

TEXTILES FROM HACHA, PERU

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The Hacha site (PV74-6) is an occupation site of the early Initial Period located in the desert behind the Hacienda Cerro Colorado near Acarí on the south coast of Peru. It was discovered by Jorge Esparza and Francis A. Riddell in 1954 and explored by University of California archaeologists in 1959, 1961, and 1962. The textiles which constitute the subject of this paper were collected in 1962 by Thomas C. Patterson and John H. Rowe in small scale excavations carried out under the auspices of the University of San Marcos, Lima, to which Patterson was attached as a holder of a Fulbright fellowship administered by the U. S. Educational Commission in Peru. The textiles are from a dry refuse deposit containing shells and abundant plant remains, including squash, beans, peanuts, guava, capsicum, gourds, and cotton but no maize. Cotton remains (twigs, bolls, seeds, cotton fiber) were particularly abundant. The artifacts recovered comprised side notched stone adzes, obsidian points, unbaked clay figurines, pottery, and textile fragments.

Radiocarbon measurements provide conflicting evidence on the age of the Hacha refuse. A direct measurement on charcoal from the Mound A refuse deposit was made by the University of California at Los Angeles laboratory in 1962 and yielded an age of 2960 ± 90 radiocarbon years (UCLA-153). The same laboratory reported an age of 3050 ± 80 for charcoal from the closely comparable Erizo site in Ica (UCLA-969, 1965). The Geochron Laboratory, however, processed two other portions of the same Erizo sample and obtained results of 3890 ± 90 (GX-0185) and 3820 ± 85 (GX-0186). Rowe believes that the Geochron measurements are more consistent with other recent radiocarbon evidence from Peru than the UCLA ones. The average of the Geochron measurements is 3854 ± 61 , which corresponds to 1905 B. C. ± 61 (5568 year half-life).¹

As separate items of fibers, cords, yarns, nets and cloths, 94 textile specimens were registered by the writer. Although these came from four locations at the site, two surface and two sub-surface, no significant technical differences were discovered in their analysis. The groupings are: Mound A, surface, nos. 1, 2; Mound A, excavated, nos. 3-83; Mound C, north end, surface, no. 84; Mound C, excavated, nos. 85-94. A few items from Mound A later proved useless for analysis; on the other hand, a few specimens had distinct parts which were later sub-numbered A, B, etc., so the total specimens analyzed remained substantially the same, that is, 100. The analyst's registry numbers have been retained in this paper (see Appendix).

The textile materials came to my hands as tightly crumpled, entangled, dirty wads of yarns and rags. Partially decayed and very

fragile, the identification of clearly individual specimens, as teased apart, cleaned, and numbered, was impossible in many cases. Some of them may be separate only in a physical sense. Little scraps of cloth might be parts of one original whole, or yarn lengths simply unravelled threads from cloths with which they were associated. Since the Hacha textiles represent very early examples of yarn and cloth-making from the south coast, it was desirable to save every usable scrap: any small bit might reveal something new or different. Hence, the total number of items means little except to suggest relative proportions of technical features in the entire collection. Yet enough clearly individual specimens emerged to substantiate definite conclusions about early Hacha textile practices and standards.

The specimens were grouped in four categories for analysis. First, there are 4 examples of cotton fibers, both with seeds and de-seeded. The second group, called "Random Yarns," includes free lengths of thread adhering to other specimens and yarns intentionally bunched or knotted together. There are 43 such specimens, 10 of which are bast (coarse, unidentified vegetal fiber). Many of these specimens had sub-parts, so analysis yielded 60 examples of fiber and spin data. There were no balls or hanks of yarn in the Hacha collection. Specimens with visible warps and wefts were classed as "Woven Fabrics," the third group. Of 42 cloth specimens, 4 were composite and gave 47 examples of warp and weft yarns and woven structure. The fourth group comprises 11 "Netted Fabrics," all of single element construction and all of cotton, from which yarn and structural data could be derived.

The general characteristics of the Hacha textiles are these. Cotton alone was used for cloth and knotless netted fabrics. No wool is evident. Bast appears only in cordage and was not spun with cotton. Samples of cotton fibers are white, creamy, and brown. Since yarns, cloths, and nets are gray or murky from age and hard use, their original color is not clear; under the microscope the fibers mainly show a creamy-yellow tone. Three fabrics are deep brown with a reddish tinge, probably once of brown cotton which has darkened with decay. The use of dye is unlikely; no laboratory test for dye was made.

An important specimen is a little bunch of deseeded white cotton fibers (no. 53, fig. 1, below) which have been paralleled in preparation for spinning. Many yarns in the finer fabrics and nets appear to have been paralleled before spinning, but here is proof of the practice.

Bast fibers probably had only rugged utilitarian uses (fig. 3). One cord of fairly coarse quality is in a little coil bound with a cotton yarn (no. 56). Another length of similar quality had been hitched into a set of loops, the purpose of which cannot be guessed to-day (no. 55, fig. 4). One short length of bast had a single lark's head knot of the same cord attached to it (no. 13). This specimen, like one of cotton (no. 30 C), was put in the Random Yarns group because there was no proof that either had been parts of netted fabrics.

Cotton yarns in cloth, as well as those occurring randomly, are almost one hundred per cent Z-spun, S-doubled; the few exceptions are for special uses. Cotton yarns in the knotless-netted fabrics are uniformly of opposite spin and doubling, that is, S to Z. Bast cords are both S and Z doubled with little or no twisting of the two basic components.

Both in cloth and net, many yarns are of good grades for a still rudimentary textile craft, often of moderately fine gauge and fairly regular diameter (fig. 2). The single ply, Z-spun yarns which serve as paired wefts or are S-doubled for warps, are often as small as .3-.5 mm.; most range around .6-.8 mm., while the coarsest are about 1 mm. thick. The degree of twist in all cotton yarns is very high, ranging from 30 to 60 degrees but centering around 35 to 50 degrees. The result is an extremely hard yarn. Often the very hard spun singles, paired as wefts, exhibit sections of tight spiral kinking, and the 2-ply warps are not always perfectly straight. The 2-ply yarns in netting are also super-twisted, ranging from 45 to 60 degrees. Super-twisting of yarns in net structures forces the loops of thread to re-spin on themselves in the opposite (S) direction when relaxed, creating an extra density in the fabrics. Short staple cotton probably necessitated hard-twist spinning.

No spindle whorls have been found as yet at Hacha, which is strange since the presence of raw and prepared fiber, as well as the fabrics, indicate that yarn and fabric-making were local activities. There was a great deal of incidental cotton fiber adhering to our specimens, and plant materials are abundant at the site. Could thigh-spinning be brought to the degree of proficiency which these yarns demonstrate? Perhaps it is possible; but perhaps, too, spindles and whorls will be found eventually at Hacha.

A cactus thorn needle threaded with cotton yarn verifies the use of needles for seaming, mending, warp-selvedge binding, and fine net-making, although it is quite evident from many specimens that a thread-carrying instrument must have been employed. The finer nets, especially the lace-like one (no. 51, fig. 13) would have required a needle or bodkin tool. In the lacy piece the 2-ply yarn is .5-.7 mm. in diameter and the loop lengths (doubled) are 4-5 mm.

Standard cloth construction was semi-basket plain weave, of 2-ply S-spun warps crossed by paired Z-spun wefts (figs. 6-10). A sufficient number of specimens with warp selvages, weft selvages, or both prove this standard beyond a doubt. Of 21 cloths with partial selvages, 19 are in semi-basket weave. The two others are plain weave, one a square count cloth (no. 85) and the other warpface tape (no. 7). There are 26 cloths without any selvages remaining; 25 of these in semi-basket construction can safely be oriented with the 2-ply yarns as warps and the paired singles as wefts. The 26th piece (no. 28 A) is a plain weave with 2-ply S yarns in both directions; however, a slightly higher yarn count in one set of elements suggests

that they are the warps. The totals, then, are 44 cloths in semi-basket weave with paired wefts and 3 cloths in plain weave.

No full lengths or breadths are recoverable. The longest single piece is 45 cm. (no. 40), and the widest is 38 cm. (no. 85), but all dimensions taken on the Hacha cloths are merely approximate because of the many extensions of ragged warps or wefts along the edges of most specimens. A composite specimen of woven and netted fabrics extends to 45 cm., but is incomplete like all the others.

