

TEXTILES OF ANCIENT PERU AND THEIR TECHNIQUES



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TEXTILES OF ANCIENT PERU
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Introduction

IN A PREVIOUS study (Harcourt, 1924) I endeavored to show, with the aid of selected examples, the degree of perfection and decorative beauty attained in Peruvian weaving in pre-Spanish times. I wanted especially to draw the attention of artists to a human production then known to only a small number of people. I also added to the plates there reproduced an explanatory notice that could be understood by the general public. Here my purpose is different. I wish to describe in detail all of the ancient techniques that examination of Peruvian weaving, network, needle-made fabrics, and plaiting has revealed to me, as well as the techniques of embroidery, and to show to what extent they are connected with one another and can be grouped together. This study seems to have been neglected up to now. We shall see that, before the arrival of the Europeans on the new continent, the Indians had invented very intricate techniques, which gave their textiles an extremely rich and varied effect, often comparable, and sometimes even superior, to those obtained in the Old World in the days before machinery had developed the possibilities of spinning and weaving to their present extent. Thus, the inventions of an industry due solely to the skill of the Indians will be specifically described. This study will serve as a trustworthy foundation for later comparative studies which space does not permit me to develop in this work. I shall be satisfied if these pages may also serve to revive in Peru and Bolivia the remarkable techniques that today have fallen into complete oblivion.

I have chosen as the cultural region for my study the central and southern portions of the Peruvian coast because they are the ones best known today and are the areas where the techniques appear to be most numerous. However, all the people of the coastal sections

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of this region were remarkable weavers; and their conquerors, the Incas, were certainly not inferior to them, as we know, thanks to a small number of specimens spared by man and time,¹ and thanks also to the evidence of the chroniclers. The excavations made at and to the south of Lima have been especially fruitful because of the protection afforded by the graves and because the particular dryness of the soil aided in their preservation. The specimens analyzed in this study came chiefly from the well-known archeological sites of Nazca, Ica, Paracas, Cajamarquilla, Ancón, Chancay, and Pachacamac.

Can the age of these textiles be determined? The specimens studied and used as examples in this work do not show any characteristics that can link them to the Inca period, which, strictly speaking, was a long one in the coastal area—from two hundred to three hundred years—and which came to an end with the arrival of the Spaniards. Furthermore, such diversified and perfected techniques could have been developed only by a civilization many centuries old. Some authors have tried to classify the fruits of their research in a relative chronology by studying the decoration of ceramics and textiles in the levels of excavated ground and correlating the more or less frequent uses of the same techniques. Others have gone even further and have attempted to fix the dates of the various periods. I shall gladly follow the first group but not the second, whose deductions, in the present state of our knowledge, contain too many hypotheses. The analysis of ancient organic matter containing radioactive carbon (C^{14}) has aroused great hopes of determining the age of archeological specimens. But the great diversity in the successive estimates of objects coming from the same place and the same stratum has caused the method to be considered insufficiently reliable up to the present time. It will be necessary to await the perfecting of the method before accepting without reservation the dates suggested by it. On the authority of Kroeber (O'Neale and Kroeber, 1930, p. 30), the variety and perfection of the textile techniques were almost as great in the most remote period he investigated, which goes back to the beginning of the Christian era, as in the period immediately preceding the coming of the Incas to the coast, which may be fixed as around the fourteenth century.² This single statement by Kroeber should make us cautious in assigning an age to a textile on the basis of its technique, or the degree of perfection of the technique. As to the persistence of styles, I have ascertained that the influence of the so-called Tiahuanaco civilization had not yet been extinguished at the time of the Inca epoch in the region of Lake Titicaca.

For complete information with respect to the quality of the textile materials formerly used in Peru, the method of obtaining the yarns, the structure of the fabric, and the methods of dyeing, I refer the interested reader to works already published.³ I shall con-

¹ The damp climate of the highlands rarely permitted preservation of funerary articles placed in the ground, other than those of stone or ceramics.

² One epoch varies from another in the percentages of use of the different textile materials and techniques.

TEXTILE MATERIALS

fine myself to the following more general summary.

The aborigines had at their disposal as primary materials the subdivided agave fiber;⁴ two kinds of cotton, natural brown and white; and the glossy wool of the llama and domesticated alpaca, as well as the finer and silkier wool of the wild vicuña. In rare instances they added human hair. An old chronicle mentions that the Incas sometimes incorporated gold and silver threads in their fabrics, but I have never seen a textile with these.

YARNS

The yarn, twisted by hand, without the aid of a spindle rotated or governed by a flywheel, was usually even and tightly twisted, often excessively so. Yarns were used in single form or in several joined strands, in conformity with the purpose for which they were required. Double or two-ply yarns predominated; of equal thickness, they were smoother and stronger than single yarns. According to Crawford, the fineness of the single Peruvian cotton yarns did not exceed No. 250, that is, either 210,000 yards to the English pound or 211,600 meters to 500 grams. These yarns are coarser than those of the delicate muslins woven in ancient times in India. On the other hand, according to the same author, the fineness of the two-ply wool yarns could reach No. 300, that is, 168,000 yards to the English pound or 169,250 meters to 500 grams, which is quite remarkable (Crawford, 1915, p. 81).

The intrinsic qualities of wool and cotton were recognized and used judiciously by the weavers of ancient Peru, and no errors can be pointed out in their use of fiber materials in the warp and weft of woven cloths. Such woven cloths might be made entirely of cotton or entirely of wool, but when the two fiber materials were used in the same fabric the warp was never of wool. There is no exception to this rule.

DYES

The ancient Peruvians had a very extensive range of colors. Their materials for dyeing and the method of their use are still, in part, unknown. In order to ascertain them, in addition to chemical analyses difficult to carry out in many cases and uncertain of result, research would be necessary in the localities where vegetable products or minerals are still used in the Andean highlands. I shall say merely a few words upon the obtaining of three essential colors: blue, red, and yellow.

³ See especially the works of Crawford (1915) and of Ephraim (1905) as well as the anonymous work entitled "Tecnología indígena" (1923).

⁴ American agave is commonly known in Peru as "cabuya."

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The Peruvians knew how to prepare a bath of light or deep indigo, which was done by the more or less prolonged immersion and reduction by fermentation of the leaves of various shrubs which contained coloring matter. When a fabric is taken from an indigo bath, it is yellow; it is the oxidizing action of the air that later turns it blue. The Indians knew how to obtain a range of very fast blues, from celestial blue to deep blue.

The reds came from vegetable and animal sources. The principal one was the insect cochineal, which gave a beautiful slightly carmine red. The cochineal is gathered from the leaves of the *Opuntia*. It is not known whether this small insect was bred on the coasts of Peru, as it was in Mexico. Dyeing with cochineal produces red or black, according to the mordant used, and it is interesting to note that the Indians in the area of Cajamarca still dye their fabrics black with this product. This leads to the belief that it was also used in this manner in former times.

Yellow often came from the bark of the false pepper tree (*Chinus mollis*), but many other substances were also used which are unknown to us at this time.

Violet and green resulted from successive dyeings of blue and red or of blue and yellow. The yellow could be simply the natural fawn color often found in the fleece of the llama, and in this case only one dyeing was necessary.

Wool is easily dyed, and the richest colors were obtained in this fiber. Cotton, on the other hand, requires mordants that the Indians did not use. Although indigo can dye cotton a satisfactory blue, cochineal, on the contrary, lacks intensity without mordant and thus was but little used for dyeing this fiber.

LOOMS

The looms were quite rudimentary. They consisted basically of two parallel bars (Fig. 3, *a, a'*), between which the yarns of the warp were stretched. The bars were sometimes kept separated by four stakes driven into the ground, or, for more delicate pieces, were attached to a small frame (Schmidt, 1911, Fig. 7, p. 9; Fig. 49, p. 60), but usually one of the bars was attached by means of a cord (Fig. 3, *i, i'*) to the branch of a tree or to a beam or rafter, while the other was held firm by means of a strap (Fig. 3, *j*) passing around the lower back of the weaver, who, by a single bodily movement, could increase or diminish the tension of the warp. That this method was common in Mexico and Peru is attested by the old documents reproduced in Figures 1 and 2.⁵ Peruvian looms generally belonged to the so-called horizontal type. The yarns of the warp were not connected directly to the bars, but to a small cord (Fig. 3, *c-c'*) running parallel to the bars and attached to them at intervals (Fig. 3).

