MONTEZUMA CASTLE ARCHEOLOGY

Part 2: TEXTILES

By Kate Peck Kent

SOUTHWESTERN MONUMENTS ASSOCIATION
TECHNICAL SERIES
Vol. 3, No. 2

MONTEZUMA CASTLE

ARCHEOLOGY

Part 2: TEXTILES

This little Gambel Quail, as painted in red on a piece of buff pottery by a prehistoric Hohokam Indian artist, is the colophon of the Southwestern Monuments Association. As such, it has appeared on many hundreds of thousands of pieces of stationery, and interpretive booklets, and, through the latter, has become widely known as a symbol of authentic interpretation of the great Southwest.

Strangers are inclined to think him a squawking parrot, but the "upper beak" was really meant to represent the curved feather topknot of this interesting desert bird. The design was copied from a piece of broken prehistoric pottery at Casa Grande National Monument, Arizona.

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PREFACE

This report was completed in 1938. Since that time the author has made more extensive studies of prehistoric Southwestern textiles, principally those woven of cotton. In the light of these studies a limited amount of revision, allowing for the addition of new material pertinent to the Montezuma Castle series, was thought necessary. The report stands, however, substantially as written then.

KATE PECK KENT

Arizona State Museum, June, 1946

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Our thanks are due to Dr. A. C. Whitford, of Alfred, New York, Dr. Volney Jones of the Department of Anthropology, University of Michigan, and F. Martin Brown of the Colorado Biological Survey, for their aid in detemining from what materials these specimens were made. The three analyses agreed for the most part. In problematical cases Dr. Whitford's opinion has been followed, as he studied the collection in its entirety, while the other investigators worked only from our slides. The variant results are always listed in the form of footnotes. Dr. Jones' color notes proved of particular interest and value in our research. Drawings were done by Frances R. Raynolds; photographs by the Denver Art Museum.

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INTRODUCTION

This series of 61 specimens was sent for analysis from the Montezuma Castle National Monument, Camp Verde, Arizona, to the Indian Department of the Denver Art Museum during the winter of 1937-1938.

LABORATORY METHODS

The specimens were received in three groups and were numbered arbitrarily upon receipt, merely as a method of identification.[1] (The PS numbers appearing on some of the pages are original National Park Service numbers.) Each piece was then cleaned as thoroughly as possible. Next, gross measurements were taken of each—in inches and centimeters. Slides were then made of the material or materials found in every specimen and checked by F. Martin Brown, Dr. Volney Jones and Dr. A. C. Whitford. Dr. Whitford made the photomicrographs shown in the paper.

Technical sketches were made after careful examination of each specimen under the microscope. One or more photographs of each piece were then taken.[2] Finally, comparative literature was checked to determine the location and techniques of similar specimens. Haury's Sierra Ancha finds, and Hough's Gila River report proved to be the most valuable data in this respect.

METHODS OF PRESENTATION

The results of this laboratory research are set down in the following pages. Specimens are grouped together in classes (textiles proper, skirts, etc.), each piece within a class being described in detail. Preceding each class there are a few preliminary remarks coordinating the salient points regarding it. These summaries are intended to offer the casual reader a good view of the Montezuma Castle finds without necessitating a study of the piece analyses.

GENERAL REMARKS CONCERNING THE SPECIMENS

Number and classes of specimens. There are 61 specimens in the Montezuma Castle series. These are described under the following classifications:

Textile proper[3]	31 specimens
Sandals	10 specimens
Cords, braids, ropes	8 specimens
Skirts	6 specimens
Matting	4 specmiens
Net	1 specimen
Twined-woven bag	1 specimen

1. These numbers appear in the photographs on the metal-edged, round disks.
2. Negatives are filed at the Denver Art Museum.
3. The term "textile" as used hereafter in this report refers to those fabrics which are products of the loom.

1. **Textiles proper.** Twenty-two of the 31 textiles are plain weave, 4 of these having paired wefts; 3, paired wefts alternating with woven strips or bundles of cotton string; and 2, single wefts alternating with woven strips or bundles of cotton string. There are 4 weft-wrap openwork textiles, 2 of which also show gauze weave. One piece shows gauze weave alone. Two of the fabrics are weft-float, 1 slit-tapestry, and 1 diamond twill.

2. **Sandals.** Of the 10 sandals, 7 are an over-one under-one braid.[4] Four strands are folded to make 8 elements, which are braided from toe to heel. The eighth sandal is an over-one under-one braid of 6 cords folded to make 12 elements. Of the remaining 2, 1 is an over-two under-two braid of 27 strands, while the other is wickerwork made by weaving cords back and forth over 6 string warps.

3. **Skirts.** Four of the six skirts are made with a center pad of two string bundles, over which other strings are woven, their loose ends twisted to make a fringe on either side of the pad. The other two have a foundation unit of three strings, with other strings twisted over them forming a fringe on one side only.

4. **Cords, braids, ropes.** In this classification are 2 braids, 1 forming a coarse 3-strand rope, the other a flat over-three under-three braid of 49 strands. There is 1 decorative cord made of 6 strings fastened at intervals by other strings wrapping around them—probably a necklace. Three cords are made with a 2-strand twist, 1 with a 3-strand twist. There is 1 small ring of partly shredded yucca leaves, not twisted in any way. This brings the total of cords, etc., to 8. If the sandal ties be considered here, the number would be increased to 17. Six sandal ties are of untwisted, partly shredded yucca leaves, 1 is a 2-strand twist, 1 a 3-strand braid, and 1 an 11-strand over-two under-two braid.

5. **Matting.** Two of the four mats are an over-three under-three twill; one is a twill too badly damaged to determine the exact technique; and the fourth is a plain checker weave.

6. **Bag.** There is one fragment of a twined-woven bag.

7. **Net.** A portion of net, made by knotting strands together with square knots, is included in the series.

MATERIALS USED

Cotton and yucca are the most common materials used. Cotton is found principally in the textiles proper, while yucca is the basic fiber in sandals, cord and ties, and skirts. Four varieties of yucca are found appearing in the frequencies:[5]

elata	7 specimens
baccata	12 specimens
macrocarpa	4 specimens
mohavensis	6 specimens

4. An "over-one under-one braid" is also called "plain plaiting," and an "over-two under-two braid," "twilled plaiting." Braiding and plaiting are synonymous terms applied to the continuous intertwining of strands from one point downward.

5. This follows Whitford's classification. He mentions the predominant type in a piece, stating ". . . sometimes there might be **Yucca elata** and **baccata** in the same object as they did not seem to be religiously careful as to the species used so long as it was yucca. I will say, though, that in most cases the samples were pure."

The first two varieties are the only ones used in the yucca textiles. All four varieties are used for skirts, cords, sandals, etc.

Agave parryi is used in four specimens, all cord; *Dasylirion wheeleri* in two mats; and juniper bark in one mat.

Photomicrographs of the four types of *Yucca, Agave parryi,* and *Dasylirion wheeleri* are shown on Plate 1.

It should be noted that no traces of apocynum were discerned by Whitford or Jones in this series. It may be that this plant was extensively used only in the Anasazi area. Whitford says, concerning this:

"In a rather extensive collection from the American Museum of Natural History of materials from the Southwest I have found some considerable apocynum but . . . chiefly from specimens found in Utah and Colorado."

He adds:

"I have looked over all the information I have obtained in my investigations of Southwest fibers and find that in northeast Arizona and south Utah there is some apocynum used by prehistoric Indians, but those are the only places outside, of course, of Nevada and that region (mentioned above.)"

Table I in the Appendix lists specimens by number and gives all data on materials used in each.

COLORS

Fourteen of the 61 specimens show coloring, produced either by dyeing the fibers, or by rubbing on paint after the piece was completed. In the latter case the color shows only on 1 surface of the piece. Red, black and yellow are the 3 colors used. The first, red, is by far the most common, appearing on 10 of the specimens. Black is found on 5 specimens, and yellow on 1. Red and black are combined on 1 piece, and black and yellow on another.

Twelve of the 14 colored specimens are cotton; the remaining 2 are yucca. This favoring of cotton as a vehicle for color is probably because textiles proper are woven from it, and merited decoration in the opinion of their weavers, whereas sandals, skirts, etc., made from coarser materials, were considered too rough for decoration.[6]

Yellow and black are always applied as a dye, but 5 of the 10 red specimens have color rubbed onto their surfaces.

The sources of dyes cannot be determined in the majority of cases. The red in two specimens reacts to a test for iron. According to McGregor:[7]

"Dyes or pigments used in coloring yarn or fabrics may be divided into two general classes: organic and inorganic. In prehistoric cotton fabrics the inorganic dyes are by far the most common, and consist largely of three colors: red, produced from hematite or some other iron oxide; yellow, from a yellow ochre; and blue or green, produced from copper sulphate. These inorganic dyes may be readily determined by a superficial examination with a medium-powered microscope, for the dye material does not penetrate the fiber but clings to it in the form of grains. Organic dyes seem to consist of only black, dark brown, and a light blue. These dyes are relatively permanent and cannot be washed out, as can the inorganic types."

6. Although in Basketmaker times coarse fiber sandals were brightly colored.
7. McGregor, 1931, pp. 3-4.

Jones notes substantially the same thing in his report on the pigments in this series:

"The pigments seem to fall into the two general groups of *internal* or absorbed pigment, and *external* or surface pigment. The former are usually of *vegetal nature* and the latter are usually *mineral*. The surface pigments appear as granular, uneven material applied to the fibers. There is considerable likelihood that surface soil adhering to the fibers might be confused with such pigment."

In line with these statements it is interesting to note that the red and yellow dyes in the Montezuma Castle series are apparently all external, or inorganic (mineral), whereas the black dye is internal, or organic (vegetal).

There are many cases in which fibers look dyed when viewed under the microscope, whereas the specimens from which they were taken show only darkening through weathering or scorching. In such cases the appearance of the piece as a whole has been considered as the determining factor. This decision checks well with Jones' statements made after examination of cotton textiles from several archeological sites in the Southwest. He finds:

" . . . considerable variations in color of the fibers from textiles which seem to be undyed. Some have sufficient coloration, due to ageing and weathering, that under the microscope they appear to have been dyed."

He notes, further, on examining lint from seeds of cotton from a Basketmaker site, that the fibers have a lovely yellowish-green color. According to Jones . . . "scorched cotton fibers have a yellow-brown, evenly distributed color, suggesting pigmentation."

The Montezuma Castle specimens have been subjected to weathering and charring, which factors have undoubtedly modified their colors.

Table III, p. 93, summarizes information on color.

HISTORY OF THE FINDS

The conditions under which the specimens were found are set down in a letter of September 22, 1937, from Earl Jackson, then custodian of Montezuma Castle National Monument, as follows:

"These specimens were found in the cave rooms of a cliff ruin about 300 feet west of the structure known as Montezuma Castle. The cave rooms were at one time the back rooms of a cliff dwelling which towered five or six stories against the vertical cliff, and contained more than 40 rooms. This dwelling collapsed entirely, probably in prehistoric times, leaving a great mound of disintegrated wall material at the foot of the cliff on a ledge about 12 feet above the river terrace level. I believe the dwelling fell as the result of a fire, because all traces of ceiling structure found in the excavation of this fallen material were completely charred.

"The cave rooms of this ruin were excavated or cleaned out (see following letter) in 1927; this work yielded practically all the textile material which you are now studying. Unfortunately, the work was not done scientifically, and no record was kept of details encountered in cleaning out the rooms.

"In the winter and spring of 1933-34, I was in charge of a project under CWA to clean out the material at the base of the cliff. This work uncovered the bases of the walls and the floor outlines of the houses which had adjoined the caves in front. While we found practically nothing in textiles in this CWA dig, since the material had been exposed to the weather, we were able to ascribe a tentative date for beginning of occupation as around 1100 A. D. A tentative closing date for this ruin would be 1425 A. D."[8]

George L. Boundey, formerly custodian of Gran Quivira National Monument, New Mexico, in a letter of April 11, 1938, states:

"In looking over the many caves in the vicinity of the main ruin, we found that vandals had excavated through the debris in practically all of them. Many modern digging tools were found, some dating back to the days when Camp Verde was an army post. In a pile of debris overlooked by the pot hunters we found several small objects. Mr. Pinkley [the late Frank Pinkley, then superintendent of Southwestern National Monuments] pronounced these museum specimens and suggested that I, with the two engineers, start a thorough cleaning out of the debris.

"We started work in each cave at the opening, digging down to the stone floor and passing back each shovelful through the opening where it was dumped on the ledge. In the light every fragment of pottery and anything which suggested man's work was placed in a paper sack and numbered.

"The textiles were taken from the largest of the caves, which evidently housed several families. Here, owing to the darkness and the depth of the debris, vandals had left the lower portions undisturbed. This room has several raised portions of the floor and we labeled the bags and boxes according to the different levels on which the material was found."

An analysis of pottery sherds from this site places it in the Pueblo III and IV periods, and indicates an infiltration into the region of trade influences from other areas. It places the most important period, culturally speaking, towards the end of occupation—in Pueblo IV—which probably lasted as late as 1425 A. D.

PROBABLE DATES OF THE SPECIMENS

The dating of the perishable specimens checks well with the preceding remarks as to the period of occupation of the site. Weft-wrap pieces, matting, and cord sandals with braid ties, like the Montezuma Castle specimens, are placed in Pueblo IV by Haury in his Canyon Creek paper.[9] Other specimens similar to ours are late Pueblo III or IV according to his classification. It is assumed, therefore, that the Montezuma Castle finds fall in these two periods. The great exception to this is the small fragment of what could be a Basket Maker III (or II) twined-woven bag. The technique of weaving and decoration check

8. Jackson and Van Valkenburgh, 1954.
9. Haury, 1934.

absolutely with Guernsey and Kidder's description of Basket Maker bags.[10] The only difference is the use of yucca here, as opposed to the apocynum of their northern specimens.

LOCATION OF SIMILAR SPECIMENS

In the case of the textiles proper the rag-weft plain weaves and the weft-wrap and gauze fabrics indicate that the weaver's art at Montezuma Castle was closely akin to that at Tonto National Monument, Canyon Creek and the Upper Gila which flourished at about the same time. Weft-wrap openwork and gauze are not unknown from Anasazi sites, but are much more characteristic of central and southern sites, and seem to be earlier in the south. Rag-weft is not definitely established as one of the Anasazi techniques. Slit-tapestry, on the other hand, appears to be a very early technique in the Anasazi area, dating back into Basketmaker times. The diamond twill, found at Montezuma Castle, ties in more closely with the northern tradition than with central and southern sites, also. Weft-float has not been reported from other prehistoric sites.

Matting and sandals are much like those from the Sierra Ancha and the Upper Gila. Two sandals described by Mera,[11] from the Guadalupe Mountains near Carlsbad, New Mexico, are also very similar to those described here.

Further comparative data will be found in the preliminary notes before each weave class. Much of this material was gathered after the Montezuma Castle report was written. It will be more fully dealt with in a study of prehistoric Southwestern textiles to be published at a future date.

10. Guernsey and Kidder, 1921, pp. 65-74. Hereafter this publication is listed as PMP VIII, 2.
11. Mera, 1938.

TEXTILES

(Nos. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 21, 33, 34, 35, 36, 37, 39, 46, 53, 54, 55)

About half of the 61 specimens, 31 in all, in the Montezuma Castle series are classified in this paper as true textiles.

MATERIALS

They are woven from cotton and two varieties of yucca.[12] Cotton is found in 27 of the 31 textiles; 23 of these have no other material combined with them. Yucca and cotton together are used in the other 4 pieces. Three of these (Nos. 53, 11 and 17) have yucca wefts and warps and some rag wefts of cotton woven in. No. 12 has yucca string warps and cotton wefts. Yucca is the sole material used in 4 specimens (5, 39, 16, 46).

COLORS

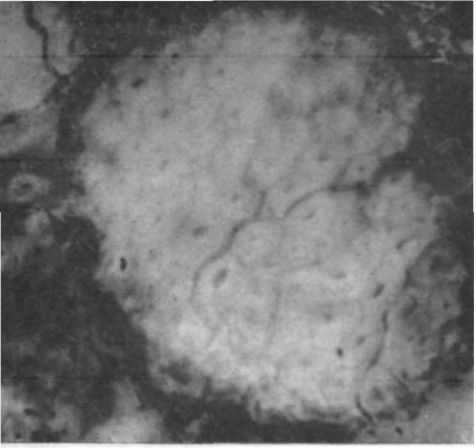
Of the 31 textiles, 10 show color,[13] either rubbed on the surface after weaving or applied as a dye. Only cotton fabric is so decorated. Red, black and yellow are the colors used. Red, in several shades, is the most common, appearing as the only color on 6 of the 10 textiles. It is rubbed on in two cases (Nos. 1 and 53), and used as a dye in four cases (Nos. 9, 11, 17 and 19). Red-dyed strands, as well as black-dyed strands are found in No. 56. Nos. 18 and 33 have black-dyed cotton wefts. No. 12 has some black and some yellow-dyed cotton wefts.[14]

In this series there is no evidence that designs were painted on cloth. In 6 of the 10 specimens which show color, it covers the whole, or nearly the whole, surface of the piece. In the remaining 4 textiles, colored threads are used simply to emphasize the design produced by the weaving technique; that is, the floated weft pieces (Nos. 18 and 33) have black wefts to contrast with the white warps and to bring the geometric patterns produced by weft-floating into sharp relief. The diamonds originating through the twill technique (No. 56) are emphasized by the use of black and red strands. In No. 12 the color follows the lines of the slit weave. (For dye sources see Introduction, page 3.)

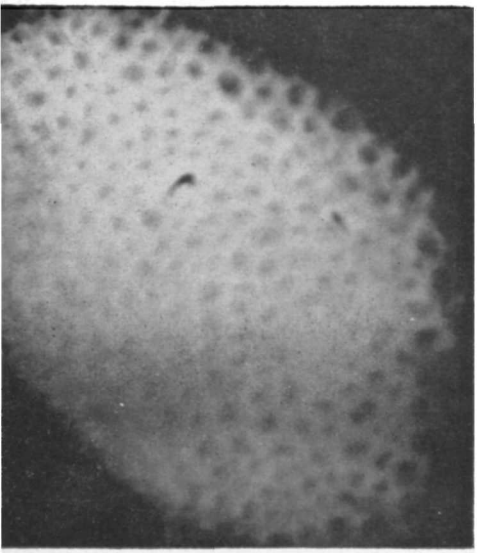
SIZE

The pieces are, with one exception, small fragments. The largest fragment (No. 55) measures 24 inches (61 cm.) by 11⅜ inches (28.9 cm.). There is one bag (No. 18) woven as a narrow cloth, 25 inches (63 cm.) long by 5¾ inches (14.6 cm.) wide.

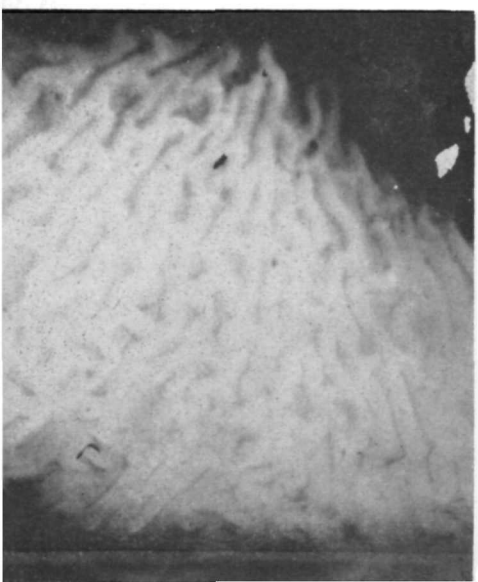
12. Eight textiles, all told, employ yucca. Of this number, six are **Yucca baccata** (11, 12, 16, 39, 46, 53) and two are **Yucca elata** (17 and 5).
13. Nos. 1, 9, 11, 12, 17, 18, 19, 33, 53, 56.
14. cf. Haury, 1934, pp. 99 and 102, and Hough, 1914, pp. 82-83.

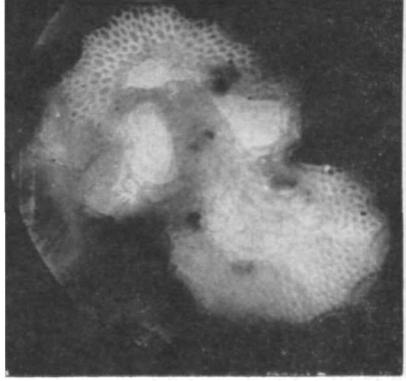


Yucca elata, magnified 600 dias.
Specimen No. 17

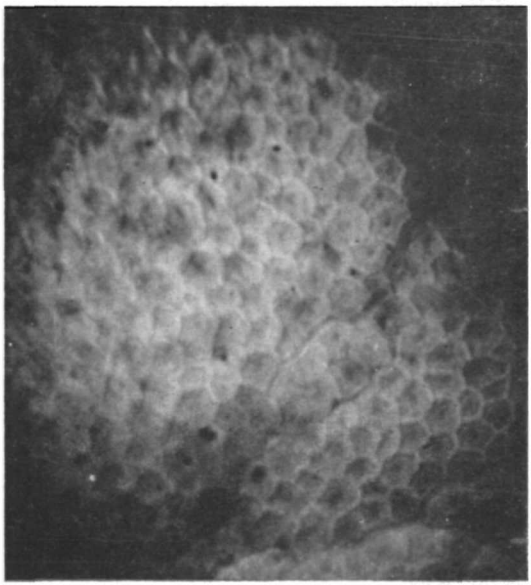


Yucca macrocarpa, magnified 600 dias.
Specimen No. 63

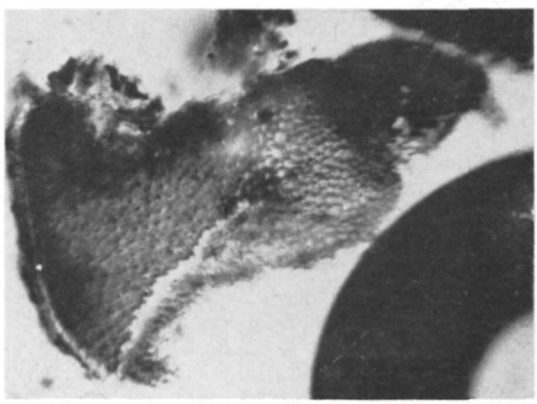




Yucca mohavensis, magnified 200 dias .
Specimen No. 43



Yucca baccata, magnified 600 dias.
Specimen No. 38



Above: *Dasylirion wheeleri*, magnified
200 dias. Specimen No. 44.

Plate 1. Photomicropraphs

Left: *Agave parryi*, magnified
600 dias. Specimen No. 5.

TECHNIQUES

All the textiles could have been woven on an upright, Pueblo-type loom, as has been determined by actual reproduction of their techniques on a model loom in the laboratory.

There are six weave techniques: plain weave, weft-warp openwork, gauze, weft-float, slit-tapestry, and diamond twill.

1. Plain weave. Thirteen of the 31 textiles are plain weave with no variations. (Nos. 1, 2, 3, 6, 7, 8, 9, 10, 14, 15, 19, 21, 55.) They are all of cotton. In these pieces it is sometimes impossible to state definitely which threads are warps and which are wefts. In cases where one element is much finer than the other, one might postulate the finer to be the warp, with coarser wefts woven in. This distinction checks with Spier's statement regarding Zuni weaving:[15]

" . . . although both yarns are said to be from the same ball, the warp appears to be somewhat thinner and somewhat more tightly twisted than the weft. This may be due to slightly greater tension on the warp."

See also McGregor:[16]

"Weaving yarn may be again divided into two classes; the more compact generally being the warp threads; the less well twisted, and consequently of greater diameter, being the fill, or weft threads."

Again, in cases where one element is in a much better state of preservation than the other, one might say the former is the more tightly twisted warp, and the latter the loose weft, which disintegrated sooner. In the detailed descriptions which follow, the element having the finest stitch count may automatically be considered as the warp, unless otherwise indicated.

In this series the finest weave (No. 21) shows a stitch count of 32 warps and 28 wefts per inch (14 and 12 per cm.). The coarsest (No. 2) shows 19 warps and 18 wefts per inch (8 and 7 per cm.). The average stitch count for either element is approximately 24 per inch (10 per cm.).

Three of the 13 plain woven fabrics are colored, all with red. The red is a dye in two cases (Nos. 9 and 19), and rubbed on in one case (No. 1).

1a. Plain weave, paired wefts. The four yucca fiber[17] textiles (Nos. 5, 39, 16, and 46) show the use of paired strands as wefts. The number of paired wefts to the inch varies from 7 to 11 (3 to 5 per cm.), three of the textiles having 11 pairs. The average number of warps to the inch is 10 (5 per cm.). These coarse fiber textiles, then, are a much looser weave than the cotton pieces. (See pp. 12-18.)

1b. Plain weave, paired and rag wefts. Three fabrics (Nos. 11, 17, and 53) have warps and paired wefts of yucca, and also rag wefts. The latter are rolled-up strips of finely woven cotton, or bundles of cotton string. In all three pieces these strips show red color, particularly on the part that is rolled inside. The occurrence of red on the inside

15. Spier, 1924, pp. 68-69.
16. McGregor, 1931, p. 3.
17. Our analysis of materials used in No. 16 allowed for yucca, apocynum and cotton. Jones found it to be primarily of yucca fibers, with some admixture of cotton, and no apocynum. We have used Whitford as final evidence.

of the rag wefts indicates that this color was rubbed onto the cotton fabric on one side only, and that this side was rolled in; or that it was rubbed on both sides or applied as a dye, but has worn off the outside. (Nos. 11 and 17 probably are dyed, whereas No. 53 has the color rubbed on.) Where enough warp and weft remain in the strips to measure, we find a stitch count of about 24 to 28 threads to the inch (around 11 to 13 per cm.).

The strips were probably torn from worn-out cotton cloths and added to the coarse fabric as decoration. They appear throughout the fabrics at irregular intervals. (See pp. 22-25.)

1c. Plain weave, single and rag wefts. Specimens Nos. 4 and 54 are a regular plain weave of cotton, with strips of cotton cloth or bundles of cotton string woven in at intervals as wefts. (See pp. 25-26.)

2. Weft-wrap open work. There are four specimens (Nos. 34, 35, 36, and 37) which are decorated with geometric designs of openwork, produced by wrapping certain wefts around warps, according to a definite plan. These pieces are all of natural-color cotton, and have a fine stitch count of from 26 to 35 stitches to the inch (12 to 16 per cm.). Nos. 36 and 37 are probably sections of one large piece. (See pp. 27-32.)

3. Gauze Weave. Nos. 36 and 37, as well as having weft-warp decoration, have a few lines of gauze weave. In this weave variation, wefts are omitted at regular intervals, leaving rows of openwork. Within these rows adjacent warps are crossed. Such rows occur at intervals of three to five wefts. (See pp. 28-31.)

No. 13 has wefts missing at intervals, although the warps are not crossed. It is so noticeable as to suggest that wefts were pulled out purposely after weaving, or were left out during weaving. (See p. 32.) All these pieces are of finely-wove, uncolored cotton.

4. Weft-float. Two of the pieces (Nos. 18 and 33) are woven by a weft-float technique. In both cases the wefts are of black-dyed cotton and the warps of natural white cotton. A regular over-one under-one weaving of the wefts through the warps would produce a black-and-white checkerwork. In order to make a design, certain wefts are allowed to "float" across several warps at a time, according to a definite plan. The only difference between these two textiles is that in No. 18 the wefts always appear paired, while in No. 33 they are single-strand. (See pp. 33-36.) No similar articles are described in the literature on prehistoric textiles.

5. Diamond twill. Another weave type shown in this series is the diamond twill (No. 56). This piece is woven from very fine cotton. The inner diamonds are divided on their long axis in two parts, one red and one black. The red and black threads are dyed cotton—the red reacting to the test for iron. Red and black threads are introduced into the weave by knotting them onto the white weft, and weaving with them as long as desired. The wefts pass over-three under-three. The loom rig for this technique calls for five heddles and a shed rod. There is no mention of such a set-up in the literature on Southwestern weaving, the diamond twills described requiring only three heddles and a shed rod. (See pp. 37-40.)

6. **Slit-tapestry weave.** There is one slit-tapestry textile (No. 12) in the Montezuma Castle series. In this technique a weft, instead of being laid in the entire width of the piece, is woven back and forth over three warps five times, then brought over a warp to right or left, and the process repeated. Hence, a number of slits are produced throughout the textile. These slits divide wefts of different colors. (See pp. 40-41.)

BORDER TECHNIQUES

Seven of the textiles have small sections of borders. The most common border technique used is similar to that found on the sides of Navaho blankets. A weft hooks between two units, each of which is composed of three loosely twisted strings, and re-enters the weave again. The units are crossed on each other once; and the next weft hooks between them again. In brief, the units are twined along the edge of the piece. Three pieces have this border type (Nos. 7, 18, and 33; pp. 14, 33, 36.)

A second technique (No. 14; p. 16) shows four strings twisted together. The wefts hook through these, over a different one each time. There is the addition of a string twisted over the four border elements to hold them more tightly together.

No. 4 (p. 25) has an edge cord consisting of five twisted threads. The warps loop over this cord.

The last two techniques classified here as "borders" may in reality be attempts to keep a cut or torn edge from raveling. There is one edge (No. 21; p. 18) showing four strands twisted over the last three weft strands of the regular plain weave. Lastly there is a piece (No. 8, p. 15) showing ¼inch of the weave rolled up at the edge and bound by a string.

COMPARATIVE DATA

Plain weave is the most common technique found in prehistoric sites. Plain weave with paired or rag wefts, however, has a somewhat more limited distribution. According to present information pieces come from Tonto National Monument, Canyon Creek and the Lower Verde. Hence it appears to be a feature of central Arizona weaving rather than an Anasazi trait.

Weft-wrap openwork and gauze are widely distributed, appearing at: Keet Seel, Nitsie Canyon, Canyons de Chelly and del Muerto, Wupatki, the Verde Salt Mines, Canyon Creek, Bear Creek Cave, the Upper Gila, Solomonsville, Snaketown, Casa Grande National Monument, and Ventana Cave on the Papago Reservation. These techniques are found in higher frequencies in central and southern sites, and appear in the south in early horizons. Fragments woven by a technique similar to weft-wrap are mentioned by Haury[18] as coming from the Sacred Cenote at Chichen Itza, Yucatan. These techniques may have originated in the Southwest with the Hohokam, and spread north as trade goods to the Anasazi in Pueblo III times.

Weft-float is not reported from any other sites.

18. Haury, 1934, p. 95.

Slit-tapestry weave is widely distributed in Anasazi sites from Basketmaker times on, and is found outside that area in the following places: Sycamore Canyon in the Verde drainage, the "Red Rock country south of Flagstaff,"[19] Kinnikinnick (southeast of Flagstaff), Wupatki National Monument, Tonto National Monument, and Ventana Cave. It is probably a typical northern technique as contrasted to weft-wrap and gauze.

Twills similar to that described here are well represented in Pueblo III Anasazi collections. The technique seems to be much more characteristic of that area than of central and southern Arizona, although there are twill fragments from Los Guanacos in the Salt River Valley of southern Arizona, Tonto National Monument, Kinishba, and Wupatki National Monument.

The pages following are devoted to descriptions, photographs, and drawings of the 31 textiles. Table IV, page 94, in the appendix, coordinates data on these specimens, listing each by number and telling what material was used in it, its weave, color, border (if present), and comparative literature relative to it.

Specimen 1. Textile

Maximum length: 22½″; 57.2 cm.
Maximum width: 13″; 33.1 cm.
Threads per inch in length: 25; 10 per cm.
Threads per inch in width: 21; 9 per cm.
Material: Cotton
Decoration: There are evidences that the piece was colored by rubbing on red paint. Most of it is gone at present.
Weave: Plain; edges frayed, with one possible border. Widely spaced darning for reinforcement near one end. (See photograph.)

Specimen 2. Textile

Maximum length: 12⅜″; 31.5 cm.
Maximum width: 3½″; 9 cm.
Threads per inch in length: 18; 7 per cm.
Threads per inch in width: 19; 8 per cm.
Material: Cotton. Dark gray due to weathering.
Decoration: Lacking.
Weave: Plain. Rather loosely woven. Frayed edges.

Specimen 3. Textile

Maximum length: 4″; 10.2 cm.
Maximum width: 3 5/16″; 8.5 cm.
Threads per inch in length: 19; 8 per cm.
Threads per inch in width: 21; 9 per cm.
Material: Cotton.
Decoration: Lacking.
Weave: Plain. Loosely woven. Frayed edges.

