor	5	2	5	..	1
below floor	11	5	7	..	..
Room 3	1	1	2	..	..
Room 4	3	1	1	..	..
Room 5	..	..	..	1	..
Room 7	1	5	2	..	..
Room 8					
fill	12	7	5	1	..
below floor	5	12	7	1	..
Room 10	..	..	1	1	..
Room 12					
fill	2	2	2	..	..
floor	3	15	17	1	1
Room 15					
fill	2	3	6	..	..
trench, north wall	3	12	8	..	..
Room 16	..	..	1	..	..
Trench A	1	..	..	..	..
Trench B	21	59	33	6	..
Trench C	8	6	5	..	..
Trench D	..	2	2	..	..
Trench E	..	..	1	..	..
Trench G	1	..	..	..	..
Kiva 1, jug-shaped pit (latest occupation)	4	12	5	1	..

While the Carter Ranch Pueblo was occupied there was a change from growing mainly Small Cob Flints to growing more medium-sized flints (Onaveño) and flour corn of the Pima-Papago race. Diagrams (in fig. 75, *a–c*) show the corn from older levels by O, that from the more recent levels by X, and indicate the change in the kinds of corn grown at the site. A list of the cobs found in the rooms and trenches of Carter Ranch (Table 18) also shows this trend of a decreasing number of rows in cobs through time.

COMPARISONS WITH CORN FROM OTHER SITES

Carbonized corn from Room 10 of the nearby Hooper Ranch Pueblo, occupied about A.D. 1200–1375 (Martin, Rinaldo and Longacre, 1961a), (fig. 75, *d*) is not greatly different from Carter Ranch corn but there are more small cobs with ten and 12 rows of grains than one would expect if the trend to larger cobs indicated during the occupation of the Carter Ranch Pueblo had continued. Observations and collections I have made in the Pueblo Indian villages and from many Mexican and Bolivian Indian villages and farms show that differences between communities separated only by a few miles may be even greater than the differences in the corn from the Carter Ranch Pueblo and the later Hooper Ranch Pueblo.

A good example of the persistence of regional patterns for cultivated plants can be seen in the cucurbits of Mexico. Although the period covered by excavations in Tamaulipas (Whitaker, Cutler and MacNeish, 1957) covers several thousand years, the cultivated squashes in the lowest levels are similar to those grown in northern Mexico today and quite different from those found in a similar sequence of several thousand years near the town of Tehuacan, Puebla, Mexico (Whitaker, Cutler and MacNeish, unpublished data). The unique nature of the corn of an area and the persistence of crop plants is not often recognized. Migrations and cultural changes are mentioned more often in studies of cultivated plants than constancy. Comparisons of the Carter Ranch and Hooper Ranch corn with that from two sites near Reserve, New Mexico (These sites are described in Martin, Rinaldo and Bluhm, 1954), show that these areas have related corn but that each has some regional characteristics. Notice how the patterns of the corn types (figure 75, *e, f*) for the two areas are similar for the same period, but the sample shown for the Reserve area has few cobs which are distinctly "Small Cob" and the size of the cob (indicated by cupule width) is considerably larger in these more eastern sites.

COMPARISONS WITH MODERN INDIAN CORN

While we have no Indians living near these sites today, we can make similar comparisons among all the Pueblo Indians, Rio Grande to Hopi and Zuni. Carter and Anderson (1945) tabulated the characters of corn for all these Pueblos and found that they could list them from east to west with the large cobbed, dented, most Puebloid forms to the east and the slender, usually flour or flint corn, Pima-Papago race-like corn in the west among the Hopi. The Carter Ranch and Hooper Ranch corn is more closely related to the corn of the western Pueblos than is the corn of Hinkle Park and Cosper Cliff Dwelling.

All of the kinds of corn Whiting (1939) listed for the Hopi probably were grown at Carter Ranch, except the few which I have marked with ×. The only kinds of corn present at Carter Ranch and not found among the Hopi today are small-cobbed, small-grained, hard flints. These types of corn probably were grown not long ago by the Hopi and can still be seen in the extremes in variation of several kinds of corn grown by these people today.