Only one instance of twining was found (no. 44, fig. 6). This is a twined weft remaining along a torn edge in an otherwise standard cloth. The pair of twined yarns are of 2-ply S cotton like the warps in the fabric (the regular wefts are single Z, paired). The twining was started by doubling the yarn around the outermost warp; the two ends then proceed to clasp two warps between each turn as a twining pair in a "down to the right" twist. Tension is uniform with the woven area above. The purpose of this twined weft remains cryptic because the adjacent web below is gone. A re-check of all the other cloth specimens showed no twined elements.

Special treatments of warp and weft selvages are present. Of 19 cases of weft selvages, 3 had been constructed as shown in figures 7, 17 (nos. 31, 47, 73). Wefts turn about an outer warp in normal fashion. Parallel to that warp is another yarn, not interlaced by the wefts, but bound to the outermost warp by a 2-ply S yarn which spirals around them both. Two rows of wefts are included in each turn of the binding yarn. The purpose seems to have been to strengthen the weft selvedge and protect the reversing wefts from friction at the edge. The single wefts so generally employed in Hacha weaving were, even though paired, more subject to damage than the plied warps. One wonders why the practice of using these weaker yarns persisted, when it is obvious from the cloth fragments and their frequent mending that the wefts were very vulnerable.

Warp selvages are quite different from those of Peruvian cloths of later periods; entirely lacking are a thick loom string and initial shots of a thick weft. From Hacha there are 7 instances of warp selvages and all are finished in the same way (nos. 16, 34, 68, 79, 85, 86 B a, 1, 2; see figs. 8, 9, 18). Five of these specimens also had weft selvedge remains, but all these were of normal type, i. e., not re-enforced as described above.

The warp finish consists of binding the warp ends with an extra 2-ply yarn which ties a group of 4 to 7 warps tightly together, then passes horizontally to the next group. The binding yarn goes through the selvedge before making each knot and always encompasses the first weft pair and sometimes one or both in the next weft shot. This must have been a post-weaving treatment done with a needle or threaded tool. The reconstruction in figure 18 shows the closed warp ends projecting beyond the knots farther than in actuality. Indeed, in most instances the warp bends are gone, probably from abrasive wear. Also, the knots

squeezed them flatly and tightly together, and age has made them brittle enough to break easily. Several of these knots were dissected under the microscope thread by thread to discover the internal construction and to find at least one which would prove that the warp ends were originally continuous. In 6 cases the binder was a 2-ply S yarn; the 7th was 2-ply Z. In all cases the cloth weave was the standard one with 2-ply S warps crossed by paired Z singles.

Like the weft selvedge treatment, this binding of the warp ends doubtless was to give additional strength to the edge. But it may imply something about warping methods. There is a continuous warp method which is used by several extant eastern Andean peoples and which Junius Bird believes was used for fabrics from Huaca Prieta.² The warp passes around two warp beams, but not in a direct spiral. A scaffold stick or cord is placed horizontally between the beams. The warp, coming down from the upper beam, on reaching the cross-cord passes around it and returns to the upper beam, thence over it and directly down to the lower beam. The warp passes under that beam, then up to the cross-cord where it reverses direction and returns downward, again going around the lower beam, thence straight up to the top beam. This cycle is repeated for the entire warp width. This warping method results in a continuous tubular warp with closed warp ends. When weaving on the warps has produced a full web from one side of the cross-cord around and up to its opposite side, the scaffold cord is withdrawn from the loops of the warp ends and the opened cloth has four selvedges.

However, the cross-cord (or stick) which has served as a scaffold must be strong enough to withstand the strain of weaving actions and tensions; it cannot be very fine. Hence, when withdrawn, the warp selvedges are slightly loose, and the first and final wefts are not pressed closely into the looped warp ends. For all practical purposes this is a poor sort of selvedge, sloppy and vulnerable to friction. I think that the post-weaving, knotted binding on the Hacha warp ends may have been compensation for this weakness and implies that the reversed continuous warping method was used. As can be seen in figures 8, 9, the knotted binding gives a firm, even, warp finish. Unfortunately, as yet, no loom parts have been recovered from the Hacha site.

That the binding was essentially a sewing or needle method is borne out not only by internal evidence in the cloths themselves, but by another use of the same stitch for mending worn fabrics. A notable feature of the Hacha specimens is the frequency of ragged areas which are held together by ineffectual attempts at repair. In general, the 2-ply warps survive, while the paired single wefts have disintegrated. The method used to rescue and keep in service badly worn cloth is the same knot-stitch employed in binding the warp ends. In the latter usage the stitch is a formal, regular, simple knotting progressing at even intervals across the selvedge. In the case of repairing, thread and knots meander over frayed areas to hold together the weakened cloth structure. This knot-stitch was found on the surface of one cloth from Aspero, Supe, so is not unique.³ A typical example of Hacha repairing by this means is shown in

figure 10. These pitiful attempts to keep every rag in service must have some meaning. They suggest that weaving was a difficult, new process for a people accustomed to a tradition of netting. The problem of spinning certainly was not a factor, for the netted fabrics have equally well-perfected yarns and represent equal quantitative needs. "When the making of things required very large effort, as in pre-industrial life, it was easier to repair them than to discard them."⁴

Among the Hacha cloths there are three examples of webs seamed together along weft selvages. Two use whipping stitch and one running stitch; all are neatly joined. There is a fourth questionable case of seaming by use of the whipping stitch.

Reliable yarn counts (the ratio of warps to wefts in a 2.5 cm. square) could be got from only 39 specimens. The average ratio is 16 warps to 15 (30) paired wefts. The highest yarn count is 22 by 20 (40) in Web 2 of specimen no. 40, and the lowest is 12 by 12 (24) in no. 79. The ratio in general is close to square count with deviations toward warpface; a very few specimens had a slight weftface count. The spread of warp-weft ratios is shown in the scatter diagram, figure 26.

In sum, the woven textiles from Hacha show a strong homogeneity with reliance on plain weave, chiefly the semi-basket variety. Some ingenuity is shown in the treatment of warp and weft selvages, but there is no attempt at patterning by means of woven or dyed methods. The potentials of weaving as an expressive art had not as yet been realized at Hacha.

All the net specimens from Hacha are in the knotless technique, although it seems probable that nets with fixed (tied) knots would have been made there. The two examples of lark's head knots, one cotton and one bast, are each a single remnant on a cord of the same fiber. These scraps do not warrant an assumption that they were originally from knotted fabrics, as the lark's head method is often employed (as in our society) to suspend a doubled strand of string from another.

The 11 examples of knotless netting from Hacha exhibit a far higher degree of proficiency with the technique and more structural variations than do the woven cloths. While netting probably was an older, pre-weaving textile art at Hacha, the nets and cloths in this collection were contemporaneous. Eight specimens were taken from Mound A along with many cloth fragments, and from Mound C came the largest piece of net (Web c of no. 86 B) which is sewn to cloths of standard Hacha style (fig. 9; see also figs. 11-13).

The outstanding example of netting is a very small, lace-like fragment (no. 51, figs. 13, 25). At regular intervals the connecting yarn between neighboring stitches has been lengthened to leave an opening, and by increasing or decreasing the number of stitches between such interstices a pattern was created. Unfortunately this tiny remnant is too small for reconstruction of the design or to indicate the nature of the original object. Presumably it was somewhat like the patterned

nets from Unit 1 at Asia.⁵ The yarn and the stitch gauge are the finest in any of the Hacha nets.

All the nets are made of cotton yarn with a uniform spin of 1 S, Z-doubled in a very hard twist, mostly 45-60 degrees. The yarn diameters range from .5-.7 mm. in the lace-like piece to .8-1.2 mm. in two of the coarsest examples. The stitch lengths, when relaxed and re-twisted on themselves because of the crêpe twist, range from 4-5 mm. to 2.0 cm. A needle must have been used in the construction of the finer pieces, perhaps for all, in order to draw the kinky yarn through preceding stitches.

The stitch structures are shown in figures 19-25. They were analyzed and classified by Sandra F. Dickey as part of a larger study of knotless netting. The terminology and classification system follow those established by D. S. Davidson, but are augmented by new sub-types and varieties in the Hacha pieces.⁶ Seven of the nets are in variations of the "loop and twist" technique (Davidson's Type II; nos. 9, 14, 19 c, 20, 21, 52, 74), while four are variations of the "hourglass" technique (Davidson's Type III; nos. 1 a, b, 51, 86 B c, 86 C). Two variations of "simple looping" (Davidson's Type I) appear as top and bottom edgings of net no. 86 B c.

Most of the net fragments are too small to indicate their original use. There is no marked evidence of shaping, and the changing number of stitches in no. 51 may have been primarily for patterning rather than for molding a form.