19. Hough, 1914.

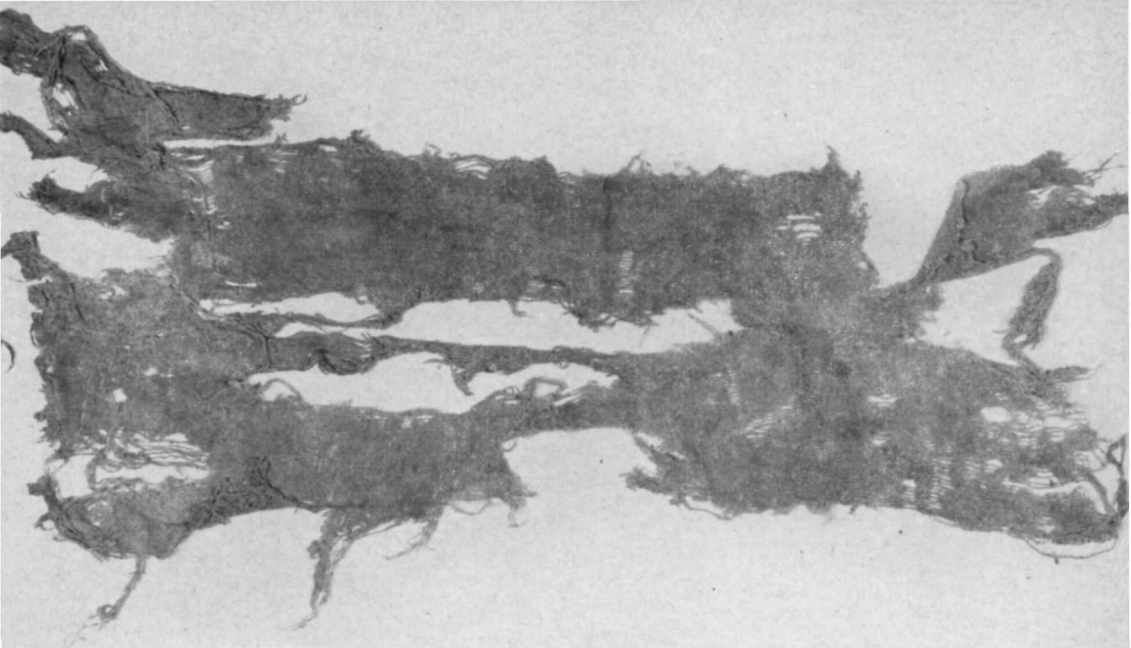
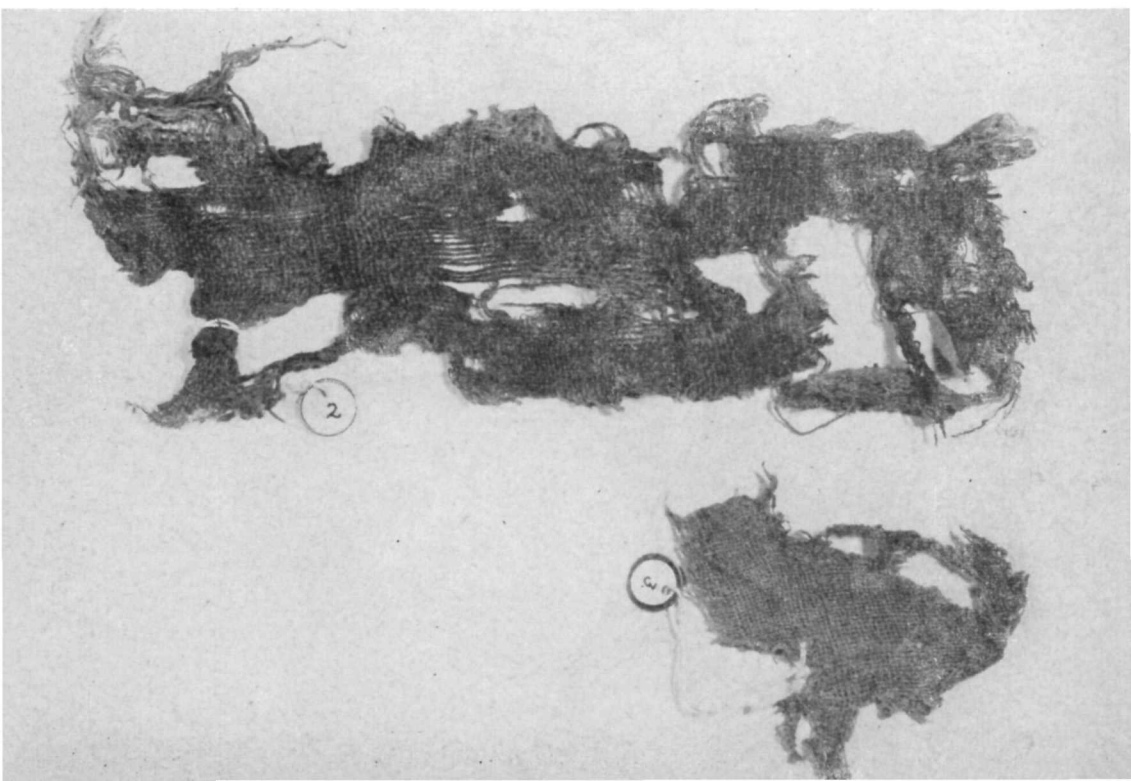


Plate 2. Plain weave, Specimen No. 1

Plate 3. Plain weave, Specimen Nos. 2, 3



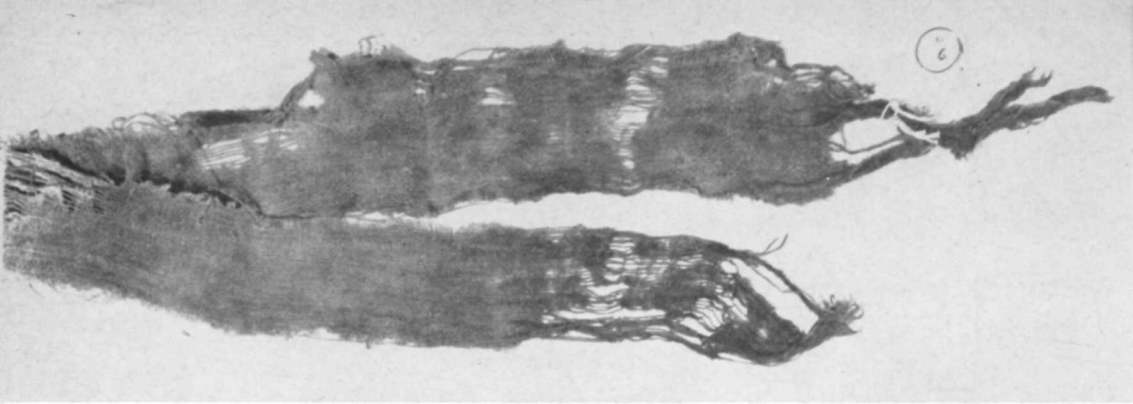


Plate 4. Plain weave, Specimen No. 6

Specimen 6. Textile

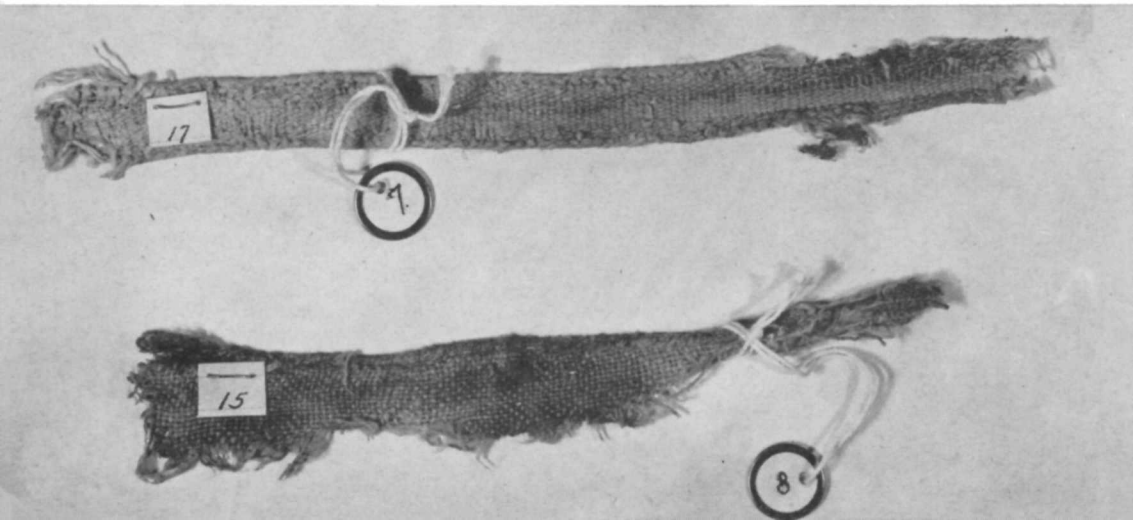
Maximum length: 32″; 81.4 cm.
Maximum width: 2⅜″; 6.1 cm.
Threads per inch in length: 23; 10 per cm.
Threads per inch in width: 22; 10 per cm.
Material: Cotton.
Decoration: Lacking.
Weave: Plain, with a frayed edge.

Specimen 7. Textile

Maximum length: 8½″; 21.6 cm.
Maximum width: ⅝″; 1.6 cm.
Threads per inch in length: 17; 7 per cm.
Threads per inch in width: 17 per ½-inch (probably 34 per inch); 14 per cm.
Material: Cotton.
Decoration: Lacking.
Weave: Plain. There are borders on both sides of the textile, running the length of the piece. (Cf. Hough, p. 77, Fig. 160; BAEB 65[20], p. 116, Fig. 44.)

20. To save space BAEB 65 is used hereafter to refer to Kidder and Guernsey, 1919.

Plate 5. Plain weave, Specimens Nos. 7, 8



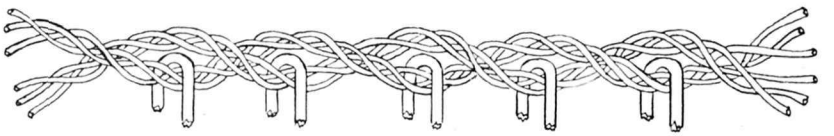


Fig. 1. A weft hooks between two units, each of which is composed of three loosely-twisted strings, and reenters the weave again. The units are crossed on each other once before the next weft hooks through them. Specimen 7.

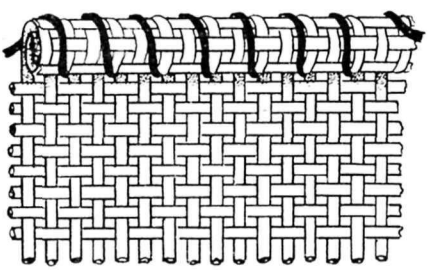


Figure 2

Specimen 8. Textile

Maximum length: 7″; 17.9 cm.
Maximum width: 1″; 2.6 cm.
Threads per inch in length: 20; 9 per cm.
Threads per inch in width: 22; 10 per cm.
Material: Cotton.
Decoration: Lacking.
Weave: Plain, with one border. One-quarter inch of the weave is rolled up at the edge and bound by a cotton string composed of two tightly-twisted strands of cotton. (BAEB 65, p. 116: "When cloth was cut across for any reason, it was kept from raveling by rolling up the edge and sewing it over and over with stout thread.")

Specimen 9. Textile

Maximum length: 16¾″; 24.6 cm.
Maximum width: 3 3/16″; 8.1 cm.
Threads per inch in length: 24; 9 per cm.
Threads per inch in width: 25; 11 per cm.
Material: Cotton.
Decoration: Orange dye, M&P 12-A-12[21], evidently applied before the cotton was woven. External, granular, mineral pigment.
Weave: Plain and rather loose. Frayed edges.

Specimen 10. Textile

Maximum length: 8½″; 21.6 cm.
Maximum width: 3¾″; 9.5 cm.
Threads per inch in length: 28; 13 per cm.
Threads per inch in width: 24; 10 per cm.
Material: Cotton. Light yellow tan, M&P 11-I-6. Color apparently due to scorching. (Jones noted the presence of one hair from a small mammal.)
Decoration: Lacking.
Weave: Plain.

21. All color references are to: Maerz, A., and Paul, M. Rea: A Dictionary of Color. New York, McGraw-Hill Book Company, 1930.

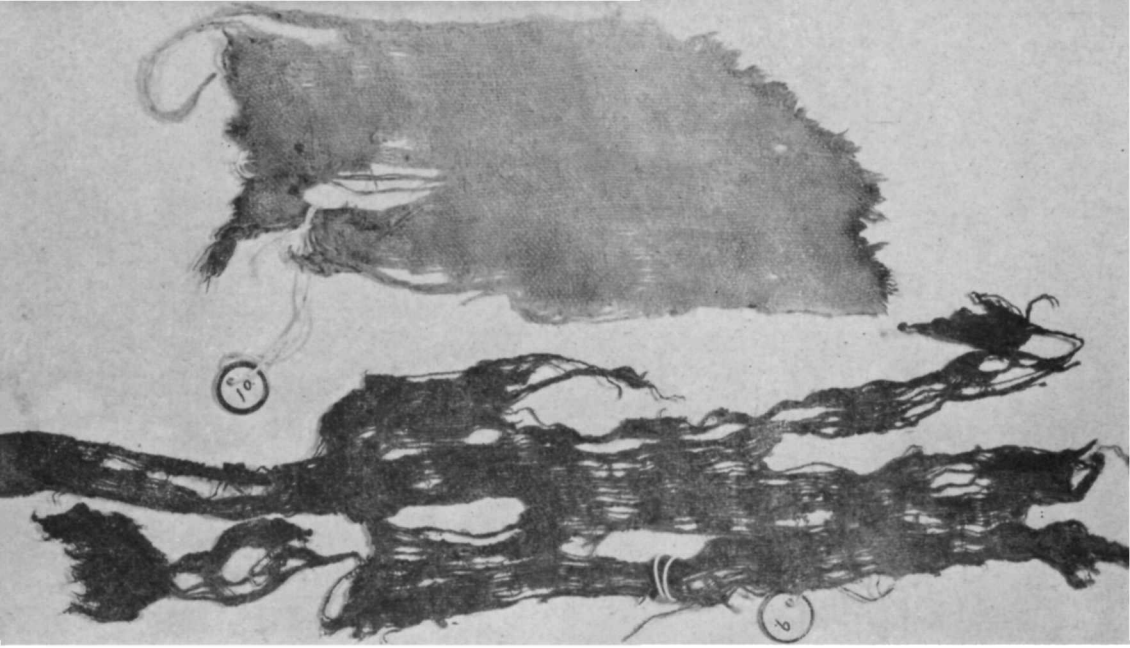


Plate 6. Plain weave, Specimens Nos. 9, 10

Specimen 14. Textile

Maximum length: 9¼″; 23.5 cm. Maximum width: 6½″; 16.5 cm.
Threads per inch in length: 23; 9 per cm.
Threads per inch in width: 22; 8 per cm.
Material: Cotton.
Decoration: Cotton has a mottled yellow color, probably due to scorching.
Weave: Plain, with one border. (Cf. Haury, p. 84, fig. 16, e; and Specimen 7, p. 14.)

Plate 7. Plain weave, Specimen No. 14

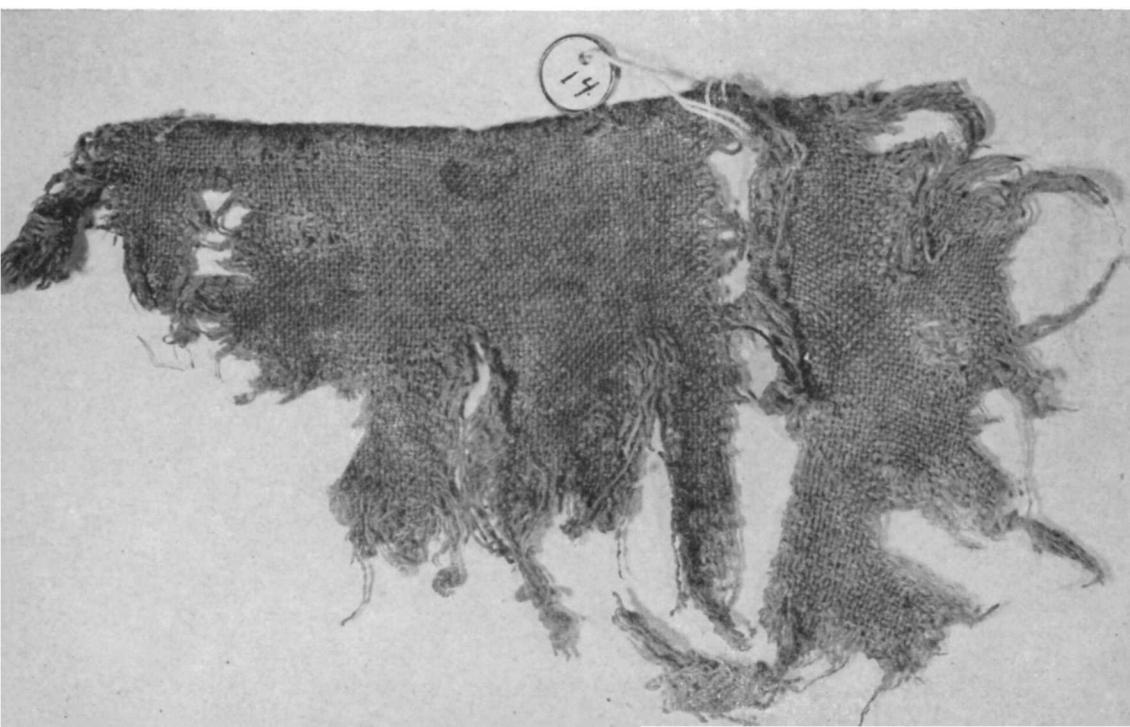


Fig. 3. There are four border elements twisted together. The warps are hooked through them, apparently over a different one each time. There is the addition of a string consisting of two strands of cotton tightly twisted (a), which serves to bind the border elements more tightly together. No. 14.

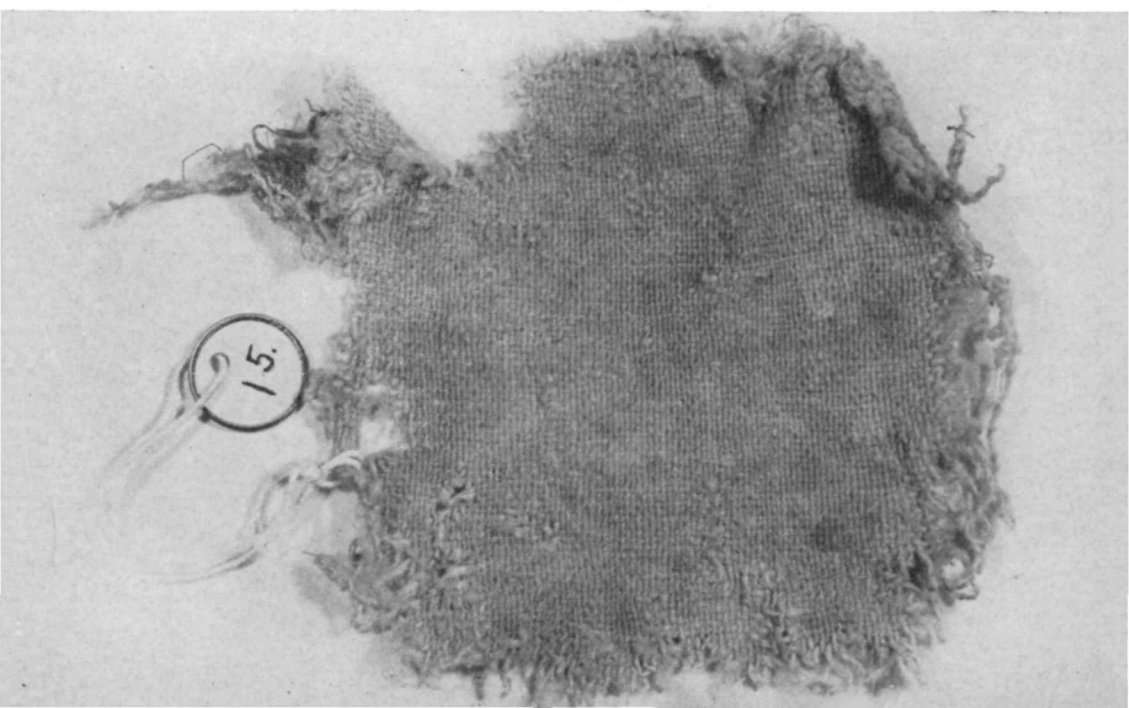
Specimen 15. Textile

Maximum length: 4″; 10.2 cm.
Maximum width: 4″; 10.2 cm.
Threads per inch in length: 27; 12 per cm.
Threads per inch in width: 27; 12 per cm.
Material: Cotton.
Decoration: Lacking.
Weave: Plain, with frayed edges. Very tight.

Specimen 19. Textile

Maximum length: 6½″; 16.8 cm.
Maximum width: ½″; 1.25 cm.
Average threads per inch in length: 37; 16 per cm.
Average threads per inch in width: 18 per half inch (probably 36 per inch); 14 per cm. Fine texture.
Material: Cotton.
Decoration: Granular, external, mineral dye, red-orange in color, M&P 5-H-11.
Weave: Plain.

Plate 8. Plain weave, Specimen No. 15



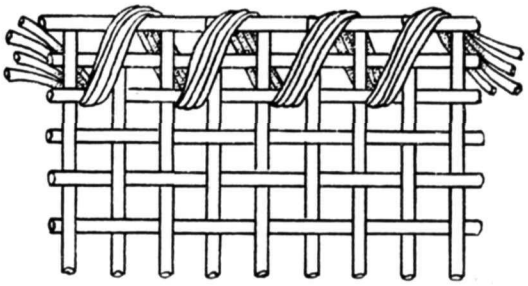


Figure 4

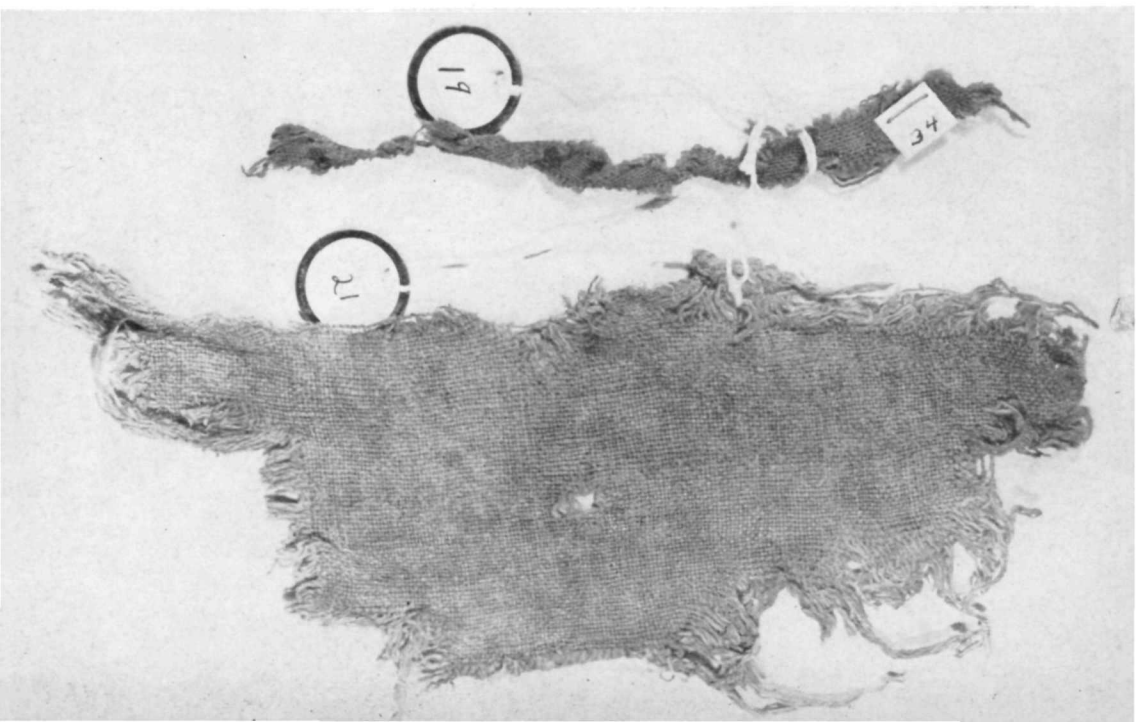
Specimen 21. Textile

Maximum length: 8½"; 21 cm.
Maximum width: 3⅛"; 8 cm.
Average threads per inch in length: 32; 15 per cm.
Average threads per inch in width: 28; 12 per cm.
Fine texture.
Material: Cotton. Brownish-gray, M&P 5-A-9. (Jones' analysis notes "some bit of extraneous material"; and ours notes one unidentified plant fiber.)
Weave: Plain. One border. (Cf. PMP, VIII, 2, p. 65.) Four strands twisted over the last three weft strands of the regular plain weave.

Specimen 55. Textile

Maximum length: 24"; 61 cm.
Maximum width: 11⅜"; 28.9 cm.
Threads per inch in length: 23; 10 per cm.
Threads per inch in width: 30; 12 per cm.
Material: White cotton.
Weave: Plain weave. One little extra piece of cloth is knotted onto the main section at one end. This specimen is the largest in the collection.

Plate 9. Plain weave, Specimens Nos. 19, 21



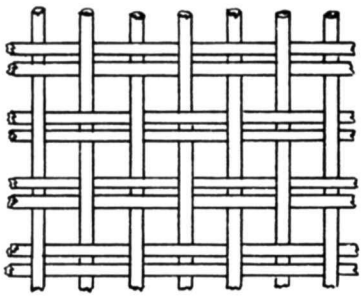


Figure 5

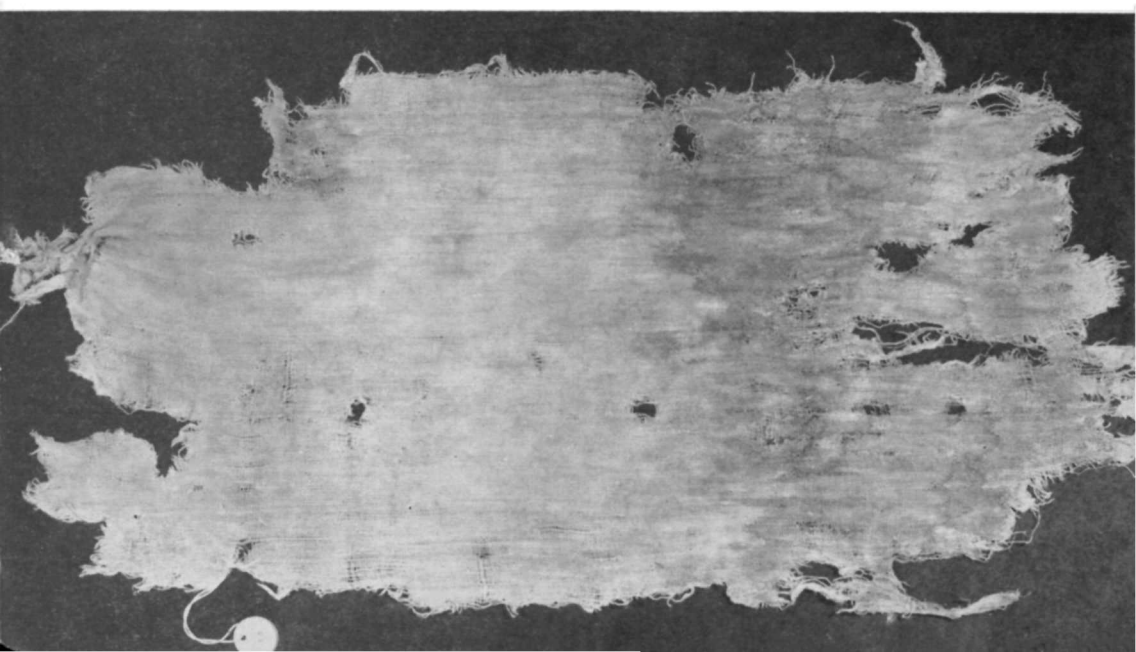
Specimen 5. Textile

Maximum length: 6¾″; 17.3 cm.
Maximum width: 4½″; 11.3 cm.
Threads per inch in length: 9; 4 per cm.
Threads per inch in width: 22 (11 pairs); 10 (5 pairs) per cm. Each strand is more tightly twisted than the warp fiber.
Material: *Yucca elata.* Tawny yellow in color, though not dyed. (Jones' analysis notes "a few cotton fibers, one hair of a small mammal and other extraneous matter.")
Decoration: Lacking.
Weave: A regular plain weave, except that the wefts are composed of two strands which are treated exactly as one. (Cf. Haury, p. 102; and Fig. 21, a, p. 101.)

Specimen 16. Textile

Maximum length: 5½″; 14 cm.
Maximum width: 5″; 12.7 cm.
Threads per inch in length: 22 (11 pairs); 10 (5 pairs) per cm.
Threads per inch in width: 12; 6 per cm.
Material: *Yucca baccata.* Dark yellow-gray, due to weathering. (Jones' analysis and ours note some cotton fibers.)
Decoration: Lacking.
Weave: Plain, with wefts composed of two strands each. (Cf. Specimens Nos. 5, above, and 39, p. 21.)

Plate 10. Plain weave, Specimen No. 55



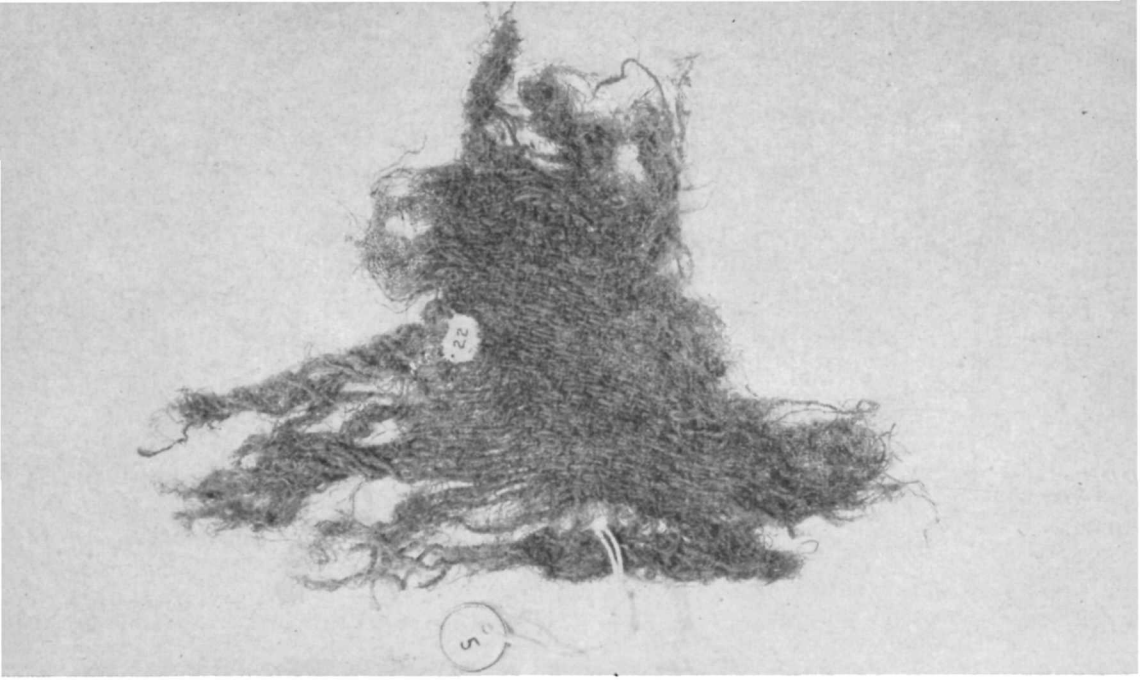
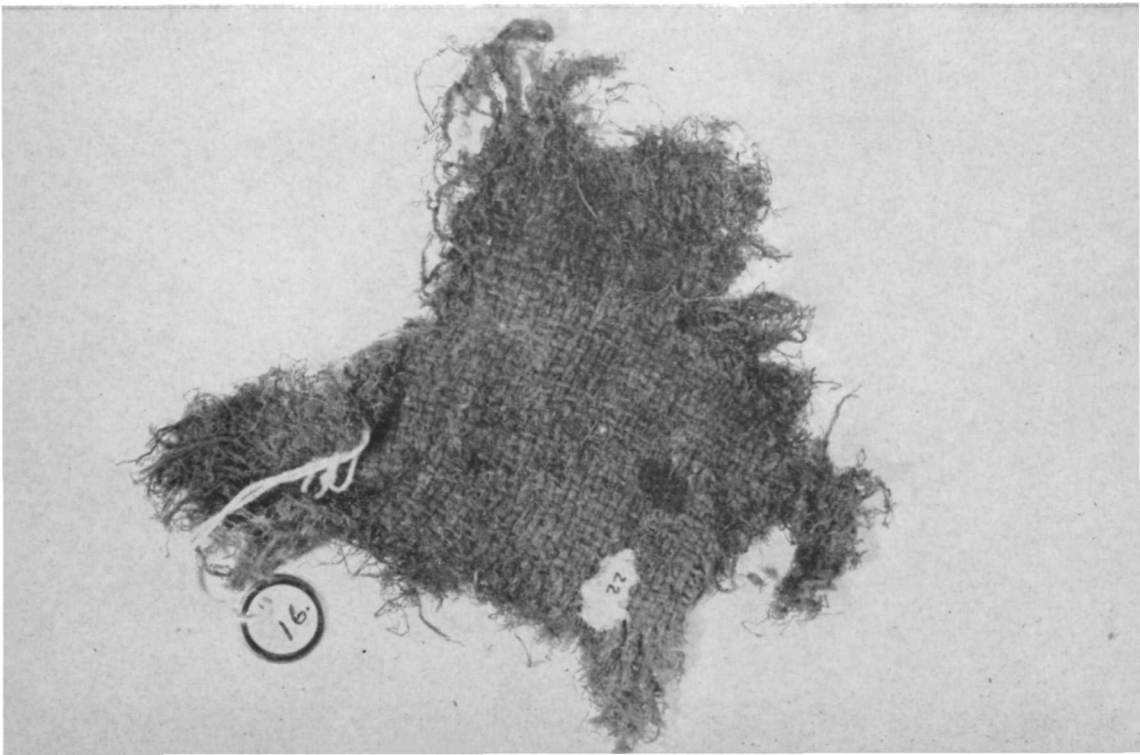


Plate 11. Paired wefts, single warps, Specimen No. 5

Plate 12. Paired wefts, single warps, Specimen No. 16



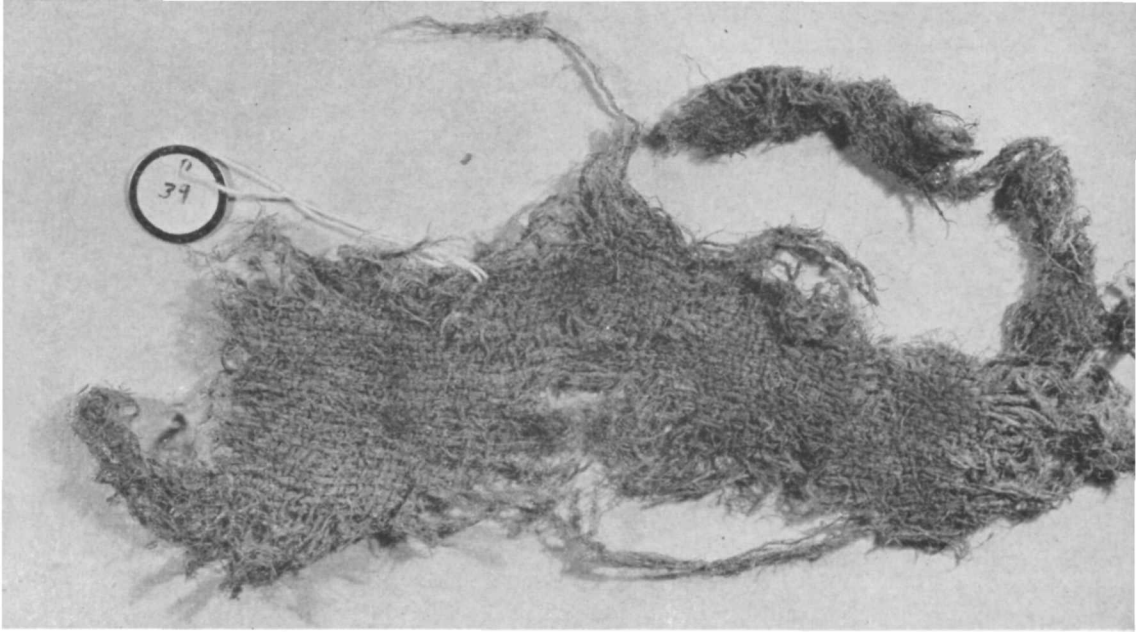


Plate 13. Paired wefts, single warps. Specimen No. 39

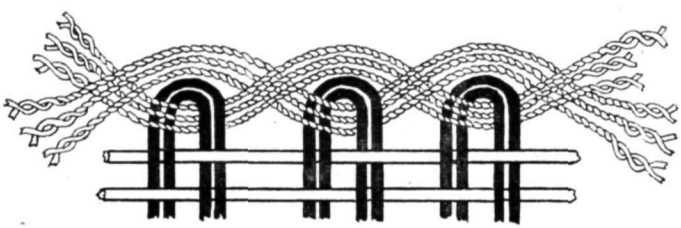
Specimen 39. Textile

Maximum length: 11⅝″; 29.5 cm.
Maximum width: 3¼″; 8.3 cm.
Threads per inch in length: 11; 5 per cm.
Threads per inch in width: 22 (11 pairs); 8 (4 pairs) per cm.
Material: *Yucca baccata.*
Decoration: Lacking.
Weave: Regular plain weave with wefts always paired. (Cf. Specimen 5, p. 19.)

Specimen 46. Textile

Maximum length: 8½″; 21.6 cm.
Maximum width: 2¼″; 5.8 cm.
Threads per inch in length: 14 (7 pairs); 6 (3 pairs) per cm.
Threads per inch in width: 8; 4 per cm.
Material: *Yucca baccata.*
Decoration: Lacking.
Weave: Plain weave, with wefts appearing in pairs. (Cf. Specimen 5, p. 19.) Border. (Cf. Specimen No. 7, p. 14; Hough, p. 77, Fig. 160.)