The entire warp was exposed because the loom did not have a warp beam. The warp

⁵ See also the reproduction of a drawing of Huaman Poma de Ayala (1936, p. 564).

Introduction

yarn went from one of the cords to another in a regular lacing or wrapping movement. Because of this fact the woven pieces are all quite small in size. They possess four selvages, so to speak, but those at the ends,⁶ to which the term "tape" should not be applied, have not the same appearance as those at the sides. It is only in rare instances that the direction of the weaving cannot be discerned by the practiced observer. This distinction is important when one wishes to reconstruct techniques and methods of work, and I have found



Figure 1. Reproduction of a scene painted on a vase from Trujillo (British Museum, London)



Figure 2. Reproduction of a scene from a Mexican manuscript (Kingsborough, 1831-48, p. 61)

that where one of the elements, warp or weft, was given a predominating role, there was a corresponding method of weaving in which the other element played this part. I shall demonstrate this in the course of the following pages.

Pieces of fabric two or three meters in length are not unusual in plain weaves, made of fairly coarse yarn, but in the fine fabrics, and especially in tapestries, these dimensions rapidly dwindle. The widths of the fabrics do not exceed the space within which a woman could freely pass the bobbin from hand to hand, which is generally 60 to 75 centimeters [23 to 30 inches] (exceptional maximum in joined plain-weave fabric 130 centimeters [51 inches]); certain delicate braids are less than 1 centimeter [$\frac{3}{8}$ inch] wide. When a very large cloth was required, either two pieces of normal width were sewed together at the selvages, or, by a more elegant method, a common yarn connected them, threading alternately the looped ends of the weft yarns of each cloth.⁷

In the course of making a plain weave, a stick—usually a large reed (Fig. 3, *b*)—separated, and kept separated, the yarns of the warp into two groups of leases, each comprising yarns of odd and even rows. By means of a system of convenient small loops (Fig. 3, *h*), a shedding stick (Fig. 3, *g*) permitted the automatic raising of the groups of yarns placed by the large roller under the other group (see Fig. 3, *b*). Thus the alternate cross-

⁶ This relates actually to the ends in which the yarns of the warp are not cut, but form loops, as do the yarns of the weft on the side selvages.

⁷ See also on this subject O'Neale and Kroeber (1930, p. 30, note 15).

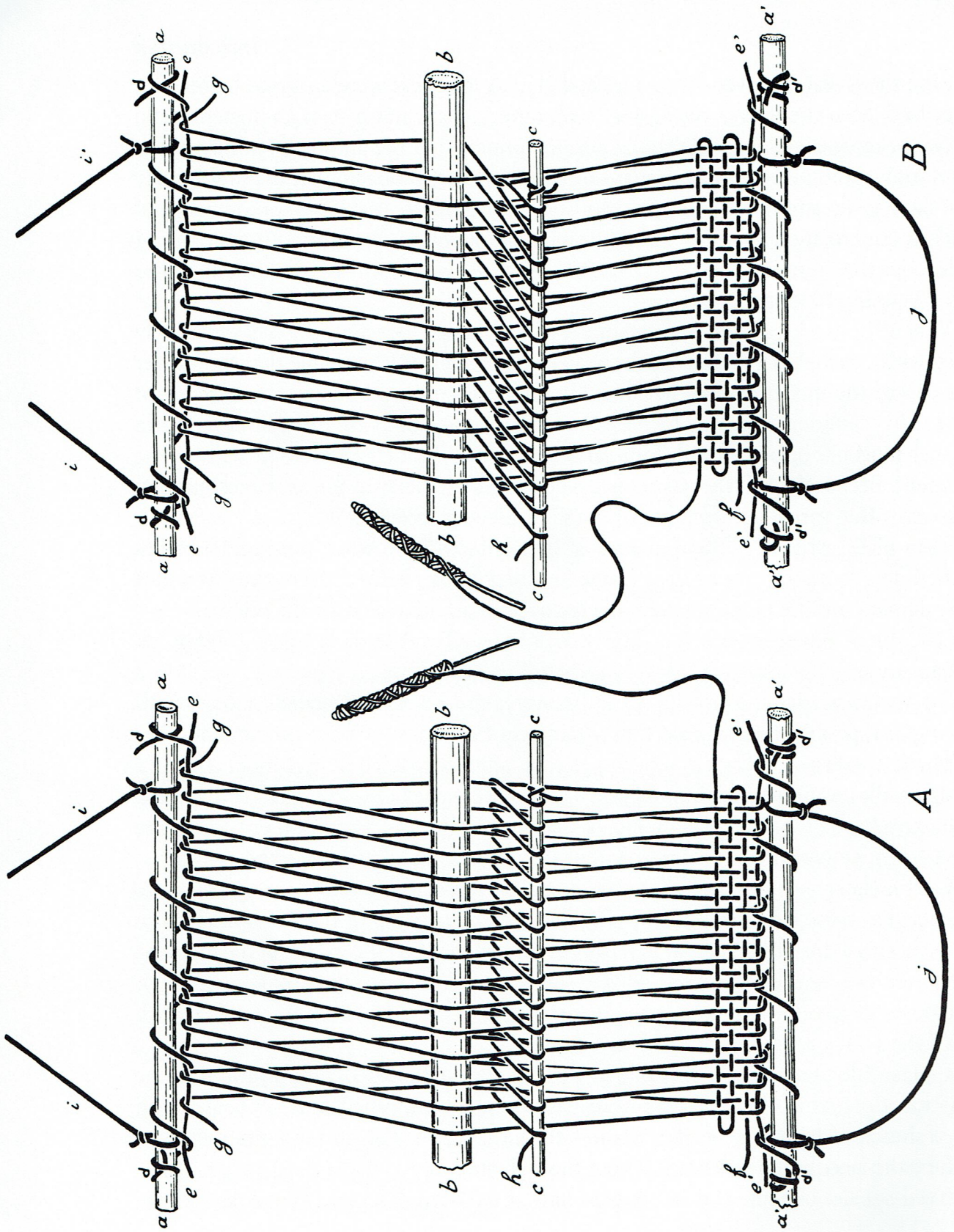


Figure 3. Common form of the ancient Peruvian loom. A: heddle lowered, odd yarns raised by rod *b*; B: heddle raised, even yarns lifted. The parts of the loom are: *a*, *a'*, loom bars supporting warp for weaving; *b*, coarse rod or roller separating the two warp sections; *c*, small rod which, with the loops formed by yarn *h*, constitutes the only heddle of the loom; *d*, *d'*, cord that secures *e*, *e'* to the loom bars; *f*, weft yarn supplied by the bobbin; *g*, continuous warp yarn; *h*, heddle loops; *i*, *i'*, small cords used to attach the upper loom bar to a given position; *j*, girth passing from the opposite loom bar around the lower back of the weaver

ing of the sheds was achieved (Fig. 3, A and B).⁸ A long, flat wooden blade helped the weaver to tighten the weft yarns against each other. I have never seen an ancient loom with two or more shedding sticks, but, since the principle of the automatic raising of the warp yarns was discovered by the Indians of Peru, it is very probable that the multiplicity of heddles had already been applied in intricate weaving; O'Neale (1946) is convinced of this. Furthermore, there has been found in an uncompleted narrow fabric a series of small heddle loops that permitted the automatic raising of the warp yarns for the making of the design (Wardle, 1936, pp. 35 f.).