HOPI CORN

White flour, frequently mixed with red
Large white corn
×Eastern white corn from Rio Grande area after 1863
×Havasupai white corn, obtained in 1915
×Third Mesa white corn
Hard blue flour corn
Soft blue corn
Gray-blue corn (2 kinds)
×Flying eagle corn, white kernels tipped with dark blue (said to have been obtained from the Havasupai in 1915)
Speckled corn or Owl corn
×Eastern speckled corn, from the Rio Grande region
Red corn
Pink corn
Havasupai chin mark corn (variegated or calico, red stripes)
Purple corn (kokoma)
Yellow corn (probably soft flour beglonging to the Pima-Papago race of corn)
Violet or orchid corn
Kachina corn (a mixture)
Light colored sweet corn
Small sweet corn
Red sweet corn
Flint corn

From my observations made on six short visits to the Hopi villages during the past twenty-five years, the most common corn is white, frequently suffused with pink or pale purple, and about intermediate between the white corn grown by the Rio Grande Pueblos and the common forms of the Pima-Papago corn race (Anderson and Cutler, 1942; Carter and Anderson, 1945). Older and more conservative people and Pueblos seem to grow forms which are closer to the Pima-Papago race and to the kinds found at Carter Ranch and Hooper Ranch Pueblos, while less conservative people grow the larger-cobbed kinds which dominate the corn of the Rio Grande Pueblos.

The second most common corn of the Hopi is blue, usually small-grained, slightly flint, with basal and tip kernels compressed and marked by the husks, similar to some Papago semi-flints of recent times. Blue corn is nearer to the older kinds of corn of this region and a few extreme ears cannot be distinguished, except for color, from specimens of Chapalote or Reventador (Cutler, 1960).

Red, yellow flour, or yellow flint probably would be third in popularity. Purple dye corn (kokoma) and sweet corn have always been less conspicuous but attract more attention because they are unusual. Brown, Anderson and Tuchawena (1952) studied white, blue and purple corn.

A very rough estimate of the proportions of corn grown by the Hopi, made in October of 1953 from observations of corn drying on roofs, village streets, and in houses and storage rooms is: white corn 80%, blue corn 10%, all others 10%. More than two-thirds of the corn kernels from several dry sites of about the same age as Carter Ranch Site, excavated by the Museum of Northern Arizona near Navajo Mountain, Arizona (Cutler, Manuscript), were white or yellow flints.

SQUASH

Several moderate-sized seeds of *Cucurbita pepo* were found in Room 4, and a peduncle probably of this species was recovered from Trench B, Square 1R1, Level 4. Pepo seeds were also found at Hooper Ranch Pueblo in Rooms 5A and 5B. Most of the squash from Cosper Cliff Dwelling and Hinkle Park was pepo but there were a few seeds and peduncles of the later squashes, *Cucurbita moschata* and *C. mixta*.

BEANS

A few fragments of at least five large beans, not common or tepary beans, were found in Room 15, floor 2. These may be lima, scarlet runner, or jack beans (*Canavalia*), most likely, because they are so large, either of the last two.

WILD PLANTS

All of the wild plant materials listed below except the amaranth seeds were carbonized.

Amaranthus sp., amaranth or pigweed seeds

Helianthus sp. (sunflower), probably *H. annuus*, although the seeds are a little small for that species, according to Dr. Charles B. Heizer.

Juglans major (*Juglans ruprestris*), walnut shells

Juniperus sp., juniper seeds

Opuntia sp., fruit and stem fragments

Oryzopsis hymenoides, Indian rice grass seeds

Pinus edulis, pinyon shells and cone fragments

Yucca sp., pod fragments, seeds, fibers. A string from Trench B, Square 1R6, Level 4, may be yucca fibers. Carbonized organic matter around the string may be seeds but is more likely strips of animal tissue, perhaps skin.

Appendix B

Some Formal Relationships among the Designs on Snowflake Black-On-White Pottery from the Carter Ranch Site

By Stevens F. F. Seaberg

Artist Preparator, Department of Anthropology

The patterns or the arrangement of decorative devices on the Snowflake Black-on-White pottery from the Carter Ranch Site can generally be divided into three groups. The first of these is an arrangement which leaves a circular space unpainted on the bottom of the bowl or jar (fig. 76, *a*), the second leaves a star-shaped space undecorated (fig. 76, *b*), and the third leaves an undecorated square (fig. 76, *c*).