Figure 6



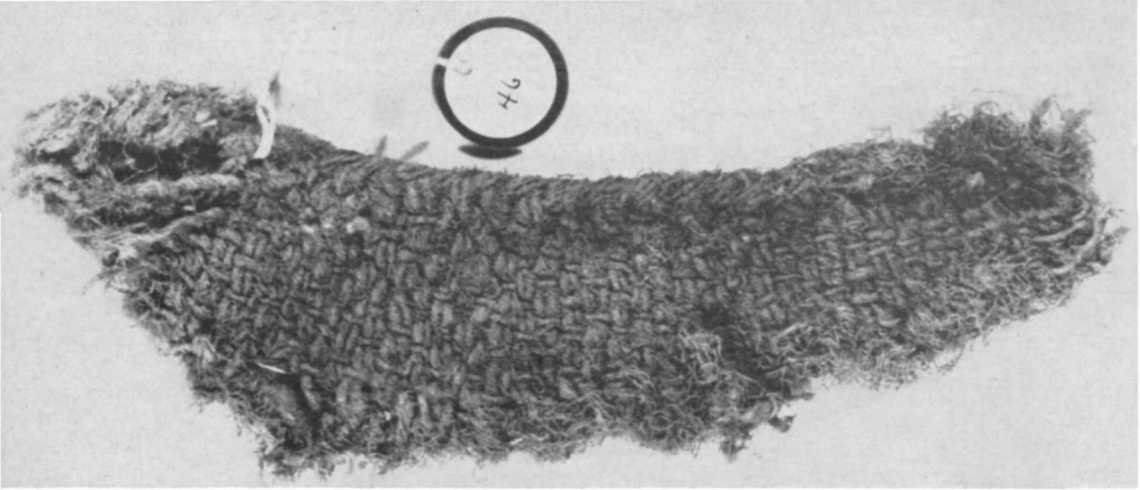
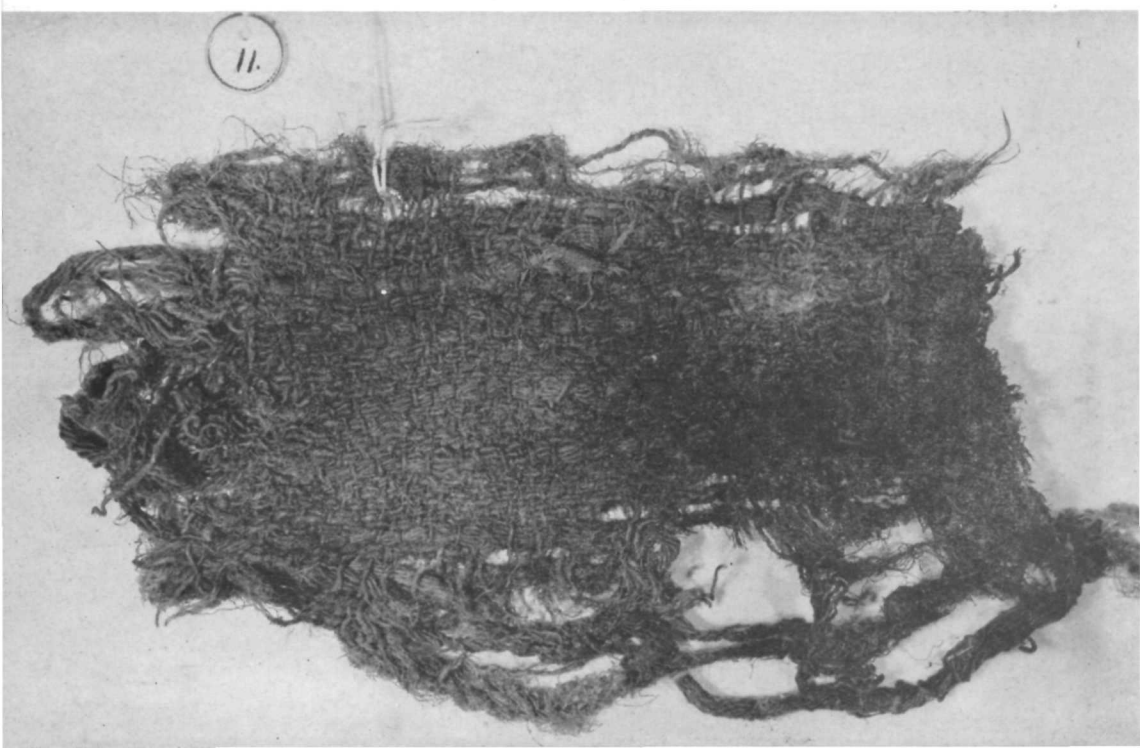


Plate 14. Paired wefts, single warps, Specimen No. 46

Specimen 11. Textile

Maximum length: 11″; 28 cm.
Maximum width: 4⅜″; 11.1 cm.
Threads per inch in length: 9; 4 per cm.
Threads per inch in width: 10 (5 pairs) per half-inch; 10 (5 pairs) per cm. See analysis under Weave.
Material: Cotton in the finely-woven strips. (Our analysis notes that the red may have one fiber of apocynum in it.) Coarse fiber in the two-weft one-warp weave is *Yucca baccata.* (Jones' analysis notes one hair of a small mammal.) Mottled medium dark yellow gray. (Cf. Haury, p. 102; Hough, p. 81.)
Decoration: The red threads used in the weft (and sometimes warp)

Plate 15. Paired wefts, rag wefts, Specimen No. 11



of the finely woven cotton strips seem to have been dyed before use with an external, granular, mineral dye.

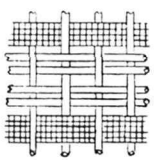


Figure 7

Weave: Basically a plain weave is used. (Cf. Haury, p. 102, and Fig. 21, c, p. 101; and Specimens Nos. 4, p. 25; 17, p. 23, 39, p. 21, and 53, p. 23.) Pairs of strands, and rolled strips of finely-woven cotton cloth are used as wefts. In most of the cloth strips the weft has disintegrated, leaving only a bundle of warp threads. The construction of the weft elements, starting from the top of the photograph, is:

1. Bundle of 20 strands. 3/16″; .5 cm.
2. Plain weave; one weft unit (two strands). ⅛″; .3 cm.
3. Bundle of 14 strands. ⅛″; .3 cm.
4. Plain weave; 5 weft units (10 strands). ½″; 1.2 cm.
5. Bundle of 12 strands. 3/16″; .4 cm.
6. Plain weave; four weft units (eight strands). ⅜″; 1 cm.
7. Bundle of 15 strands. 3/16″; .4 cm.
8. Plain weave; four weft units (eight strands). ⅜″; 1 cm.
9. Bundle of 30 strands, red in color. ¼″; .7 cm.
10. Plain weave; two weft units (four strands). 3/16″; .4 cm. Widens to four weft units (eight strands). ⅜″; 1 cm.
11. Bundle of two narrow woven strips rolled together. Where the weft remains one finds: Strip No. 1: Nine gray warp threads. ¼″; .6 cm. Eight strands of weft in ¼″, .6 cm. Four wefts are gray, and four are red. Strip No. 2: All gray strands. Twelve warp strands in ¼″, .6 cm. strip. Eight wefts per ¼″, .6 cm. Both strips are of an over-under plain weave.
12. Plain weave, and frayed edge.

Specimen 17. Textile

Maximum length: 10¾″; 27.4 cm.
Maximum width: 4″; 10.2 cm.
Threads per inch in length: 8; 4 per cm.
Threads per inch in width: See analysis under Weave.
Material: Cotton in the finely-woven strips. Coarse fiber in the plain weave is *Yucca elata.*
Decoration: Some of the fibers of the finely-woven cotton strips are dyed red. Granular, external, mineral dye. Whole piece is rusty brown.

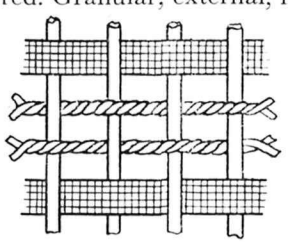


Figure 8

Weave: Plain weave, with paired strands, and rolled strips of finely-woven cotton cloth used as wefts. (Cf. Haury, p. 102; Hough, p. 82.) (See drawing.)
Two strips of cotton cloth, each ca. 3/16″ (.4 cm.) wide. The ¾″ (1.9 cm.) between the two strips contains 10 yucca fiber wefts (5 pairs). In the cotton strips there are 14 warps per cm. (⅜″), and 14 wefts per cm.

Specimen 53. Textile. (PS No. 165)

Maximum length: 10″; 25.5 cm.
Maximum width: 3¾″; 9.5 cm.
Threads per inch in length: 5; 2 per cm. (warps).
Threads per inch in width: 20, 9 per cm. (wefts).
Material: Cotton in the rag wefts: *Yucca baccata* in coarse wefts and warps.

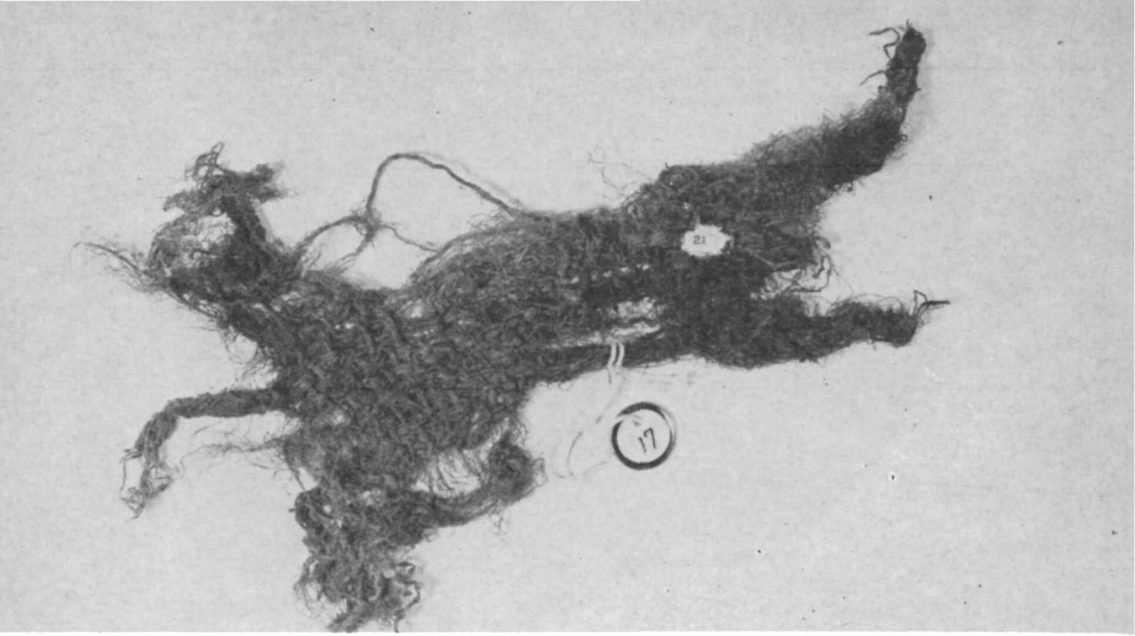


Plate 16. Paired wefts, rag wefts, Specimen No. 17

Decoration: Red color is rubbed on to the rag wefts, appearing generally on the side which is folded in. (It is probable that both sides originally showed color, rubbed on or applied as a dye, and that the color has worn off the outer sides of the strips.)
Weave: (Cf. Haury, p. 101, Fig. 21, d; Specimen No. 11, p. 22) Plain weave. Warps are coarse one-unit strands. Wefts: Appear most regularly as coarse strands consisting of two smaller units twisted together. In some of the more ragged portions, three and four strands pass over a warp together, as though they were 1 weft element. Cotton rags are

Plate 17. Paired wefts, rag wefts, Specimen No. 53

woven in irregularly as wefts. Composition: (starting at top of photograph)

1. Large rag strip. Measures when unfolded, 1⅜"; 3.5 cm. (When folded, ⅜"; 1 cm.) Stitch count, 24 per inch; 12 per cm.
2. Four double-twist wefts.
3. Rag weft, 3/16"; .5 cm., when folded.
4. One double-twist weft.
5. Rag weft, ¼"; .7 cm., when folded.
6. Five double-twist wefts.
7. Rag weft, ⅛"; .3 cm., when folded.

Specimen 4. Textile

Maximum length: 5½"; 13.2 cm.
Maximum width: 2⅝"; 6.8 cm.
Threads per inch in length: 14; 6 per cm.
Threads per inch in width: See analysis of Weave.
Material: Cotton. (Jones' analysis notes two hairs of a small mammal and one of a large mammal.)
Decoration: Some evidence that yellow was rubbed on, but this is so problematical that it is not considered elsewhere in the paper. Woven strips or twisted cotton threads are introduced to vary the weave.

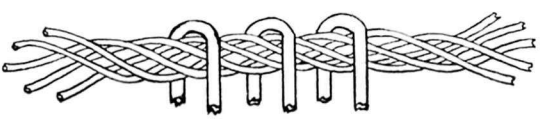


Figure 9

Weave: Plain weave, with weft elements of woven strips or twisted cotton threads. (Cf. Haury, p. 102; Hough, p. 82; Specimens Nos. 11, p. 22, 17, p. 23, 39, p. 21, and 53, p. 23.) In general, the warp strands are much thicker and less tightly twisted than the strands which go to make up the bundle wefts. The fragment appears to be from the border of a piece. Counting down from the top, the sequence of wefts is:

1. Border: composed of five twisted threads, over which the warp is looped.
2. Plain weave; two wefts. 1/16"; .2 cm.
3. Bundle; ca. 5 strands, somewhate twisted. ⅛"; .3 cm.
4. Plain weave; three wefts. ⅛"; .3 cm.
5. Bundle; crudely woven strip. 3/16"; .5 cm.
6. Plain weave; two wefts. 1/16"; .2 cm.
7. Bundle; braided strands. ca. 3/16"; .4 cm.
8. Plain weave; two wefts. 1/16"; .2 cm.
9. Bundle; ca. 10 strands, not twisted. ⅛"; .3 cm.
10. Plain weave; two wefts. 1/16"; .2 cm.
11. Bundle; eight strands, not twisted. 1/16"; .2 cm.
12. Plain weave; five wefts. ¼"; .7 cm.
13. Bundle; five untwisted strands. 1/16"; .2 cm.
14. Plain weave; six wefts. ⅜"; 1 cm.
15. Untwisted bundle of strands and frayed edge.

Plate 18. Single wefts, rag wefts, Specimen No. 4

Specimen 54. Textile. (PS No. 49)

Maximum length: 17¼″; 43.8 cm. Maximum width: 3½″; 8.9 cm.
Threads per inch in length: 13; 6 per cm. Two strands tightly twisted. (warps)
Threads per inch in width: 11 thread wefts, 4 bundle wefts per inch; 4 regular wefts, 2 bundle wefts per cm.
Material: Cotton.

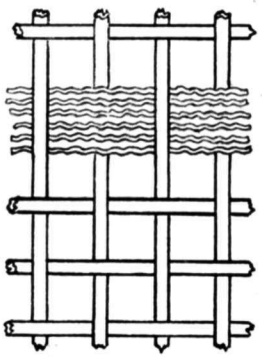
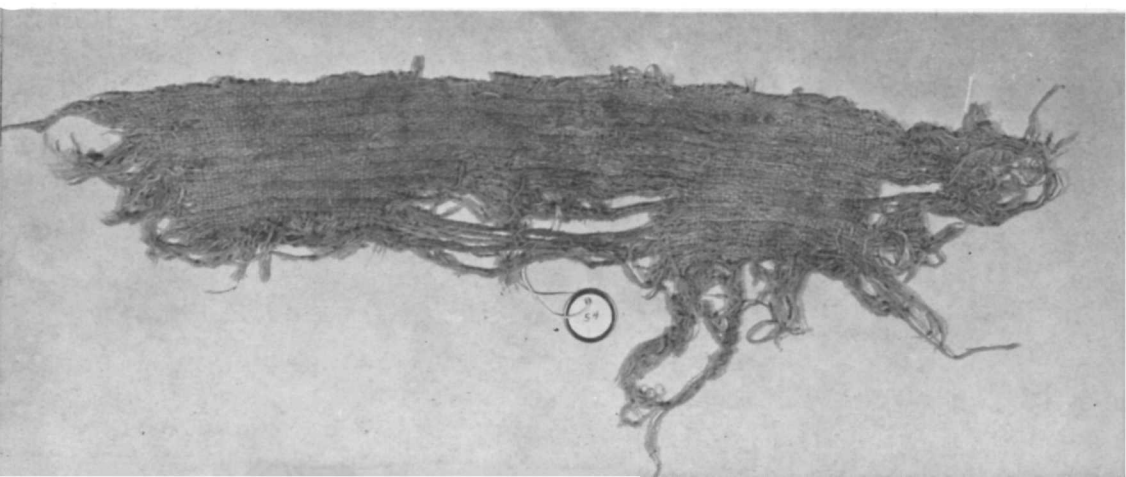


Figure 10

Decoration: The bundle wefts have a yellowish tinge. However, it does not seem to be true color rubbed on, but to be stained cotton.

Weave: Cf. Hough, p. 82, Fig. 170; Specimens Nos. 11, p. 22, and 53, p. 23.) Plain weave. At intervals of three to five wefts, a bundle weft is introduced, each measuring ⅛″ (.3 cm.) in width. These bundle wefts contain from six to nine threads. They seem to have no wefts within themselves, but to be simply long ropes of cotton threads. In some places, however, there is evidence that wefts formerly existed. The assumption is that these threads have been ravelled out of a piece of woven cloth, and still retain the impressions of wefts, if not the actual threads.

Plate 19. Single wefts, rag wefts, Specimen No. 54



Specimen 35. Textile

Maximum length: 7⅝″; 19.5 cm.

Maximum width: 2½″; 6.5 cm.

Stitch count: 27 per inch; 12 per cm.

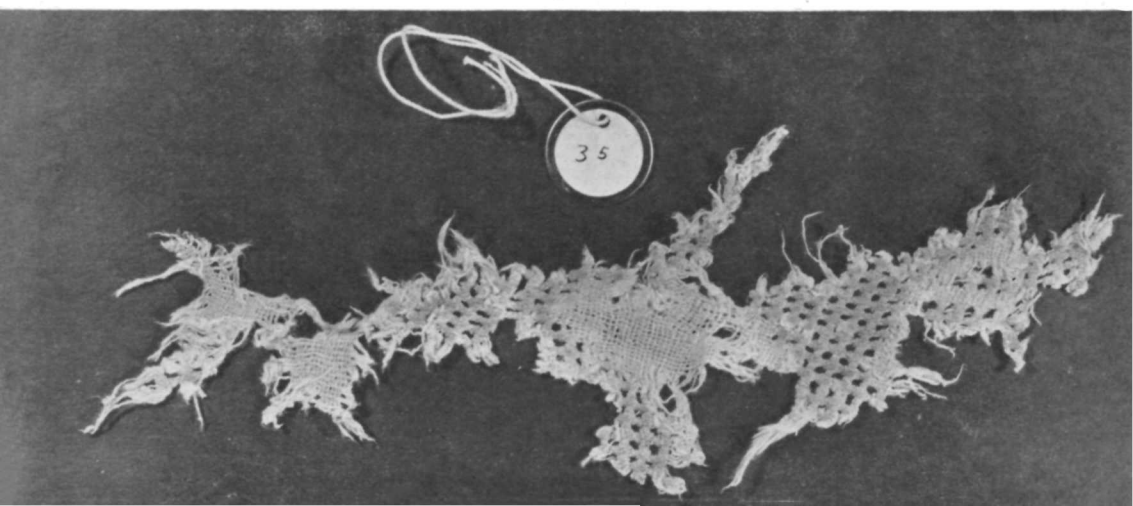
Material: Cotton.

Decoration: Geometric design made by wrapping wefts. (See photograph).

Weave: Weft-wrap openwork. (Cf. Specimens Nos. 34, p. 31, 36 and 37, p. 28-9; Haury, p. 92; Hough, pp. 78-79.) (See drawing.)
The principle of weft-wrap is fairly simple. Assume that the warps are strung on a loom much like the Navaho-Pueblo loom of today, and that the weaving is proceeding from the bottom upward. When the weaver desires an openwork pattern, she wraps the weft most recently inserted twice over the three wefts below it. Then she weaves this weft over and under the next four warps and wraps it twice around them. From there the weft passes once under the weft below and repeats the weaving and wrapping of the four warps. Next the three wefts below are wrapped twice. After this the weft wraps once around the next warp and goes back into regular weaving. This makes openings in the fabric. The process is continued till the desired number of openings has been produced. Every fourth weft is used thus till the design is completed. There are slight variations in the manner of wrapping the weft, but the small section shown in the technical drawing (p. 28) is typical for Specimens Nos. 35, 36 and 37. The wrapping may have been done with the help of a needle.

Close observation of each piece leads to the conclusion that all wrapping is done with the wefts, the warps remaining stationary. Haury's analysis agrees with this, but Hough's drawings and descriptions of similarly decorated pieces show both warps and wefts being used as wrapping elements. If this were so, it is obvious that the piece must have been at least partially removed from the loom when wrapping commenced; or else that the fabric was woven plain and then certain

Plate 20. Weft-wrap, Specimen No. 35



warps and wefts were selected, partially extracted from the weave, and used as wrapping elements. Sections of the weft-wrap pieces were worked out in the laboratory and proved very simple to execute on a regular loom, with the help of a needle for the wrap-sections.

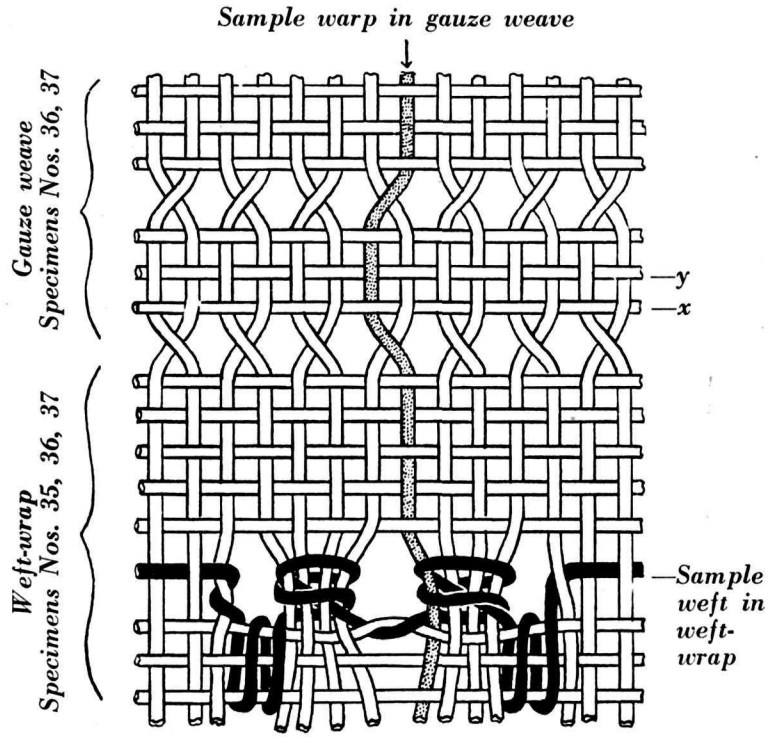


Figure 11

Specimen 36. Textile

Maximum length: 7½"; 19 cm.
Maximum width: 4½"; 11.5 cm.
Stitch count, solid section: 34 per inch; 15 per cm.
Material: Cotton.
Decoration: See under Weave.
Weave: Weft-wrap openwork, as in Specimen No. 35, p. 27. Gauze weave (explanation below).

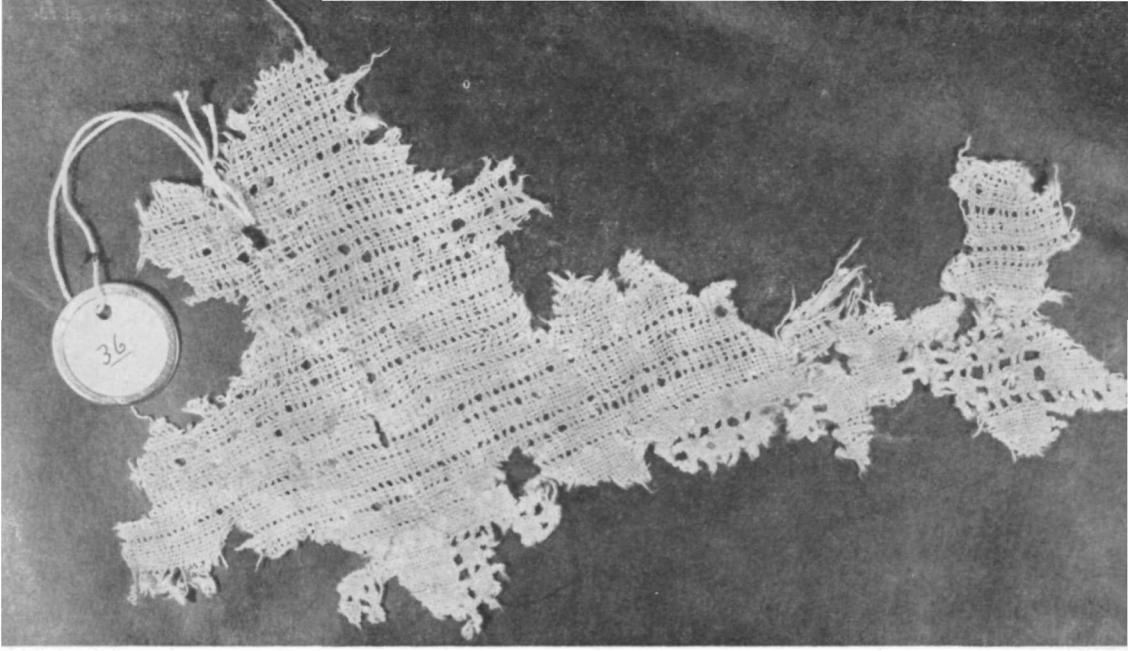
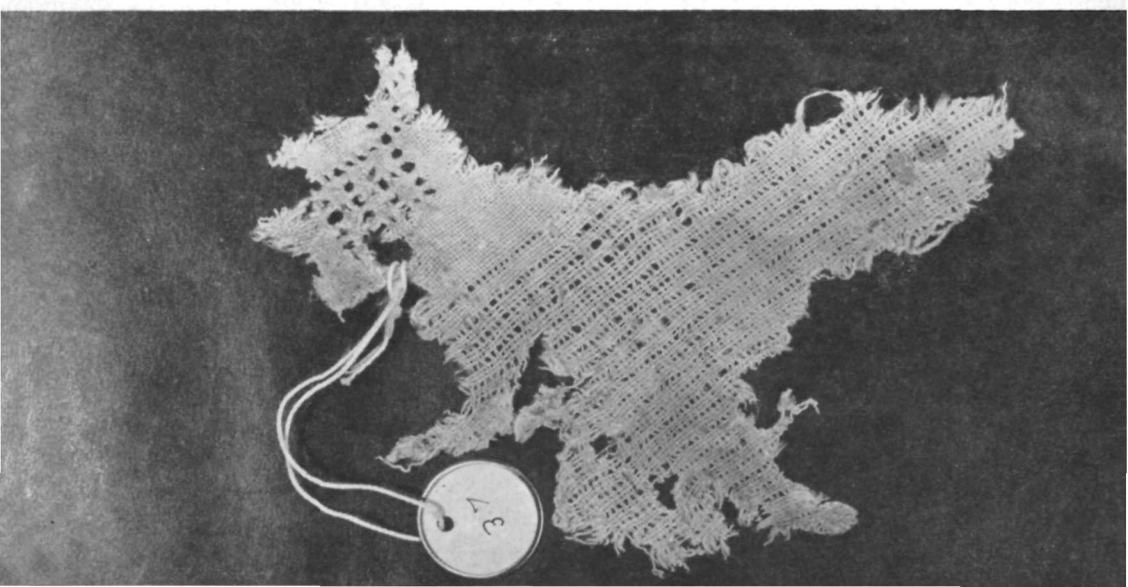


Plate 21. Weft-wrap, gauze weave, Specimen No. 36

Specimen 37. Textile

Maximum length: 5⅜″; 13.7 cm.
Maximum width: 5″; 12.7 cm.
Stitch count, solid section: 35 per inch, 16 per cm.
Material: Cotton.
Decorations: see under Weave.
Weave: Weft-wrap openwork, as in specimen No. 35, p. 27. Gauze weave. Specimens Nos. 36 and 37 are pro ably fragments of one large piece. In both of them the weft-wrap design is produced as shown in the drawing (p. 28). There are also lines of gauze weave openwork at intervals of three, sometimes five, threads, wherein one weft is omitted, and pairs of warps are crossed once over each other. They are then taken back into the regular weave by the next weft.

Plate 22. Weft-wrap, gauze weave, Specimen No. 37



This decoration has been produced on a regular loom, without untying the warps from the loom bars. Commence the gauze pattern when the warps controlled by the shed rod are forward, as though for insertion of the batten. Now, starting at your right, cross the first

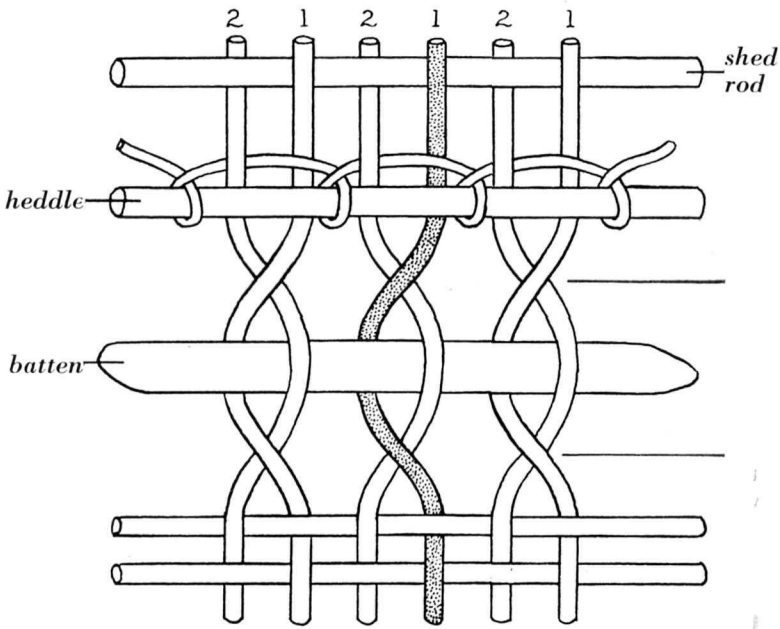


Figure 12

forward warp to the left and behind the first back warp. Insert the batten in the loop thus formed. Repeat this same procedure the width of the piece. The batten will then be in the position illustrated, and there will be two twists in the warps (a and b). (The shed rod controlled strings are numbered 1, the heddle rod controlled strings, 2.) Now insert the weft and remove the batten. For the next row, force the warps controlled by the shed rod forward again (as in regular weaving) and insert the weft behind them. If another row of weft is desired before the warps cross back to their original positions in the weave, it is necessary to pull forward each heddle-controlled warp by hand, keeping 2 always to the right of 1, and insert the batten behind it below twist b. To bring the warps back to the original positions, pull the heddle rod forward and insert the weft above twist b. The plain checker weave can now be continued.

Haury, (pp. 95-98) describes gauze weaving, and figures a piece exactly like ours from the Verde Salt Mine. Hough (pp. 79-80) shows fragments from Bear Creek Cave, Blue River, Arizona, and tells of an example from a cave near Solomonsville, Arizona. His figure 166 (p. 80) shows gauze weave produced by an entirely different technique from the one described in this paper. He says certain **warp** threads were not carried

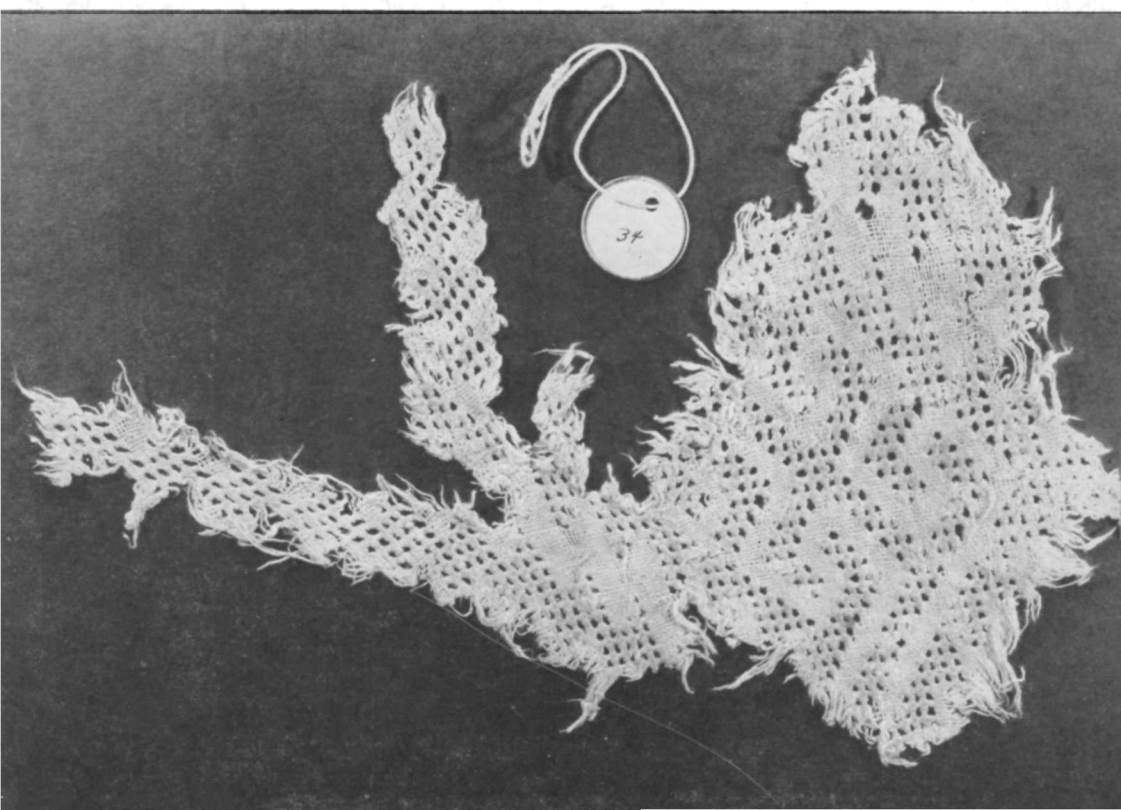
the whole length of the piece, thus leaving spaces, wherein **wefts** were crossed in pairs, and the gauze weave pattern made. If this were so, the gauze weave could not be a loom product. It is impossible to draw conclusions concerning Hough's technical description without studying the piece he figures. However, it would seem more logical to call his warps "wefts," and his wefts "warps."

Specimen 34. Textile

Maximum length: 8¾"; 22.3 cm.
Maximum width: 5¾"; 14.7 cm.
Stitch count: 26 per inch; 12 per cm. The warps and wefts run diagonally to the length and width of the piece as measured. The stitch count for both is the same.
Material: Cotton.
Decoration: Geometric design made by wrapping with wefts. (See photograph.)
Weave: Weft-wrap openwork. (Cf. Specimens Nos. 35, p. 27, 36 and 37, p. 29, Haury, p. 92; Hough, pp. 78-79.) See drawing.

The wrapping in No. 34 presents some differences from that just described. As will be concluded from the technical drawing (p. 28), photographs and the explanation (p. 30), the wrappings in Nos 36, 37 and 35 will always be parallel to the warps or wefts. In No. 34, however, the wrapping can be either at an angle or parallel to the warps and wefts. The weft chosen, instead of first enclosing only the three

Plate 23. Weft-wrap, Specimen No. 34



wefts below it, wraps around a woven section consisting of the three wefts below it and the four warps just ahead, or behind, the point where the wrapping commenced. It will be seen in the drawing below that the irregular manipulation of wefts A and D occurs simply as a means of enlarging the holes. Irregular manipulation of B and C before and after use as wrapping elements serves the same purpose, and also enables them to leave and reenter the plain weave at right angles to the warps.