When the work consisted of a fabric with an intricate design, the weaver usually worked with a model as a guide, which she kept before her. It is probable that the worker either copied the model or used her own interpretation of it, as circumstances required (Fig. 1). In examining Peruvian textiles, the fact that the loom gave the weaver but little assistance must not be overlooked. Manual skill, however, made up for the rusticity of the instrument. Because of this the worker had a good deal of liberty in the use of techniques, which were often varied in the course of the same piece of weaving.

Torn pieces of fabric, or garments that had suffered from wear, were undoubtedly stretched on a loom, or at least on a frame, in order to be repaired. Here they were not merely darned, but the fabric was actually rewoven in accordance with the original crossing of the yarns; numerous examples bear this out (see Garcilaso de la Vega, 1609, Book IV, chap. xiv).

To my knowledge, no archeological discovery, and no evidence contemporary with the Conquest, permits the assertion that the ancient Peruvians used any instrument other than a needle with an eye for joining yarns to each other or to a fabric. Crochet hooks and knitting needles seem to have been unknown. There were needles with eyes in both curved and straight shapes, of metal, of fishbone, of wood, and of thorns. Some of them must have been very fine, suitable for the close work that still arouses our admiration today.

Cactus thorn needles must have predominated. An examination of the eyes leads to the belief that these were obtained by simple lateral perforation of the thorn made with another thorn used as a bodkin. The eye must have been made by the worker at the moment she required the needle. In coastal graves, small plaited baskets containing weavers' or embroideresses' accessories sometimes contain boxes of carved pelican bone, filled with cactus thorns not yet transformed into true needles.

I, personally, have found only one fine cactus needle threaded with a yarn; this one was with cotton yarn. The threading must have been accomplished simultaneously with the perforation of the thorn needle by another thorn, that is, the yarn was simply forced into the thorn needle and was not truly put through an eye.

Eyed needles of copper, silver, or gold have often been described. To make the eye,

⁸ See also Schmidt (1911, p. 7, Fig. 5).

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the end of the needle opposite to the point was bent into a rounded hook, which was then caught between two flanges formed by flattening the needle stem near the end of the bent-over hook. These flanges were then hammered and closed around the end of the hook, making a coarse, round, closed eye. Metal needles are relatively coarse. I have never seen curved needles; however, they would appear necessary for certain types of work.

I shall not attempt to describe the harmony of color of the Peruvian textiles. As for the interesting decorative designs, the plates in this volume speak for themselves. An explanatory account of each of the specimens reproduced will be found preceding the plates.

The methods of weaving and knotting and the stitches that I am going to describe have all been reconstructed by me; I can guarantee, therefore, that their execution is feasible, without claiming, of course, that the weaver followed exactly the same procedures I did, and that she may not have used actions of the hands which were different or more practical.

To avoid uncertainty, I shall specify some definitions and also the meanings I attribute to certain words:

Woven cloth: the product obtained by the intercrossing at right angles of yarns divided into at least two elements—warp and weft (muslin, tapestry, etc.).

Warp: the assemblage of parallel yarns stretched between the two loom bars.

Lease: the assemblage of warp yarns raised simultaneously to allow passage of the weft yarns; in plain weave, the assemblage of even or odd warp yarns.

Warping: the operation that consists of placing and stretching the warp yarns between the loom bars, with a view to their being crossed by the weft.

Weft: the yarn that crosses the warp perpendicularly.

Weft row: section of the weft yarn comprised between the two side selvages.

Plaiting or braiding: the product obtained by the regular interlacing of yarns originally arranged in the same way as the leases of warp, that is, with alternating odd and even yarns.

Draft: planned preparation of the elements of woven cloth or braid.

Network or netting: needle or single element construction, usually made of loops or knots.

Embroidery: ornamental yarn incorporated by means of a needle into a woven, needle-made, or plaited fabric after it has been constructed.

Introduction

In spite of the inconvenience that may result, I am refraining from using the names of current techniques to designate the ancient ones that merely resembled them, but were basically different, nor shall I use the name of a country in connection with a general technique of world-wide use. Thus, the words "velour," "knitting stitch," "Gobelins," and so forth will be avoided, as their use has already caused too much misunderstanding.

The assistance afforded the study of Peruvian weaving by the ancient chroniclers is negligible. Although some of them, such as Garcilaso de la Vega (1609, Book IV, chaps. ii and xiv), Cobo (1890-95, Book XIV, chaps. ii and xi), and Huaman Poma de Ayala (1936), did speak of weaving and woven fabrics, they touched only upon generalities and cast scarcely any light upon the problems required to be solved.

TEN

Plaiting or Braiding

FLAT BRAIDING or plaiting is formed by the regular intersecting of two sections of warp in a chosen plan; these warps, separating from the perpendicular, proceed first in opposing directions, and then meet to form an angle, usually in the neighborhood of forty-five degrees from the perpendicular (Fig. 44, *a*). The yarn sections cross each other, therefore, at approximately right angles. The sections, in relation to each other, have the reciprocal functions of warp and of weft. Because of their oblique direction, the yarns reach the lateral selvages successively; there they are folded over and begin once more their course, making an angle with the perpendicular that is complementary to the first one. The simplest form of plaiting is represented by the flat plaiting with three strands that everybody knows.

The oblique progression of the two sections and their interchangeable character in the plaiting make possible the locking of the yarns be-

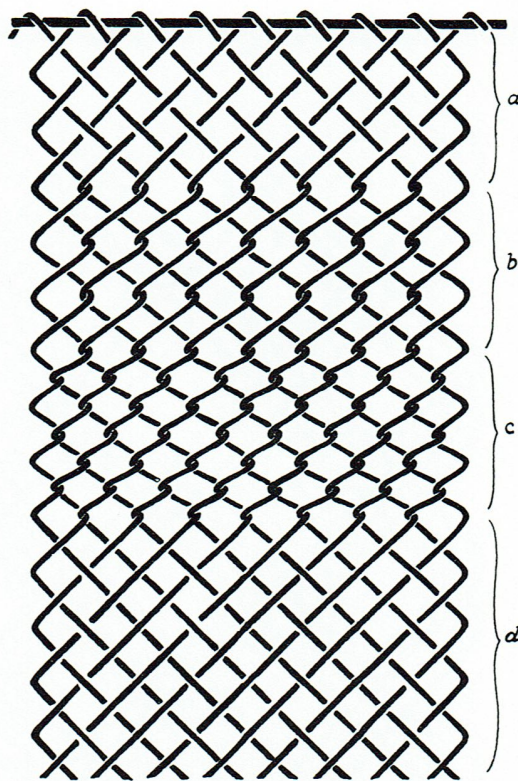


Figure 44. Draft of ordinary plaiting in which the yarns cross each other (*a, d*) or interlock (*b, c*)

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tween each other in a manner that cannot be accomplished in weaving; thus, instead of two yarns each belonging to a different section crossing each other and continuing their progress, they can lock around each other and substitute for each other in their further passage (Fig. 44, *b, c*). This special method leads to multiple combinations, according to the intervals and order of the interlocking. Because of its simplicity, plaiting often precedes weaving with two elements, warp and weft, and it is known to have been used by many primitive peoples. Basketry is no doubt one of its first forms. In the course of centuries, however, plaiting among the Peruvians developed complex forms whose techniques were often derived from weaving. With this explanation, it will be understood why weaving has been studied first.

The methods of plaiting can be grouped under two different headings, depending upon whether or not the lower ends of the yarns are left free in the course of the operation. These methods will be studied successively.

PLAITING OF YARNS WITH THE LOWER ENDS LEFT FREE

It is almost certain that the worker, to facilitate the weaving operations, rolled each yarn into a small ball or wrapped it around a reed to serve as a bobbin. This was particularly necessary for fabrics of large proportions, requiring work over a long period of time.