The most interesting specimens, aside from the bit of patterned net, are the composite cloth (no. 86 B) and a small noose (no. 27).

The composite cloth (fig. 9) consists of three woven webs on the one hand and a single piece of net on the other. Two of the woven parts (Webs a 1, 2), identical in construction and scale and each with one warp selvedge present, are seamed together along their weft selvedges by a whipping stitch. The third cloth (Web b) which has one weft selvedge but no intact warp end, has been later applied by means of the knotted mending stitch onto Web a 2. It is sewn on at an overlapping angle although its upper edge is aligned with the warp edges of the paired cloths. To this three-part edge, then, is sewn the finished edge of a single large piece of knotless netting (Web c). Much of the net's edge has broken away, but a sufficient amount remains to identify this as the starting edge of the network. At the opposite end of the net a small section of finish remains. These two short sections are the only examples of netted edges from Hacha; both are done by different methods of "simple looping" technique. The main net fabric is a variation of "hourglass" netting which also occurs in net fragments from the surface of Mound A. Specimen no. 86 B taken as a whole represents a combination of Hacha's standard cloth with bound warp selvedges, typical well-made netting, and mending to conserve materials. A combination of cloth and net was found at Unit 1, Asia, but there the cloth portion was a twined,

rather than woven fabric.⁷

The noose (figs. 14-16) is an enigma. Its chief interest lies in the manifest excellent control of cotton yarns in the construction of a pre-planned object. It is classed with "Random Yarns" because there is no comparable object in the Hacha collection and it exhibits various kinds of yarn manufacture deliberately used in differing parts. The loop or noose portion and a single extension beyond the bound central section are of 1 S, 4-ply Z cotton, 1-1.5 mm. in diameter, and presumably are parts of one continuous yarn from the loop on into the extension. The close wrapping of the central section is 1 Z cotton yarn, .5-.8 mm. in diameter, as is an additional thread loosely coiled around this part of the object. The whole specimen is not large: the loop when lying relaxed is 7 cm. in length, the extension (broken off) is 6.5 cm., while the central section with its careful binding is but 3 cm. Great care and dexterity went into its manufacture. At first glance the loop appears to be a "running noose," but the knot which terminates the loop is made in such a way that it cannot move upward to shorten the loop and can only slightly move downward on the central section because of obstruction by the binding. In spite of this the noose may be part of a trap; bait could have been placed under the lightly coiled thread at the center.

Two objects which have yarns attached were retained with Dr. Rowe's non-textile specimens and have no numbers in my register. One is a thorn needle 8.7 cm. in length which is threaded with a fuzzy 2-ply Z cotton yarn. The diameter of the yarn ranges from 1-1.7 mm., and the degree of twist varies from 30 to 45 degrees. The basic single strands have little twist and were made from unparalleled fibers. Dr. Rowe believes that this yarn was once a closed circle which was broken when the needle was pulled from the soil. There is some warrant for this assumption because of a slight thickening in one part of the yarn which could have been the point where ends were spliced, but analysis could not prove this.

The other object consists of a pair of small wooden cylinders linked by a cotton yarn. This 2-ply S yarn, taken at its center point, wraps twice around one cylinder and ties in a simple, one-turn knot. The pair of extending yarns are then Z-spun into one strand for about 7 cm. and wound twice around the other cylinder. Then the ends of the basic 2-ply S yarns are separated and tied to the connecting section in a tight knot. This cryptic little object is neatly made, evincing the same kind of careful pre-planning as the noose.

In summary it can be said that the Hacha textile remains are of the quality and construction expectable from an early ceramic site on the Peruvian coast. As known from Huaca Prieta and Asia preceramic settlements, cotton fiber at very early times was spun into yarns which were utilized for netted and twined fabrics. Hacha is a site with early ceramic developments paralleled by comparable developments in the textile crafts. The good - though not fine - quality of the spun yarns

and the varieties and scale of the knotless netted fabrics indicate a background of cotton and netting exploitations similar to those at Huaca Prieta and Asia. But at Hacha textile manufacture had advanced to the basic stage of weaving: the interlacing of yarns as warps and wefts to form cloths with four selvages. The regularity of the interlacing and the yarn counts which average 16 warps by 15 (30) paired wefts per inch (2.5 cm.) imply that a loom frame, bobbin, and batten were used, with the additional high probability that there was a heddle attachment on the loom. Although the only weave structure present in this collection is simple plain weave in its semi-basket variation, there is evidence of established, though narrow, standards. These are an adherence to 1-ply Z, S-doubled yarns, paired single Z wefts crossing 2-ply S warps, and knotted bindings on warp selvages.

No variations in weaving, such as are exhibited in the netted fabrics, had as yet been attempted. This, together with the fact that all yarns in net-work are of opposite spin to those in weaving, i. e., 1-ply S, Z-doubled, suggests that weaving was a recently introduced art at Hacha. Weaving began to accompany, without displacing, the traditional manufacture of knotless netting. As yet the use of loomstrings and thick, starting weft shots, so prevalent in later Peruvian weaving, were unknown.

The almost complete absence of twining in this collection of cloths does not necessarily mean that the Hacha weavers by-passed this stage of textile development. Rather, there is simply no evidence for it in this admittedly small group of textile fragments. Further excavations at Hacha may reveal what are now notable absences: twined cotton cloth, knotted nets, spindles, whorls, and loom parts. Hacha weavers were acquainted with the fundamentals of the weaving craft; they had yet to develop weaving as an art.

NOTES

¹My thanks are due to Dr. John H. Rowe for contributing the introductory paragraphs on the nature and dating of the Hacha remains and to Miss Sandra F. Dickey for assistance with the analysis of the knotless netted fabrics from Hacha. The technical drawings were made by Brian Shekeloff and Robert Berner, the photographs by Eugene Prince.

²Hald, 1962, figs. 4, 5, 6, 7; Bird and Mahler, 1951, p. 76.

³Willey and Corbett, 1954, p. 124, pl. XXVI e.

⁴Kubler, 1965, p. 78.

⁵Engel, 1963, p. 42, figs. 83, 84, 86. The structural detail shown in fig. 86 closely resembles that of our specimen, but the reconstruction of the openwork in fig. 85 does not.

⁶Dickey, ms., Davidson, 1935.

⁷Engel, 1963, fig. 89.

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APPENDIX

Specimen registry numbers as used in the final report. Upper case
 A, B, etc., mean separate items under one number. Lower case a, b, etc.,
 mean sub-parts of a single specimen. Arabic numbers indicate further
 sub-parts of specimens 25, 36 A, 78, and 86 B.

Unspun fibers: 53, 54, 82, 83.

Random yarns: 3 a, b; 4 a, b, c; 5; 6 a, b; 6 C; 11 A; 11 B; 12; 13; 17 a, b, c; 19 A; 22; 23; 24; 25 a, b, c 1, 2, 3; 26; 27 a, b, c; 33 B; 36 B; 36 C; 55; 56 a, b; 57 a, b; 58; 59; 60; 61; 62; 63; 64; 65 a, b; 66; 67; 78 a 1, 2, 3, b 1, 2; 80; 86 A; 89 A; 89 B; 90; 91; 92; 93; 94.

Woven cloths: 2; 7; 8; 10; 15; 16; 28; 29; 30; 31; 32; 33 A; 34; 35; 36 A 1, 2; 37; 38; 39; 40 a, b; 41; 42; 43; 44; 45; 46; 47; 48 a, b; 68; 69; 70; 71; 72; 73; 75; 76; 77; 79; 84; 85; 86 B a 1, 2, b; 87; 88.

Netted fabrics: 1 a, b; 9; 14; 19 C; 20; 21; 51; 52; 74; 86 B c; 86 C.

Excluded from final report: 18; 19 B; 28 B; 49; 50; 81 a, b.

KEY TO ILLUSTRATIONS

Plates I-X

Scale and materials. A centimeter/inch scale is included in all photographs except Plate I, fig. 1. Dimensions for this are listed below. Yarn counts are per 2.5 cm. All specimens illustrated in photographs and drawings are cotton except those in Plate II, figs. 3, 4, which are bast.

Plate I

Fig. 1, above. No. 54, Mound A; ca. 4 cm. wide in position as shown.

Fig. 1, below. No. 53, Mound A; ca. 7 cm. wide in position as shown. Dark spots are imbedded dirt and other detritus which could not be extracted without disturbing the paralleled fibers.