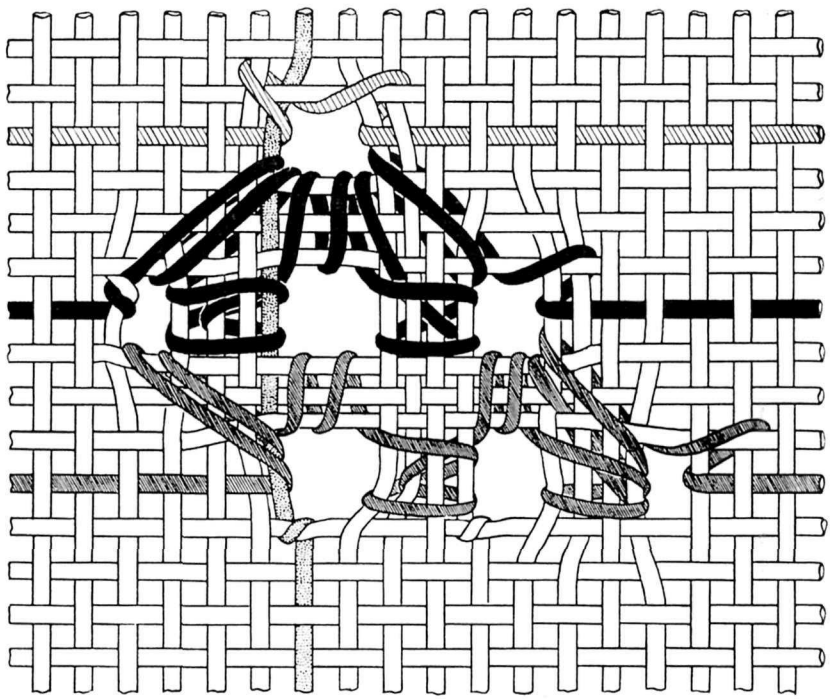


Figure 13

Specimen 13. Textile

Maximum length: 11″; 28 cm.
Maximum width: 2⅜″; 6.1 cm.
Threads per inch in length: 9 per half-inch; 7 per cm.
Threads per inch in width: 25; 11 per cm.
Material: Cotton.
Decoration: See analysis under Weave.
Weave: Gauze? The weft is missing at regular intervals of one-half inch (1.3 cm.). The open slits thus left measure ca. ¼″ (.6 cm.). Nine such slits can be distinguished. In some of them one can see two warp threads twisted together. The suggestion is that the slits are intentional, and for purpose of forming a design. (Cf. Hough, p. 79, Fig. 165; Haury, p. 95, and Fig. 20, a, p. 96; and Specimens Nos. 36 and 37, pp. 28-29.) A bit of coarse two-ply cotton cord is attached at one end of a slit place. One white ply and on orange-yellow. Purpose undetermined.

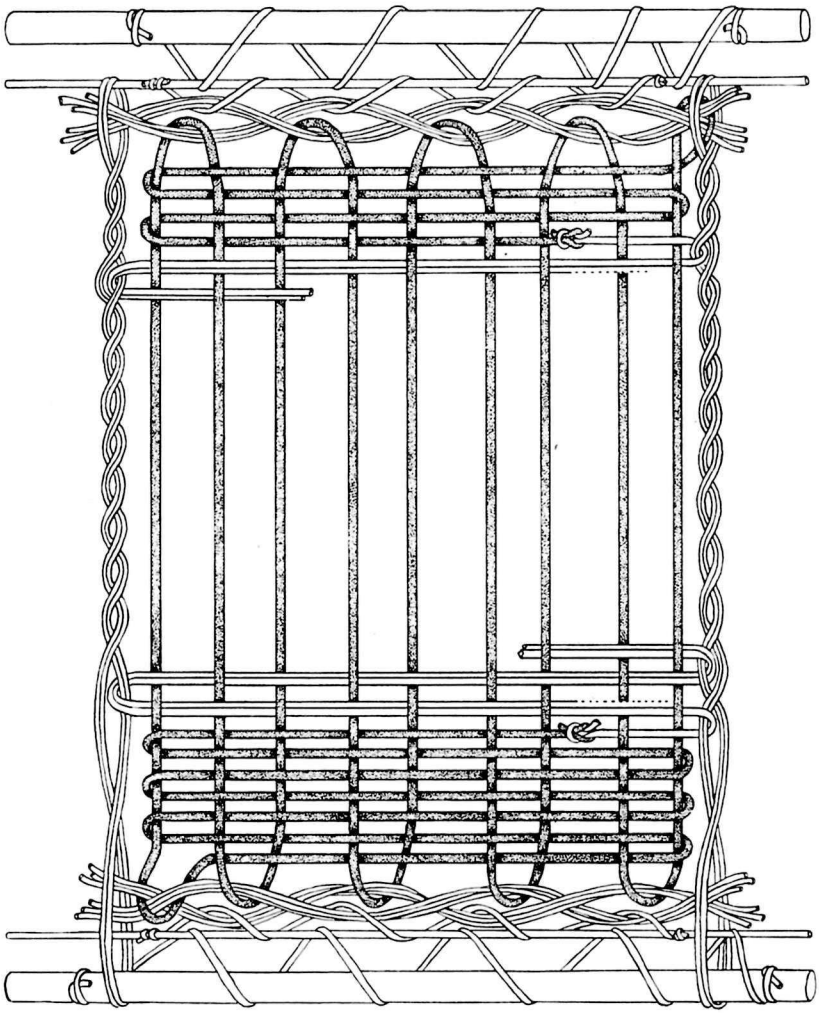


Figure 14. Possible reconstruction of loom set-up for Specimen No. 18

Specimen 18. Textile

Maximum length: 25″; 63 cm.
Maximum width: 5¾″; 14.6 cm.
Threads per inch in length: 40; 20 per cm.
Threads per inch in width: 28; 12 per cm.
Material: Cotton. Black and white weft threads and white warp.
Decoration: Geometric design in black and white, made by skipping, or floating, the weft threads. (See photograph.) The black is internal, vegetal dye.
Weave: Weft-float. Wefts are skipped or floated to produce the design. The weft elements always appear in pairs. (Cf. Specimen No. 33.) There

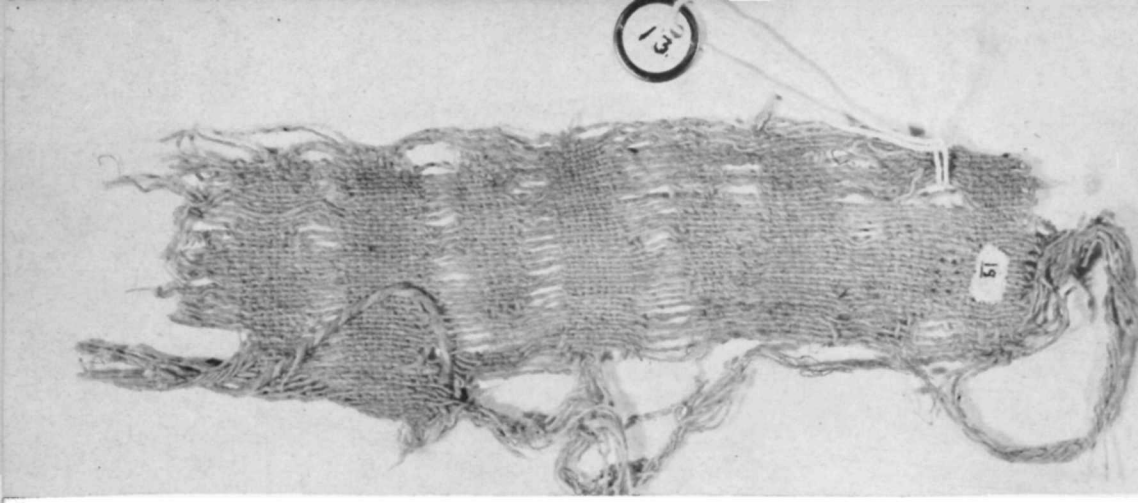


Plate 24. Gauze weave, Specimen No. 13

is a border at either end of the piece. Border A is one-fourth inch (.6 cm.) wide, and contains six weft threads. Border B is one-eighth inch (.3 cm.) wide, and contains three weft threads. These borders are plain weave and are finished off with the same technique used in specimen No. 7, p. 14). The side borders are handled exactly the same. The piece was sewed up the sides with a regular running stitch, so that it became a bag. A possible reconstruction of the loom set-up for the piece shows similarities with the Pueblo loom of today. It is impossible to say whether the warp threads were strung as figure eights. The warps were controlled by the fingers, rather than by heddle rods.

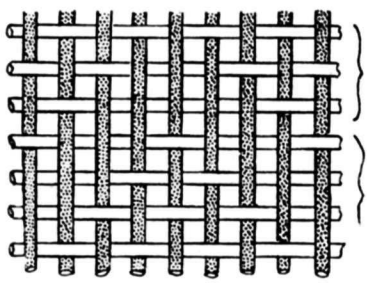
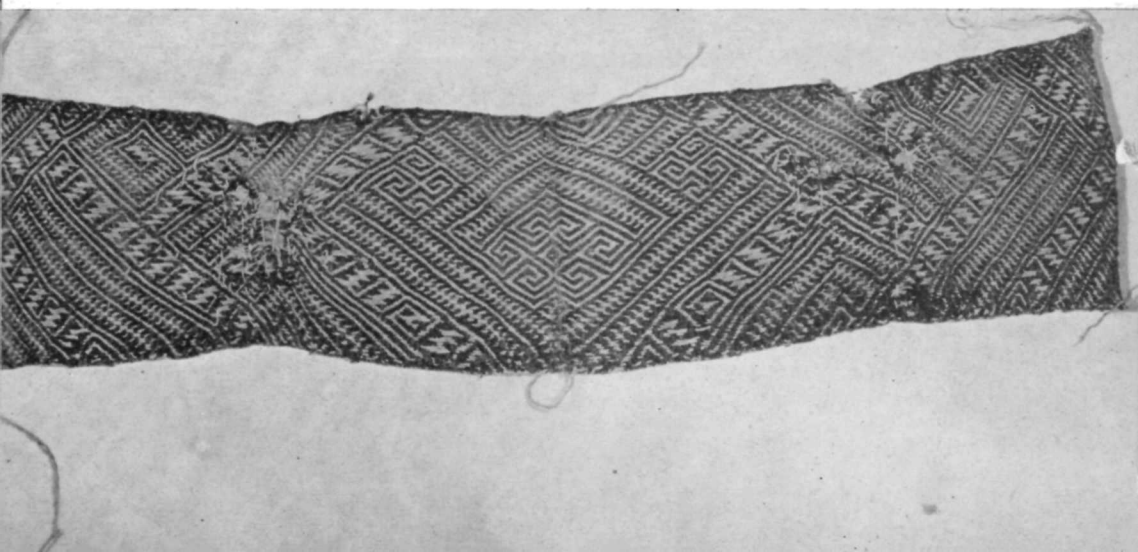


Figure 15

Plate 25. Weft float, Specimen No. 18



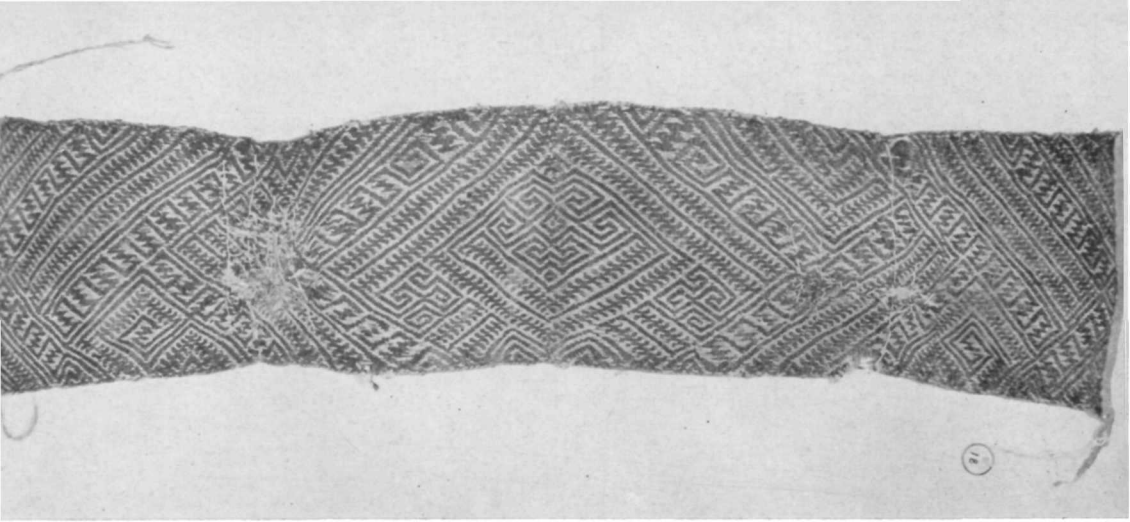
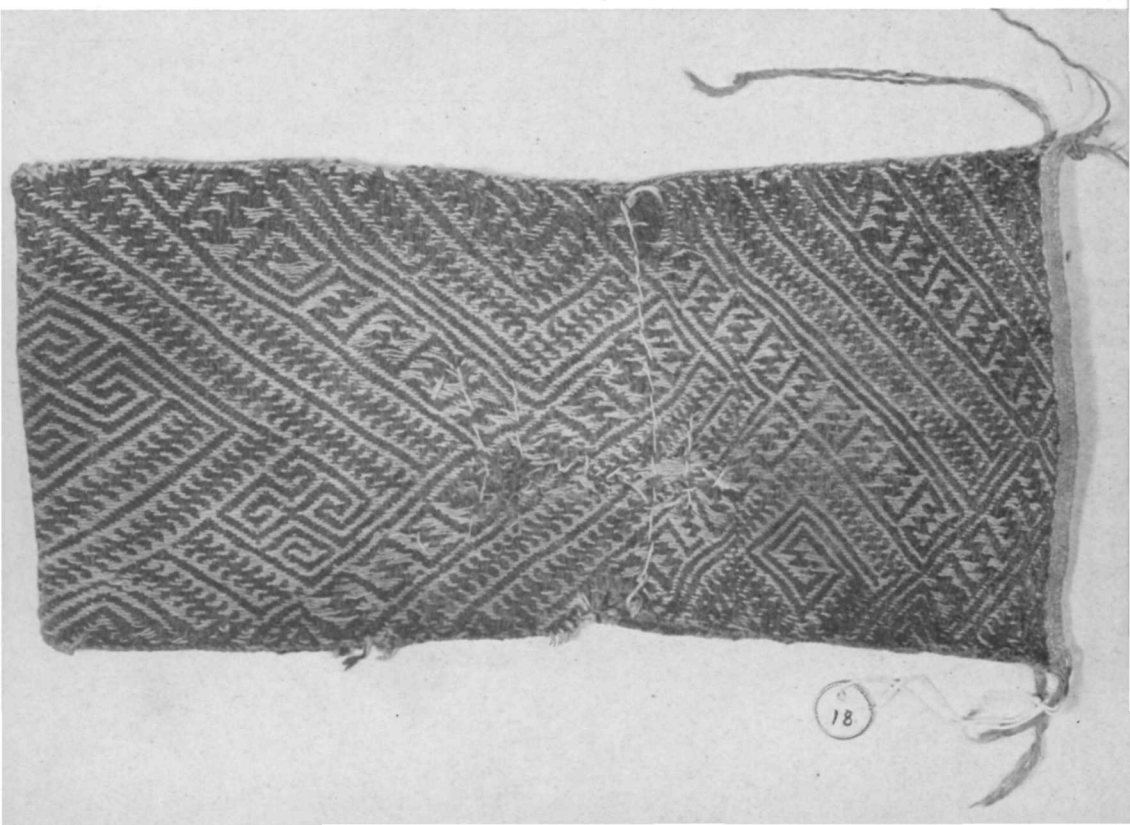
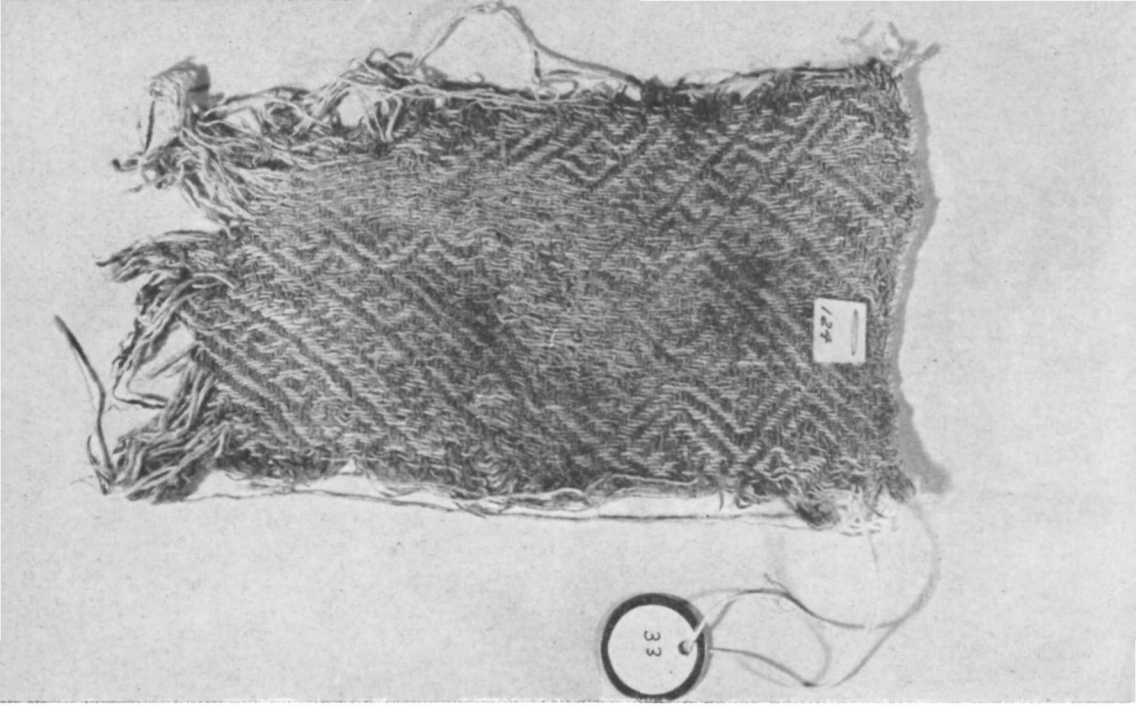


Plate 26. Weft float, Specimen No. 18

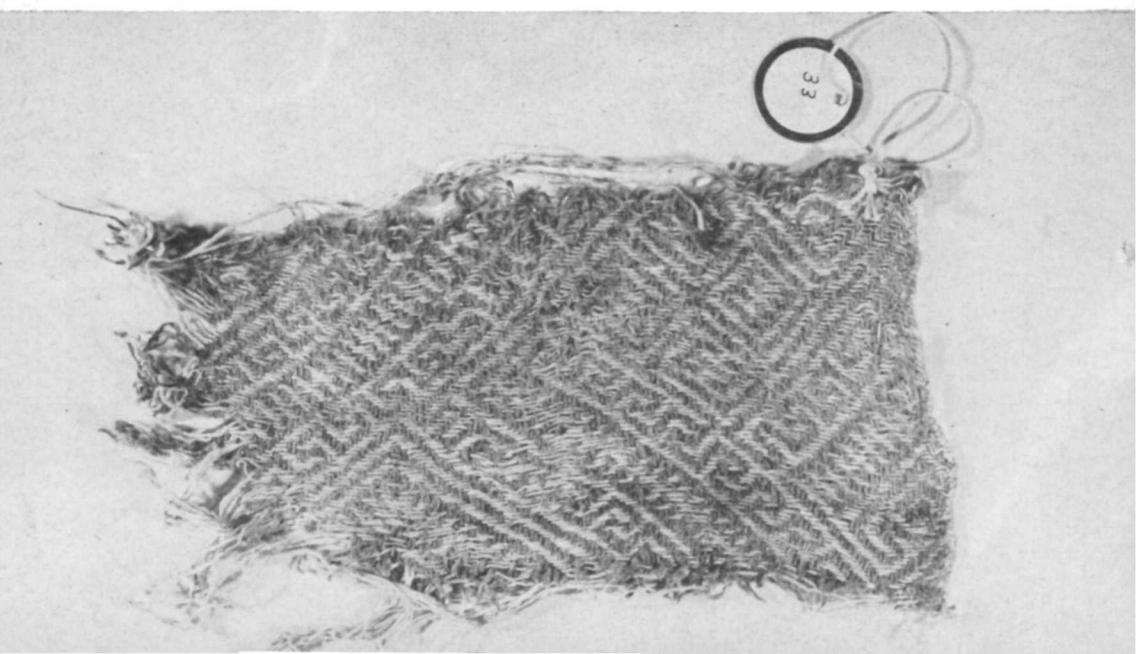




Specimen 33. Textile. (PS No. 124)

Maximum length: 7½″; 19 cm. Maximum width: 4″; 10.2 cm.
Threads per inch in length: 25; 10 per cm. (wefts)
Threads per inch in width: 32; 15 per cm. (warps)
Material: White cotton warps. Black cotton wefts.
Decoration: Geometric design made by floating the white warp threads. The black is internal, vegetal dye.
Weave: Weft-float. (Cf. Specimen No. 18, p. 33.) In this piece the weft strands always appear as single units, whereas in No. 18 they are always in pairs. One border. (Cf. Specimen No. 7, p. 14.)

Plates 27 (Upper) and 28. Weft float, Specimen No. 33. Lower is obverse view.



Specimen 56. Textile

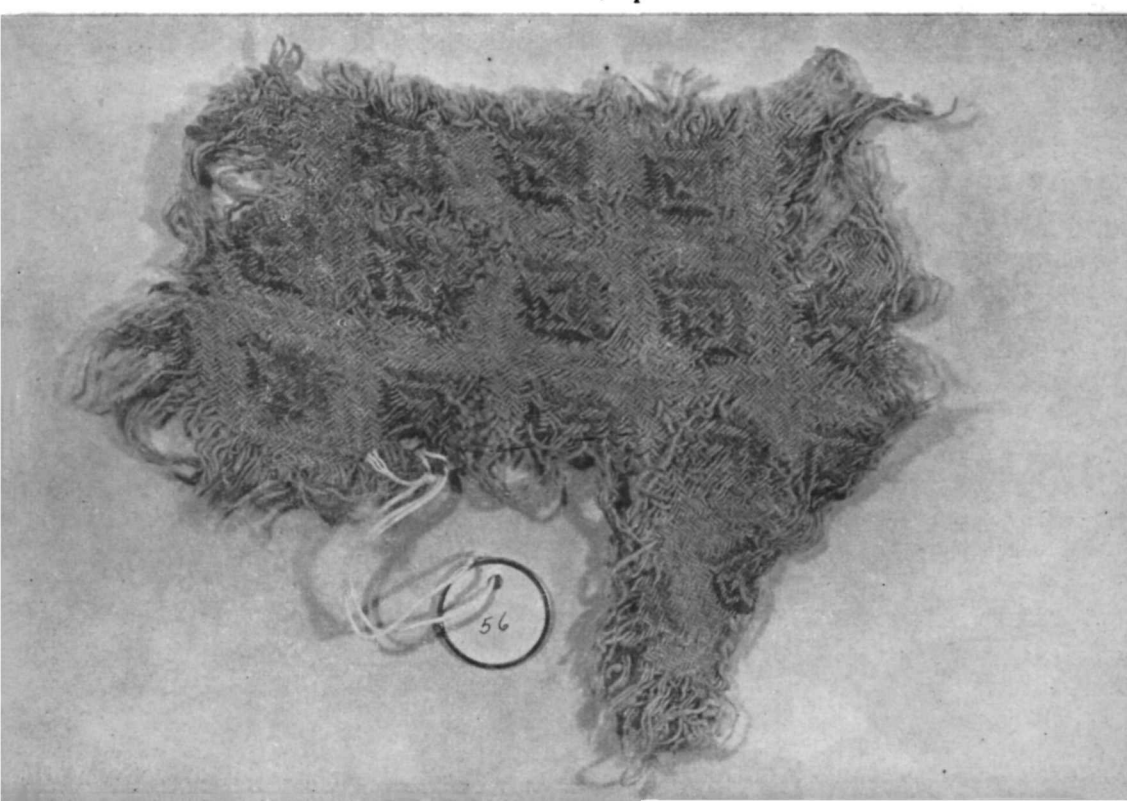
Maximum length: 6⅞"; 17.5 cm.
Maximum width: 5 5/16"; 13.5 cm.
Threads per inch in length and width: 22; 10 per cm.
Material: Cotton.

Decoration: Red dyed cotton; external dye which reacts to the test for iron. Black dyed cotton; the black dye is internal vegetal. Pattern of concentric diamonds. The inner diamonds are divided on their long axis in two parts, one red and one black. Each diamond has sides 1" (2.5 cm.) long.
Weave: Diamond twill with interlocking wefts.

The heddle arrangement for this technique calls for five heddles and a shed rod. The wefts pass over-three, under-three warps. Red and black threads are tied into the weave when desired for the design. There is no mention of such a set-up in the literature on Southwestern weaving, the diamond twills described requiring only three heddles and a shed rod. Amsden figures the fragment here described and says in speaking of the technique (page 57):

> "I find no evidence that the diamond twill was used in mechanical weaving by the prehistoric Pueblos, although they used the diagonal twill, as was said. They knew the diamond twill as a finger method, certainly, as plate 35, c proves. (This) . . . is a cotton cloth fragment which appears to be loom-woven; close scrutiny shows, however, that the weft threads forming the diamond do not extend across the full width of the warps as they would if woven in the

Plate 29. Diamond twill, Specimen No. 56



loom. Inferentially, the diamond twill originated in a hand technique and was adapted to the loom by a weaver skillful enough to work out the complicated heddle arrangement. (Unless it should prove another European trait introduced by Spaniard or American.)"

The fact that the wefts are not continuous across the piece is not a valid objection to a mechanical weaving of the piece, as laboratory research shows. Assume the weaver wishes to insert the black wefts as shown in the drawing. He is about to place a weft in the shed opened by the shed rod, passing the thread from left to right. He draws it only to the point where he desires a black thread to appear. He then

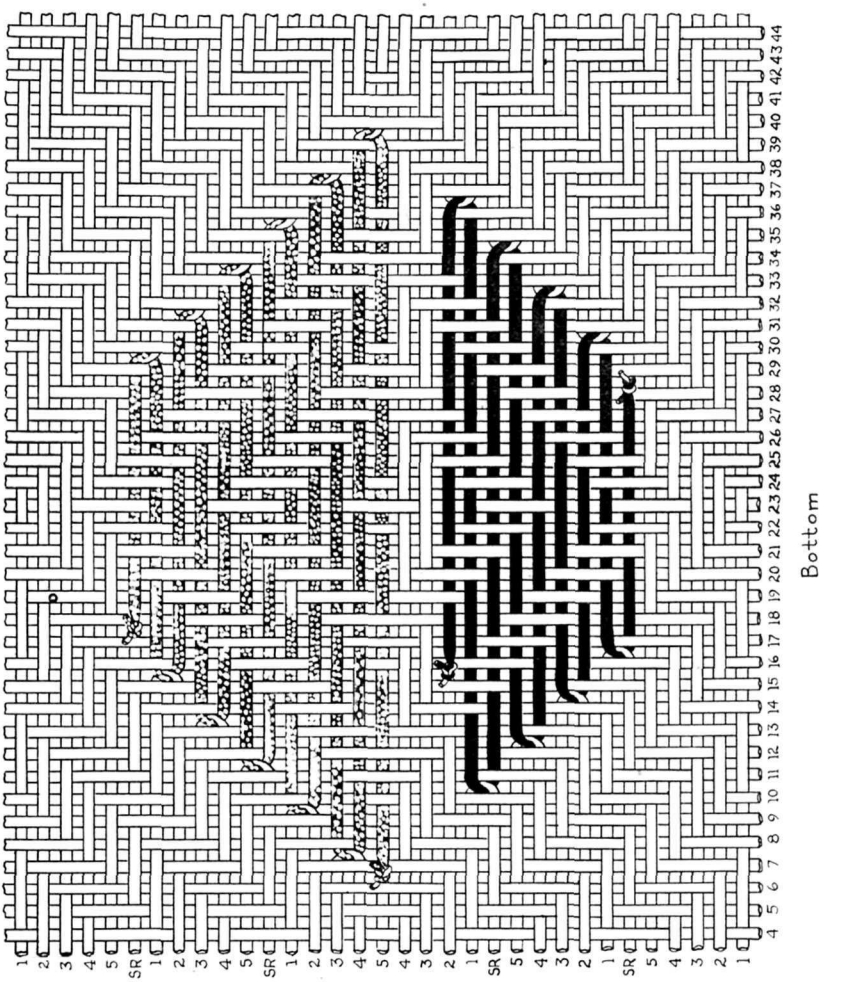


Fig. 16. Numbers up the side of the diamond indicate heddle numbers as shown on page 39. SR indicates "shed rod," as shown on the same page. Numbers at the bottom of the diamond refer to warp threads as listed on the same page.

Heddle *one* pulls forward: 2, 3, 4-8, 9, 10-14, 15, 16-20, 21-22- drop one -24, 25, 26-30, 31, 32-36, 37, 38-42, 43, 44-48, 49, 50- drop 51, 52 and repeat the above.

Heddle *two* pulls forward: 1, 2, 3-7, 8, 9-13, 14, 15-19, 20, 21,- drop three -25, 26, 27-31, 32, 33-37, 38, 39-43, 44, 45-49, 50, 51 - drop 52 and repeat the above.

Heddle *three* pulls forward: 1, 2-6, 7, 8-12, 13, 15-18, 19, 20- drop five-26, 27, 28-32, 33, 34-38, 39, 40-44, 45, 46-50, 51, 52-repeat the above

Heddle *four* pulls forward: 1-5, 6, 7-11, 12, 13-17, 18, 19-23, 27, 28, 29-33, 34, 35-39, 40 ,41-45, 46, 47-51, 52-repeat the above.

Heddle *five* pulls forward: -4, 5, 6-10, 11, 12-16, 17, 18-22, 23, 24-28, 29, 30-34, 35, 36-40, 41, 42-46, 47, 48-52- repeat the above.

Shed rod takes: -3, 4, 5-9, 10, 11-15, 16, 17-21, 22, 23, 24, 25-29, 30, 31-35, 36, 37-41, 42, 43-47, 48, 49-drop 50, 51, 52 and repeat the above

To make the diamond pull the heddles and shed rod in the following order:

1, 2, 3, 4, 5, shed rod;
1, 2, 3, 4, 5, shed rod;
1, 2, 3, 4, 5, 4, 3, 2, 1;
Shed rod, 5, 4, 3, 2, 1;
Shed rod, 5, 4, 3, 2.

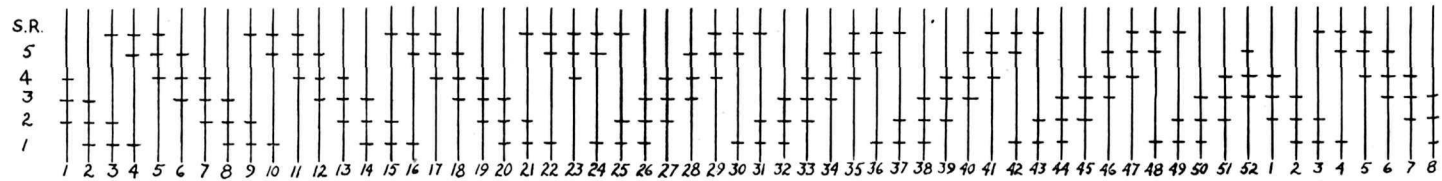


Figure 17. Chart showing warp stringing for diamond twill, No. 56

inserts the black, drawing it from left to right, as far as desired. At this point a white thread is tied to it and carried across the remainder of the row. The next shed is opened with heddle 1. The two white weft sections pass from right to left, and the black fills the space between them, passing from left to right. That the use of five heddles and a shed rod was not unknown to the prehistoric Pueblo weavers is further demonstrated by a herring-bone twill specimen from Wupatki. The wefts pass over and under three warps, which would require five heddles and a shed rod.

Specimen 12. Textile

Maximum length: 7″; 17.9 cm.
Maximum width: 3¾″; 9.6 cm.
Threads per inch in length: 29; 14 per cm. (wefts)
Threads per inch in width: 11; 5 per cm. (warps)
Material: Cotton wefts; warps of *Yucca baccata.* (Jones notes: "Gray weft includes extraneous material and a hair of a small mammal." Our analysis notes: "Gray weft is primarily cotton, but contains animal hair, probably from *Lutrea sonora,* the Arizona Otter, which has been collected at Montezuma Well.")
Decoration: Geometric design in gray (faded black), yellow and brown. The design is strictly governed by the technique. The yellow is granular, external, mineral dye; while the black is internal, vegetal dye.
Weave: Slit-tapestry. (Cf. Steen, pp. 458-459; Hough, p. 81; Guernsey, p. 97-98.)

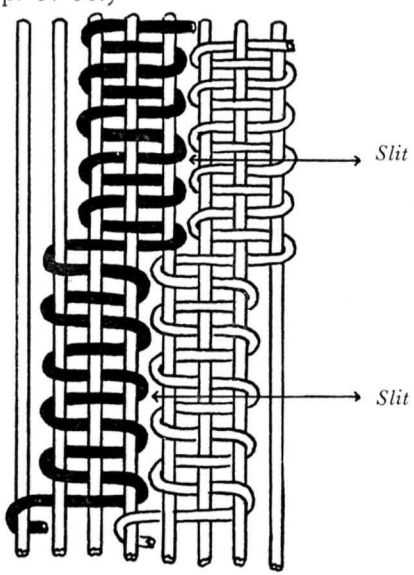


Figure 18

A weft, instead of being laid in the entire width of the piece, is woven back and forth over three warps five times, then brought over a warp to right or left, and the process repeated. Hence, a number of slits are produced throughout the textile. This technique was easily reproduced on a model loom without the use of heddle rods. The desired warps were chosen by hand and held forward with the batten while the wefts were woven over them. The colors are separated into geometric designs by the slits produced in weaving. Wefts are beaten so closely together that warps are completely covered.

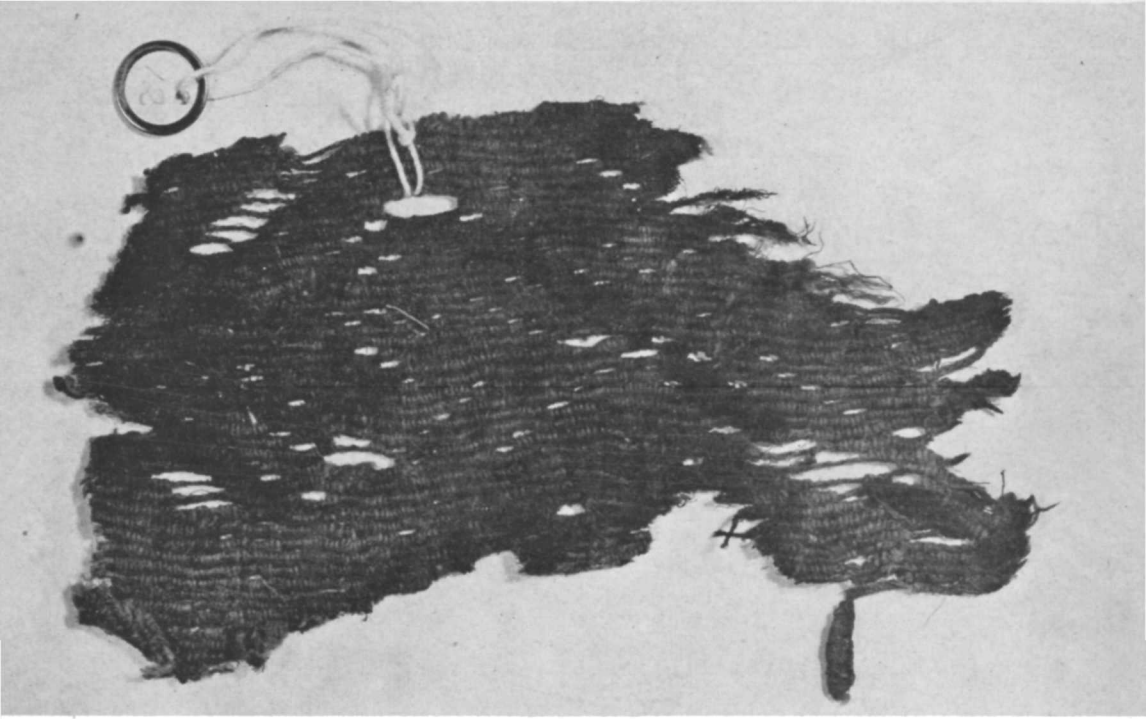
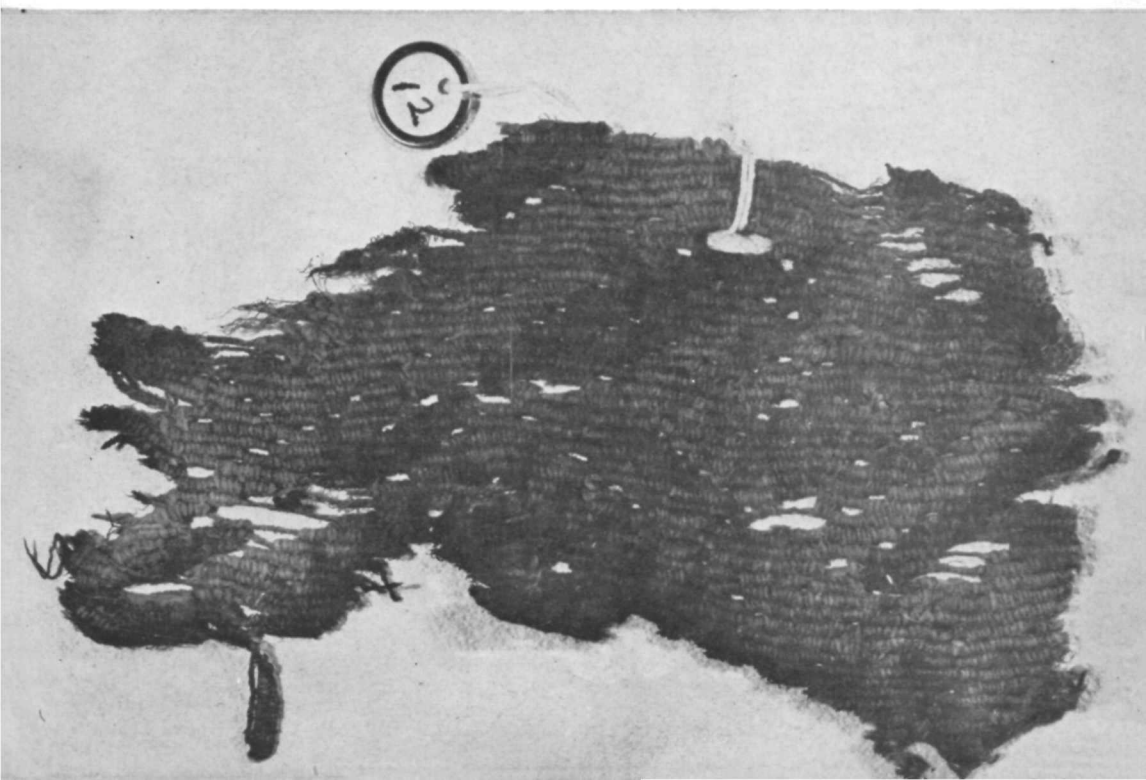


Plate 30. Slit-tapestry weave, Specimen No. 12



SANDALS

(Nos. 25, 27, 28, 29, 30, 31, 32, 45, 50, 51)

The 10 sandals and their ties are all made from yucca leaves or fibers,[22] with two exceptions: No. 45 is of *Agave parryi;* and the instep cord of No. 27 is cotton.