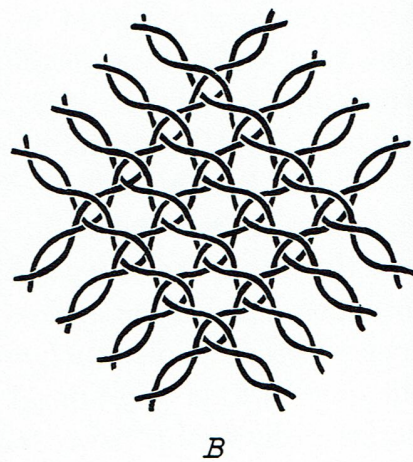
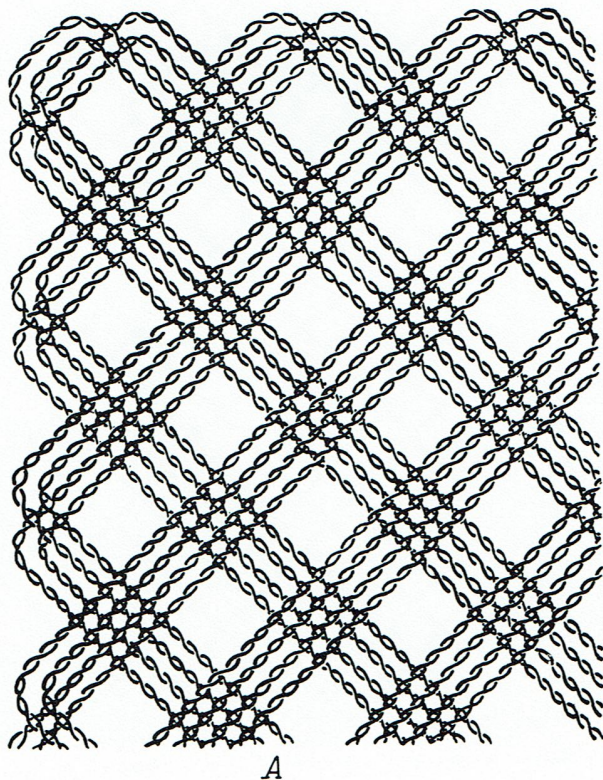


Figure 45. Method of weaving of the specimen shown in Plate 54, B; the yarns in each passage twist around each other by twos. A: general appearance of the plaiting; B: arrangement of the yarns in crossing

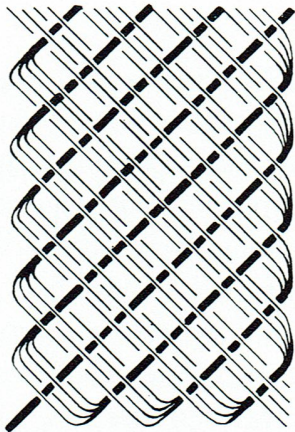
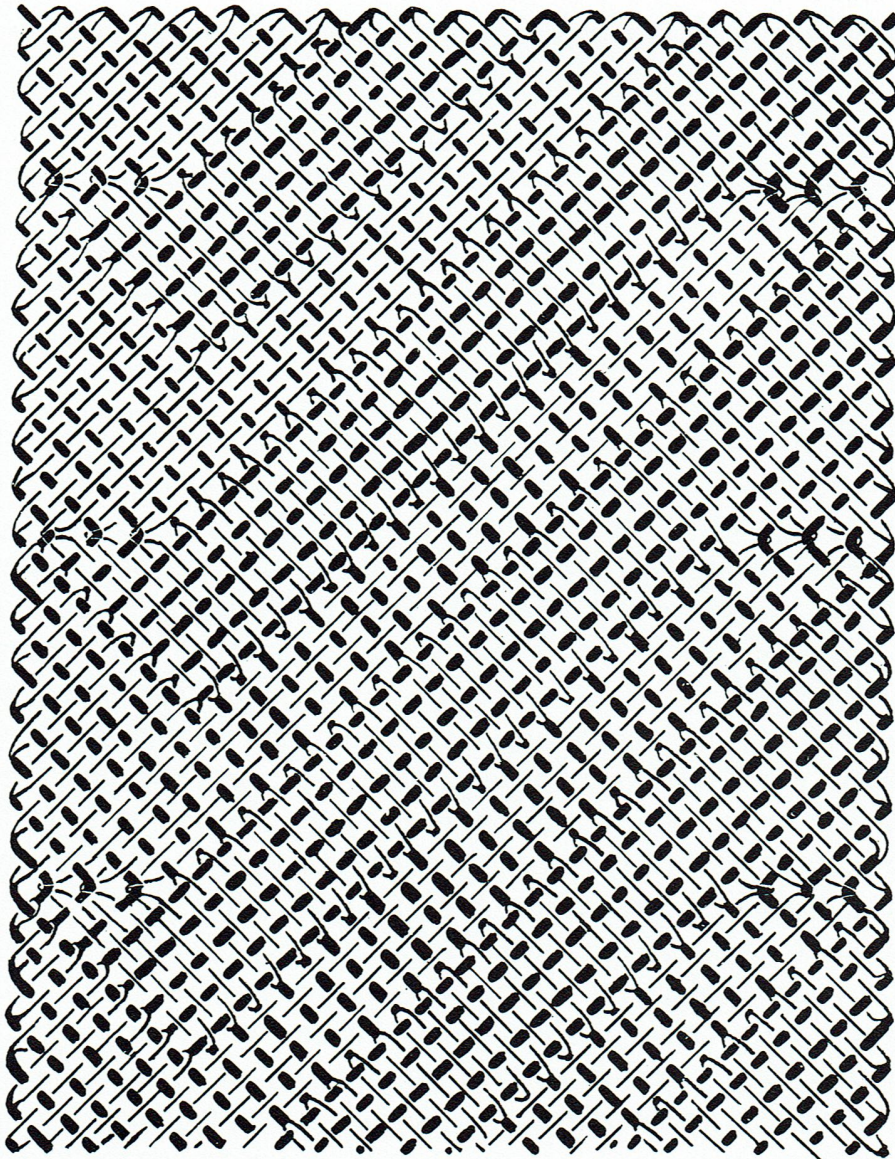


Figure 46 (left). Schematic plan of the yarns of the braid shown in Plate 55, B

Figure 47 (below). Detail of arrangement of the yarns of the band shown in Plate 55, C



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The specimen shown in Plate 56, A, enables us to advance this theory without fear of error.

Plaiting, like weaving in this respect, can be of plain construction or of irregular construction. Figure 44 shows the simplest plan of plaiting, upon which I shall not dwell further.

Plaiting with twisted yarns

Plaiting can be accomplished by a method of twining the yarns of the two warp sections around each other, in pairs, always in the same direction (as opposed to the principle of gauze). The rule for crossing the yarns is clearly shown in Figure 45, B, while Figure 45, A, demonstrates precisely how the work as a whole was carried on. It is similar to the principle applied to the making of bobbin lace. By plaiting with twisted yarns, very open fabrics can be produced that are delicate but cannot be distorted. Plate 54, B, shows a simple example (see also O'Neale and Kroeber, 1930, Pl. 7, a). A more compact fabric can be made when the yarns contact each other. This method was also used in plaited specimens in which the yarns were held fast at their two extremities.

Plaiting with only one element visible

As in woven cloth with only one element visible—reps—plaiting may also have one of the warp sections covered and concealed by the other section, with the special characteristic that the roles are reversed at the point where the oblique yarns, reaching the selvage, start out in their new direction. This principle is applied to fabrics of quite diverse appearance. Following are some of the types which I have had the opportunity to study.

First type (braid B of Pl. 55). The braiding is commenced with two groups of equal numbers of yarns (twenty-four in the braid in question); one group is light and the other dark. The group beginning in the upper left-hand corner will have the function of the covering group, which will proceed obliquely toward the right, and these yarns, like those in rep, will then "weave" (one yarn above and one yarn below); in so doing they cover the passive yarns of the other group, which have been arranged in two subgroups [of twelve yarns each], and which progress obliquely toward the left. Thus, in the specimen shown, each group has twenty-four yarns, and each is divided into two subgroups of twelve yarns during its passive role. The first two subgroups, which are passive, upon reaching the left-hand selvage, re-form their original group of twenty-four yarns and, progressing in a new direction (to the right), become an active and covering group; the second of the original groups, reaching the right-hand selvage, divides into two passive subgroups and progresses in its new direction (to the left). The plaiting continues according to this rhythm and re-

sults in a fabric formed of different-colored, oblique, parallel bands. Figure 46 has been simplified in the interest of clarity: the twenty-four yarns are reduced to four, and in their covered parts they are all joined without being divided into subgroups. The method of plaiting shown in the figure is not any less exact because of this simplification.