Fig. 2. Yarn sources and spins from top to bottom: No. 58, Mound A, random yarn (1 Z, 2 S); No. 89 A, Mound C, random yarns (1 Z, 2 S); No. 89 B, Mound C, random yarn (1 Z, 2 S); No. 63, Mound A, random yarn (19, 2 Z), white and tawny plies; No. 62, Mound A, random yarn (1 Z, 2 S), white and tawny plies; No. 40, Mound A, warp (1 Z, 2 S), warp (1 Z, 2 S), 1 left of a pair (1 Z).

Plate II

Fig. 3. Yarn sources and spins from left to right, all Mound A: No. 12 (1 S, 2 Z); No. 67 (1 Z, 2 S, 2 Z); No. 5 (1 Z).

Fig. 4. No. 55, Mound A (1 S, 2 Z). When flattened out, there are 5 identical loops lying parallel to one another and bound over 6 supporting strands.

Fig. 5. No. 78, Mound A, a mixture of yarns mostly 1 Z, 2 S, some 1 S, 2 Z, others 1 S, 2 Z, 2 S and 1 Z, 2 S, 2 Z.

Plate III

Fig. 6. No. 44, Mound A, warps 1 Z, 2 S, wefts paired 1 Z, twined wefts 1 Z, 2 S; yarn count 15x15 (30).

Fig. 7. No. 47, Mound A, warps 1 Z, 2 S, wefts paired 1 Z, extra weft selvedge yarn 1 Z, 2 S, binding yarn 1 Z, 2 S; yarn count 19x16 (32).

Plate IV

Fig. 8. No. 16, Mound A, warps 1 Z, 2 S, wefts paired 1 Z, binder on warp selvedge 1 Z, 2 S; weft selvedge normal; yarn count 18x16 (32).

Fig. 9. No. 86 B a 1, 2, Mound C. Web a 1, warps 1 Z, 2 S, wefts paired 1 Z, warp binder 1 Z, 2 S; yarn count 17x17 (34); Web a 2, warps 1 Z, 2 S, wefts paired 1 Z, warp binder 1 Z, 2 S; yarn count 16x16 (32); sewing yarn 1 Z, 2 S.

Plate V

Fig. 10. No. 3, Mound A, warps 1 Z, 2 S, wefts paired 1 Z; count (in best preserved area) ca. 13x14 (28); mending yarn 1 Z, 2 S.

Fig. 11. No. 1 a, b, Mound A. Yarn 1 S, 2 Z; length of loops (relaxed) 7 mm.

Plate VI

Fig. 12. No. 86 B c, Mound C. Yarn 1 S, 2 Z; length of loops (relaxed) 1 cm.

Fig. 13. No. 51, Mound A. Yarn 1 S, 2 Z; length of loops (relaxed) 4 mm.

Plate VII

Figs. 14, 15. No. 27, Mound A. Yarn of loop and extension 1 S, 4 Z; yarns of loose spiral and central binding 1 Z.

Plate VIII

Fig. 17. Drawing based on No. 47; other specimens Nos. 31, 73, all Mound A.

Fig. 18. Drawing based primarily on No. 79; other specimens Nos. 16, 34, 68, 85, all Mound A, and 86 B a 1, 2, Mound C.

Plate IX

Fig. 19. "Loop and twist" variation (Dickey Type II, S-T2); drawing based on Nos. 9, 19 C, 20, 52, all Mound A.

Fig. 20. "Loop and twist" variation (Davidson Type II, S-T1); drawing based on Nos. 14, 21, 74, all Mound A.

Fig. 21. "Hourglass" variation (Davidson Type III); drawing based on No. 86 C, Mound C.

Fig. 22. "Hourglass" variation (Dickey Type III, S-T1, VC); drawing based on No. 1 a, b, Mound A and No. 86 B c, Mound C.

Fig. 23. "Simple loop" variation (Dickey Type 1, S-T4, VB); drawing of starting edge of No. 86 B c, Mound C.

Fig. 24. "Simple loop" variation (Dickey Type 1, S-T3, VF); drawing of finishing edge of No. 86 B c, Mound C.

Plate X

Fig. 25. "Hourglass" variation (Dickey Type III, VC); drawing of No. 51, Mound A, showing methods of making interstices and narrowing.

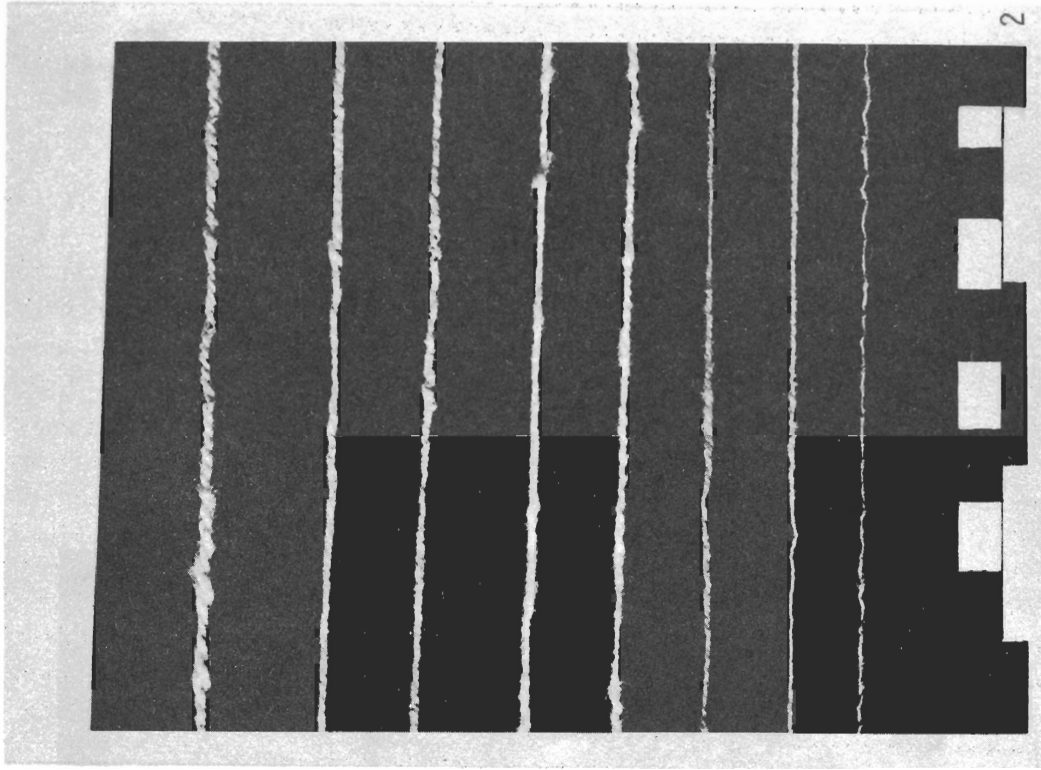
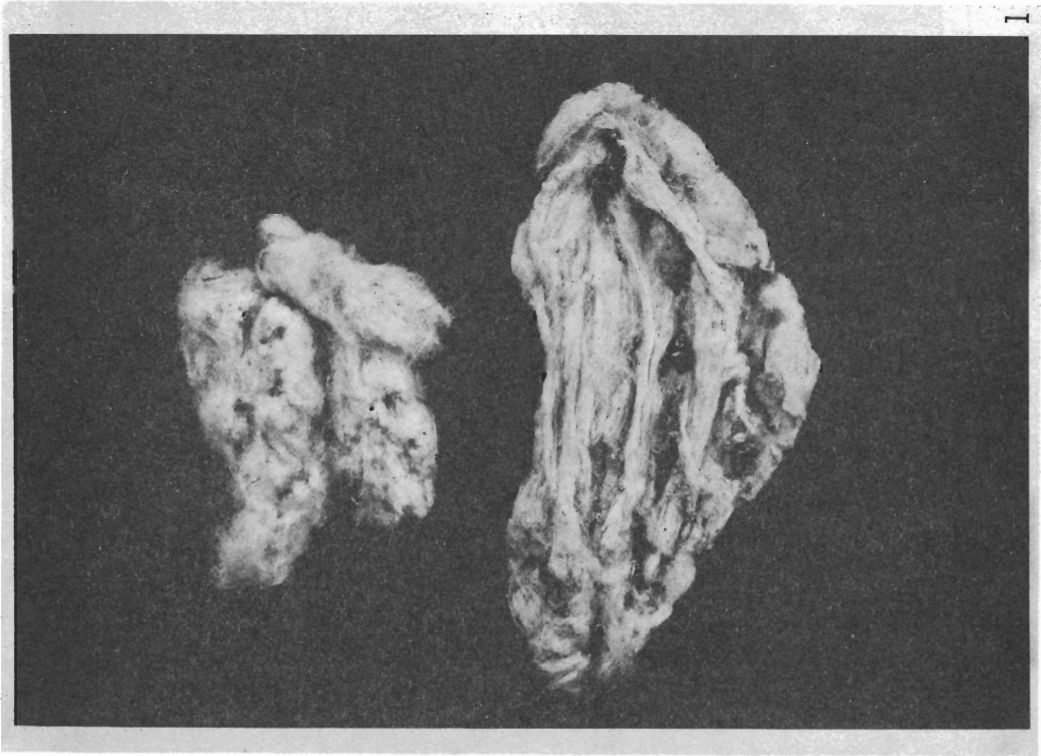


Plate I. Cotton fibers and yarns. Raw white cotton fiber with seeds, above; deseeded, paralleled, white cotton fiber, below (fig. 1); examples of cotton yarns (fig. 2). See key to illustrations.