The decoration which usually appears on pottery of the first type is made up of stripes circling the vessel or of bands of repeated figures. The bands can be segregated into two groups. The first consists of repeated solid black or of solid and hatchured figures. These bands occur singly and sometimes in tiers having base lines in common (fig. 76, *d*).

The second kind of band is made up of a larger and more complex design. Such a figure usually contains more than one design element. It usually appears as a single large band circumscribing the vessel (fig. 76, *e*).

THE SCROLL-SQUARE AND TRIANGLE

Both the simple and complex type of bands can in turn be grouped according to their inner arrangement. An example is shown in the drawing (fig. 76, *f*) where S stands for the square area occupied by the interlocking scrolls and T for the triangular spaces in the band. These black triangles appear because of the oblique position of the scroll-square. Using examples from sherds found at the site, an ordering can be postulated for the scroll-square-triangle relationship. This is meant to show formal relationship rather than any development in time. It begins as an entwining motion within this band of keys (fig. 76, *g–h*).

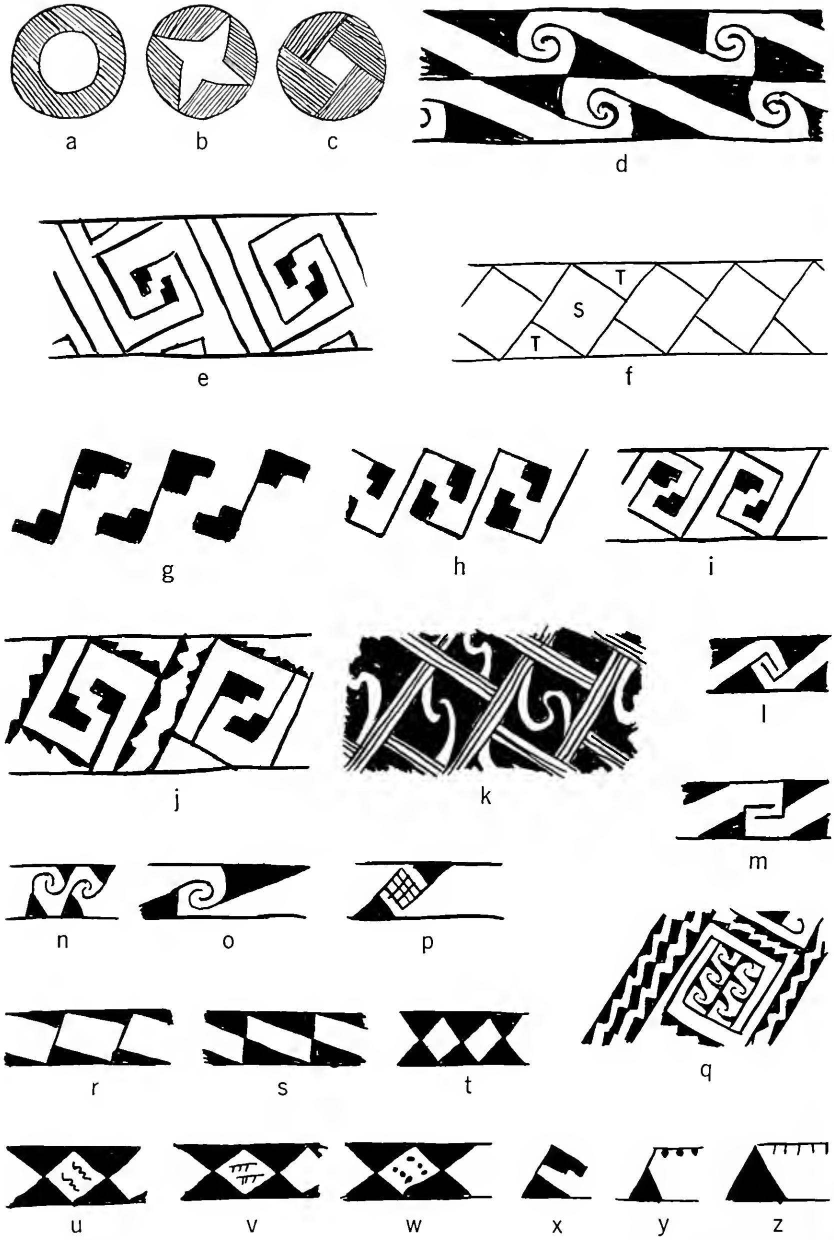

FIG. 76. Layouts and motifs found on Black-on-White ceramics.