Second type (specimen C of Pl. 55). The Peruvians succeeded in plaiting pieces of fabric likewise made of different-colored oblique bands, but which were crossed; each of them, after having crossed the fabric diagonally from right to left, in such a way as to be visible at all times, crossed again from left to right in such a manner as to be visible only at intervals. To achieve this result, it was necessary to maintain the arrangement of alternately "covering-separated" yarns and "covered-grouped" yarns, and to pursue it in a still more complex fashion. It was necessary also to be able to reverse the direction of the crossing of the yarns in each of the sections. This is shown in Figure 47, a scheme by which the groups of yarn are reduced to a thick line in the covered parts and to two light lines in the covering parts.

Third type (braid A of Pl. 55; see also O'Neale and Kroeber, 1930, Pl. 17, f). In this type of plaiting, the yarns of the two sections are arranged in pairs of the same color, which are always used together. The yarns of the left half of the first section are passive and covered in pairs during half of their passage, that is, up to the middle of the braid, while the corresponding yarns of the second section, during the same passage, are active and covering, like the twined or twisted warp yarns of the fabric studied on page 62. These yarns are twined in pairs, one around the other, taking up in each crossing the pairs of the passive yarns. The direction of the twisting of the pairs of yarns alternates regularly. In the second half of the braid (at the right), the yarns of the two sections have a reverse role, that is, upon reaching the center of the work all the passive yarns become "covering," and all the active yarns become "covered." At the selvages the roles are again reversed. Two special features may be noted in Figure 48. First, the yarns of the right and the left halves cross each other at right angles, but they form, respectively, a lower and an upper angle of forty-five degrees with the perpendicular. The passive yarns, at the point in the center of the braid where they change their role and become active, modify their direction in order to cross the newly passive yarns of the second half of the braid at right angles. Second, to introduce variety into the appearance of the braid, the weaver, at intervals, maintained the passive character of two of the pairs of yarns in the second half of their passage; these yarns cross each other in the form of an X, while the active yarns continue their covering role

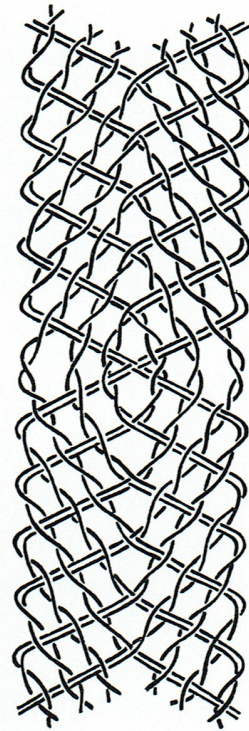


Figure 48. Arrangement of the yarns of the plaited braid shown in Plate 55, A, central part

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after having changed their direction, as shown in the center of Figure 48. The concentric lines that appear in the central part of specimen A of Plate 55 were obtained in this way.

In plate 60, D, will be found a braid of wool in four colors which combines the second and third types of plaiting discussed above. It makes use of the principle of yarns alternately covering as separated yarns and being covered as grouped yarns according to the requirements of the design and the principle of yarns twisted by pairs. Thus, in their covered section, the yarns of one color are joined in groups of four; in the section where they are covering, these yarns are twisted around each other in pairs, taking up in each spiral the four grouped yarns; the direction of the twisting of the yarns is reversed from one pair to the other.

Plaited passementerie

A passementerie from Nazca (Pl. 59, F) makes use, with some modification, of the third type above. It consists of two plaited bands placed parallel to each other, joined in the center and bound on the exterior edges by a small decoration in regular zigzags, likewise plaited (Fig. 49), which can also be seen in specimen B of Plate 67.

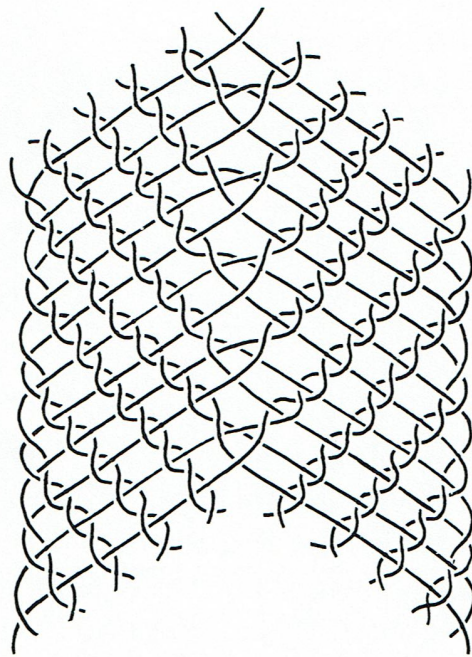


Figure 49. Method of plaiting of the narrow braid shown in Plate 59, F

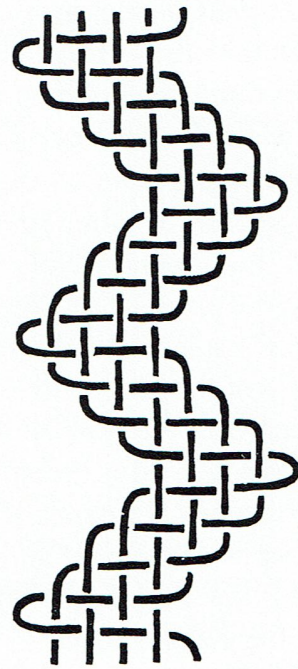


Figure 50. Method of plaiting the yarns joining and bordering the braids of the passementerie shown in Plate 59, F

The yarns of the braids and those of the decorative zigzag use local wrapping of the yarns in order to effect color changes (see p. 60).

Plaiting or Braiding

The method of plaiting of the two braids is very similar, as I have said, to that described above. It differs, however, in two particulars that completely change its appearance. The pairs of yarns intended to twist around each other all turn in the same direction for each half of the width of the braid, instead of changing direction one after the other; and these pairs of yarns, in their successive twists, cover only one yarn at a time instead of grouped yarns in the parts in which they function as hidden weft (Fig. 50). The plaiting is very close.

Double plaiting

The Peruvians applied the principle of double-cloth weaving to plaiting. Specimen E of Plate 55 gives an interesting example of this application (see also Pl. 31, A). For double plaiting one system of suitably colored yarns (as in all plaiting divided into halves with alternately active and passive roles) is superimposed upon a second system of differing colors, which is simultaneously fashioned in the same manner as the first. As in double-cloth weaving, the two systems are substituted for each other by interpenetration when change of color makes this desirable. The use of the double systems does not render this type of plaiting especially difficult, as only simple crossing of yarns or their twisting by pairs is involved.