Six of them (Nos. 28, 29, 30, 31, 32 and 50) are made from whole yucca leaves in the following manner: four leaves are folded to make eight strands. The folds are at the toe of the sandal, and the strands are braided from the toe to within 2 inches of the heel, with an over-one under-one movement (plain plaiting; see drawing, p. 46). The last 4-inch section at the heel is turned up on the sandal sole and fastened with yucca fiber, to form a heel pad. The toe straps for these sandals are of yucca leaves, partly shredded. They enter the weave at the front of the sandal, enclosing the second and third toes, cross one, and re-enter the weave at either side of the heel. Sometimes there is a heel cord of an extra length of yucca fiber attached to the toe straps just before they enter the weave at the heel.

One heel fragment of a sandal (No. 51) made from shredded yucca leaves, is braided as those just described.

These simple sandals are not shaped to fit the foot; the toes are squared or only slightly rounded. Similar ones are described in the Sierra Ancha finds, although they are generally an over-two under-two braid (twill plaiting). Haury calls them Pueblo III products (pp. 64-65, Pl. XLI, b; Hough, p. 83; BAEB 65, type 1, a, 1, p. 101; Mera, p. 55).

One sandal (No. 25, p. 49) is braided with the same over-one under-one movement, but with 6 yucca fiber cords, folded at the toe to make 12 strands. An extra cord binds the sandal sides. The toe strap for this is a three-strand braid of small yucca fiber cords, fastened in the weave at heel and toe. The heel strap is missing.

No. 45 (p. 51) is made from fibers of *Agave parryi.* It is a braid of 27 strands. (Cf. Haury, p. 65.) The braiding follows an over-two under-two movement (twill plaiting). The heel and toe are so frayed that it is impossible to determine how they were finished. The sandal broadens at the toe, which was evidently notched. The toe strap is of two 11-strand cord braids, originating from a woven section over the toe, and passing along each side of the foot to enter the weave at the heel. The heel strap is a separate cord arrangement of *Yucca baccata.* Haury places sandals like this in the Pueblo IV period.

The cords used for the last two sandals described are composed of bundles of fibers bound spirally with a few single fibers to keep them compact.

There is one sandel which is made by wickerwork (No. 27, p. 52). Here yucca fiber cords are woven back and forth over six tightly twisted,

22. All four species of yucca are used. Classification shows:
Yucca mohavensis—Nos. 28, 29, 30, 51
Y. elata—Nos. 31, 32, 27
Y. baccata—No. 50 and heel tie of No. 45
Y. macrocarpa—No. 25

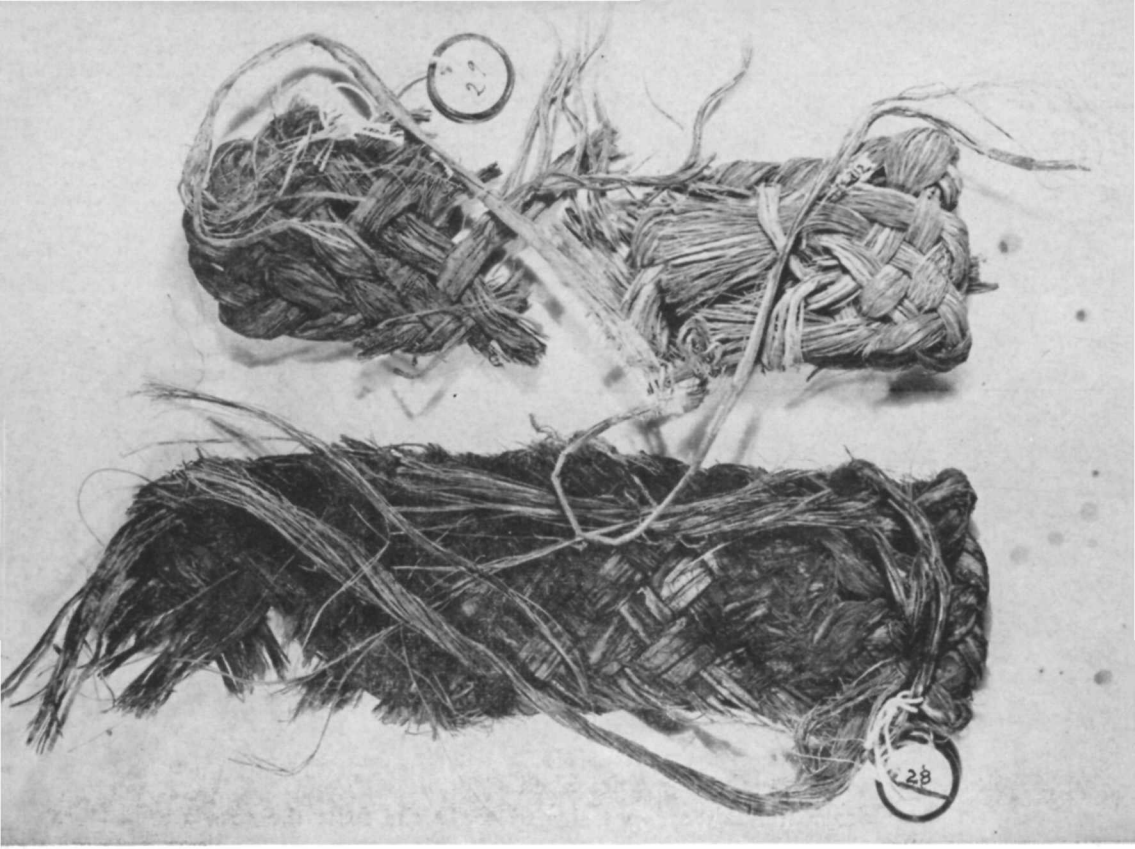
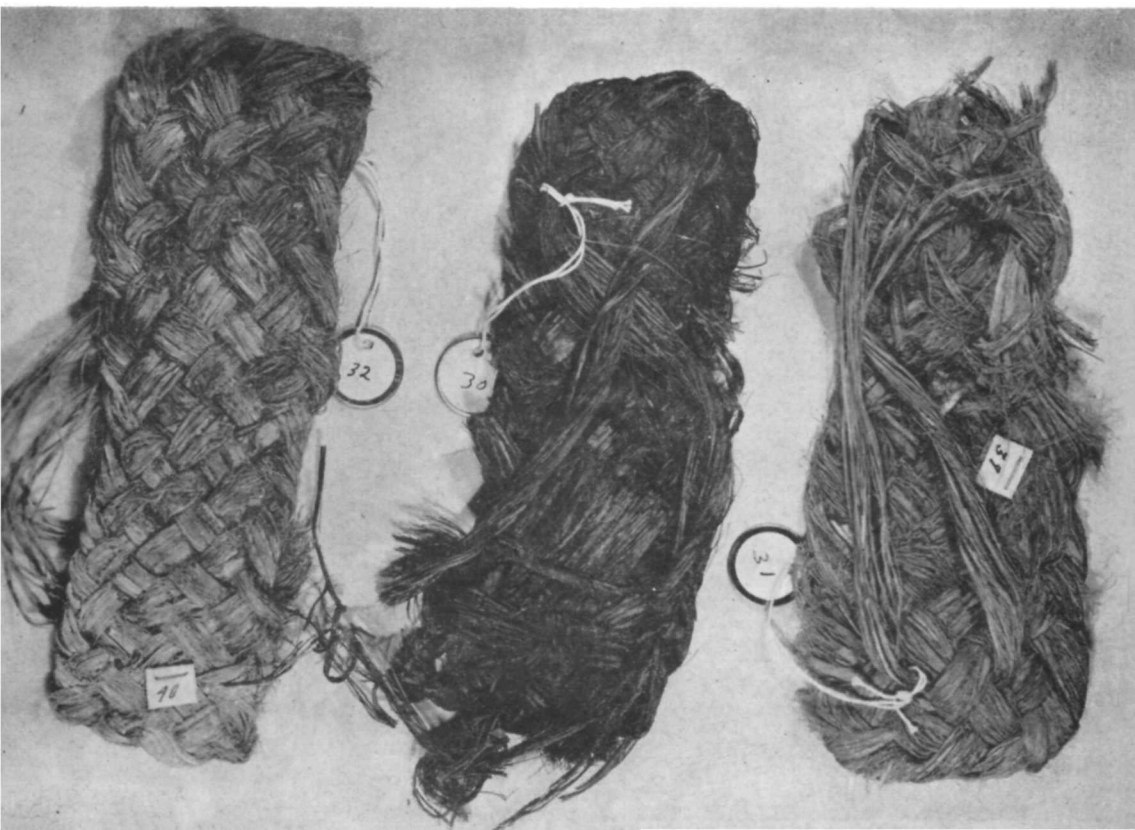


Plate 31. Sandals, Specimens Nos. 28, 29, 30, 31, 32



two-strand yucca warps. This sandal is round-toed and shaped to fit the foot. The toe and heel cords are of yucca string, and the instep cord of cotton. There is a description in Hough (p. 84) of a sandal like this, with four rather than six warps. (Cf. BAEB 65, type II, a, p. 103, and Baldwin, 1938, p. 466.)

There is no dye or coloring applied to any of the sandals. It will be seen that they vary in shade, but the shading is doubtless due to weathering and dirt ground into the specimens.

Specimen 28. Sandal with Frayed Toe (PS No. 41)

Maximum length: 9¼″; 23.5 cm.
Maximum width: 2¾″; 7 cm. Heel, instep and ball.
Amount turned under for heel pad: 2½″; 6.4 cm.
Toe straps: Longest section left measures 9¼″; 23.5 cm.
Heel strap: Doubled, 4½″; 11.4 cm.
Material: Natural colored leaves of *Yucca mohavensis.* (Yucca leaf toe straps.) Shades from light sole, M&P 11-J-7, to dark top, M&P 16-A-12.
Weave: Same as in specimen No. 30, p. 46. Method of attaching toe straps at heel, see specimen No. 29, below. Heel strap attachment is looped over the toe straps and tied with a square knot.

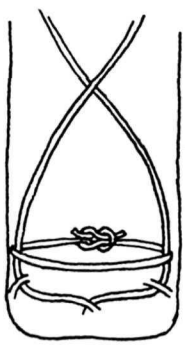
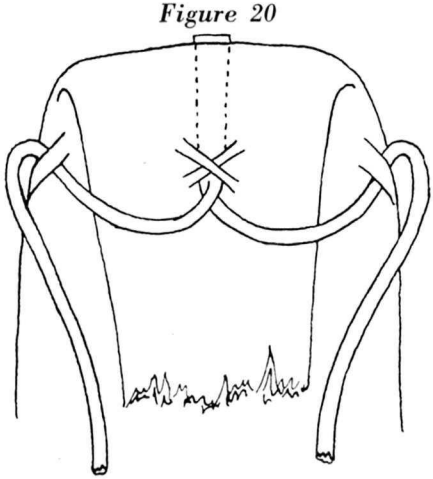


Figure 19

Specimen 29. Sandal (in two parts)

Maximum length: Section a (toe): 4″; 10.2 cm. Section b (heel): 4″; 10.2 cm. Probably ca. 8″ to 8½″ long.
Maximum width: Section a: toe and ball: 2½″; 6.4 cm. Section b: at heel 2⅜″; 6 cm. at instep; 2⅛″; 5.5 cm.
Amount turned up for heel pad: 3¼″; 8.3 cm.
Tie: Entirely separate from sandal. Entire length of tie: 20″; 50.8 cm. Impossible to see exactly how it was joined at toe.
Material: Natural colored leaves of *Yucca mohavensis.* (Yucca fiber strips for straps.) Shades from light sole, M&P 4-A-9, to dark upper, M&P 7-A-12.
Weave: Same as specimen No. 30, p. 46. Different attachment of heel and heel pad, and then

Figure 20



split; each half passes over opposite sides of the heel pad and down through the braid at the sandal edges; then up again and forward, to become the toe strap.

Specimen 30. Sandal

Maximum length: 7¾″; 19.8 cm.
Maximum width: 2¾″; 7 cm. Width at heel: 2¾″; 7 cm. Width at instep: 2¾″; 7 cm. Width at ball: 2¾″; 7 cm. Width at toe: 2½″; 6.3 cm.
Width at ball: 2¾″; 7 cm. Width at toe: 2½″; 6.3 cm.
Amount turned up for heel pad: 3½″; 8.9 cm.
Length of straps: Toe (each), from point where it enters weave at the toe to point where it enters weave at heel: 7″; 17.8 cm. Heel, from knot to knot: 6″; 15.2 cm. (See drawing.)
Material: *Yucca mohavensis*. Straps: yucca fiber strips. Shades from light tan sole, M&P 11-I-5, to dark upper, M&P 15-L-12.
Weave: (see drawing) (Cf. Hough, p. 83; BAEB 65, p. 101, type I,a,1; Haury, pp. 64-68, pl. XLI, a and b; Guernsey, pp. 66-67, Fig. 24; Roberts, p. 516.) Over-**one** under-**one** braiding, such as is used here, is apparently rare. Over-**two** under-**two** braiding is more frequently described.

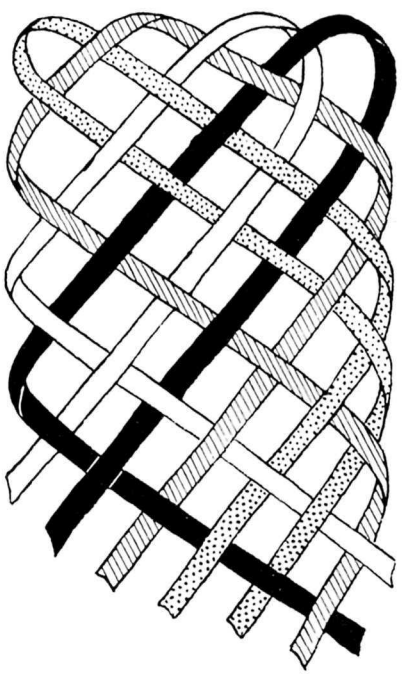


Figure 21. Over-one under-one braiding

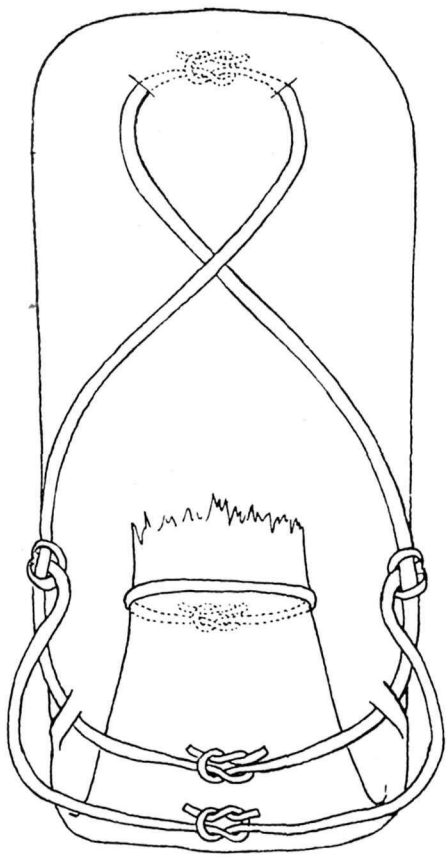


Fig. 22. Top of sandal, showing method of attaching heel tie (a) and toe tie (b). Specimen 30.

Specimen 31. Sandal (PS No. 39)

Maximum length: 7¾″; 19.7 cm.
Maximum width: 3¼″; 8.3 cm. Width at heel: 2¼″; 5.7 cm. Width at instep: 2¾″; 7 cm. Width at ball: 3¼″; 8.3 cm. Width at toe: 3″; 7.6 cm.
Amount turned up for heel pad: 3¼″; 8.3 cm.
Length of straps (each): Toe strap, from point where it enters weave at toe to point where it enters weave at heel: 6¾″; 17.2 cm.
Material: Natural colored leaves of *Yucca elata.* (Yucca fiber strips for straps.) Shades from light sole, M&P 10-G-2, to dark top, M&P 15-L-12.
Weave: Same as specimen No. 30 (p. 46). No heel strap. One loose end of the square knot of the toe straps at the heel is drawn back through the weave to the sole of the sandal.

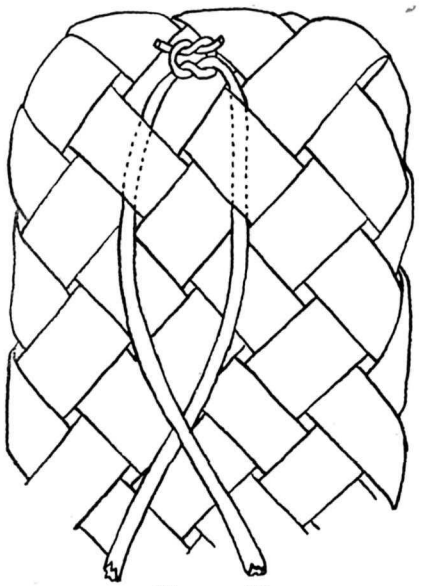


Figure 23

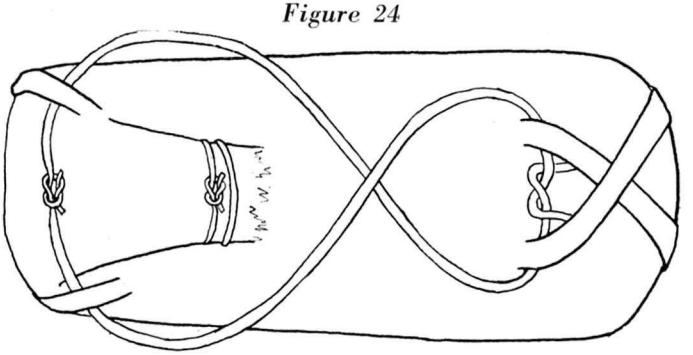
Specimen 32. Sandal (PS No. 40)

Maximum length: 8¼"; 21 cm.
Maximum width: 3"; 7.6 cm.
Width at heel: 2½"; 6.4 cm.
Width at instep: 2⅜"; 6 cm.
Width at ball: 2⅞"; 7.4 cm.
Width at toe: 3"; 7.6 cm.
Amount turned up for heel pad: 3"; 7.6 cm.
Length of straps (each): Toe straps, from the knot at the toe to point of attachment at heel: 10¼"; 26 cm. Heel straps: missing.
Material: Natural colored leaves of *Yucca elata.* (Yucca fiber straps.) Shades from light sole, M&P 12-H-2, to dark top, M&P 15-A-12.
Weave: Same as in specimen No. 30 (p. 46), with two exceptions: 1. Lack of heel strap. 2. Toe straps tie differently at toe. Each strap passes through the weave at the toe to the under side of the foot, then back up through a hole more to the front of the foot. They tie on top of the sandal in a square knot. They tie at the heel as in specimen No. 30 (p. 46).

Specimen 50. Sandal

Maximum length: 7⅛"; 18.1 cm.
Maximum width: 3"; 7.6 cm. Width at heel: 3"; 7.6 cm. Width at instep: 2⅜"; 6 cm. Width at ball: 3"; 7.6 cm. Width at toe: 2½"; 6.4 cm.
Amount turned up for heel pad: 3"; 7.6 cm.
Length of heel strap (doubled): 5½"; 14 cm.
Length of toe strap (each): From point of entrance in weave at heel to point of entrance in weave at toe: 7½"; 19.1 cm.
Material: *Yucca baccata* leaves. Shades from light sole, M&P 12-B-6, to dark upper, M&P 15-A-12.
Weave: (Cf. specimen No. 30, p. 46, drawings and references.)

Figure 24



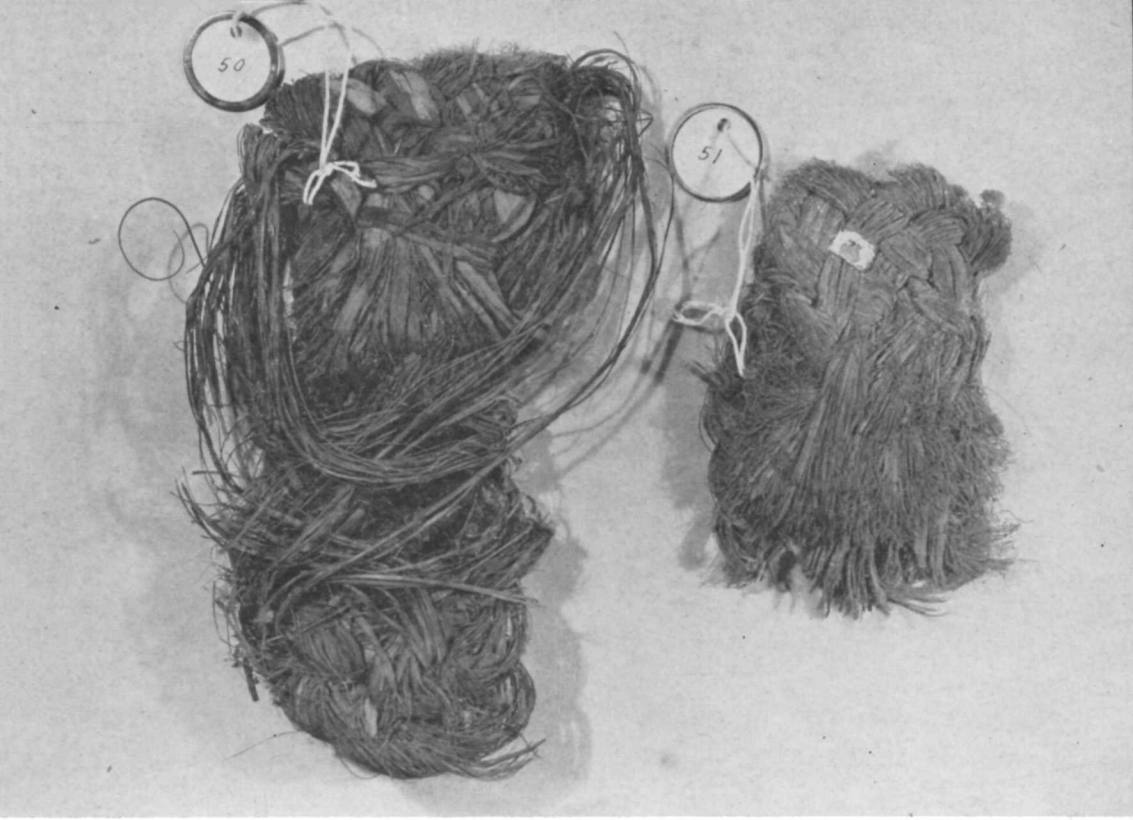


Plate 32. Sandals, Specimens Nos. 50, 51

Specimen 51. Sandal Fragment

Maximum length: 4″; 10.2 cm.
Maximum width: 3″; 7.6 cm.
Material: *Yucca mohavensis.* Color M&P 12-A-6.
Weave: Heel section and pad of sandal woven as specimen No. 50 (above).

Specimen 25. Sandal (PS No. 8)

Maximum length: 9¾″; 24.8 cm.
Maximum width: 3¼″; 8.3 cm. Width at heel: 3″; 7.8 cm. Width at ball: 2¾″; 7 cm. Width at toe: 3¼″; 8.3 cm.
Length of braided tie: From point of attachment to weave in toe to point of attachment to weave in heel: 8½″; 12.7 cm.
Material: *Yucca macrocarpa,* some natural colored, some stained. Shades from light sole, M&P 4-A-8, to dark top, M&P 15-A-12.
Weave: Sandal, composed of yucca fibers bunched to form cords; these fibers are bound by a few strips of yucca fiber twisted over them at irregular intervals. The technique of the sandal braiding is like that of Specimen No. 30 (p. 46), except that there are six strands used. Also an extra strand (or cord of yucca fibers) is bound down each side of the sandal. The tie is a three-strand braid of yucca fibers. It is caught into the weave at the toe on top of the sandal (the section called "toe" appears to

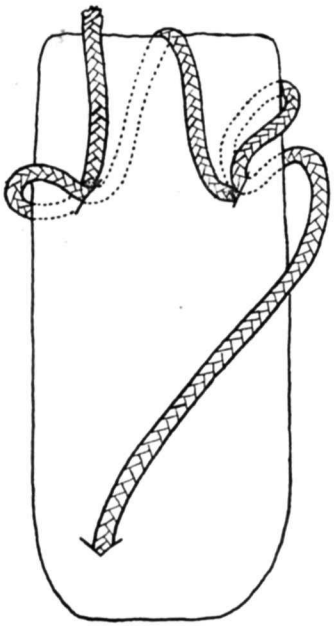


Figure 25

have a double thickness, which might indicate it to be the heel, but the strap arrangement seems more logical if it be designated toe") and into the weave *under* the heel. A piece of braid attached to it before it passes beneath the foot at the heel to enter the weave seems to be a remainder of a heel strap. After entering the heel weave about one-half inch from the sandal's edge, the braid passes through the weave and loops over the edge of the sandal, back through the same hole, and loops over the sandel edge again, this time in the center of the heel. Then it passes under the sandal and up through the weave about one-half inch from the opposite side of the sandal, loops around that edge, back through the same hole, and is then broken off. It might have been part of the heel strap arrangement, or might have become the second toe strap. (See illustration.)

Sandal, Specimen No. 25

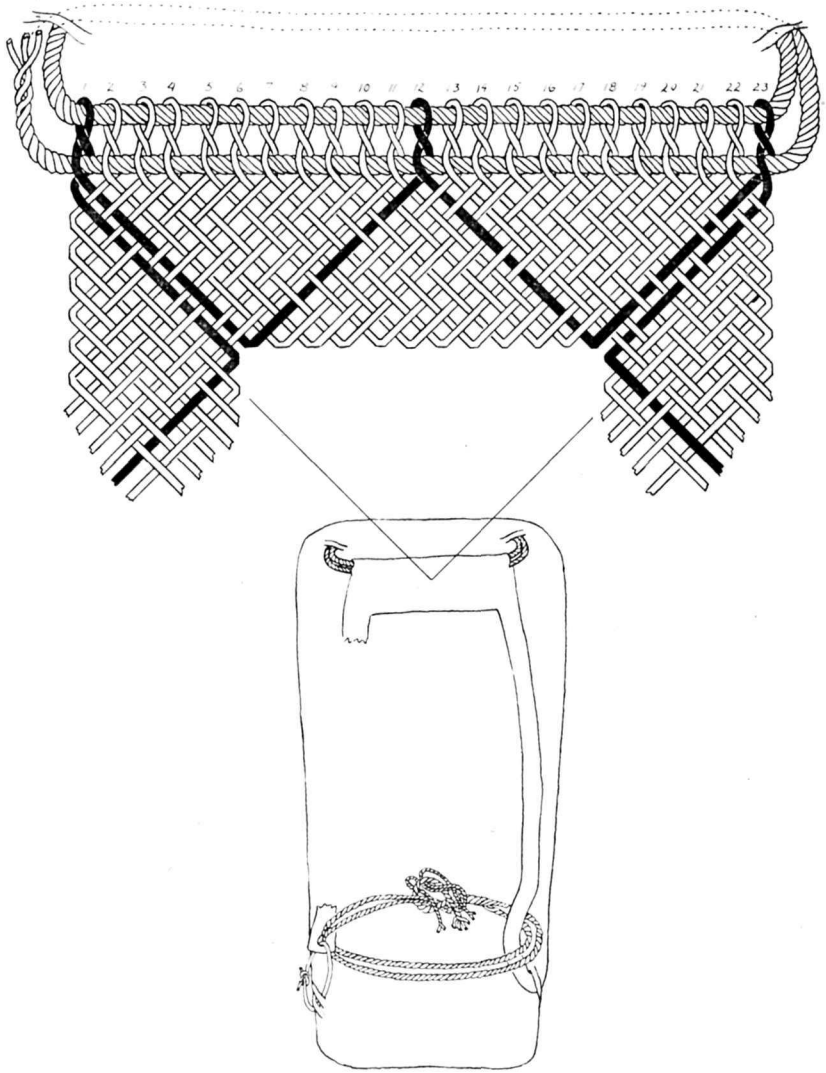


Figure 26

Specimen 45. Sandal (PS No. 161)

Maximum length: 8½″; 20.5 cm.
Maximum width: 3¾″; 9.6 cm. Width at heel: 2¾″; 7 cm. Width at instep: 3″; 7.7 cm. Width at ball: 3¾″; 9.6 cm. Width at toe: 3½″; 9 cm.
Length of toe strap: Braided. From point of entrance in weave at heel to point of entrance in weave at toe: 6″; 15.3 cm.
Material: *Agave parryi* in sandal. Fiber bundles, bound spirally with other fibers. Heel tie of *Yucca baccata*. The toe strap is a braid of

small bundles of fibers. The heel strap is two bundles of fiber twisted loosely.

Weave: The sandal is an over-two under-two braid of 27 fiber bundles. The heel and toe sections are so frayed that it is impossible to analyze how they are finished. The heel and toe strap arrangements can be seen in the technical drawings. (Cf. Haury, pp. 65-66, Pl. XLII, b, c, and d; and p. 67, Fig. 12, a.)

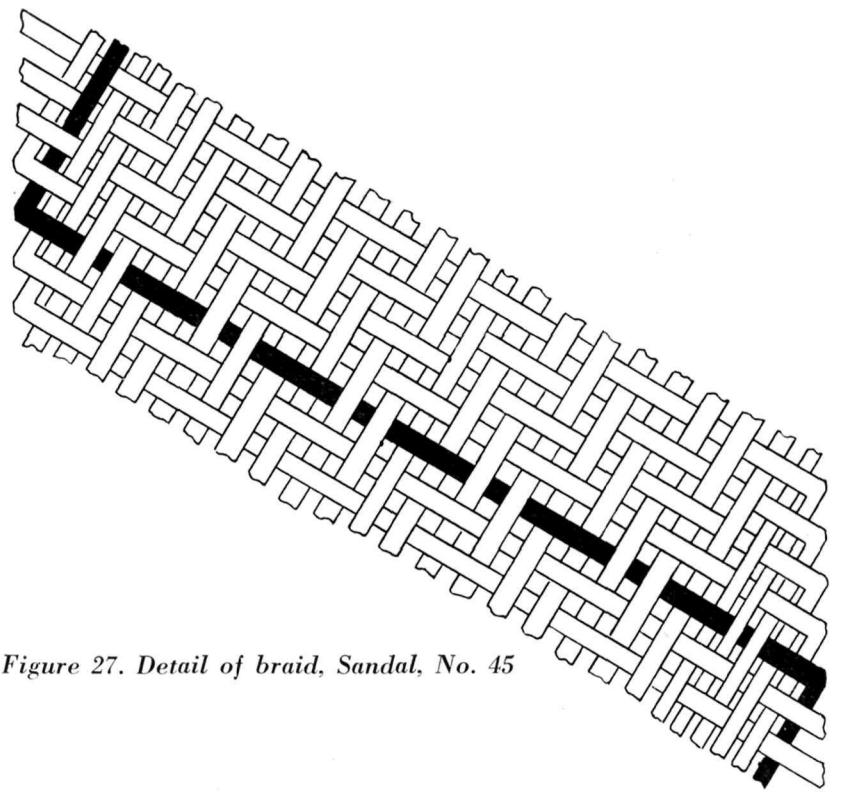


Figure 27. Detail of braid, Sandal, No. 45

Specimen 27. Sandal. (PS No. 159)

Maximum length: 8¾″; 22.4 cm.

Maximum width: 2½″; 6.4 cm. Width at heel: 2″; 5.1 cm. Width at instep: 2⅛″; 5.4 cm. Width at ball: 2⅜″; 6.1 cm. Width at toe: 2½″; 6.4 cm.

Toe straps: Section A (see Fig. 28): Length from point of entrance into weave to point of knotting, 2⅜″; 6.1 cm. for No. 1; 2″; 5.1 cm. for No. 2. Average width of strands: .2 cm.; composed of two elements twisted together.

Section B (see Fig. 28): Length, knot to knot, 3″; 7.6 cm. Consists of a large cotton cord composed of two smaller cords twisted together.