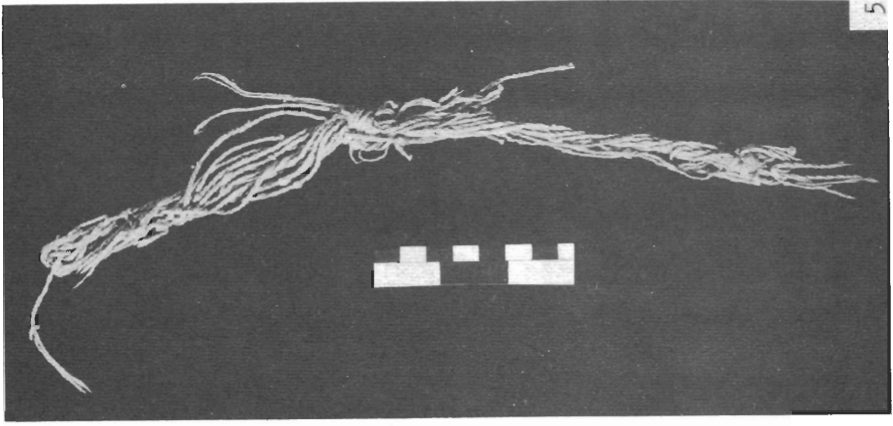
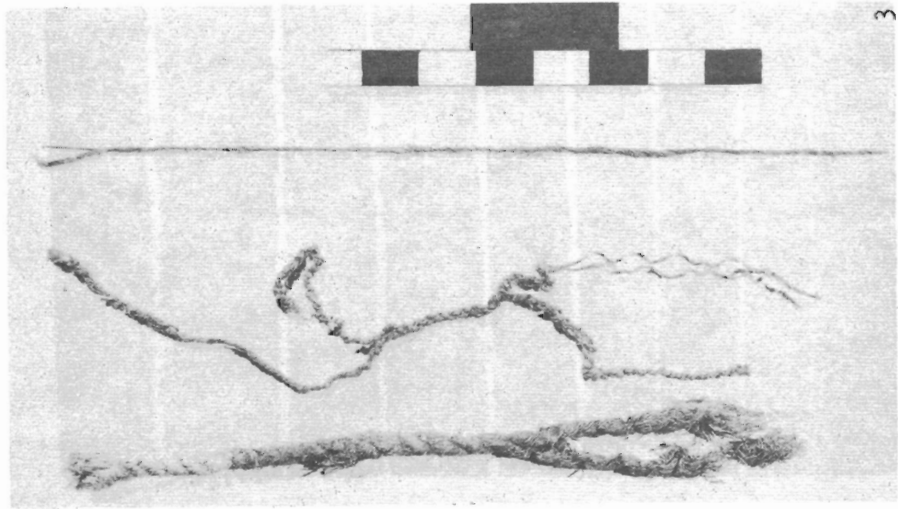


Plate II. Bast fiber and cotton fiber yarns. Examples of coarse, medium, and fine bast yarns (fig. 3); coarse bast yarn tied into loops (fig. 4); cotton yarns knotted and reknotted in a now meaningless way (fig. 5). See key to illustrations.

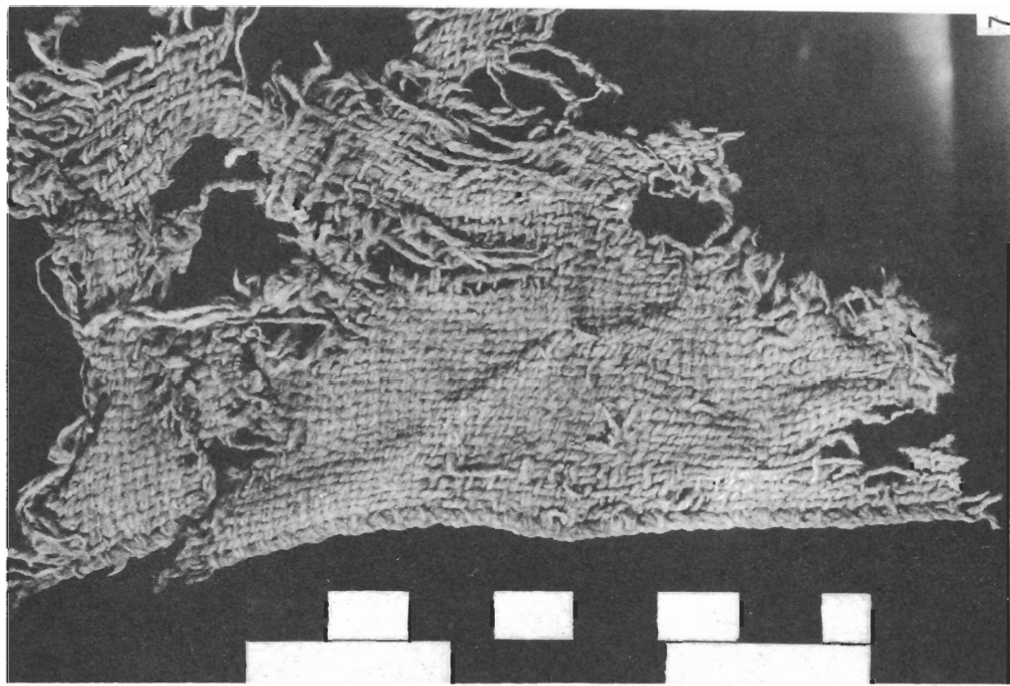
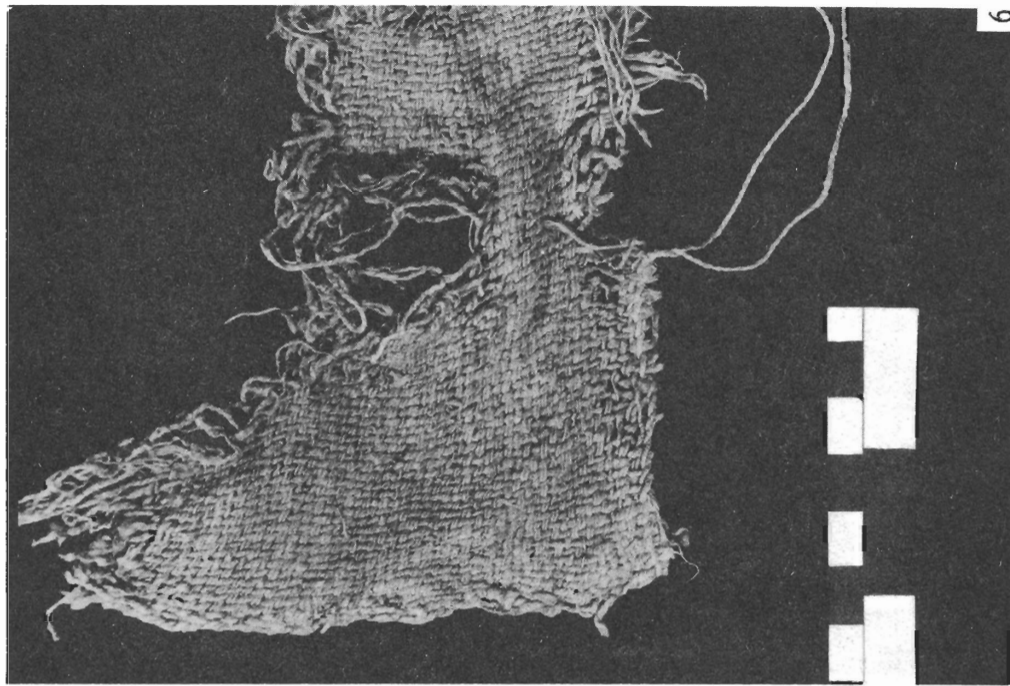


Plate III. Cotton cloths in semi-basket weave. Cloth with a pair of twined wefts along torn warp edge and normal weft selvedge (fig. 6); cloth with reenforced weft selvedge (fig. 7). See Plate VII, fig. 17 and key to illustrations.