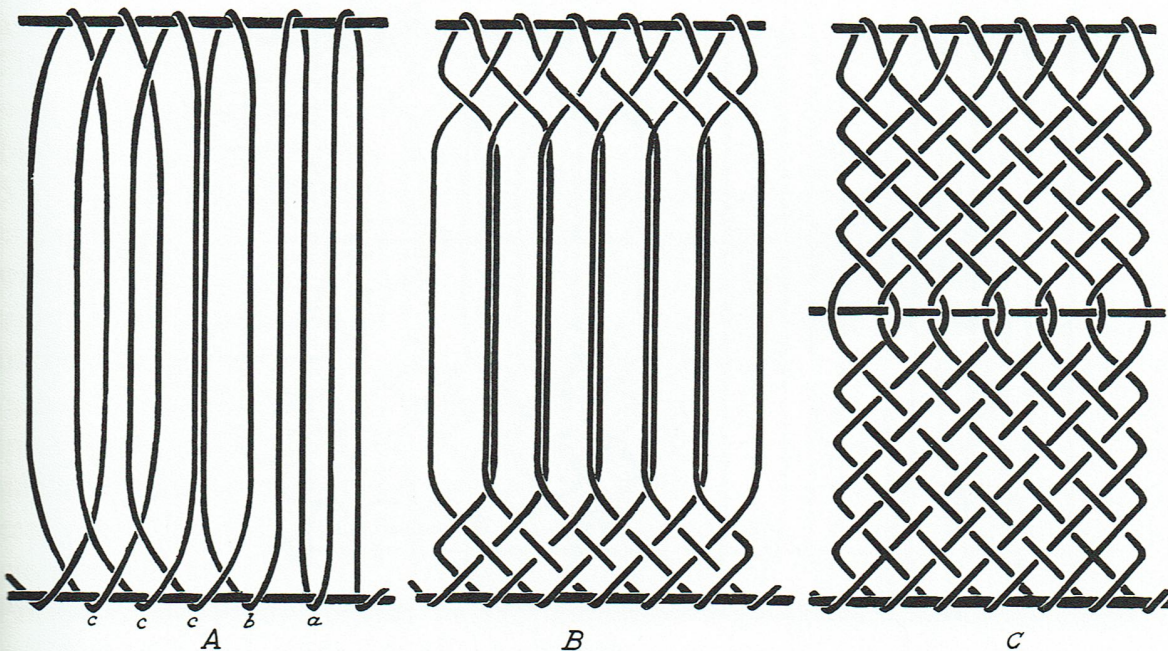


Figure 51. Detail showing the successive steps in the making of a braid whose elements are secured at their two ends (plaiting by crossing of yarns). A: the beginning of the plaiting; a, yarns not yet crossed; b, first stage of yarns crossing each other; c, second stage; B: plaiting in process; C: plaiting finished and transverse yarn in the center to hold the plaiting

Simple plaiting

There is another method of plaiting in which the yarns are arranged in the beginning like those of an ordinary warp (Figs. 51, 52) and are kept stretched during the plaiting operation, but in a sufficiently elastic manner to allow for the progressive shortening of the yarns resulting from their oblique passage. The yarns are crossed or twined by taking them between the fingers, or with an instrument, at the center of their length. Because they are secured at the ends, each crossing or twining that is produced in the upper part of the yarns is likewise reproduced in the lower part, but in a reverse direction. The plaiting is thus carried on at the two extremities of the yarns, and the successive rows gradually draw near to each other at the center (Figs. 51, C; 52, B). A point is reached at which the fingers can no longer function because the yarns are too short, and a finer instrument must be substituted for the fingers (hook, small wooden or bone rod, or the like). In the last operation, a yarn is passed like a weft through the center of the fabric to prevent the disintegration of the crossing and twistings.¹

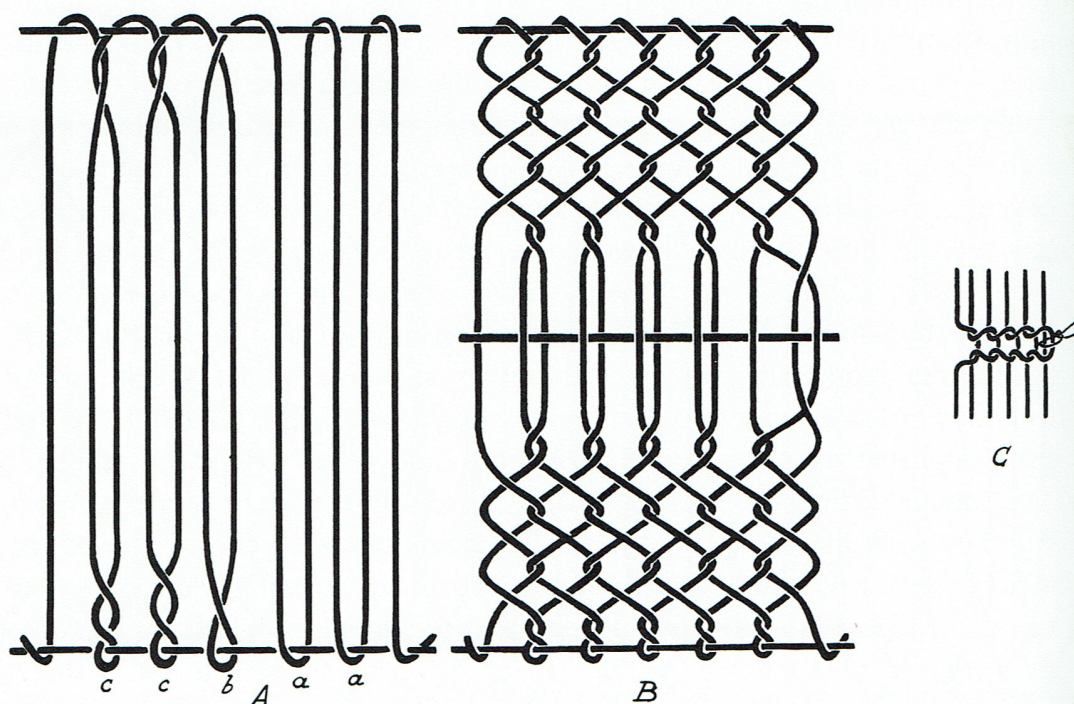


Figure 52. Detail showing the successive steps in the making of a braid whose elements are secured at their two ends (plaiting by interlocking of yarns). A: the beginning of the plaiting; a, yarns not yet interlocked; b, first stage of yarns interlocking; c, second stage; B: plaiting in process; C: chain of self yarns securing the center of the plaiting

¹ For explanations concerning this type of plaiting (still well known in Sweden under the name of *sprang*) see Reesema (1926).

Plaiting or Braiding

The small bag shown in Plate 54, A, indicates clearly the reversed direction of the crossings where the transverse yarn just mentioned passes.

In the case of plaiting with intercrossed yarns, the fastening of the work in the center may also be achieved in another way; when the successive loopings of the upper part and the lower part have almost met, the yarns, in the short space in which they are still free, are made to overlap each other and to form a little chain, which is shown in Figure 52, C, and Plate 56, B. Finally, it is only necessary to join together the last loop of the little chain and the yarn at the edge of the fabric, to keep the whole plaiting in position.

Plaiting with yarns fastened at their extremities was known to the Peruvians. It permits of most diversified construction. By the intentional omission of intertwining among certain yarns it is possible to form open spaces, which can be arranged as designs (see Fig. 52, Pl. 56, B).

Double plaiting

The making of the specimen reproduced in Plate 57 presupposes the complete mastery of a technique that is in this case particularly complex. We have just seen that double plaiting with yarns left free at the lower edge was a technique used in Peru. Plaiting was also done, and perhaps with greater facility, with the yarns fastened at both extremities—a veritable warping of yarns, like the two superimposed warps in double-weave cloth. Decorative neck coverings were made in this way, especially in the Nazca region. These neck coverings consisted of two similar sections, which were fixed to the sides of the head by means of little cords; a sample showing only one of the two parts is reproduced in Plate 57. Two systems, each made up of the usual two sections, one red and the other yellow, arranged like those in Figures 51 and 52, were superimposed, and the plaiting of the two was pursued simultaneously at the two extremities, as I have just explained, but with the substitution of one system for the other in order to obtain a design. When the central part of the still unplaited yarns was reduced to about 8 centimeters [$3\frac{1}{8}$ inches], the plaiting operation was discontinued and the piece of work, separated from its supports, was folded in half in the middle of the unplaited yarns. The lateral selvages were sewed together. The unplaited center yarns, which formed the top of the neck covering, were pressed against each other, then joined together by lines embroidered in loop stitch. Examination of the piece of work, the interior as well as the exterior, leaves no doubt as to the method used. Finally, it may be remarked that the rules of the crossings of the yarns vary in the course of operations: the respective systems at the beginning and at the end of the plaiting are different, and the yarns in each of them intercross by fours, but in the whole central area, where the yellow and red sections are substituted for each other, different and varied construction will sometimes allow simple crossing of the sections, and sometimes the inter-

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twining of the yarns from one system to the other. The specimen shown in the first plate of *Art of Old Peru* (Lehmann and Doering, 1924) was made with a technique similar to that which has just been described (see also O'Neale and Kroeber, 1930, Pl. 21).