In figure 76, *i*, the secondary bands are similar to my drawing (fig. 76, *f*). In figure 76, *j*, these secondary bands look like a woven pattern; the relationship, however, of the squares and triangles is the same, and the square still contains an interlocking figure.

A complex band of scroll-square and triangles (fig. 76, *k*) not only occurs frequently and with great internal variation, but it can also be shown to be the basic arrangement for many of the simple repeated figure-bands. Figure 76, *l–o* shows several examples in which the oblique triangle-scroll-triangle figure is used.

I suggest a formal connection between designs *d* and *e* (fig. 76) since both have the scroll-square and triangle arrangement. The element which suggests this connection is figure 76, *p*, which is like figure 76, *m*, but has hooks joined to form a panel which replace the scroll-square. This is quite similar to figure 76, *q* which also approximates figure 76, *f*. The scroll-square here has almost lost connection with the interlocking scrolls of the previous examples, although it still contains interlocking figures.

The scroll-square and triangle relationship is exactly reproduced in some of the grid figures (fig. 76, *r–t*). Even though these figures seem to be replicas of my drawing (fig. 76, *f*), they are not like the scroll-square and triangle figures themselves in that they do not have scrolls or interlocking toothed parts. An empty square appears where the scrolls were placed in the complex figures discussed above. At this point the comparison might end except for the appearance of other figures, the same as the above, but with squiggles, dots, or ticked lines placed in the center of the squares (fig. 76, *u–w*). All variations of figure 76, *t*, even the rows of dots, seem to be in opposition to one another (fig. 76, *u–w*). This opposition is the same as that characterizing the first endings of the interlocking scrolls or hooks. I suggest that squiggles, ticks, and dots represent, or perhaps have the same import as, teeth or frets, and in similar figures are likely to replace them. A series arranged according to this hypothesis is shown in figure 76, *x–z*.

THE BAND OF SQUARES

The second band pattern can be thought of as a row of tangent squares (fig. 77, *a*). An ordering can be set up analogous to that of the scroll-square and triangle band discussed above (fig. 77, *b–h*). The basis for this band pattern is a grid of simple squares (fig. 77, *i*).

In figure 77, *j*, the dot may be thought to stand for the interlocking hooks or frets which occur in the complex examples of this design (fig.