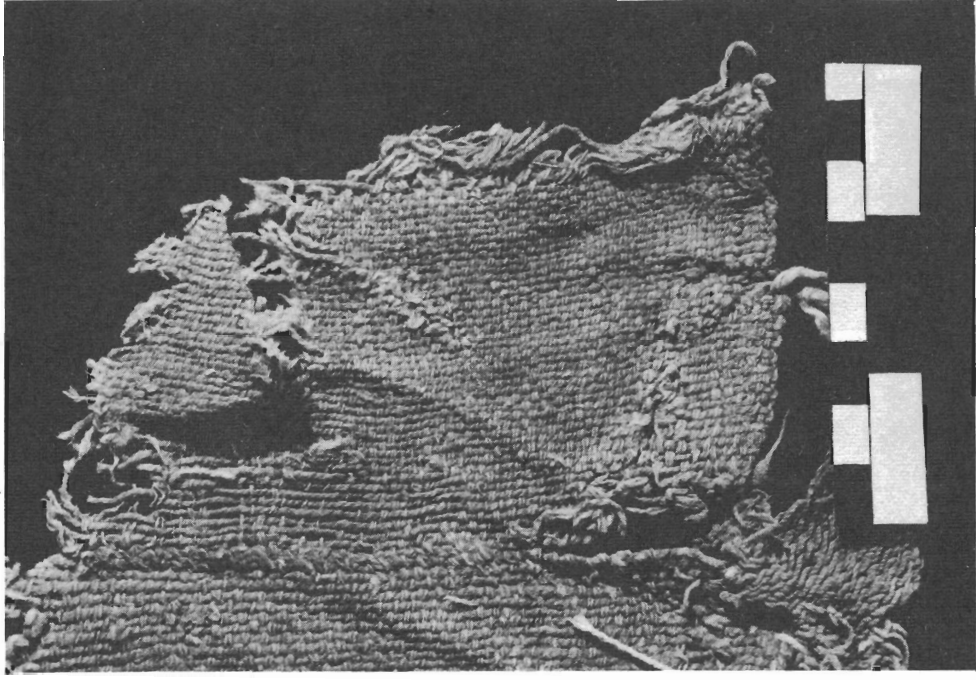
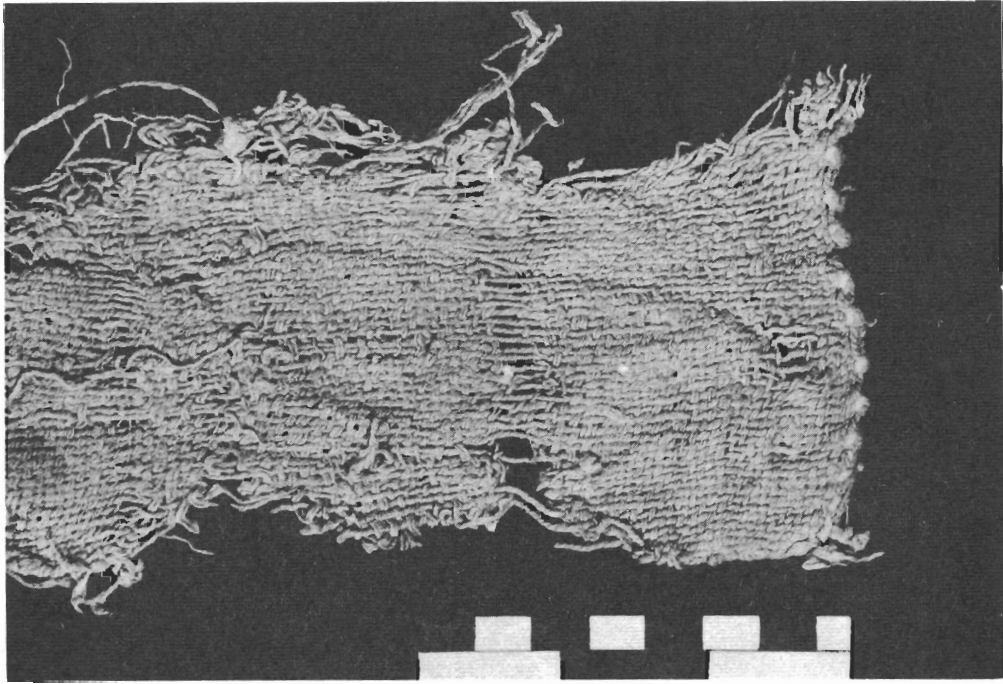
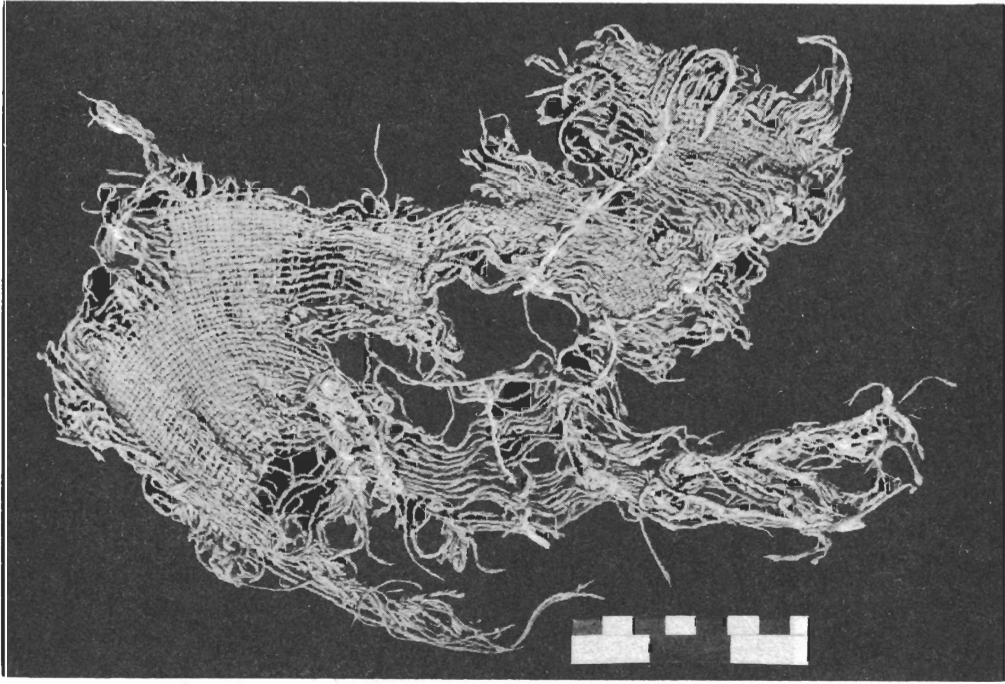
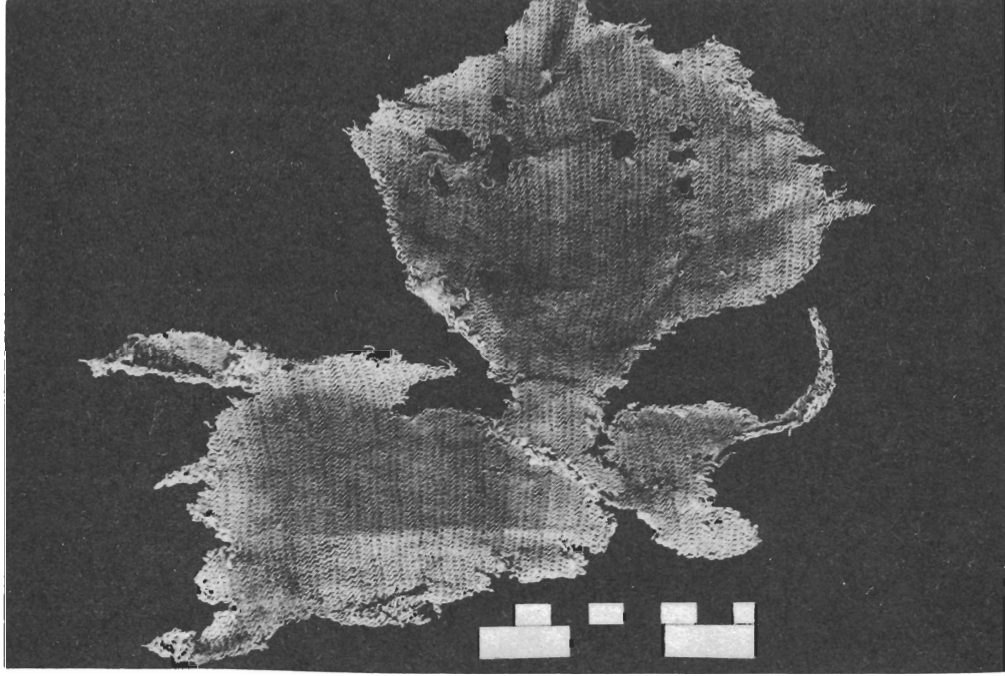


Plate IV. Cotton cloths in semi-basket weave with bound warp selvages and normal weft selvages. Two webs whip-stitched together along weft selvages; a small part of an attached knotless net shows to left of the scale (fig. 9). See Plate VIII, fig. 18 and key to illustrations.