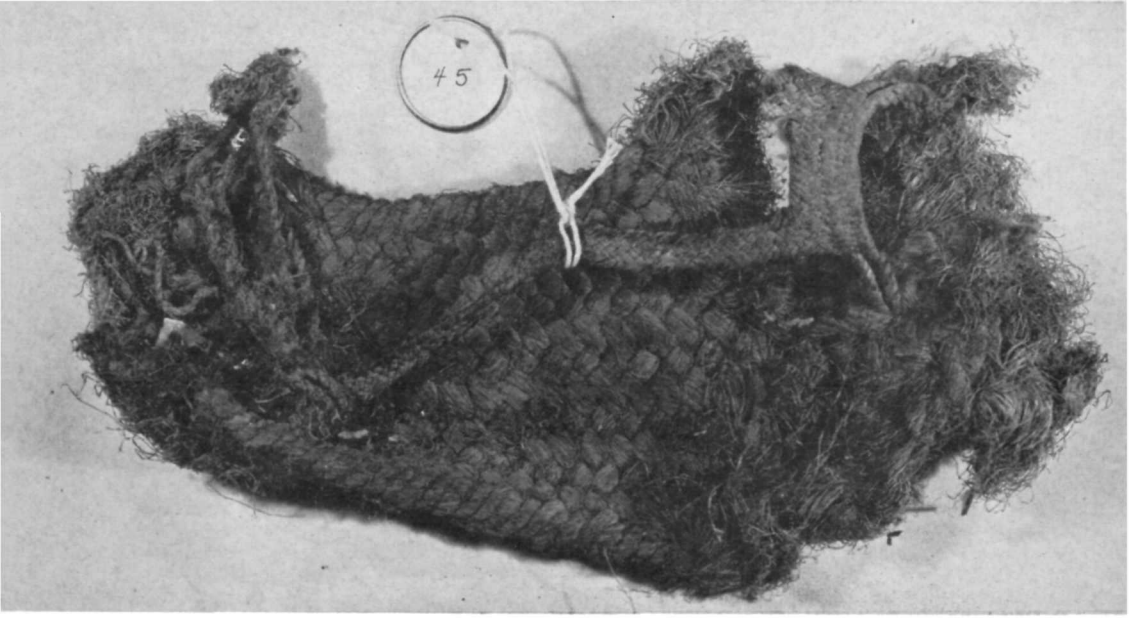


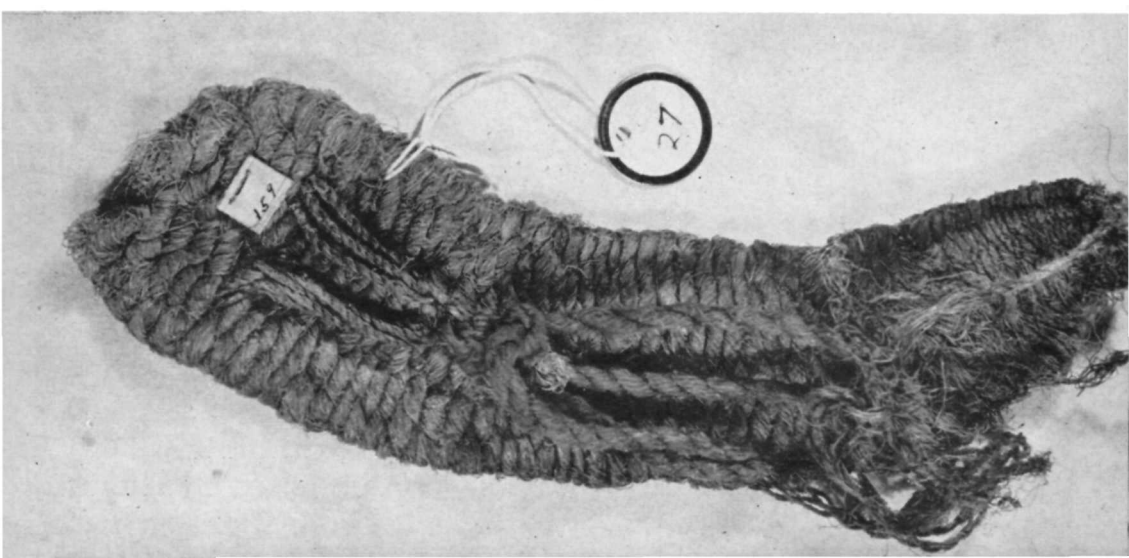
Plate 34. Sandal, Specimen No. 45

Each of the smaller cords is made of eight slender strings of cotton twisted.

Material: Sandal, *Yucca elata.* Section A, cord, *Yucca elata.* Section B, cord, cotton. Color ranges from light sole, M&P 4-E-7, to dark upper, M&P 6-A-11.

Weave: Wicker work, six warps of very tightly twisted yucca fibers. Twisted yucca cords woven over these (see drawing p. 55). The heel cord is missing, but the toe cord attachment is shown in Fig. 28. (Cf. Hough, p. 84; BAEB 65, Type II, a, p. 103. Baldwin, 1938, p. 466.)

Plate 35. Sandal, Specimen No. 27



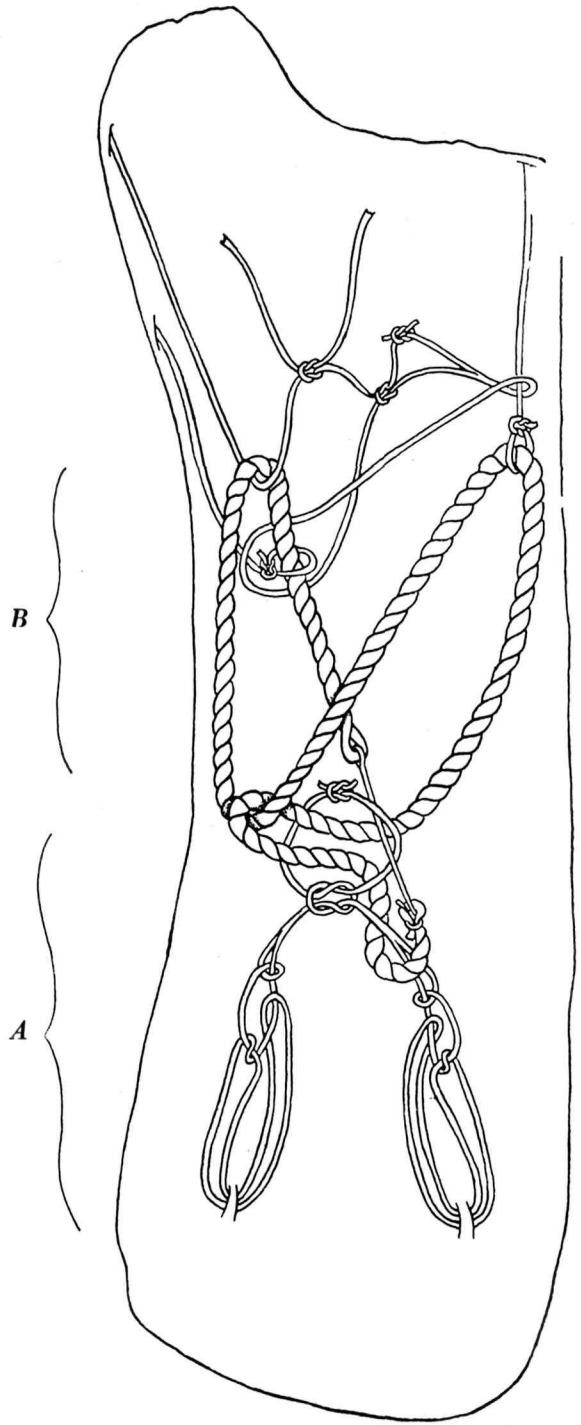


Figure 28. Specimen No. 27, showing toe and heel tie attachment

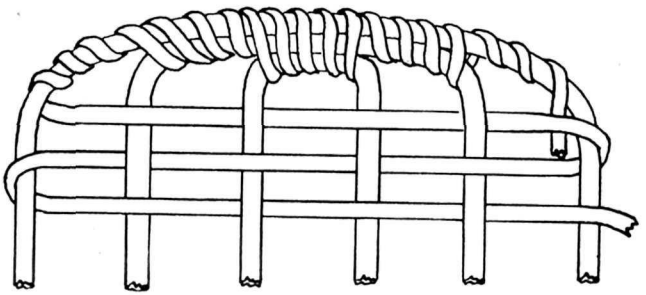


Figure 29. Weave of sandal, No. 27

SKIRTS

(Nos. 23, 24, 26, 40, 41, 49)

There are fragments of six skirts in the series. Four of these (Nos. 23, 26, 40 and 49) are of yucca fiber.[23] The fifth (No. 24) is made of yucca strands woven over cords of *Agave parryi*. The sixth (No. 41) is of cotton.[24]

Two of the skirts are decorated by coloring. The yucca fibers of No. 23 are dyed red-brown with external pigment; the cotton skirt (No. 41) is a reddish-orange color due to the rubbing on of paint.

All four yucca specimens are constructed by the same technique. They have a center pad of two bundles of string. Other strings are woven over and under these bundles, their loose ends twisted into fringes on either side of the pad (see drawing, p. 56; and cf. Haury, p. 62). Haury (p. 63) describes the method of attaching such a skirt with a waist cord. (There were two halves to each skirt, one worn in front, and one in back.) The pad was placed on the stomach . . .

> ". . . beneath (the waist cord) were caught the doubled-under fringes extending from the upper margin of the foundation piece (or pad.) The strings of the lower border hung free." (Haury, Pl. XL.)

The other two skirts (Nos. 24 and 41) have foundation units of three string bundles, over which other strings are woven so as to form a fringe on one side of the pad only. Waist cords for these were probably an extension of the foundation ropes. (See drawing, p. 60.)

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23. Three species of yucca are used:
Yucca baccata—Nos. 26, 49, and part of 24.
Y. mohavensis—No. 23
Y. elata—No. 40
24. See analysis of Specimen No. 23, page 56; No. 24, page 59; No. 41, page 60.

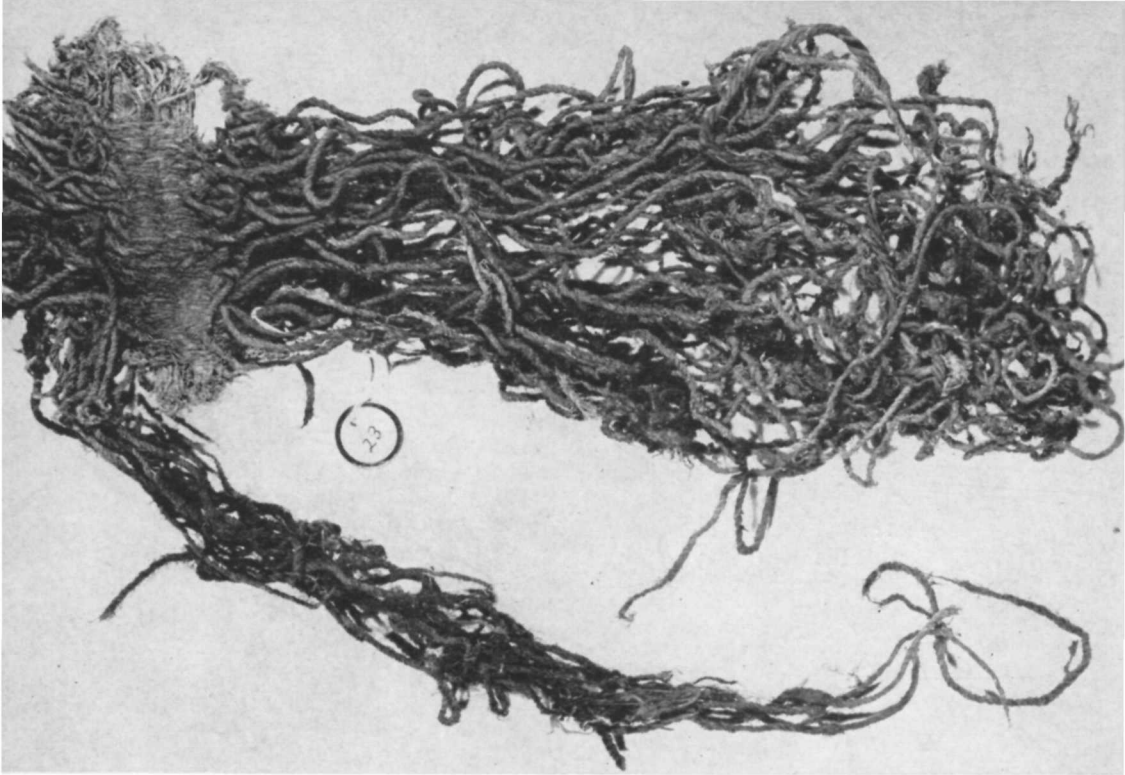


Plate 36. Skirt, double fringe, Specimen No. 23

Specimen 23. Skirt

Maximum length: Two fringes and center strip: 32″; 81.4 cm. Fringe A (heavy): 13½″; 34.3 cm. Fringe B (light): 17″; 43.2 cm. Center woven strip: 1½″; 3.8 cm.

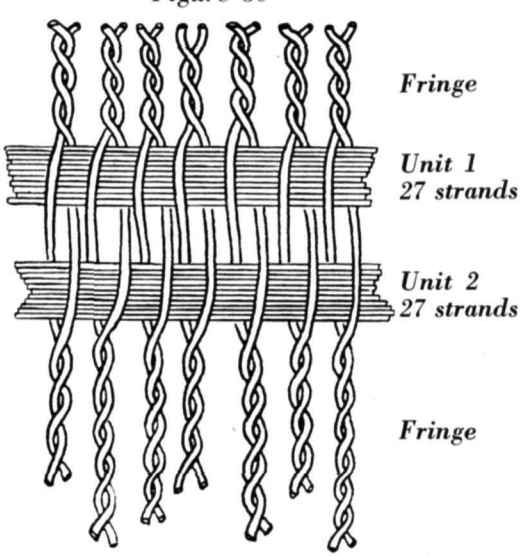
Maximum width: (In this case the length of the woven strip) 5½″; 13.8 cm.

Material: *Yucca mohavensis.* (Jones' analysis and ours show a few cotton fibers.)

Decoration: The yucca fiber strands have been dyed, with external, mineral dye, a red-brown color, M&P 14-A-11. Some of it is black, evidently due to burning.

Weave: Skirt (Cf. Haury, p. 62; Nos. 26, p. 57, 40 and 49, p. 58.) Every strand in the piece is made up of two smaller yucca fiber strings twisted together. Long strands woven over two central units. Each of these center units has 27 strands in it. There are 22 strands per inch woven over them; 10 per cm. These are twisted in pairs to form the fringe. (See illustration.) The fringe elements measure nearly ⅛″; .3 cm., in diameter.

Figure 30



Specimen 26. Skirt (PS No. 6, 9)

Maximum length: 8¼″; 21 cm.
Maximum width: 3″; 7.8 cm. Width of weave: 1½″; 3.8 cm.
Material: *Yucca baccata.* Natural color of the yucca, M&P 13-J-6.

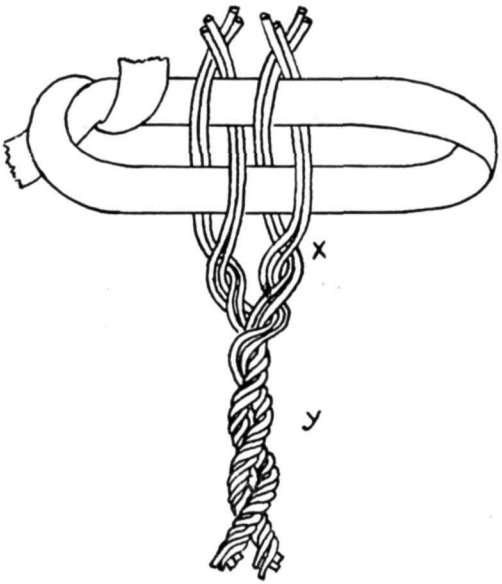
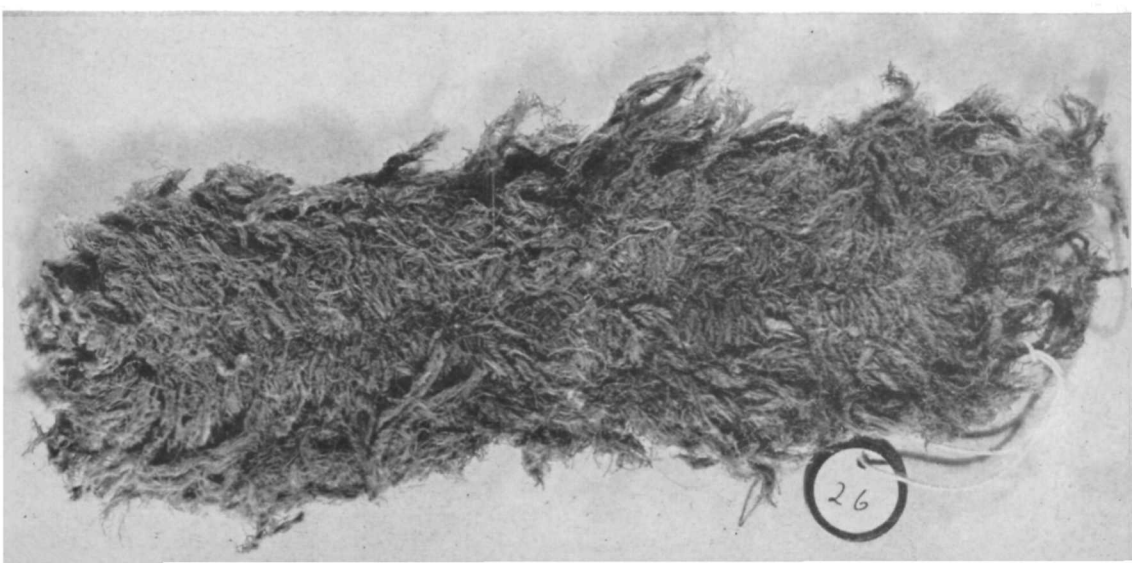


Figure 31, Weave of Specimen 26

Weave: Skirt (Cf. Haury, p. 62; Specimens Nos. 23, p. 56, 40 and 49, p. 58.) The foundation is a loosely twisted bunch of yucca strands (about 27), bent double and tied at one end in a simple twist. Small twisted yucca strings are twined over and under the two units thus formed. These small strings are paired; two pairs are twisted to make the fringe (x, ⅛″ wide strands). Sometimes fringes thus made will be paired off and twisted again (y). There are 44 yucca strings per inch; 22 per cm. The base units are bulky, and the weave elements are crowded close together, usually on top of each other, so that the article is very thick (½″; 1.2 cm.).

Plate 37. Skirt, double fringe, Specimen No. 26



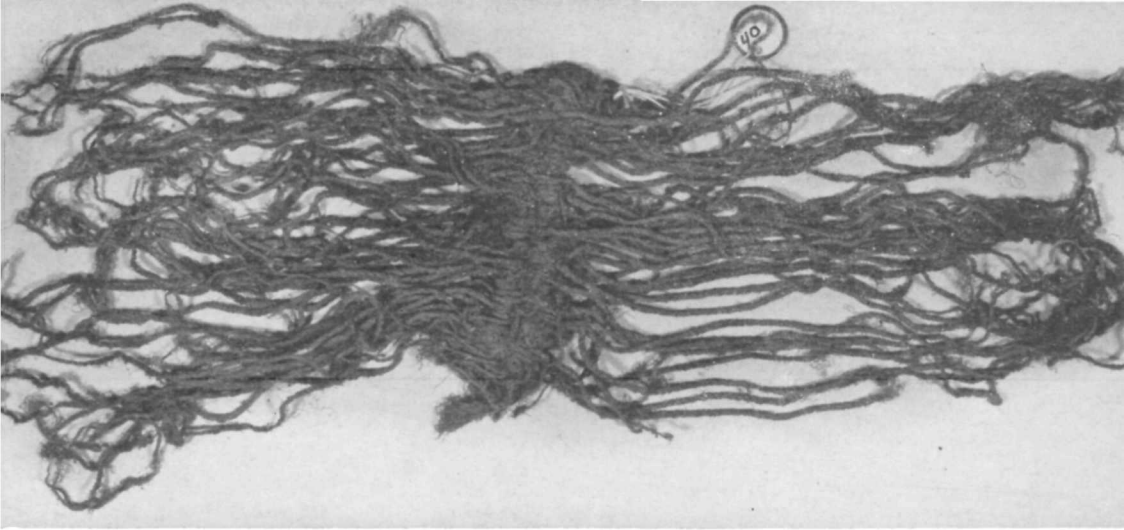


Plate 38. Skirt, double fringe, Specimen No. 40

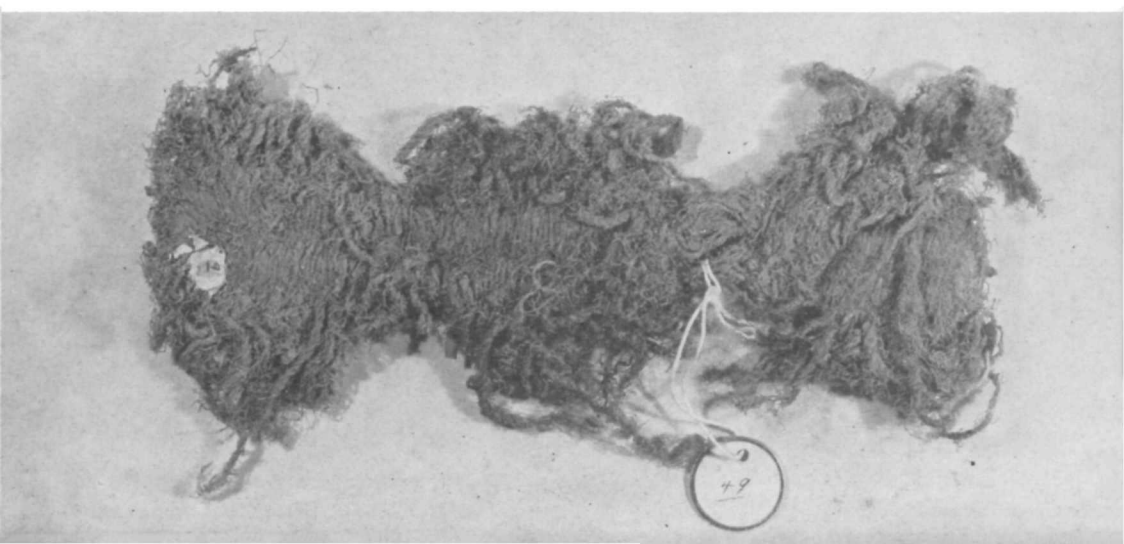
Specimen 40. Skirt

Maximum length: (Two fringes and center section) 19 3/16″; 48.7 cm. Maximum length of fringe: 9½″; 24.1 cm. Width of center section: 1½″; 3.8 cm.
Maximum width: (In this case, length of center section) 5¾″; 14.6 cm.
Material: *Yucca elata.*
Weave: Skirt (Cf. Haury, p. 62; Specimens Nos. 23, p. 56, 26, p. 57, and 49, below.) Yucca strands woven over a rope composed of 22 yucca strings. This rope is doubled and the ends tied in a simple twist, so that it forms two central units. There are 12 strands per inch (6 per cm.) woven over the central units. These strands are treated as pairs, and twisted into four-strand fringes on either side of the central units. (See drawing for Specimen No. 28, p. 45.)

Specimen 49. Skirt. (PS No. 9)

Maximum length: (length of center pad) 8″; 20.4 cm.
Maximum width: (center pad and fringes) 3½″; 8.9 cm. Width without fringe: 1¼″; 3.2 cm.

Plate 39. Skirt, double fringe, Specimen No. 49

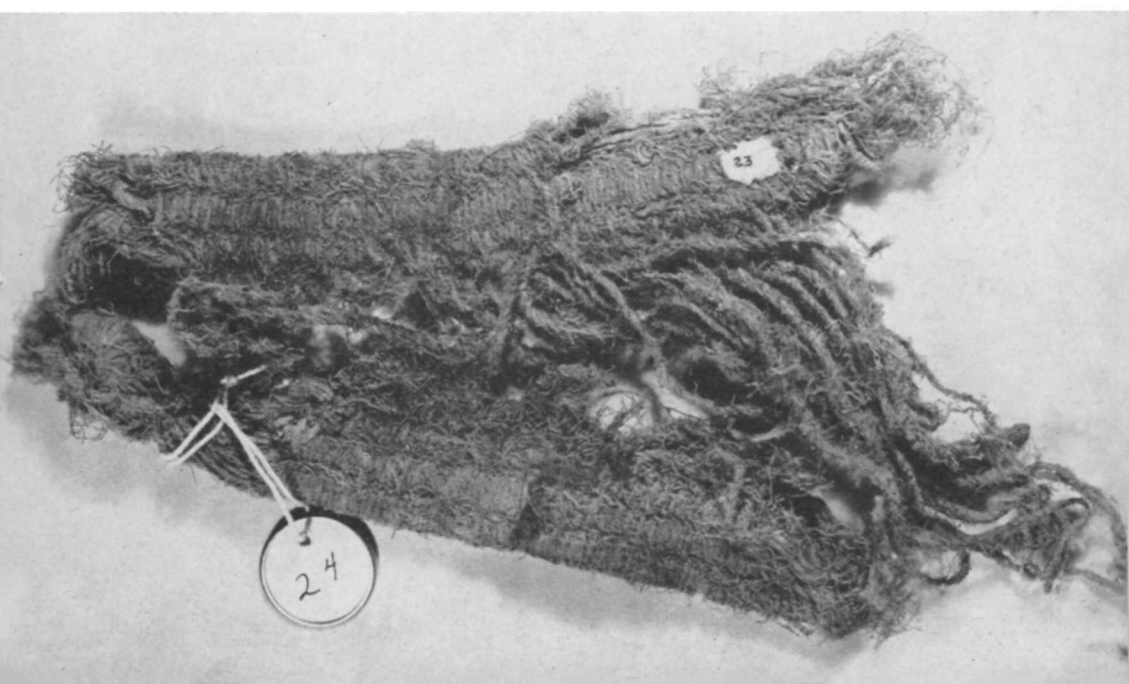


Material: *Yucca baccata.*
Weave: Skirt (Cf. Haury, p. 62; Specimens Nos. 23, p. 56, 26, p. 57, and 40, above). Yucca strands woven over a rope composed of 20 yucca strings, 1/16″ (.2 cm.) wide. This rope is doubled and the ends are tied in a square knot, so that two center units are formed. Pairs of strands are woven over these center units, 10 pairs per inch (5 pairs per cm.). The pairs are twisted together to make four-strand fringe units. (See drawing for Specimen No. 26, p. 57.)

Specimen 24. Skirt. (PS No. 23)

Maximum length: 15″; 38.2 cm. There are two sections, joined together by a square knot. (See photograph.) Length of section a: 6″; 15.2 cm., to edge of knot. Length of section b: 7⅜″; 18.8 cm., to edge of knot. Maximum width: Fringe plus woven section: 7¼″; 19.6 cm. Maximum length of fringe: 6¾″; 17.1 cm. Maximum width of woven section: 1″; 2.5 cm.
Material: *Yucca baccata* strands woven over cords of *Agave parryi.* (Our analysis and Jones' find some cotton and one hair from a small mammal mixed with the yucca. The hair was probably caught in the weave by chance.)
Weave: Skirt (Cf. Haury, p. 62, Pl. 40). The skirts Haury mentions, though in similar technique to the ones in the collection, were made of apocynum fiber.) Composed of small twisted strands of yucca fiber. Strings twined over and under three basic units of agave fiber. Twenty-four of these strings per inch; 12 per cm. Unit 1: 12 strands; unit 2: 12 strands; unit 3: 6 strands. The fringe is composed of four of the over-under strings twisted into strands ⅛″; .3 cm., wide.

Plate 40. Skirt, single fringe, Specimen No. 24



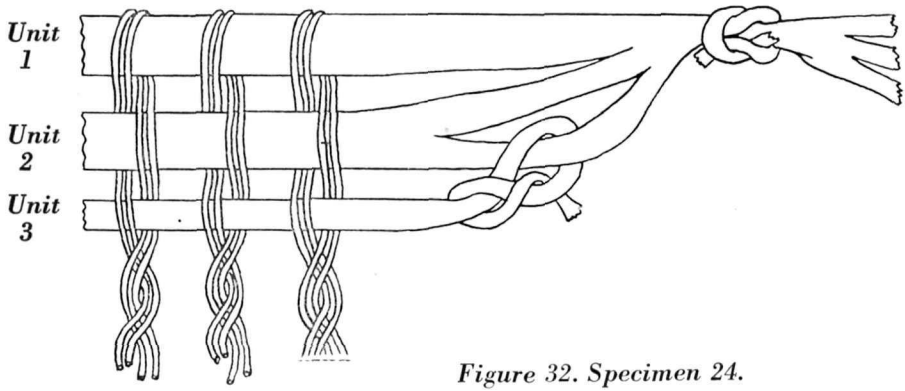


Figure 32. Specimen 24.

Specimen 41. Skirt (PS No. 16)

Maximum length: (fringe and waist band) 9¾″; 24.8 cm. Maximum length of fringe: 9″; 23 cm. Width of waist band: ¾″; 2 cm.
Maximum width: (length of waist band) 9¾″; 24.8 cm.
Material: Cotton. (Jones' analysis and ours note the presence of some yucca fibers.)
Decoration: Color, M&P 13-A-9. Several long twisted strands of the same color and material appear to be sections of the fringe which have broken off, or pieces from an identical skirt. Reddish-orange color is rubbed on.
Weave: Skirt (Cf. Haury, p. 62; specimens Nos. 23, p. 56, 24, p. 59, 26, p. 57, 40 and 49, p. 58.) Waist band composed of: One cord of 14 strands, which is doubled to make the two main units of the waist band (a); One additional cord of two strands (b). Fringe: Two-ply strands twisted over the waist cords, 31 per inch, 14 per cm. (c). These strands are then twisted together to make four-strand fringe units (d). The 14-strand waist cord is fastened to a cord composed of eight tightly-twisted strings. This was probably part of a tie arrangement to fasten the skirt. (See Fig. 33, e.)

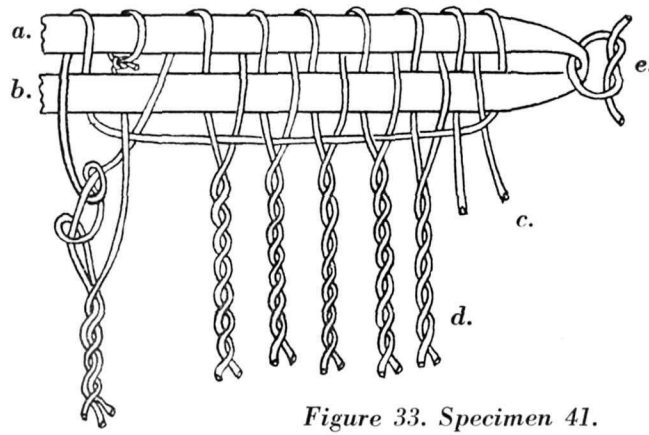


Figure 33. Specimen 41.

CORDS, TIES, BRAIDS, ETC.

(Nos. 47, 48, 57, 60, 63, 64, 59, 20)

The sandal ties have already been described in the section on sandals. All but one of these are of yucca fiber. The exception is one cotton instep cord (No. 27). Six of the sandals have ties of partly-shredded yucca leaves; one has a three-strand yucca fiber braid; one an 11-strand yucca braid.

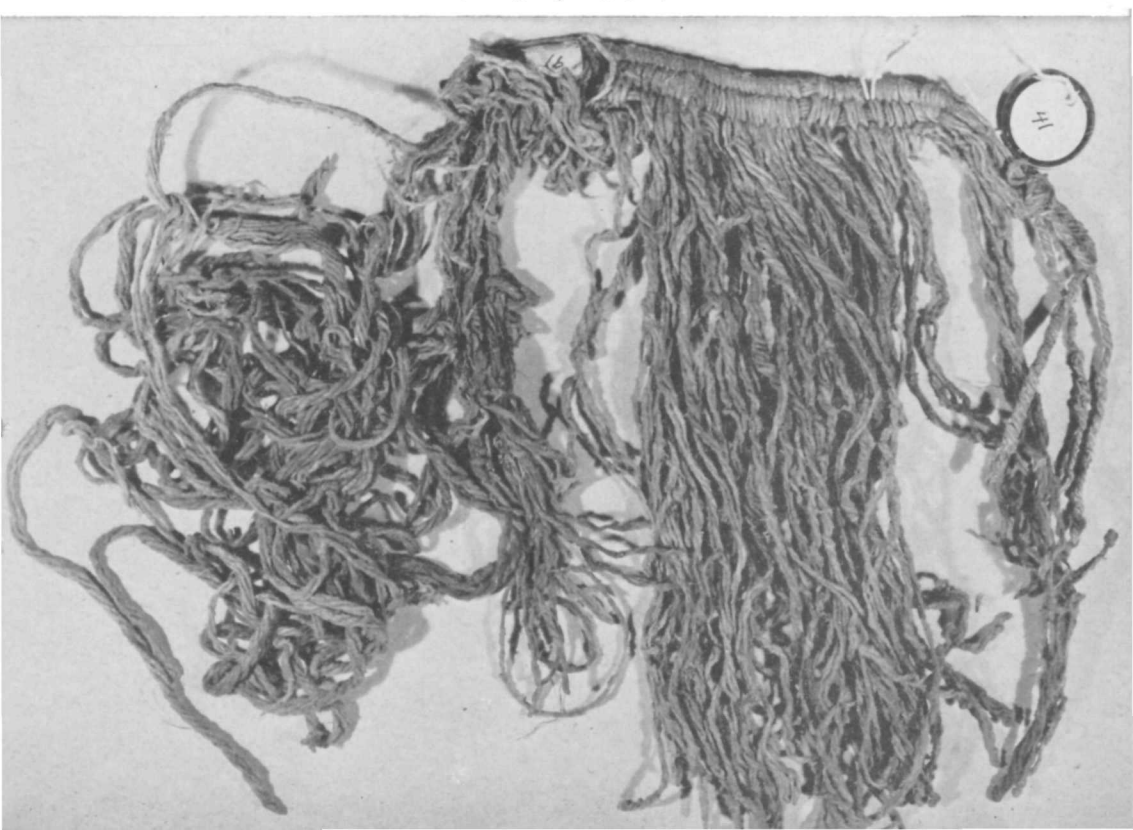
There are eight other specimens which come under the "cords, ties—" classifications. Of these five are of yucca,[25] two of cotton, and one of *Agave parryi*. It is apparent that yucca was the most common material used for the making of cordage and rope. This is even more obvious if we consider the sandal ties and cords in this connection. Cotton was employed in cases where a minimum of strain was to be placed on the tie. Twisting and braiding were common techniques.

No. 20 is a braid of 49 cotton strings. It is probably part of a sash, as the one described by Hough (p. 75). See p. 63.

No. 47 has the appearance of a necklace or hair tie of some sort. It is too fragile and elaborate to have been used as a tie where much

25. **Yucca mohavensis**—Nos. 59, 60.
Y. elata—No. 48
Y. macrocarpa—Nos. 57, 63.

Plate 41. Skirt, single fringe, Specimen No. 41



strain would have been placed on it. It is made of six black (dyed) cotton strands, bound together at 1-inch intervals by white cotton string. There are two ties made in this fashion and fastened together in the center and near each end to make the completed specimen. (See drawing, p. 65.)

No. 59 is a ring of yucca fibers, tied with a square knot. It might well have been a sandal heel strap.

No. 48 is a heavy flat braid of three yucca fiber cords. It is folded and the ends tied in a square knot. One use for such an object is suggested by Kidder and Guernsey (BAEB 65, p. 50) where we see an identical rope figured and described as a loom loop.

No. 57 is composed of two sections of yucca leaves tied at one end in a square knot, and very loosely twisted together.

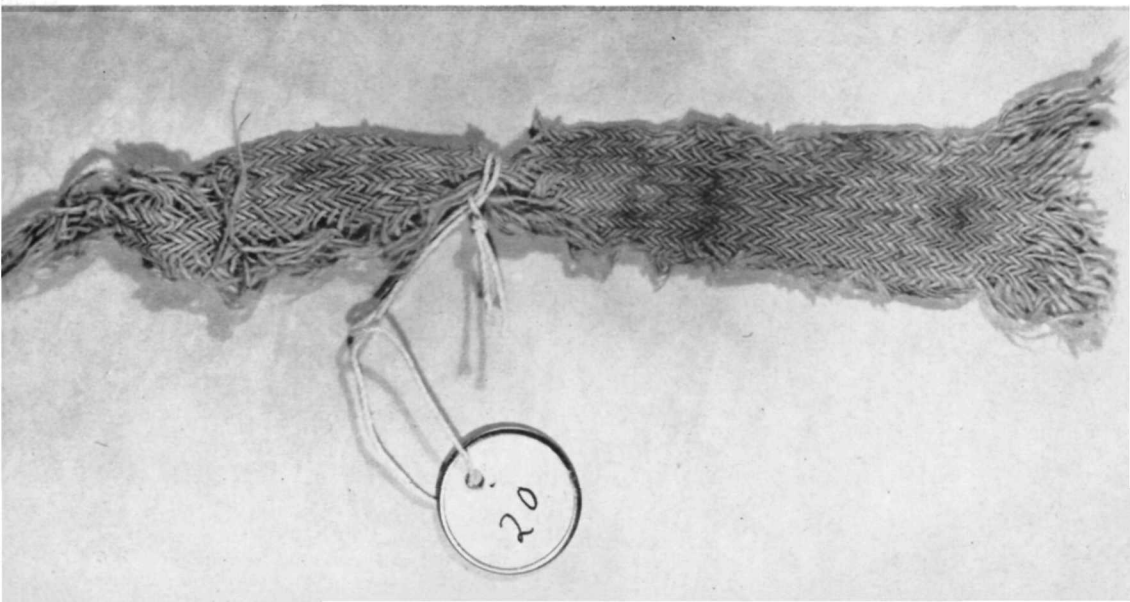
Nos. 63 and 64 are simple two-strand twists, the former of yucca and, the latter of *Agave parryi*. No. 64 has a small piece of cotton attached to it, and suggests a tie used to fasten cotton shirts or shawls in place. (Cf. Haury, pp. 84-85, Fig. 16, b, c; Hough, pp. 68-70, Fig. 147, g.)