Double plaiting can be still more complex. Instead of two superimposed sections, some neck coverings use four. Double plaiting takes place between the two paired sections, but at intervals all the yarns cross each other at the same level, so that the two lower sections take over the uppermost position and vice versa. Let us assume that the first two sections are red and yellow, and the other two green and blue; the piece of work will be composed on one face of a plaited red and yellow band, followed by a green and blue band, then a red and yellow band; on the other face the order of the bands will be reversed. Such is the case with the specimen shown in Figure 54. As the method produces a quadruple

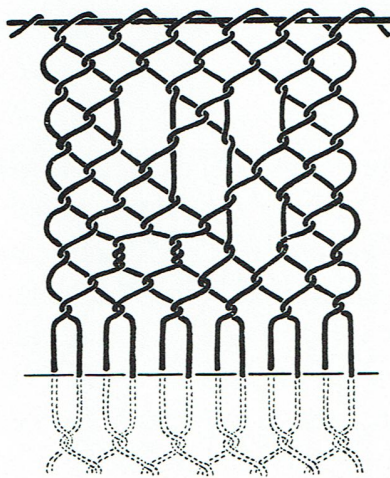


Figure 53 (above). Arrangement of the yarns of a braid made by interlocking of the yarns, resulting in open spaces and double interlocking. The figure shows only half of the specimen

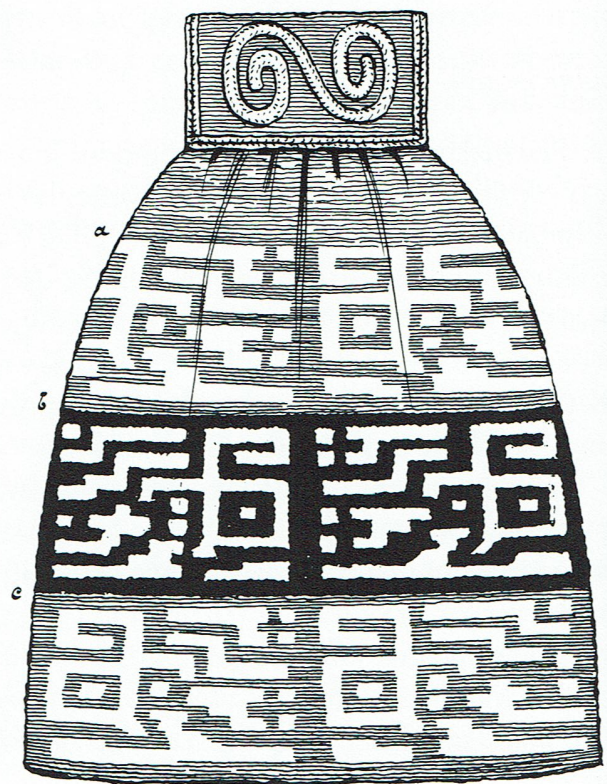


Figure 54 (right). Part of an ornamental neck covering made by the superimposition of two double plaitings made of yarns twisted in pairs, one blue and green, the other yellow and red, which reverse their elements at points *b* and *c*. Above point *a*, the specimen consists of four thicknesses of simple plaiting

plaiting, that is, four superimposed thicknesses, the fabric will be of sufficient density and thus will not require the folding and lateral sewing of the specimen reproduced in Plate 57. Here the worker merely cut the fabric in two at the center, after having firmly tightened and secured to each other the nonplaited yarns that were to form the top of the two parts of the neck covering; thus the worker obtained at one step the two similar pieces that together formed the complete neck covering (Pl. 58).

PLAITED CORDS AND PLAITED COVERINGS OF CORDS

In addition to the straps and narrow bands plaited in simple structure (Pl. 31, B) or in complex structure (Pl. 55, D), the Peruvians made cords with round or square cross sections by plaiting together four, eight, sixteen, or more strands. The plaiting of these cords, which no doubt had multiple uses, is chiefly revealed in the slings taken from graves. Contemporary Indians of the highlands continue to use many of the ancient methods in making their slings.

Plaiting with square cross sections using eight strands can be done in several ways. It may be assumed that it was done in the following manner. At the beginning the strands are divided as shown in Figure 55, into two equal groups; in each of these the strands are numbered 1, 2, 3, and 4 from the exterior to the interior. Strand 1 on the left passes under its group, emerges in the center of the right-hand group, and returns on top of strands 3 and 4 to take up its place as 1' in its own group at the side of 4. Strand 1 of the right-hand group describes a similar movement, and then it is the turn of strand 2 on the left-hand side and strand 2 on the right-hand side, and so forth, the plaiting being carried on by the alternative crossing in each group of the strand that is on the outside.

Round braid of four strands can be obtained by a method similar to that which has just been explained, with the sole difference that, instead of the strands being divided into two groups of four, they are divided into two groups of two; the movements remain the same. This method can also be used for plaiting with twelve strands, which are divided into two groups of six.

The rules of crossing of the strands obviously become more complex as the decorative motive to be obtained is more intricate.

It was interesting to me to study these rules of crossing in the motives that are most frequently met; they show the inventive genius of their makers. To make them comprehensible, I shall accompany the figure of the design being considered with a sequence of diagrams numbered in order and showing, in a cross section perpendicular to the axis of plaiting of the cord, the successive positions taken by the strands (represented by small disks designated by numbers or letters) in the course of their crossings until the cycle of the movements, producing a complete motive, leads the strands back to their initial position.

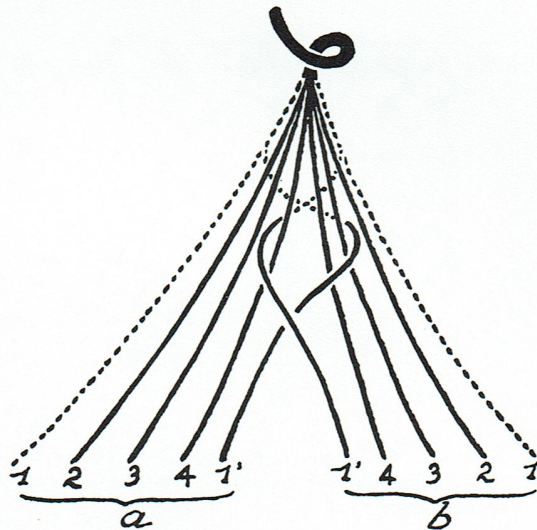


Figure 55. Arrangement of the strands of plaiting with square cross section (eight strands), showing the method of crossing of the first two yarns

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Darts in each diagram indicate the path traveled by the strands in order to reach their new position, which is defined in the following diagram.

In accordance with the general plan of this book, I shall proceed from the simple to the complex.

Plaiting with four strands in two colors

This plaiting, one of the simplest when it is carried out with strands of two colors, permits two different patterns depending upon whether or not the two strands that cross each other are of the same color. In the first case, the pattern shows a regular spiral (Fig.