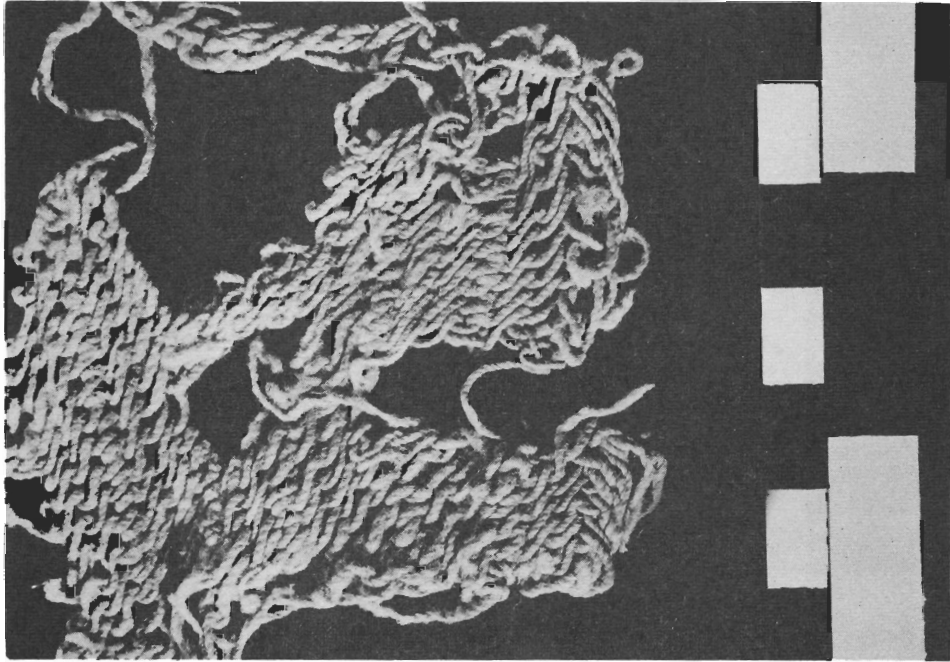


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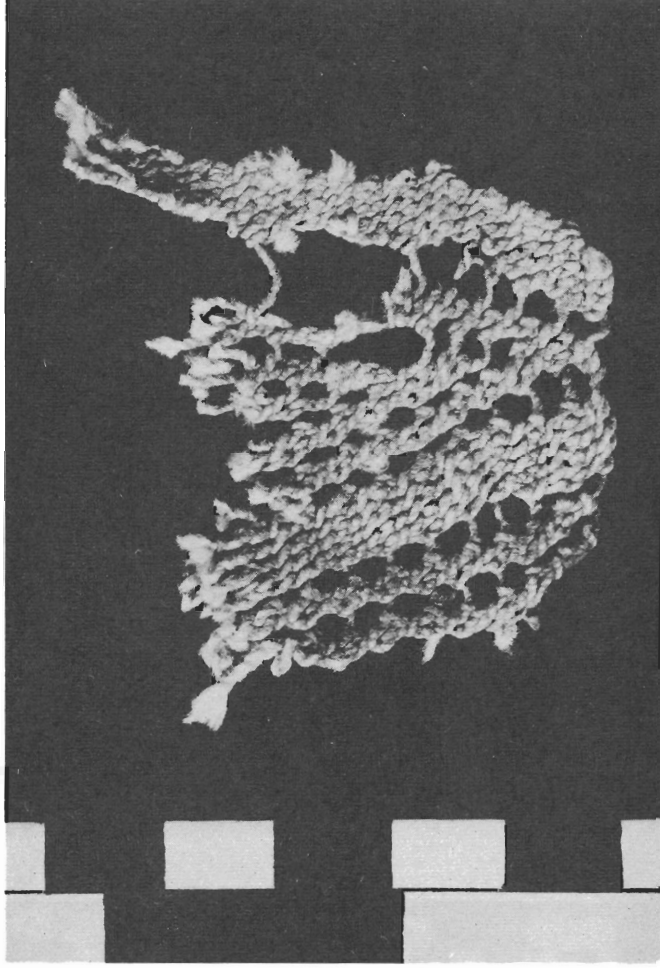


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Plate V. Repaired cotton rag in semi-basket weave and knotless net fragment. Example of mending with knot-stitch (fig. 10); knotless netting in "Hourglass" variation (fig. 11). See Plate IX, fig. 22 and key to illustrations.

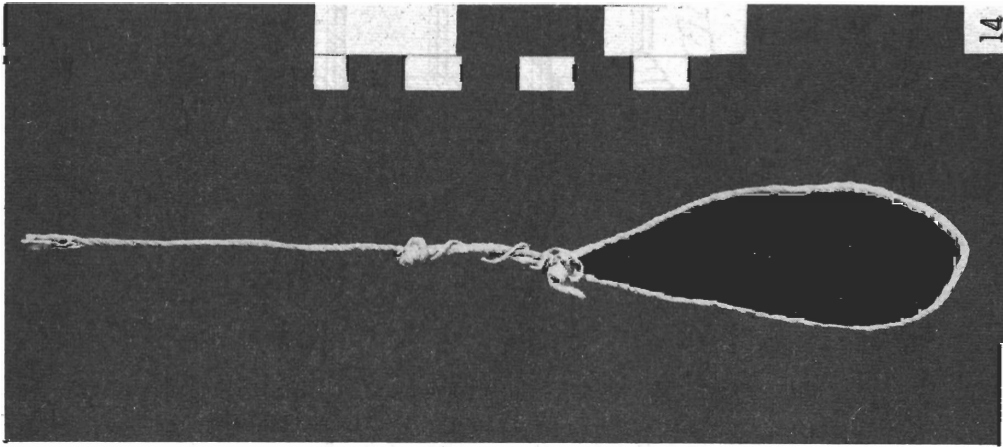


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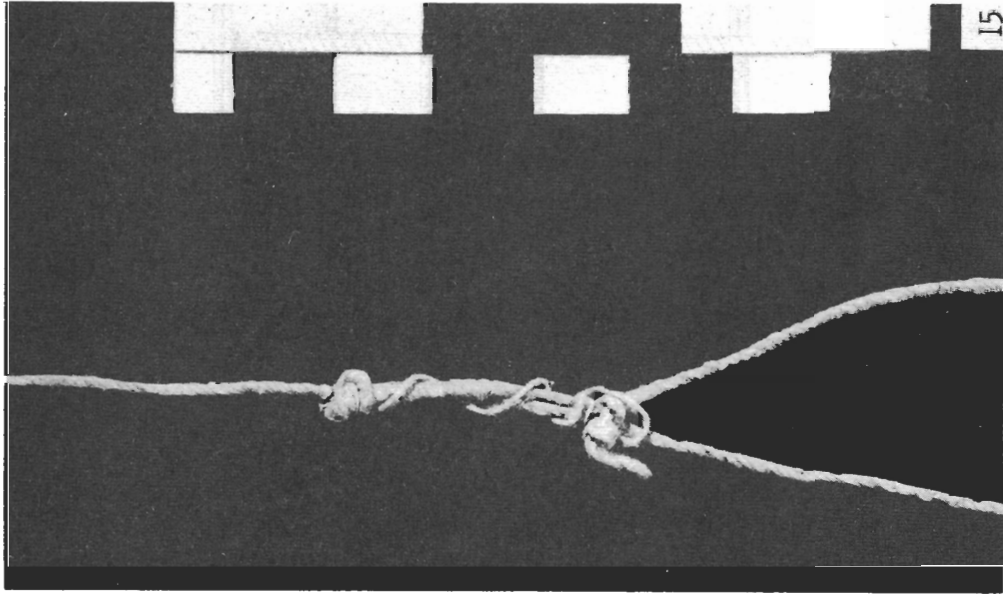