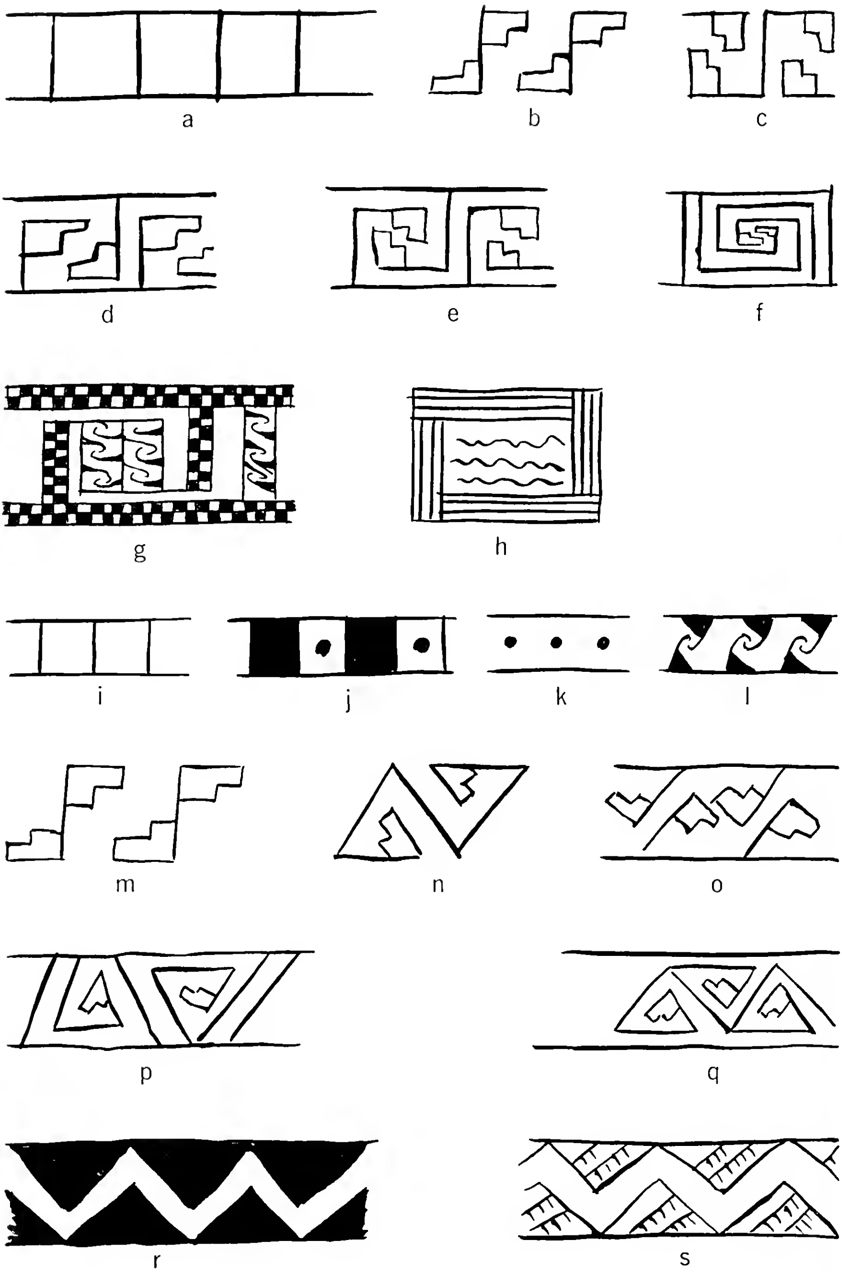

Fig. 77. Layouts and motifs found on Black-on-White ceramics.