No. 60 is a fragment of yucca cord, made by twisting three strands together. (Cf. Haury, pp. 84-85; Hough, pp. 68-70, Fig. 147, b.)

There are no apocynum or feather cords, such as those described by Haury (pp. 83-86) and Hough (pp. 70-71).

Braids and cordage similar to the Montezuma specimens are found in prehistoric collections from many Southwestern sites. Many-strand, flat, white cotton braids like No. 20 are very common. They may have been woven between supports like the modern Hopi wedding sashes, or they may have been fabricated in the manner described in this paper.

Plate 42. Braid, 49-strand, Specimen No. 20



Specimen 20. Braid

Maximum length: 7½″; 19 cm .

Maximum width: 1 1/16″; 2.7 cm.

Average threads per inch in length: 16; 7 per cm.

Average threads per inch in width: 49 in the total width of the piece.

Material: Cotton.

Decoration (see Weave). The cotton is yellow-white in color, M&P 3-A-9. Tinges of yellow in some places. This color seems due to the natural cotton shades, not to dye or rubbed-on paint of any kind.

Weave: A braid of 49 strands. (See illustration; cf. Hough, p. 75).

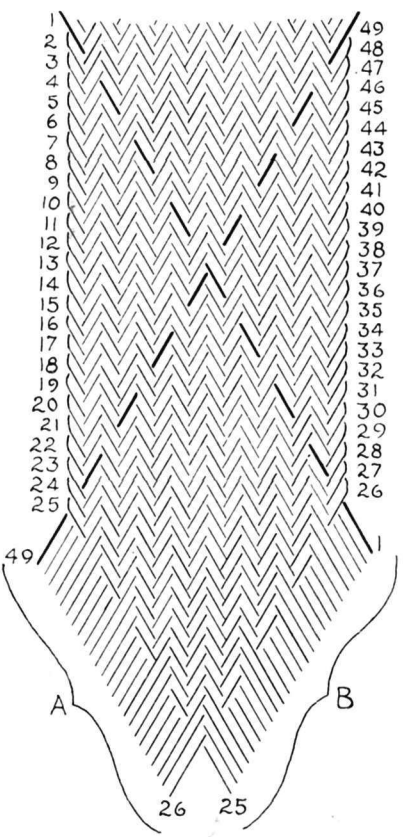
To braid: 1. Separate 49 strands into two groups, with 25 strands in the left hand group, and 24 in the right hand group. Number the strands from left to right. Nos. 1 to 25 inclusive will be left of the center in Group A, and Nos. 26 to 49 inclusive will be to the right of the center in Group B.

2. Pass No. 1 over-three under-three (over 2, 3, 4, under 5, 6, 7, etc.) until it crosses to the right of the center and becomes the inner strand of Group B. Now pass No. 49 over-three under-three (over 48, 47, 46, under 45, 44, 43, etc.) until it crosses to the left of the center and becomes the inner strand of Group A.

3. Nos. 2 through 25 pass left to right in the same manner as No. 1, over-three, under-three, until they have replaced all the strands in Group B. Nos. 26 through 48 pass from right to left as did No. 49, until they have replaced all the strands in Group A. They will then be in the position shown below.

4. The process is repeated, always crossing the extreme left hand strand over-three under-three to the right of the center and the extreme right hand strand over-three under-three to the left of the center.

Figure 34



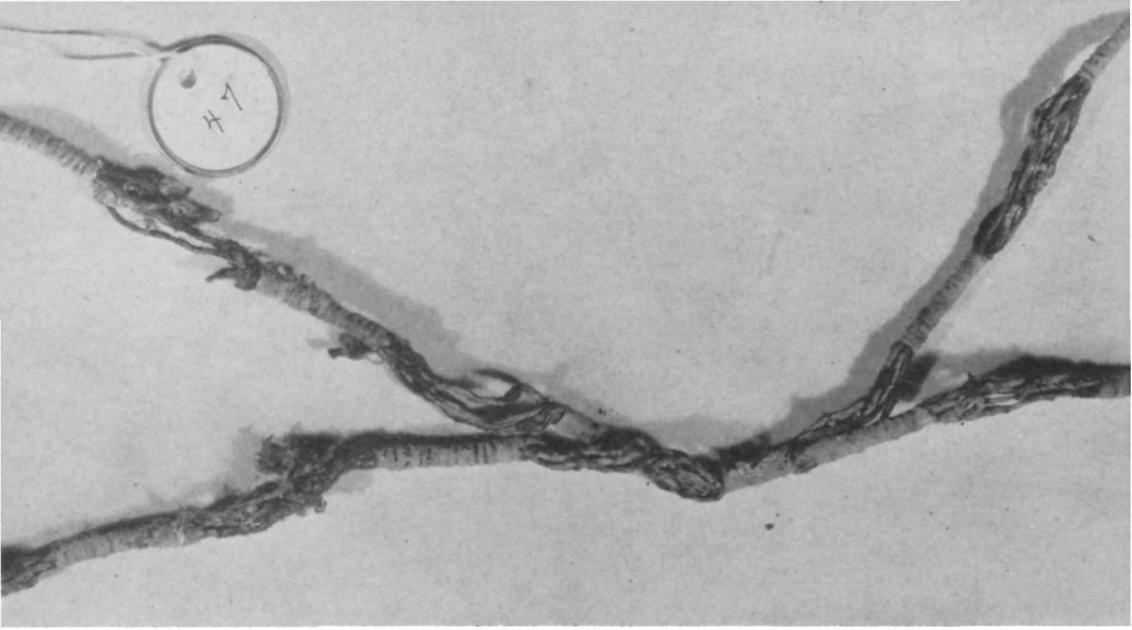
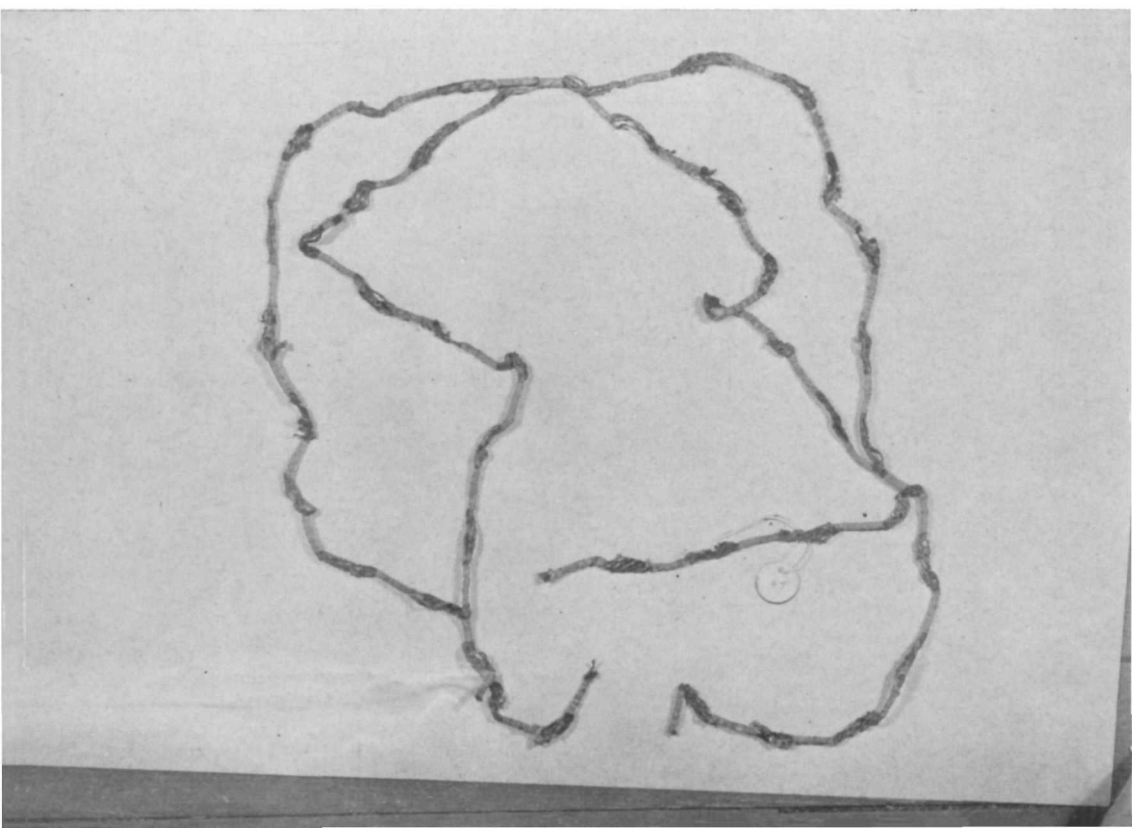


Plate 43. Necklace, Specimen No. 47



Specimen 47. Necklace(?)

Maximum length: 53″; 134.7 cm.
Width of strand in toto: Average ⅛″; .3 cm.
Number of black strands used: six.
Material: Cotton caked with mud. Some strands dyed black.
Description: The six black strands are wrapped with white threads at intervals (average) of 1⅜″ (3.5 cm.). These white threads wrap from 15 to 18 times around the black, covering about 1″ (2.5 cm.). The white threads sometimes appear to be colored brown and orange, but no signs of dyeing or rubbing can be found, so this is evidently the natural color of the material. Two black and white strands were produced in the above manner. These were bound together with white thread wrapping in three places: (1) at center; (2) 13″ (33.1 cm.) from one end; (3) 5″ (12.8 cm.) from the other end. The piece was probably a necklace or ornamental hair tie of some sort, as it is too fragile for use as a belt or tie on which much strain would be placed. Whitford calls it a string for beads.

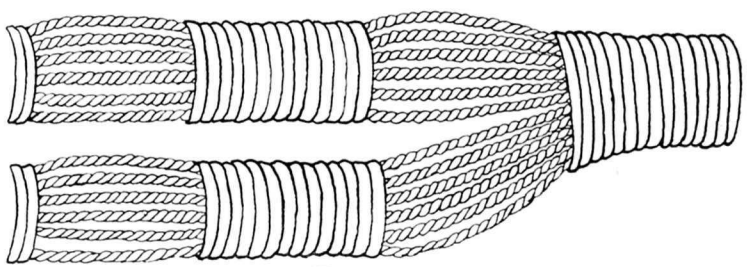
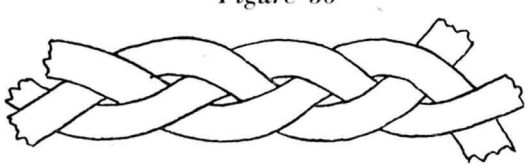


Figure 35

Specimen 48. Rope (PS No. 36)

Maximum length: (unfolded) 37½″; 95.3 cm.
Maximum width: (when laid flat) ½″; 1.2 cm.
Material: *Yucca elata*
Weave: Three-strand flat braid. Each strand averages ¼″ (.7 cm.) in width, and contains about 116 fibers. A small piece is added on near one end of the rope with a square knot. The piece was folded and the two ends tied together, also by a square knot. (Cf. BAEB 65, p. 50; possibly a loom loop.)

Figure 36



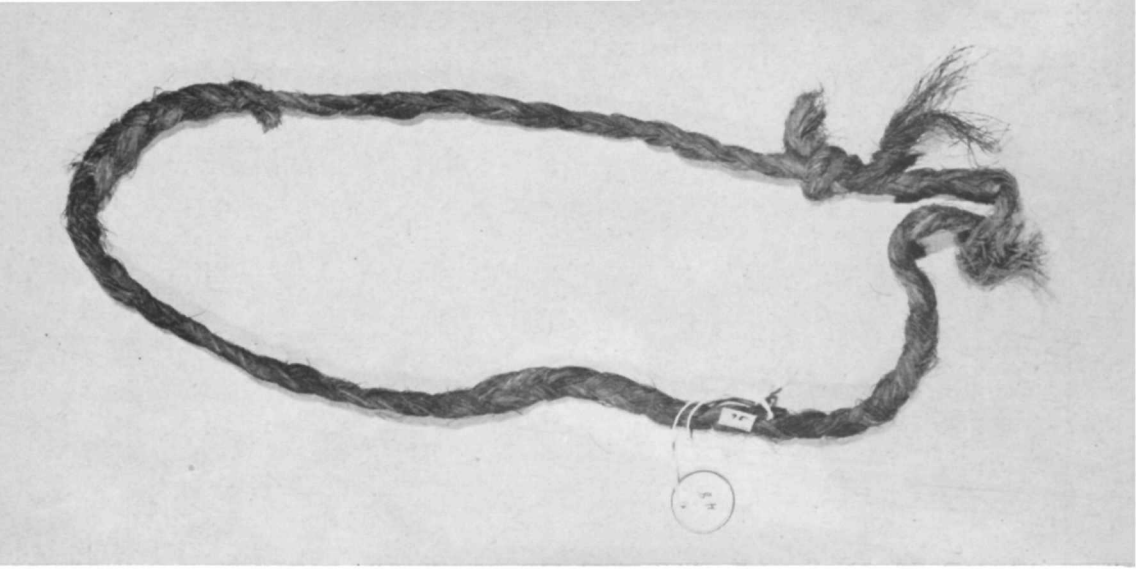
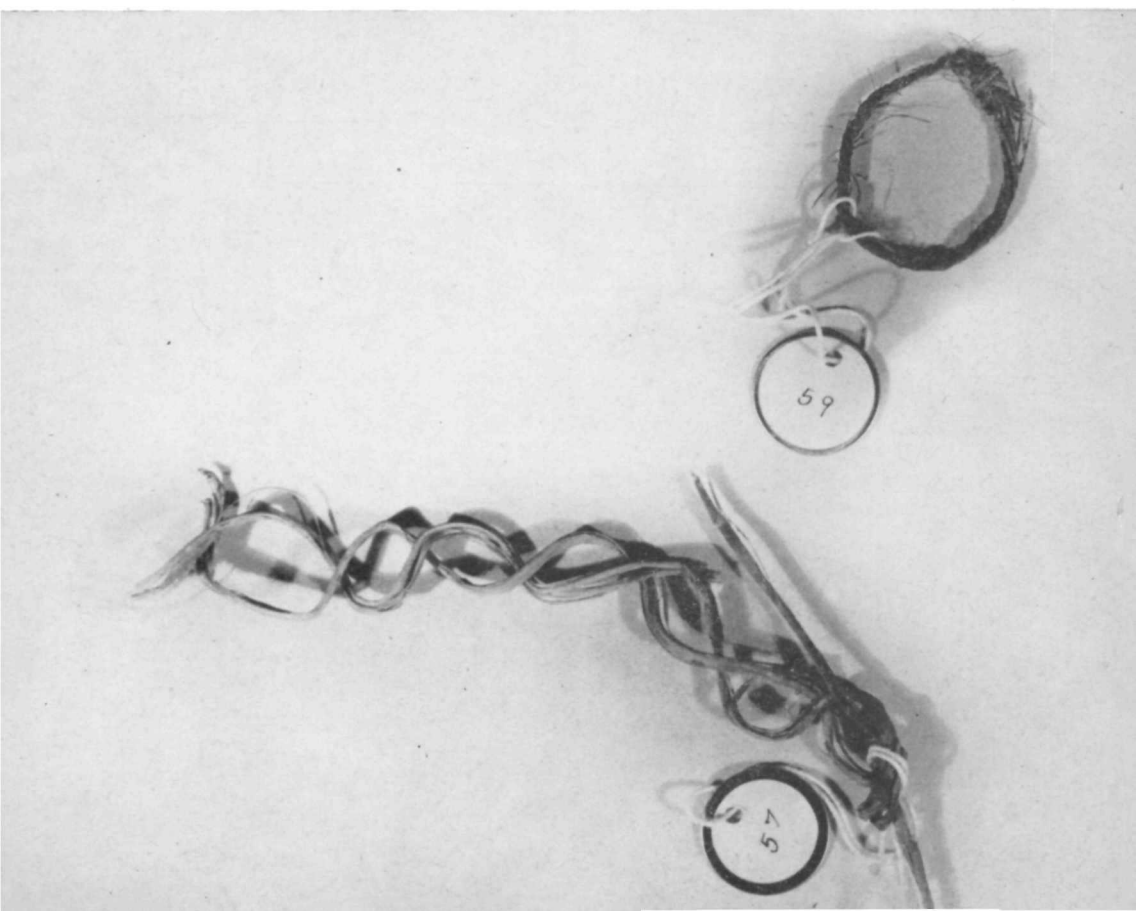


Plate 44. Rope, Specimen No. 48

Plate 45. Braids, ties, Specimens Nos. 57, 59



Specimen 57. Tie

Maximum length: 5½″; 14 cm.
Width of strands used: ⅛″; .3 cm.
Material: *Yucca macrocarpa.*
Description: This is a piece of what must have been a very coarse tie. It is made of two sections of yucca leaves twisted, and tied at one end with a square knot. The twist has been much loosened. (Cf. Hough, pp. 67-70; Haury, pp. 83-88.)

Specimen 59. Ring of yucca

Description: Ring of *Yucca mohavensis* fibers tied with a square knot. The average diameter of the ring is 1¼″; 3.2 cm. The width of the strand is ⅛″; .3 cm. (Cf. Hough, p. 67.)

Specimen 60. Rope (PS No. 13)

Maximum length: 5½″; 14 cm.
Maximum width: 5/16″; .8 cm.
Width of strands used: ⅛″; .3 cm. each. ca. 150 fibers per strand. 6 twists per inch; nearly 3 per cm.
Material: *Yucca mohavensis.*
Weave: Simple, three-strand twist. (Cf. Haury, pp. 84-85; Hough, pp. 68-70, and Fig. 147, b.)

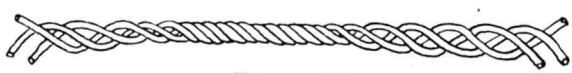
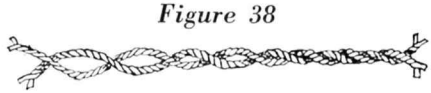


Figure 37

Specimen 63. Twine

Maximum length: 16″; 40.7 cm.
Maximum width: ⅛″; .3 cm.
Material: *Yucca macrocarpa.*
Weave: Two strands twisted together. Each of these is composed of two smaller strings tightly twisted; about 32 fibers in each of the small strings. There are nine twists of the strands per inch; four per cm.

Figure 38



Specimen 64. Twine

Maximum length: (Agave strand) 5½″; 14 cm.
Maximum width: (Agave strand) 1/16″; .2 cm.
Material: Cord, *Agave parryi;* fabric, cotton.
Weave: This is a slender two-ply twisted cord with a piece of cotton cloth knotted to one end. It might have been a tie loop fastened to a cotton shirt or shawl. The cord is doubled and the ends tied in a square knot. To one arm of the square knot a piece of cotton is fastened.
Length of cotton: 2″; 5 cm.
Width of cotton: ½″; 1.3 cm.
Stitch count: 14 threads per inch; 7 per cm.

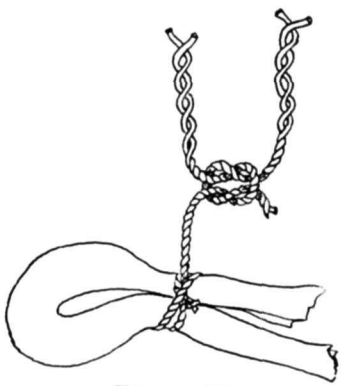
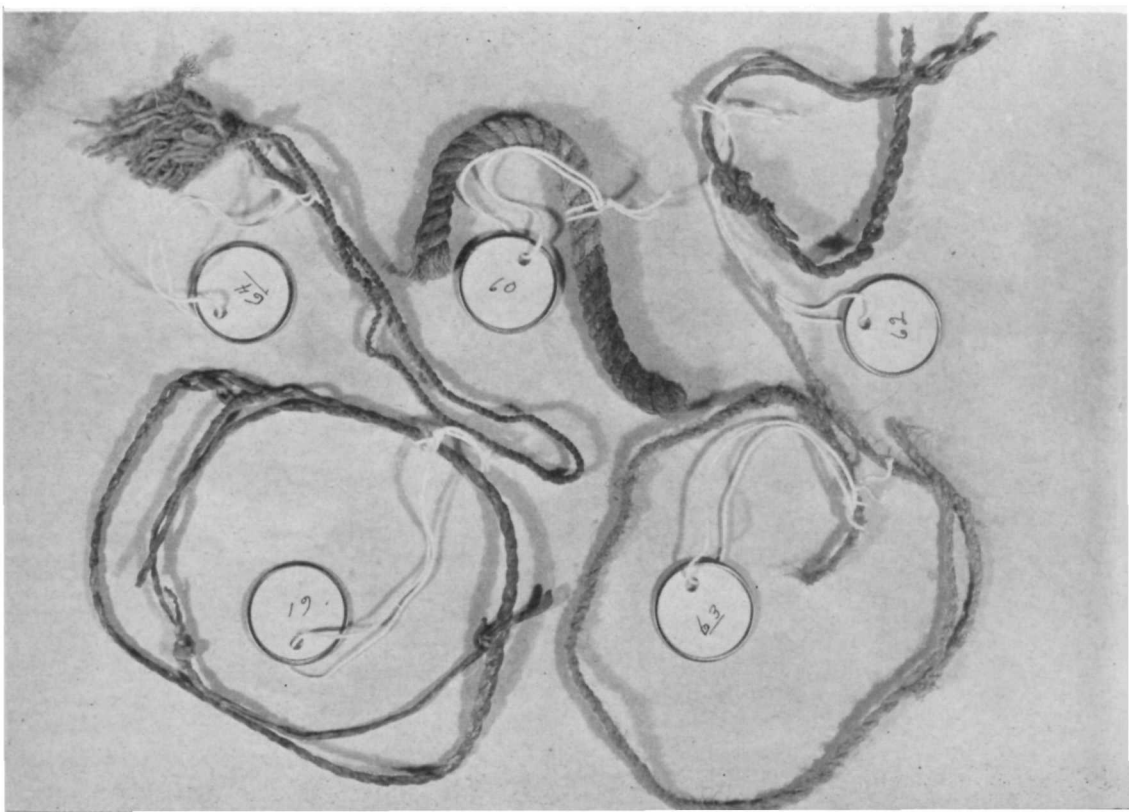


Figure 39

Plate 46. Ties, cords, Specimens Nos. 60, 63, FD



MATTING

(Nos. 42, 43, 44, 58)

There are four small pieces of matting among the specimens. Nos. 42 and 44 are of *Dasylirion wheeleri;* No. 43 is of *Yucca mohavensis;* and No. 58 is of Juniper bark.

The two *Dasylirion* specimens are an over-three, under-three twill, the weaving elements being broad flat twigs. No. 44 shows the warps and wefts doubled on themselves at the edges of the mat, and carried back into the weave. The method of manipulating the weave elements in this piece changes the direction of the chevron produced in twilling, and a simple design results. Similar specimens are described in Haury (pp. 81, 82, Fig. 14).

No. 43 is so battered that it is impossible to say exactly how the twill proceeded. It evidently had a border made by splitting the weave elements in half near the edge of the piece and twilling the halves together. It is similar to Haury's fig. 15 (p. 83), but in such poor condition that no absolute technique can be determined. No. 58 is composed of two tiny fragments of fine checker weave.

Specimen 42. Matting

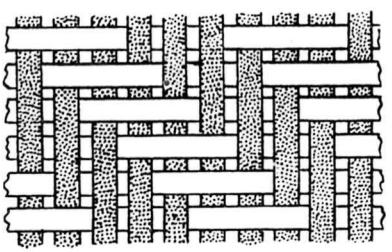


Figure 40

Maximum length: 5¾″; 14.8 cm.
Maximum width: 3¾″; 9.6 cm.
Width of plaits: ⅛″; .3 cm. to 3/16″; .4 cm.
Material: *Dasylirion wheeleri.*
Weave: Mat (Cf. Haury, pp. 81-82, and Pl. LIV; Hough, Pl. 16.) Twilled from flat fibers. See drawing. No border remains.

Specimen 43. Matting (PS No. 6)

Maximum length: 4¼″ 10.8 cm.
Maximum width: 3¼″; 8.3 cm.
Width of plaits: 3/16″; .4 cm. to ¼″; .6 cm.
Width of border: ⅜″; 1 cm.
Material: *Yucca mohavensis.*

Weave: Mat (Cf. Haury, pp. 81-82, and Pl. LIV.) The piece is so fragmentary that reconstruction of the technique, particularly that used for the border, is nearly impossible. The flat fibers were probably woven over-one under-one. As nearly as can be determined, the border was made by splitting some of the fibers in half near the edge of the piece, and twining these halves together. Other weave elements were simply cut off at the border, and not employed in it. (See drawing.)

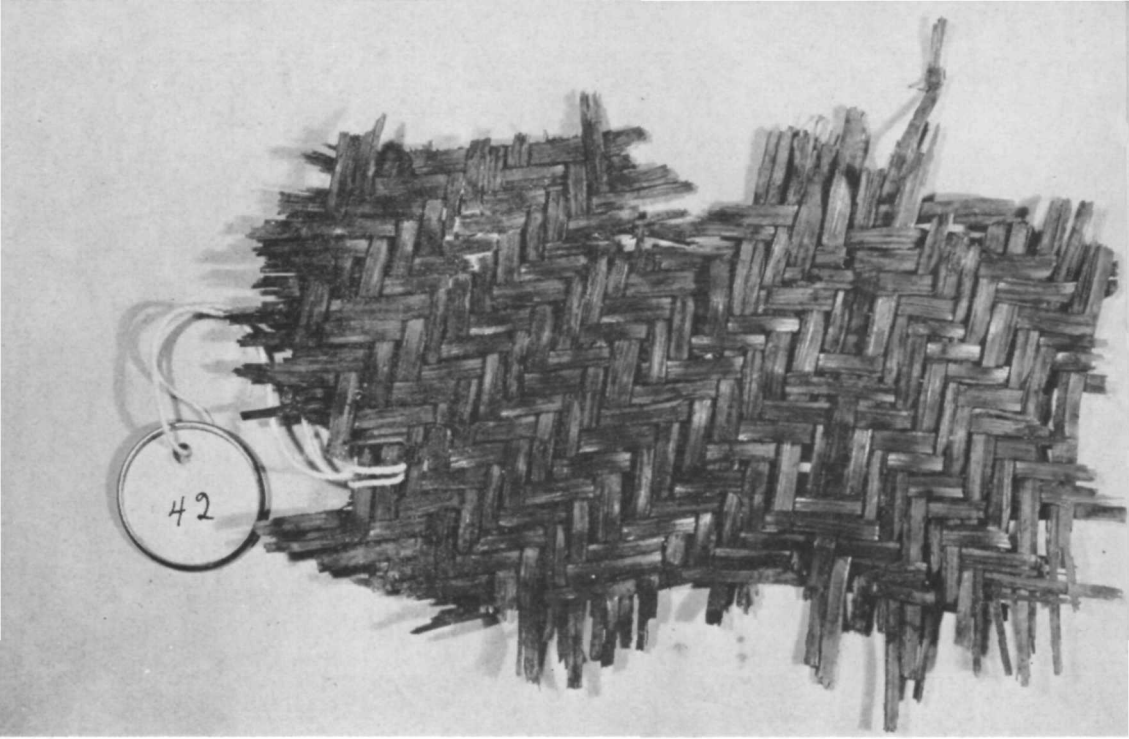
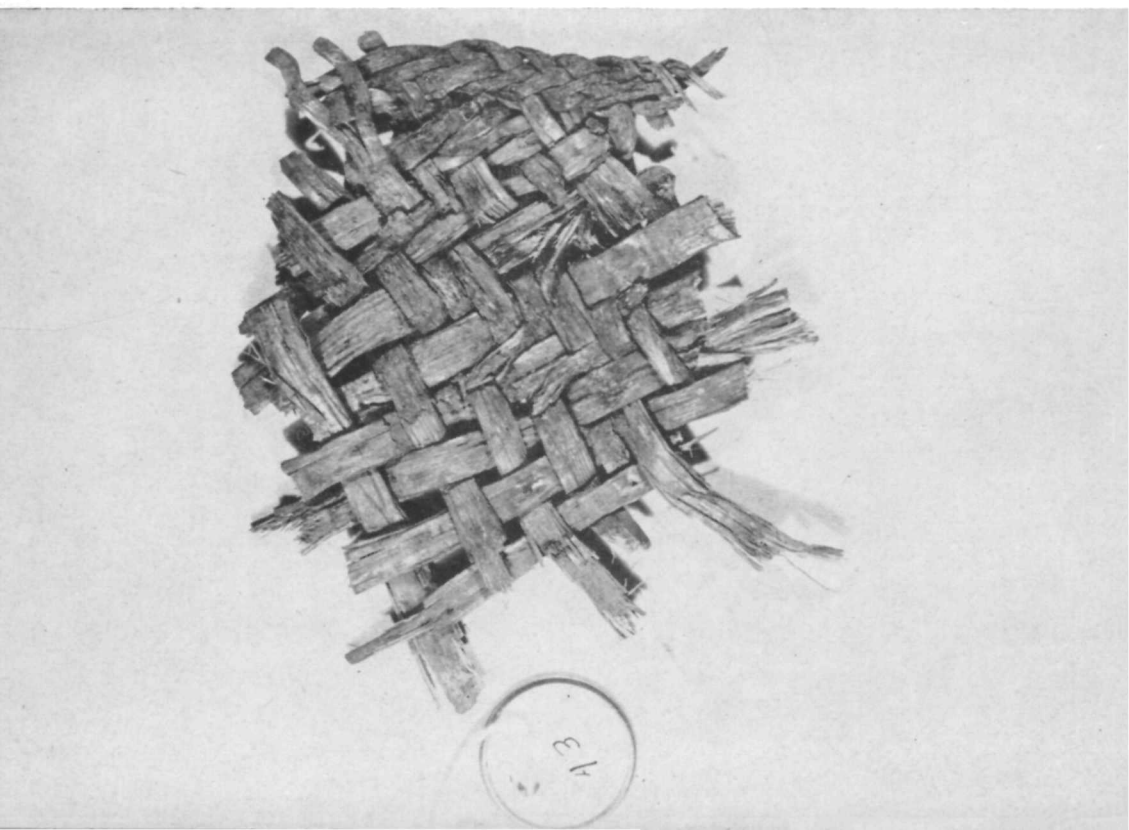


Plate 47. Matting, Specimens Nos. 42, 43



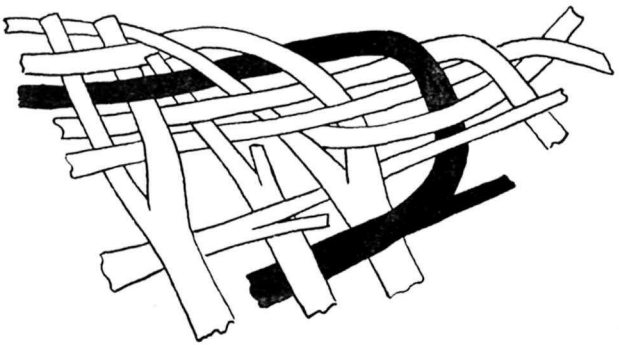


Figure 41, Specimen 43

Specimen 44. Matting

Maximum length: 6⅝″; 17 cm.
Maximum width: 5½″; 14 cm.
Width of plaits: 3/16″; .4 cm. to ¼″; .6 cm.
Material: *Dasylirion wheeleri.*
Weave: Mat (Cf. Haury, pp. 81-82, and Pl. LIV; Hough, Pl. 16.) Over-three under-three twill. The strands are folded so as to produce border A, and are then carried across the piece and folded again to make border B. As the photograph and technical drawing show, the direction of the twilling changes 2″ in from border B, producing a decorative effect.

Specimen 58. Matting (two small pieces)

Dimensions: Larger section: 2¼″ x 1½″; 5.7 cm. x 3.8 cm.
Stitch count: 16 per inch, 8 per cm.
Material: Juniper bark caked with mud. One small area is stained purple. (No explanation. Not listed on Color Chart.)
Weave: Plain checkerwork weave. The fragments are extremely fragile, and there is evidence that this is due to charring. The larger section is doubled (probably folded on itself).