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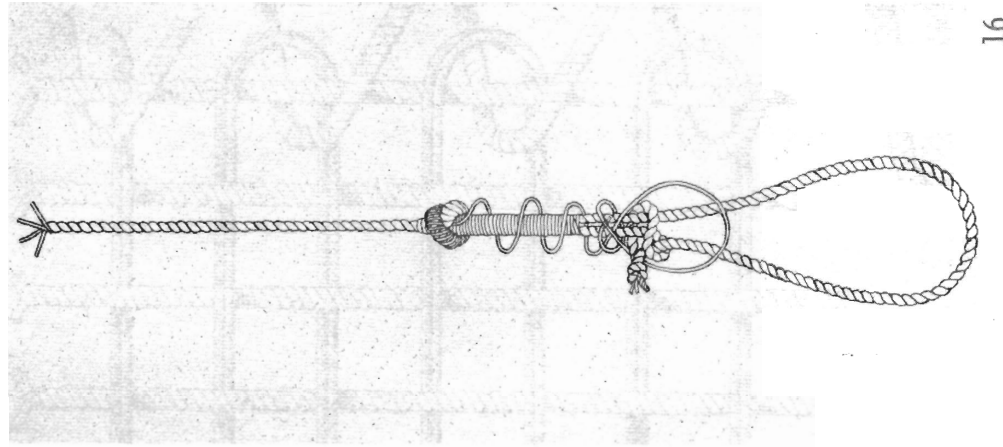
Plate VI. Examples of knotless nets in "Hourglass" variations. Detail of edge finish in a "simple loop" variation (fig. 12); fragment of patterned net, bottom edge is intact, other edges broken (fig. 13). See Plates IX, figs. 22, 24, X, fig. 25, and key to illustrations.



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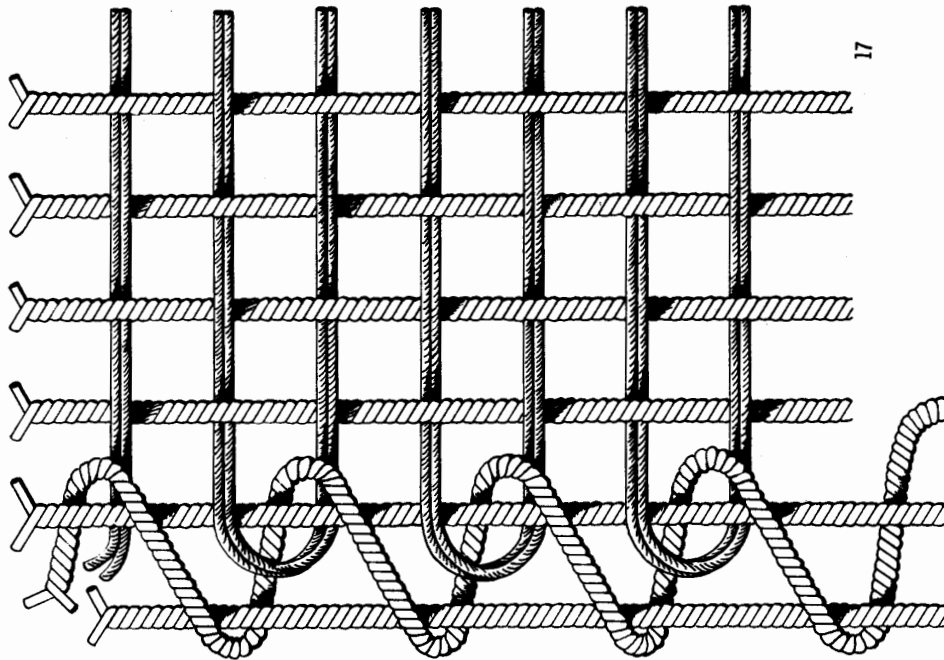


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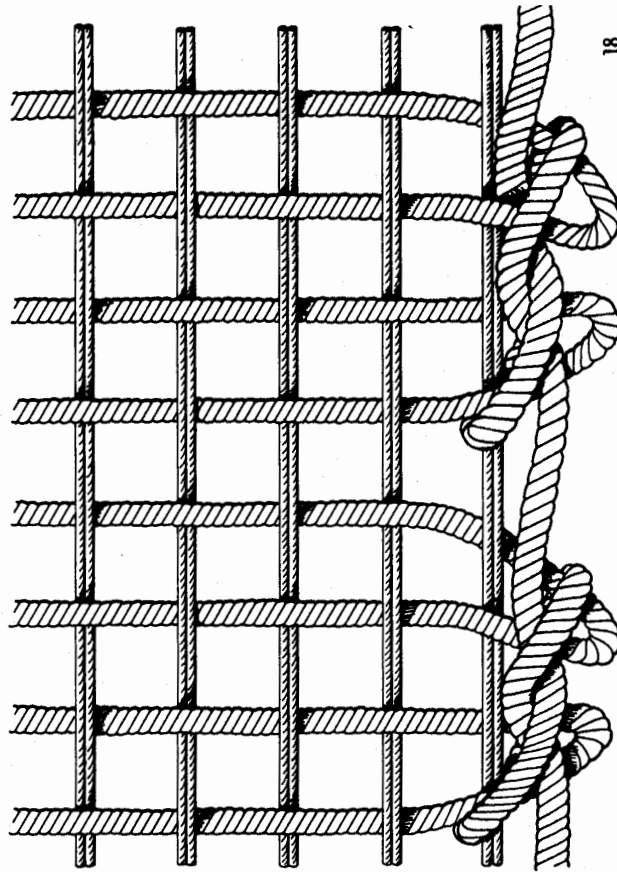


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Plate VII. Noose of cotton yarns. Whole (fig. 14); detail of center portion (fig. 15); technical drawing of the structure (fig. 16). See key to illustrations.

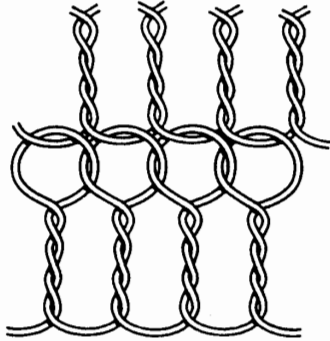


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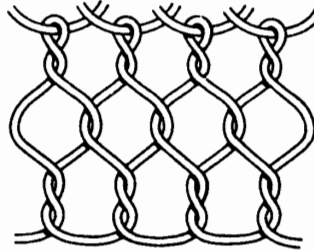


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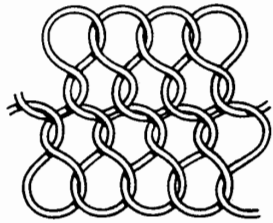
Plate VIII. Technical drawings of reenforced selvedges. Weft selvedge with extra yarn bound to outer warp (fig. 17); warp selvedge with extra yarn knotted around warp ends and passing over paired wefts (fig. 18). See key to illustrations.



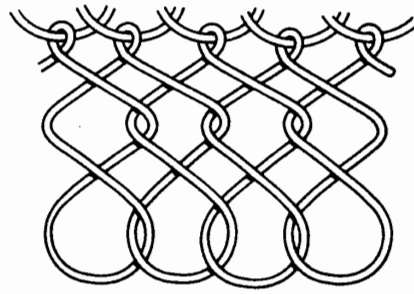
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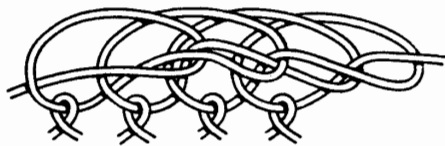
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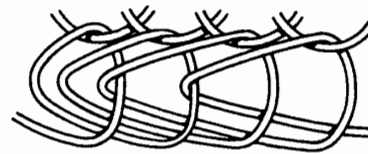
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Plate IX. Knotless netting structures. "Loop-and-twist" variations (figs. 19, 20); "Hourglass" variations (figs. 21, 22); "Simple Loop" starting and finishing methods on one net (figs. 23, 24). See key to illustrations.