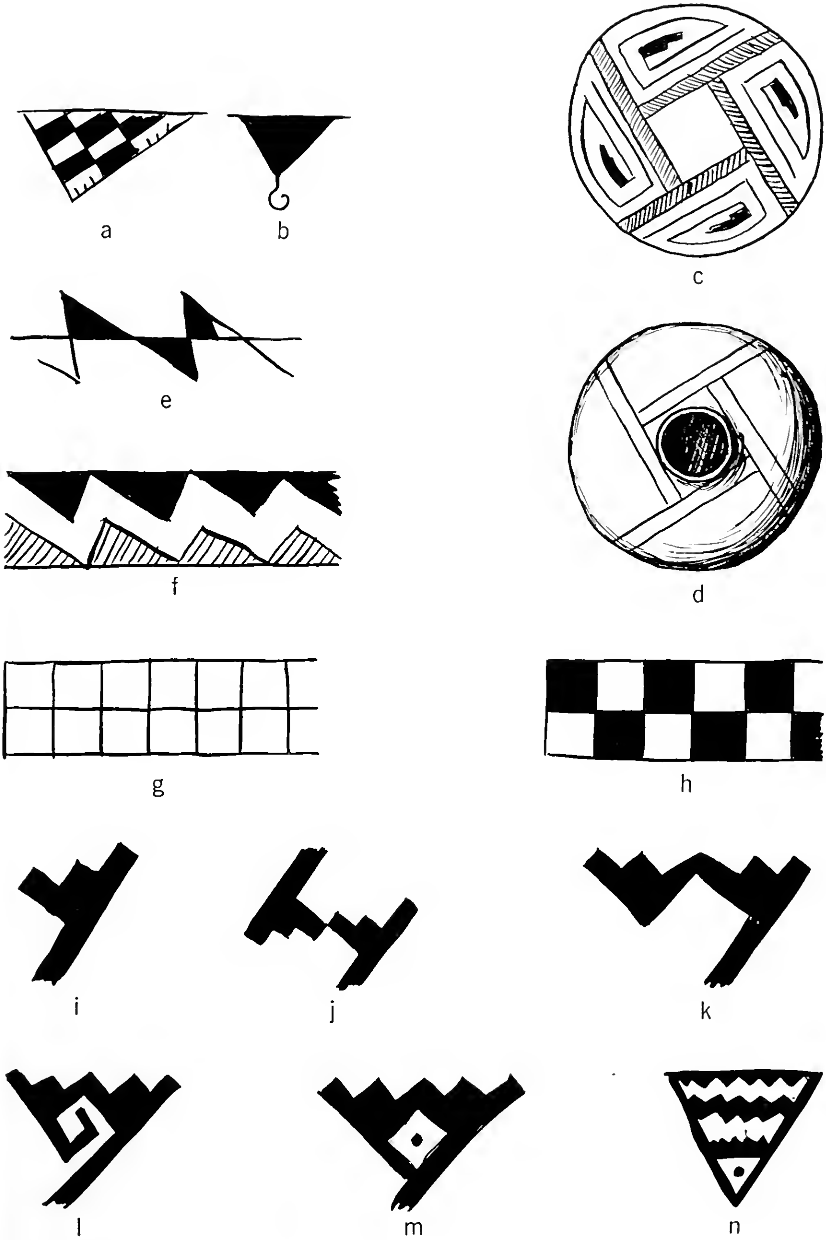

Fig. 78. Layouts and motifs found on Black-on-White ceramics.

77, *b–g*). The figure consisting of a row of dots may be related to the design which consists of a row in interlocking hooks (fig. 77, *k*, *l*).

THE BAND OF SCROLL-TRIANGLES

A band of scroll-triangles is the third complex figure appearing in band patterns. A hypothetical ordering similar to that of the previous two complex figures is shown in figure 77, *m–q*. Its most simple form is the band of interlocking triangles (fig. 77, *r*). Figure 77, *s*, is an example of the replacement of the scroll and fret by ticked lines, or at least of their appearance inside the triangle.

THE PENDANT TRIANGLE PATTERN

The pendant triangle pattern, which leaves a star-shaped area unpainted in the bottom of the bowl, is made up of a row of triangles which are pendant from the rim of the bowl (fig. 76, *b*). These triangles are either solid or filled with a rectangular grid figure; scrolls do not occur. The only motifs that are similar to the frets or interlocking elements of the other complex figures are the ticks that are often found inside the apex of the triangle (fig. 78, *a*) or the hook which occurs at the apex (fig. 78, *b*). As hooks and ticks do not occur together on the same figure, I suspect that they, in some way, represent the same thing.

THE SQUARE HOLE PATTERN

The square hole pattern (fig. 78, *c*) is like the pendant triangle pattern in that it is made up of triangular areas. Here, however, the triangles have been pushed together so that they have sides in common, leaving a square space unpainted in the bottom of the bowl. The figures which occur within the triangles are more often like those occurring in the band patterns. Formally, they can be shown to be related to the scroll-square and triangle design. Viewing the bowl or jar from the top, the simple bands which border each triangular area may be seen to join around the open square, much as the secondary bands join around the scroll-square in the scroll-square and triangle arrangement. Here, as in some of the grid figures already shown, the scroll-square is blank, except when the opening of the jar emerges through it (fig. 78, *d*). In this case the opening might be likened to the dot or vortex in some of the other motifs.

GUIDE LINES, BASE LINES, AND GRIDS

The designs on the sherds collected from the Carter Ranch Site may be classified into two groups according to the manner in which they were painted. First are those figures painted without any preparatory laying out of the design. In this case stripes are usually the same width as the brush used, and corners are often rounded. In short, the painting has the appearance of having been done freehand.

In the second group, the design appears to have been first painted in outline with a fine brush and then filled in. Such examples can be identified by their straight edges and sharp corners. In many cases the fine lines can be seen beneath the filling paint. Figure 78, *e* and *f*, show the use of guide lines. The horizontal lines to which the figure is attached are base lines or ground lines. Perhaps the most striking of all these figures are those using a guide-line system forming a grid, that is, one in which the fine lines cross between two base lines, making a system of enclosed spaces. These spaces are usually filled in alternately (fig. 78, *g*, *h*).

Although the reverse fret does not occur as often as the fret shown as an element in figure 61, no. 1, it seems worth mentioning because of its many variations. Compared to the fret which most commonly occurs at the end of a scroll and which looks very much like a key, the reverse fret is attached in reverse to the end of the scroll (fig. 78, *i*). Unlike the more common fret, it often appears joined to other frets at a corner (fig. 78, *j*). This peculiar arrangement comprises a whole series, starting with figure 78, *k* and *l*, in which a hook appears and is replaced by a dot as in figure 78, *m*. This occurrence of a dot replacing the hook is not surprising. Since these figures are most often found in triangular areas, I may even speculate that figure 78, *n*, is related to them. Here, the toothed lines replace the stepped edges of the frets and the dot appears to take the place of the hook.

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