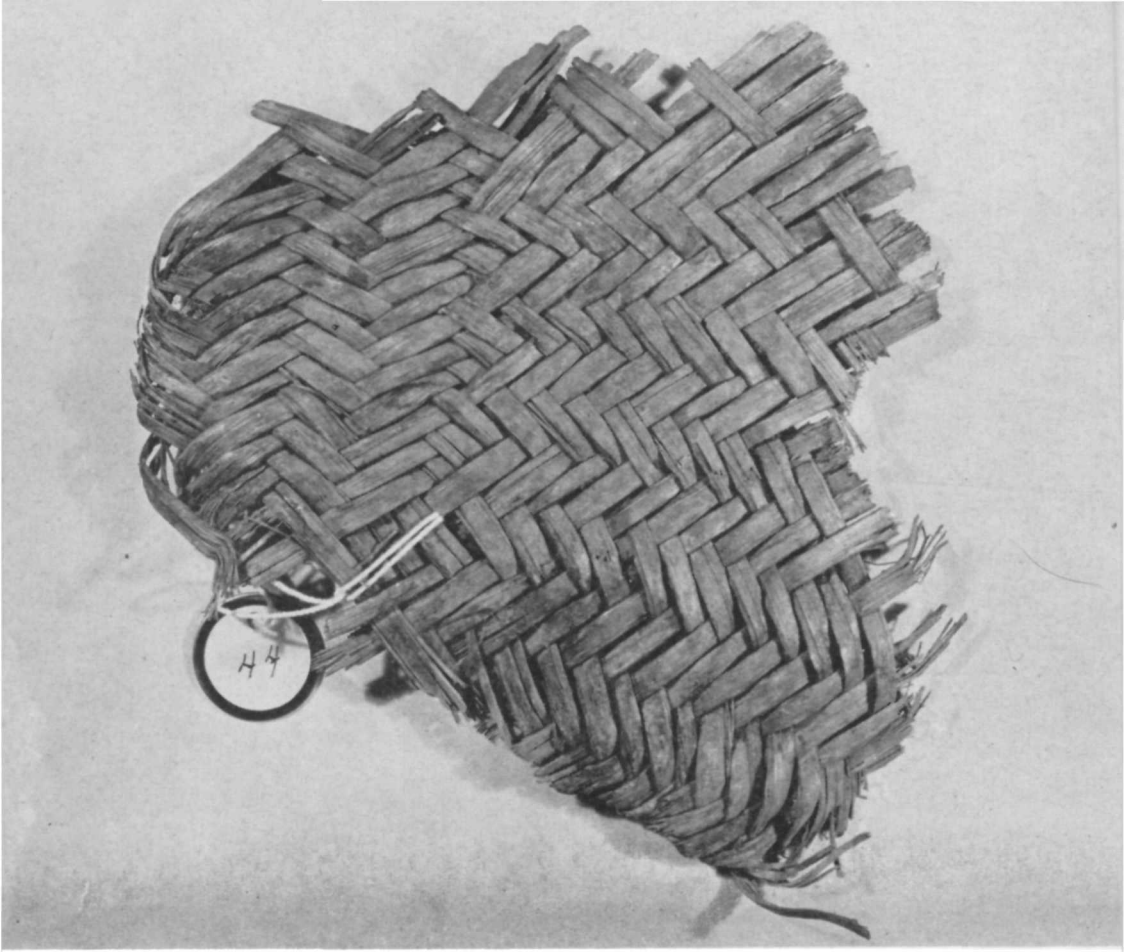
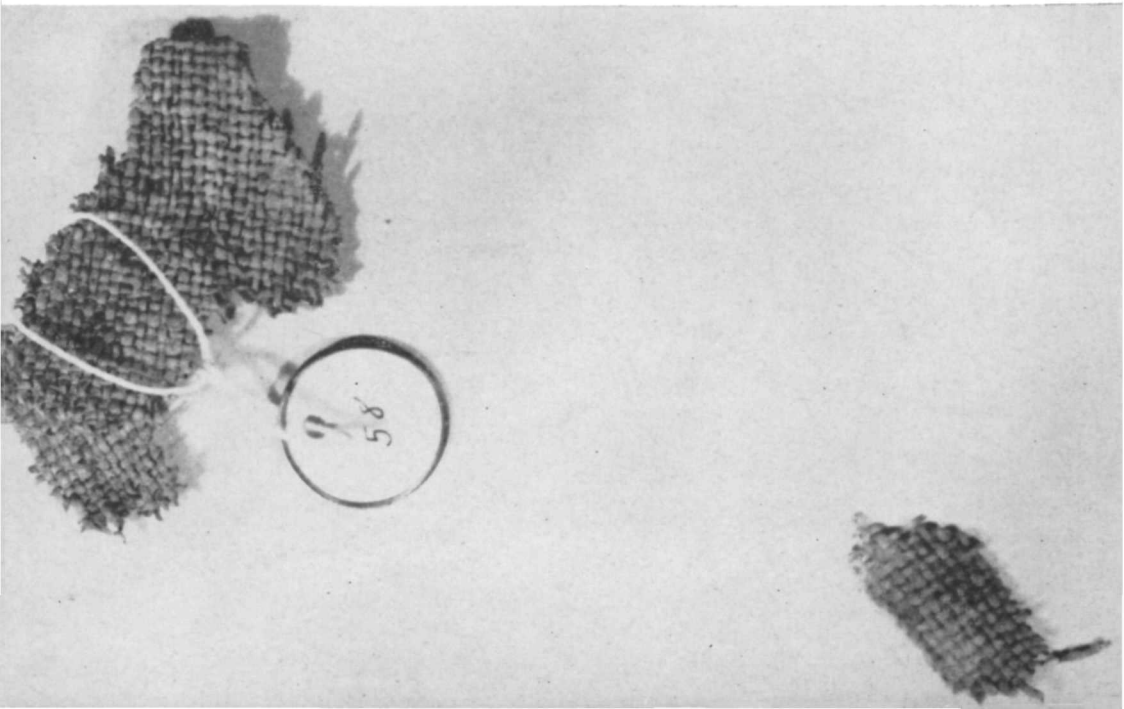


Plate 48. Matting, Specimens Nos. 44, 58



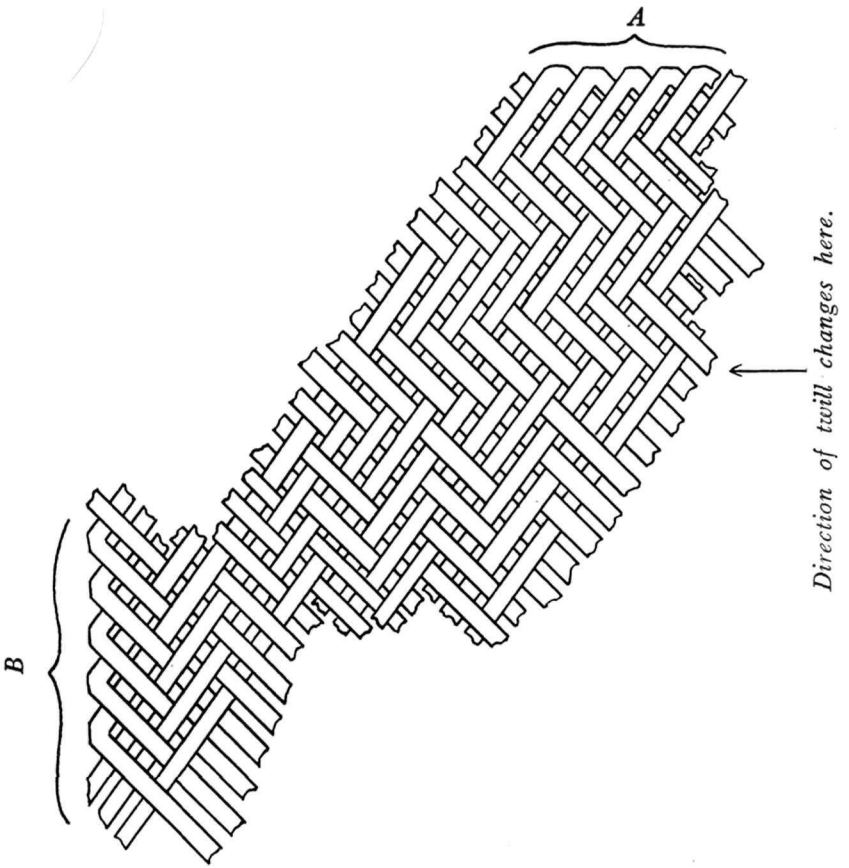


Figure 42

NET

(No. 22)

There is one net (No. 22) made from two-strand cord of *Agave parryi*. The cord has an average width of .04″ (.1 cm.). The meshes are 2″ by 2¼″ (5.1 cm. by 5.7 cm.) rectangles, with a square knot at each corner. Knots which appear at other points in the net, for the purpose of adding more cord, are composed of two square knots drawn tightly together. (See Fig. 43.) The specimen is in two pieces.

Haury (p. 86; p. 84, Fig. 16, f; Pl. LVI) describes a two-ply yucca cord net similar to this one, with smaller meshes and a slightly different knotting technique. BM II and III nets similar to this are mentioned in the literature (PMP VIII, 2, p. 77; Guernsey, p. 79), but these are of apocynum or yucca, and human hair.

Plate 49. Net, Specimen No. 22

Plate 50. Bag, Specimen No. 38

Specimen 22. Net (in two pieces, a and b)

Maximum length: a: 19″, 48.3 cm. b: 11½″; 29.3 cm.
Maximum width: a: 12″; 30.5 cm. b: 9⅜″; 23.8 cm.
Average dimensions of squares: 2″ x 2¼″; 5.1 cm. x 5.7 cm. Range from: 1⅝″x2″ to 2½″x3″; 4.1 cm. x 5.1 cm. to 6.3 cm. x 7.6 cm.
Material: *Agave parryi.* Brown; shades from M&P 6-A-9 to M&P 8-J-1.
Weave: Net (Cf. Haury, pp. 84, 86, 87, Pl. LVI; BAEB 65, p. 113; PMP VIII, 2, p. 77.)

1. The net is composed of strands, each made of two twisted units.

a. Width of strands: Maximum: ⅛″; .3 cm. Minimum: .04″; .1 cm. Average: 1/16″; .2 cm.

b. Number of plies per unit (double for number per strand): Maximum: 26.

Minimum: 20. Average: 23. The very small strands seem to be made by tighter twisting rather than by greatly lessening the number of plies.

2. Knots: a. Knots at the corners of the squares are regular square knots (A). b. Those in other places, used evidently for piecing out strands, are of a different technique, shown in the drawing below (B).

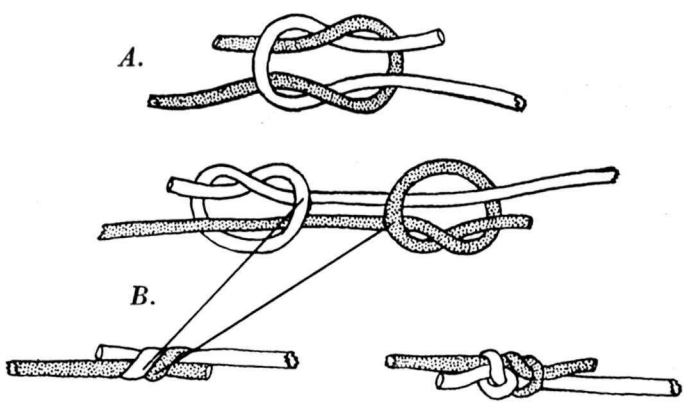


Figure 43. When pulled tight Knot B appears as shown in smaller drawings.

BAG

(No. 38)

Specimen 38 does not fall into the Pueblo III and IV period, as most of the other items do. It is a small fragment of what appears to be a BM II or III twined-woven bag. The weaving technique follows exactly that described in PMP VIII, 2 (pp. 65-74, Pl. 27, Figs. c and d). The wefts are paired, one strand passing over, and one under a warp. To make the next step, the back strand is brought forward, *over* the next warp, and the front passed under it, etc.

The only difference from the BM bags described is that they are made chiefly of apocynum, sometimes with a little yucca fiber added, whereas this fragment is of two-ply twisted yucca cords throughout. A mixture of *Yucca macrocarpa* and *Y. baccata* fibers is used.

In one small section of the fragment one of each weft pair is colored red with an external dye which reacts to the test for iron. Thus each line of weaving is beaded, half red and half gray. This decoration again parallels Guernsey and Kidder's description.

This tiny fragment assumes an important role in the series because it is strikingly different in age from the other specimens examined. Its place in the picture can only be determined by comparison with the non-textile objects of material culture at Montezuma Castle.

Specimen 38. Bag (PS No. 162)

Maximum length: 4¾″; 12.1 cm.
Maximum width: 3½″; 8.9 cm.
Threads per inch in length: 10; 5 per cm. (Course of two-ply twined wefts)
Threads per inch in width: 7; 3 per cm.
Material: *Yucca baccata* and *Y. macrocarpa.*
Decoration: In one small section of the weave some of the wefts are dyed red. The dye reacts to the test for ferric iron. In the two-ply wefts of this section one appears red, the other gray. M&P 13-A-10.
Weave: Appears to be a twined Basketmaker bag. (Cf. PMP VIII, 2, Pl. 27, d.)
Wefts: Each weft is composed of two units of string twisted together. 13 fibers per unit; 26 per strand.
Warps: Same.

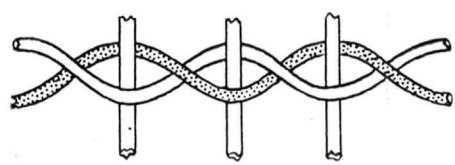


Figure 44

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APPENDICES

Table. 1. COMPARISON OF THREE BOTANICAL ANALYSES

Specimen Number	Whitford's analysis	Brown's and our analysis	Jones' analysis	Page No.
1. Textile, plain weave	Cotton	Cotton. Evidence that piece was colored by rubbing on red paint.	Cotton. Light brown pigment, internal, vegetal(?)	12
2. Textile, plain weave	Cotton	Cotton	Cotton. Deep brown pigment, internal, vegetal(?)	12
3. Textile plain weave	Cotton	Cotton	Cotton. Gray-brown pigment, internal(?)	12
4. Textile, plain weave, rag wefts	Cotton	Cotton	Cotton. Gray-brown pigment, internal(?). Two hairs of small mammal and one of large mammal.	25
5. Textile, plain weave, wefts in pairs	*Yucca elata*	Yucca	Extracted strands of leaf fibers (Yucca?) frayed in places but not finely hackled. A few cotton fibers, one hair of small mammal and other extraneous matter noted.	19
6. Textile, plain weave	Cotton	Cotton	Cotton. Gray-brown pigment, external(?).	14
7. Textile, plain weave	Cotton	Cotton	Cotton. Mostly unpigmented. Some possibly with brownish internal(?) pigment. Mass of brown material, nature indistinguishable, possibly portion of (Yucca?) leaf.	14

Table 1. (Cont.)

Specimen Number	Whitford's analysis	Brown's and our analysis	Jones' analysis	Page No.
8. Textile, plain weave	Cotton	Cotton	Cotton. Gray-brown pigment, external(?).	15
9. Textile, plain weave	Cotton	Cotton. Red-orange dye evidently applied before cotton was woven.	Cotton. Pigmented deep orange-red. Pigment external granular, mineral(?).	15
10. Textile, plain weave	Cotton	Cotton	Cotton. Pigmented light brown, internal(?). Some fibers unpigmented. One hair of small mammal noted.	15
11. Textiles, paired wefts and rag wefts	(11a) Cotton (11b) (11c) *Yucca baccata*	11a. Cotton and possibly 11b. some apocynum in rag wefts. Red threads used in wefts (and sometimes warps) of finely-woven cotton strips seem to have been dyed before using. 11c. Yucca warps and paired wefts.	11a. Cotton. Heavily pigmented, brownish-red, external, granular, mineral(?). Apocynum not noted. 11b. Cotton. Gray pigment, granular, external(?). 11c. Extracted but not finely hackled strands of leaf fibers (Yucca?) These are frayed in places. Two strands have been loosely twisted together in a counter-clockwise direction. Pigmented with brown, external, granular, mineral(?) pigment. One hair of small mammal noted.	22

Table 1. (Cont.)

Specimen Number	Whitford's analysis	Brown's and our analysis	Jones' analysis	Page No.
	(12a) *Yucca baccata*	12a. Yucca warp	12a. Extracted, fairly fine strands of leaf fibers (Yucca?) frayed in places and fairly finely divided. The granular surface material is probably soil rather than intentionally added pigment.	40
12. Textile, slit-tapestry weave	(12b)	12b. Cotton. Yellow wefts evidently dyed before using.	12b. Cotton. Yellow-brown pigment, granular, external(?).	
	(12c) Cotton	12c. Cotton. Black wefts evidently dyed before using.	12c. Cotton. Dark brown pigment, internal(?).	
	(12d)	12d. Cotton, white. One animal hair.	12d. Cotton. Gray pigment, internal(?). Extraneous material including a bit of leaf fibers (Yucca?) and a hair of a small mammal.	
13. Textile, evidences of gauze weave	Cotton	Cotton	Cotton. Lightly pigmented, gray, external(?).	32
14. Textile, plain weave	Cotton	Cotton	Cotton. Some unpigmented, but some fibers with brown, internal(?) pigment.	16

Table 1. (Cont.)

Specimen Number	Whitford's analysis	Brown's and our analysis	Jones' analysis	Page No.
15. Textile, plain weave	Cotton	Cotton	Cotton. Mostly unpigmented, but some fibers with brown, internal(?) pigment.	17
16. Textile, plain with wefts always paired.	*Yucca baccata*	Yucca, apocynum and some cotton	Primarily of extracted leaf fibers (Yucca?) which are more or less in strands but rather finely separated. These may have been pigmented with external, granular brown pigment. There is some admixture of unpigmented cotton fibers. Apocynum not noted.	19
17. Textile, paired wefts and rag wefts	(17a) *Yucca elata*	17a. Yucca warps and paired wefts.	17a. A coarse strand of extracted leaf fibers (Yucca?) frayed at the ends and in places. Possibly external, granular pigment.	23
	(17b) Cotton strips	17b. Cotton rag wefts. Some of fibers in cotton strips are red in color.	17b. Cotton. Mostly unpigmented, some coated with granular, external red-brown pigment.	
18. Textile, weft-float	Cotton	Cotton	18a. Cotton. Very evenly pigmented with black pigment which without doubt is internal, or absorbed by the fibers.	33
		18a. Black dyed cotton.	18b. Cotton. Possibly lightly pigmented with brown internal pigment.	

Table 1. (Cont.)

Specimen Number	Whitford's analysis	Brown's and our analysis	Jones' analysis	Page No.
19. Textile, plain weave	Cotton	Cotton. Evidently dyed before weaving. Red-orange in color.	Cotton. Reddish-brown, granular, external(?) pigmentation.	17
20. 49-strand braid	Cotton	Cotton	Cotton. Mostly unpigmented, but some possibly with brown pigment. No explanation of "pellets" on some fibers is offered.	63
21. Textile, plain weave	Cotton	Cotton	Cotton. Light brown, internal pigment. Some bits of extraneous material.	18
22. Net	*Agave parryi*	Yucca	Does not appear to have structure of fibrous leaf. Seems to be inner bark (bast) of some woody plant. Color may be due to pigment or adhering soil.	73
23. Skirt	*Yucca mohavensis*	Yucca and one cotton fiber. Strands have been dyed to a red brown color. Some is black, evidently due to scorching.	Coarse strands of extracted, not finely divided leaf fibers (Yucca?) which are frayed in places. These are apparently pigmented with brown, external pigment. Extraneous material including one unpigmented and one pigmented cotton fiber.	56

Table 1. (Cont.)

Specimen Number	Whitford's analysis	Brown's and our analysis	Jones' analysis	Page No.
24. Skirt	24a *Agave parryi* (two-ply cord foundation units) 24b *Yucca baccata* (two-ply cord, fringe)	Yucca, cotton and apocynum. (One rodent hair by chance)	24a. Apparently inner bark (bast) of some woody plant. 24b. Extracted, fairly finely separated leaf fibers (Yucca) probably unpigmented, but possibly brown, external pigment. Admixture of cotton fibers both unpigmented and with brown pigment, and one hair of small mammal.	59
25. Sandal	*Yucca macrocarpa*	Yucca	25a. Seems to be inner bark (bast) of some woody plant. 25b. Identical with 25a except with reddish-brown, external pigment and with slight admixture of cotton.	49
26. Skirt	*Yucca baccata*	Yucca	Extracted strands of leaf fibers (Yucca?) frayed in several places.	57
27. Sandal	*Yucca elata*	Yucca	Seems to be inner bark (bast) from some woody plant. There is some extraneous material. The rodent hair was not noted, but there is a small bit of bird down which might easily be confused with a hair.	52

Cont. on next page

Table 1. (Cont.)

Specimen Number	Whitford's analysis	Brown's and our analysis	Jones' analysis	Page No.
27. Sandal *Cont. from last page*	27a. See note at end of chart. 27b. Cotton	27a. Toe tie—yucca 27b. Instep tie—cotton	27a. Seems to be inner bark (bast) of some woody plant. 27b. Cotton with yellowish-brown external(?) pigment. Also a strand of leaf fibers (Yucca?) and a few individual fibers apparently leaf fibers mixed in with the cotton and pigmented as are the cotton fibers.	52
28. Sandal	*Yucca mohavensis*	Yucca	Strands of leaf fibers (Yucca?) which have been extracted from the leaf but have not been cleaned or separated. Other parts of the leaf, including conducting tissue, are still associated.	45
29. Sandal	*Yucca mohavensis*	Yucca	Similar to No. 28.	45
30. Sandal	*Yucca mohavensis*	Yucca	Similar to Nos. 28 and 29.	46
31. Sandal	*Yucca elata*	Yucca	Seems to be inner bark (bast) of some woody plant.	47
32. Sandal	*Yucca elata*	Yucca	Seems to be inner bark (bast) of some woody plant.	48

Table 1. (Cont.)

Specimen Number	Whitford's analysis	Brown's and our analysis	Jones' analysis	Page No.
33. Textile, weft-float	Cotton	Cotton 33b. Black dyed cotton.	33a. Cotton. Unpigmented. 33b. Cotton. Black internal pigment, fairly uniformly and evenly pigmented.	36
34. Textile, weft-wrap	Cotton	Cotton	Cotton. Evenly distributed internal brown pigment.	31
35. Textile, weft-wrap	Cotton	Cotton		27
36. Textile, weft-wrap	Cotton	Cotton	Cotton. Unpigmented or very lightly pigmented.	28
37. Textile, weft-wrap	Cotton	Cotton	Similar to No. 36.	29
38. Twined-woven bag	*Yucca baccata* and *macrocarpa*	38a. Yucca. Gray. 38b. Yucca. Red ferric iron dye.	38a. Extracted leaf fibers (Yucca?) well-cleaned and fairly finely separated. Also cotton fibers and other extraneous material. 38b. Identical with 38a except the fibers are pigmented with granular, red external pigment.	75

Table 1. (Cont.)

Specimen Number	Whitford's analysis	Brown's and our analysis	Jones' analysis	Page No.
39. Textile, wefts always paired	*Yucca baccata*	39a. Warp yucca 39b. Weft yucca	39a. Extracted leaf fibers (Yucca?) moderately finely separated. Some conducting tissue. Pigmented with brownish, granular external pigment. 39b. Identical with 39a except more finely separated and no conducting tissue noted.	21
40. Skirt	*Yucca elata*	Yucca	Extracted, cleaned and rather finely separated leaf fibers (Yucca?) which seem to be unpigmented.	58
41. Skirt	Cotton	Cotton. Red rubbed on.	Predominantly cotton pigmented with brown internal(?) pigment. Also some extracted leaf fibers (Yucca?) moderately finely divided, external(?) pigment.	60
42. Mat	See note at end of chart.	Unknown	Portion of fibrous leaf (Yucca?) showing fibers, conducting tissue and other tissue (parenchyma?). Extracted but not cleaned and divided.	69
43. Mat	*Yucca mohavensis*	Unknown	Similar to Nos. 42 and 44, but in smaller bits. Extraneous material including a hair of small mammal and cotton fibers.	69

Table 1. (Cont.)

Specimen Number	Whitford's analysis	Brown's and our analysis	Jones' analysis	Page No.
44. Mat	*Dasylirion wheeleri*	Unknown	Similar to No. 42.	71
45. Sandal	45-a. Sandal of *Agave parryi* 45b. Heel tie of *Yucca baccata*	Yucca	45a. Seems to be inner bark (bast) of some woody plant. 45b. Extracted leaf fibers (Yucca?) cleaned and fairly finely separated.	51
46. Textile, wefts always paired	*Yucca baccata*	Yucca	Same as No. 45b.	21
47. Necklace	Cotton	Cotton. Some dyed black		65
48. 3-strand rope	*Yucca elata*	Yucca	Seems to be inner bark (bast) of some woody plant.	65
49. Skirt	*Yucca baccata*	Yucca	Extracted, cleaned and fairly finely separated leaf fibers (Yucca?). Possibly with small amount of brown external pigment.	58
50. Sandal	*Yucca baccata*	Yucca	Appears to be inner bark (bast) of some woody plant but is not separated sufficiently to examine the individual fibers.	48
51. Sandal	*Yucca mohavensis*	Yucca		49

Table 1. (Cont.)

Specimen Number	Whitford's analysis	Brown's and our analysis	Jones' analysis	Page No.
53. Textile, paired wefts and rag wefts	53a. *Yucca baccata* 53b. Cotton	53a. Yucca warps and paired wefts. 53b. Cotton strips. Red color rubbed on.	53a. Extracted leaf fibers (Yucca?) cleaned and rather finely separated. Apparently with brown, granular, external pigment. Cotton with brown, internal pigment.	23
54. Textile, rag wefts	Cotton	Cotton	Cotton with brown, internal pigment.	26
55. Textile, plain weave	Cotton	Cotton	Cotton. Unpigmented(?).	18
56. Textile, diamond twill	Cotton	56a. Cotton, white. 56b. Cotton, red, ferric iron dye. 56c. Cotton, black dyed	56a. Cotton with faint brown internal pigment. 56b. Cotton. Red pigment, internal(?). 56c. Cotton with black internal pigment.	37
57. 2-strand cord	*Yucca macrocarpa*	Yucca	Portion of fibrous leaf (Yucca?) showing filament of fibrous tissue with other associated tissues.	67
58. Mat	Juniper bark	Juniper bark	Shows structure of bark and compares well with a prepared slide of bark of cedar *(Juniperus sp.)*	71

Table 1. (Cont.)

Specimen Number	Whitford's analysis	Brown's and our analysis	Jones' analysis	Page No.
59. Fiber ring	See note at end of chart.	Yucca	Seems to be inner bark (bast) of some woody plant.	67
60. 3-strand cord	*Yucca mohavensis*	Yucca	Apparently same as No. 59.	67
63. 2-strand cord	*Yucca macrocarpa*	Yucca fiber	Extracted and cleaned filaments of leaf fibers (Yucca?) which are frayed in places.	67
64. 2-strand cord	64a. Cord, *Agave parryi* 64b. Fob, cotton	64a. Yucca fiber cord 64b. Cotton fob	64a. Seems to be inner bark (bast) of some woody plant. 64b. Cotton pigmented with internal brown pigment.	68

NOTE: In three cases Whitford has given no analysis. In these cases results were reached as follows:

Jones says 27a and 27 are the same. This would make No. 27a *Yucca elata.*

Jones says 42 and 44 are the same. This would make No. 42 *Dasylirion wheeleri.*

Jones says 59 and 60 are the same. This would make No. 59 *Yucca mohavensis.*

Table II. MATERIALS, WEAVES, COLORS

Material (After Whitford)	Number of specimens	Weave, if textile	Color	
			Dye	Rubbed color
Cotton	23 textiles	13 plain weave	2 red	1 red
		2 rag wefts		
		2 weft-floats	black wefts	
		1 diamond twill	red and black wefts	
		4 weft-wrap, 2 with gauze weave		
		1 gauze weave		
	1 necklace		black	
	1 braid			
	1 skirt			red-orange
	(1 sandal instep cord)			
Yucca	9 sandals and ties 1 sandal tie			
	5 cords and ties			
	4 skirts		1 red-brown	
	4 textiles	paired wefts		
	1 mat			
	1 bag	twined woven	some wefts of red	
Yucca and cotton (fibers not twisted together)	4 textiles	3 yucca warps and paired wefts; cotton in rag wefts	1 red on cotton	2 red on cotton
		1 slit weave, yucca warps, cotton wefts	black and yellow wefts, cotton	
Agave parryi	1 cord			
	1 net			
	1 sandal			
Yucca and *Agave parryi* (fibers not twisted together)	1 skirt	Yucca strands woven over *Agave parryi* foundation		
Dasylirion wheeleri	2 mats			
Juniper bark	1 mat			

Table III. COLORS

Specimen Number	Material	Color	Rubbed on	Dyed	External, inorganic, mineral	Internal organic, vegetal
1. Textile, plain weave	Cotton	Red	x		x	
9. Textile, plain weave	Cotton	Red		x	x	
11. Textile, rag wefts	Cotton wefts	Red		x	x	
	Yucca warps					
12. Textile, slit-tapestry	Cotton wefts	Black		x		x
		Yellow		x	x	
	Yucca warps					
17. Textile, rag wefts	Cotton wefts	Red		x	x	
	Yucca warps					
18. Textile, weft-float	Cotton	Black wefts		x		x
19. Textile, plain weave	Cotton	Red		x	x	
23. Skirt	Yucca	Red		x	x	
33. Textile, weft-float	Cotton	Black wefts		x		x
38. Twined Bag	Yucca	Red wefts		x	x	
41. Skirt	Cotton	Red	x		x	
47. Necklace	Cotton	Black		x		x
53. Textile, rag wefts	Cotton wefts	Red	x		x	
	Yucca warps					
56. Textile, diamond twill	Cotton	Red wefts		x	x	
		Black wefts		x		x

Table IV. TEXTILES

Spec. No.	Material	Weave	Color	Border	Comparative Literature
1	Cotton	Plain	Red rubbed on		Haury, pp. 89-91
2	Cotton	Plain			Haury, pp. 89-91
3	Cotton	Plain			Haury, pp. 89-91
6	Cotton	Plain			Haury, pp. 89-91
7	Cotton	Plain		Two border units, each of three twisted cotton strands twined down edge of piece.	Hough, p. 72, Fig. 160
8	Cotton	Plain		¼″ of edge of weave rolled up and bound with cotton string.	BAEB 65, p. 116
9	Cotton	Plain	External, granular, mineral orange dye		Haury, pp. 89-91
10	Cotton (Jones notes 1 hair from small mammal.)	Plain			Haury, pp. 89-91
14	Cotton	Plain		Four cotton strings twisted down edge of piece.	Haury, p. 84, Fig. 16e

Table IV. (Cont.) TEXTILES

Spec. No.	Material	Weave	Color	Border	Comparative Literature
15	Cotton	Plain			
19	Cotton	Plain	Red-orange dye, granular, mineral, external		
21	Cotton (possibly also some extraneous material)	Plain		Four cotton strings twisted over last two warp(?) strands of weave.	BAEB 65, p. 116
55	Cotton	Plain			
4	Cotton. (Jones notes two small hairs of a small mammal and one of large mammal	Plain, weft elements of woven strips or twisted cotton threads.	(Some evidence of yellow rubbed on)	Fine twisted cotton strings over which wefts are looped.	Haury, p. 102 Hough, p. 82
54	Cotton	Plain, weft elements of woven strips or twisted cotton threads.			
17	*Yucca elata* in warps and paired wefts; cotton in rag wefts.	Plain, paired strands and cotton bundles or woven strips as wefts	Red dye on cotton rag wefts, external granular, mineral.		Haury, pp. 101-102 Hough, p. 82

Table IV. (Cont.) TEXTILES

Spec. No.	Material	Weave	Color	Border	Comparative Literature
53	*Yucca baccata* in warps and paired wefts; cotton in rag wefts.	Plain, paired strands and cotton bundles or woven strips as wefts.	Red rubbed on cotton rag wefts		Haury, pp. 101-102 Hough, p. 82
11	*Yucca baccata* in warps and paired wefts; cotton in rag wefts. (Jones notes one hair of small mammal)	Plain, paired strands and cotton bundles or woven strips as wefts.	Wefts of cotton strips dyed red, granular, mineral, external pigment		Haury, pp. 101-102 Hough, p. 82
5	*Yucca elata* (Possibly some cotton fibers, one hair of small mammal and other extraneous material).	Plain with wefts always paired			Haury, pp. 101-102 Hough, p. 82
39	*Yucca baccata*	Plain with wefts always paired.			Haury, pp. 101-102 Hough, p. 82
46	*Yucca baccata*	Plain with wefts always paired.			Haury, pp. 101-102 Hough, p. 82
16	*Yucca baccata* (Jones and our analyses note some cotton fiber).	Plain with wefts always paired.			Haury, pp. 101-102 Hough, p. 82

Table IV. (Cont.) TEXTILES

34	Cotton	Weft-wrap openwork			Haury, p. 92 Hough, pp. 78-79
35	Cotton	Weft-wrap openwork			Haury, p. 92 Hough, pp. 78-79
36	Cotton	Weft-wrap openwork and some gauze weave.			Haury, pp. 92, 95-96 Hough, pp. 78-79
37	Cotton	Weft-wrap openwork and some gauze weave.			Haury, pp. 92, 95-96 Hough, pp. 78-79
13	Cotton	Evidences of gauze weave.			Haury, pp. 95-96 Hough, p. 79
18	Cotton	Weft-float paired wefts.	Warps white, wefts dyed black with internal, vegetal dye	Two border units, each of three twisted cotton strands, twined down edge of piece.	
33	Cotton	Weft-float single wefts.	Warps white, wefts dyed black with internal, vegetal dye.	Two border units, each of three twisted cotton strands, twined down edge of piece.	

Table IV. (Cont.) TEXTILES

Spec. No.	Material	Weave	Color	Border	Comparative Literature
12	*Yucca baccata* warp, black and yellow wefts cotton, white weft cotton (Jones' and our analyses note extraneous material: one hair of small mammal, etc.)	Slit-tapestry weave	Black and yellow dyed wefts; black internal, vegetal; yellow external, mineral, granular.		Hough, p. 81 Steen, pp. 458-459
56	Cotton	Diamond twill	Red and black dyed wefts; black internal, vegetal; red external, mineral, granular		Amsden, p. 57

Table V. SANDALS

Spec. No.	Material	Weave	Tie	Comparative Literature
28 29 30 31 32 50	Whole yucca leaves *mohavensis* — 28, 29, 30 *elata* — 31, 32 *baccata* — 50	Over-one under-one braid. Four leaves folded at toe; braided nearly to heel. Four inches at heel turned up for heel paid.	Yucca leaves, partly shredded, two leaves,enter weave at toe, enclosing two toes, cross each other and enter weave at sides of heel. Yucca in cords is of same variety as that in sandal.	BAEB 65, type I, a, 1, p. 102 Guernsey, pp. 66-67, Fig. 24 Haury, pp. 64-65, Pl. XLI, a, b Hough, p. 83 Roberts, p. 516
51	Shredded yucca leaves *mohavensis*	Over-one under-one braid. Four leaves folded at toe; braided nearly to heel. Four inches at heel turned up for heel pad.	Missing	same as above
25	Yucca fibers bound spirally with other yucca fiber to make compact cords, *macrocarpa*	Six cords folded at toe and braided as above; no heel pad.	Three-strand braid of yucca fiber strings, only one strap remains; fastened as described above.	
45	*Agave parryi* fibers bound as for No. 25, above. Heel tie of *Yucca baccata*	Twenty-seven-strand braid, over-two under-two.	Toe straps; two 11-strand yucca string, over-two under-two braids, originating from woven section at toe, and passing to sides of sandal at heel; heel strap of yucca strings.	BAEB 65, type I, a, 2, pp. 101-102 Haury,, p. 65
27	*Yucca elata* fibers bound as for No. 25, above. Instep tie of cotton.	Cords woven over six tightly twisted, two-strand yucca string warps.	Toe ties of yucca string Instep tie of cotton.	BAEB 65, type II, a p. 103 Hough, p. 84

Table VI. SKIRTS

Spec. No.	Material	Weave	Coloring	Comparative Literature
26 40 49	Yucca fiber *Yucca baccata* — 26, 49 *Yucca elata* — 40	Center pad of two string bundles; strings woven over these and their loose ends twisted to form fringes on both sides of pad.		Haury, p. 63, Pl. XL
23	*Yucca mohavensis* (Possibly some cotton)	Center pad of two string bundles; strings woven over these and their loose ends twisted to form fringes on both sides of pad.	Red-brown dye, external, mineral	Haury, p. 63, Pl. XL
24	*Yucca baccata* strands woven over *Agave parryi* cords (Possibly some cotton and one rodent hair)	Three-string foundation unit; fringe on one side of this unit only.		Haury, p. 62, Pl. XL
41	Cotton (Possibly some yucca fibers)	Three-string foundation unit; fringe on one side of this unit only.	Red-orange paint rubbed on.	Haury, p. 62, Pl. XL

Table VII. CORDS, BRAIDS, ROPES

Spec. No.	Material	Technique	Comparative Literature
20	Cotton	49-strand braid	Hough, p. 75
47	Cotton, white and dyed black	Six black strands, bound at 1″ intervals with white cotton string; suggests a necklace or hair tie.	
59	*Yucca mohavensis* fibers	Ring of fibers tied with square knot; suggests sandal heel cord.	
48	*Yucca elata* fiber cords	Flat three-strand braid, rope	BAEB 65, p. 50
57	*Yucca macrocarpa* leaves	Loose two-strand twist	Haury, pp. 84-85, Fig. 16, b, c Hough, pp. 68-70, Fig. 147, g
63	*Yucca macrocarpa* fibers	Two-strand twist	Haury, pp. 84-85, Fig. 16, b, c Hough, pp. 68-70, Fig. 147, g
64	*Agave parryi* fibers	Two-strand twist	Haury, pp. 84-85, Fig. 16, b, c Hough, pp. 68-70, Fig. 147, g
60	*Yucca mohavensis* fibers	Three-strand twist.	Haury, pp. 84-85, Fig. 16, b, c Hough, pp. 68-70, Fig. 147, g

Table VIII.

A. MATTING

Spec. No.	Material	Technique	Border	Comparative Literature
42	*Dasylirion wheeleri*	Over-three under-three twill		Haury, pp. 81-82, Pl. LIV Hough, Pl. 16
44	*Dasylirion wheeleri*	Over-three under-three twill	Weave elements doubled back in weave	Haury, pp. 81-82, Pl. LIV Hough, Pl. 16
43	*Yucca mohavensis*	Twill	Weave elements split in two at border and halves twined together.	Haury, pp. 81-82, Pl. LIV Hough, Pl. 16
58	Juniper bark	Checker weave		

B. BAG

No.	Material	Technique	Dye	Comparative Literature
38	*Yucca macrocarpa* and *baccata* fibers	Twined woven	Iron dye on some of strands	PMP, VIII, 2, pp. 65-71, Pl. 27, Figs. c, d

C. NET

No.	Material	Technique	Comparative literature
22	*Agave parryi*	Square knots at corners of 2″x2½″ (5.1 x 5.7 cm.) squares	BAEB 65, p. 113 Haury, pp. 84, 86, 87 PMP, VIII, 2, p. 77

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