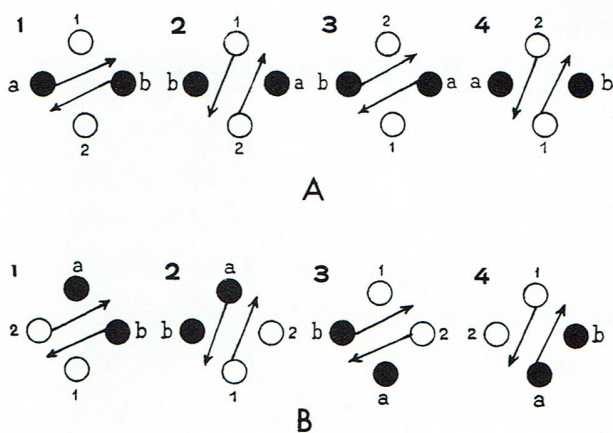


Figure 56. Plaiting with four strands of two colors. A: yarns of same color crossing each other; B: yarns of different color crossing each other

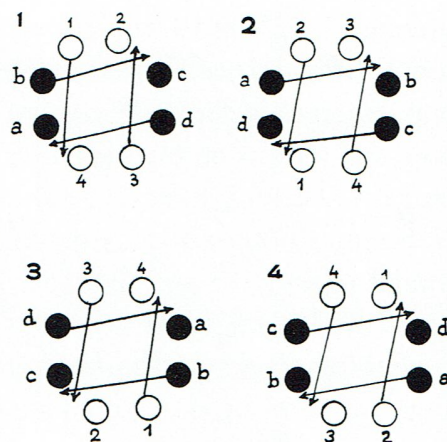


Figure 57. Plaiting with eight strands in two colors with square cross section

56, A); in the second, the pattern of the cord is divided into four longitudinal bands of alternating colors (Fig. 56, B).

Plaiting in square cross section with eight strands in two colors

Plaiting with eight strands requires sixteen movements before the strands return to their initial position. Figure 57 groups these movements into four diagrams and provides that the strands are of two colors, four white and four black.

When the strands are crossed as indicated in Figure 57, a cord with square cross section is obtained, divided on the four sides into two equal parts, one white and the other black. If the plaiting is done with the strands held in the hands as shown in Figure 55, it is necessary in the beginning to place the four white strands on one side and the four black strands on the other.

Plaiting or Braiding

Instead of the strands being arranged across from each other, the white across from white and the black across from black, as in Figure 57, the white strands and the black strands can be regularly alternated in such a manner that a white strand will always be across from a black strand. When the yarns are then moved as indicated in Figure 57, there will be produced on each face of the cord a sequence of simple motives in the form of a V of alternating colors (one white and one black). When the strands are held as shown in Figure 55, it is necessary in beginning the plaiting to alternate the color of the strands in each group of four strands (one white, one black, one white, one black, or vice versa, in each group commencing with the outside).

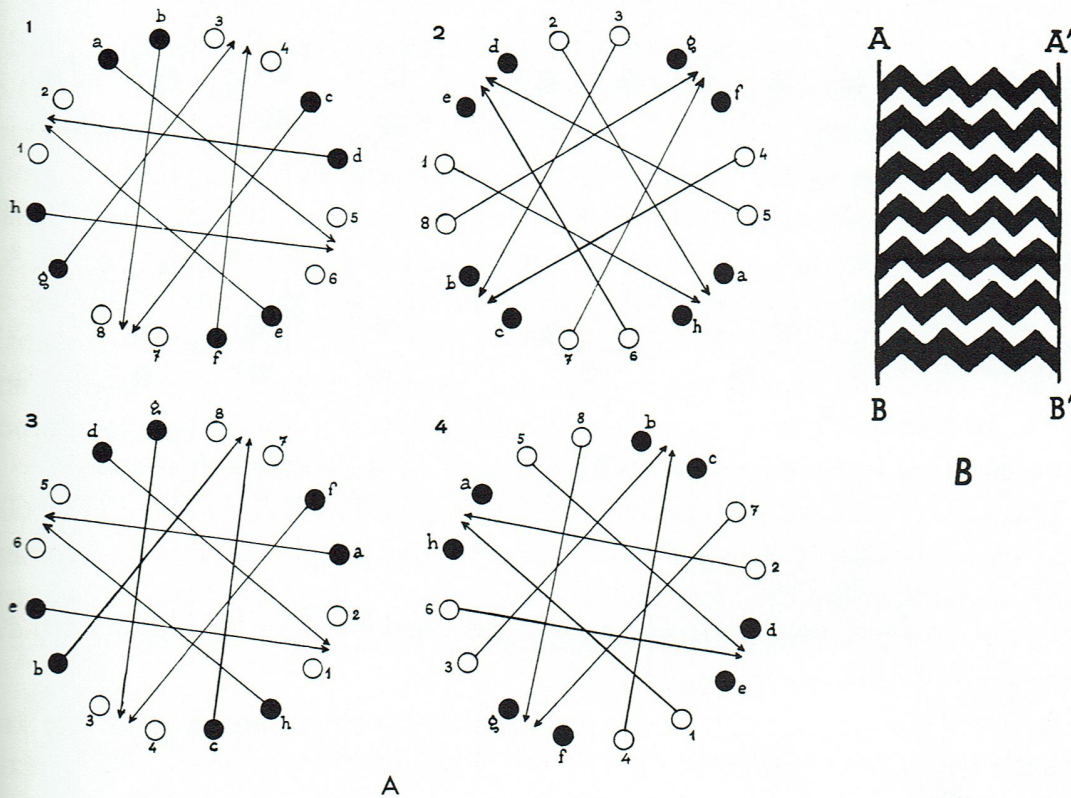


Figure 58. Plaiting with sixteen strands in two colors with round cross section producing zigzag pattern. A: 1-4, successive positions of the strands; B: pattern produced by these movements

Plaiting in round cross section with sixteen strands in two colors

The number of strands becomes too great for me to continue to indicate with any degree of accuracy the manner in which the worker would hold the strands in her hands. I shall, therefore, use diagrams indicating the passage of the strands in order to form a certain pattern. Plaiting with sixteen strands requires at least thirty-two movements in order

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that the strands may resume their original position. With eight strands of one color and eight strands of another, varied designs can be formed, of which the following three types are frequently encountered in Peru on both ancient and modern specimens.

Regular zigzag lines. The strands are distributed as shown in Figure 58 in groups of two strands of the same color, with regular alternation of the colors (here called black and white). The black strands *a* and *h* are placed between the white strands 5 and 6, then the two symmetrical black strands *d* and *e* between the white strands 2 and 1; the black strands *b* and *c* are placed between the white strands 7 and 8, then the strands *f* and *g* between strands 3 and 4. When these movements are completed, the strands are in positions shown in Figure 58, A, 2. From this position the white strands are now manipulated in the same manner as the black were previously, and so on. If a fifth diagram had been made, the strands would have resumed their initial position and the cycle would thus be completed. The cycle can then be repeated as many times as desired. The pattern formed is of regular small zigzag black and white lines arranged one under the other (Fig. 58, B).²

Chevrons. In order to form this pattern (Fig. 59, B), the strands are first arranged in four groups of four strands of the same color set opposite each other; that is, a group of four black strands is placed across from a group of four other black strands, and the adjacent group of four white strands across from a group of four other white strands (Fig. 59, A, 1). The strands of one color cross successively with the strands of the other color in the order and at the points indicated by the eight diagrams (Fig. 59, A); each diagram contains four movements (two crossings). Thus, in diagram 1, strand 8 crosses with *b*, 4 with *f*, and so forth. After the thirty-second movement is accomplished, the strands have returned to their original places and the cycle is completed and may be repeated (Pl. 59, A).

Lozenges. The initial arrangement of the strands in the lozenge pattern (Fig. 60, B) is the same as for that of chevrons: four groups of four strands of the same color are set opposite each other. But the movements are carried out successively between two strands of the same color according to the order indicated in Figure 60, A: *a* changing place with *e*, *c* moving to 5, *g* moving to 1, and so forth.

As in the preceding case, the cycle requires thirty-two movements before the strands return to their initial position (see Pl. 59, B). The initial arrangement and its periodic resumption allow easy change of the pattern from lozenges to chevrons and vice versa. The cord seen in Plate 59, A, shows this occurring.

In the plaiting of modern slings with sixteen strands there are other patterns, more or less derived from the motives above mentioned, which were perhaps used in former times.³

² In this and the following diagrams, the motive is illustrated as if the cylinder of the cord were opened and laid flat, the original A' and B' meeting in fact with A and B.

³ I have described one of them in "Tressage de frondes au Pérou et en Bolivie" (Harcourt, 1940b, p. 115).

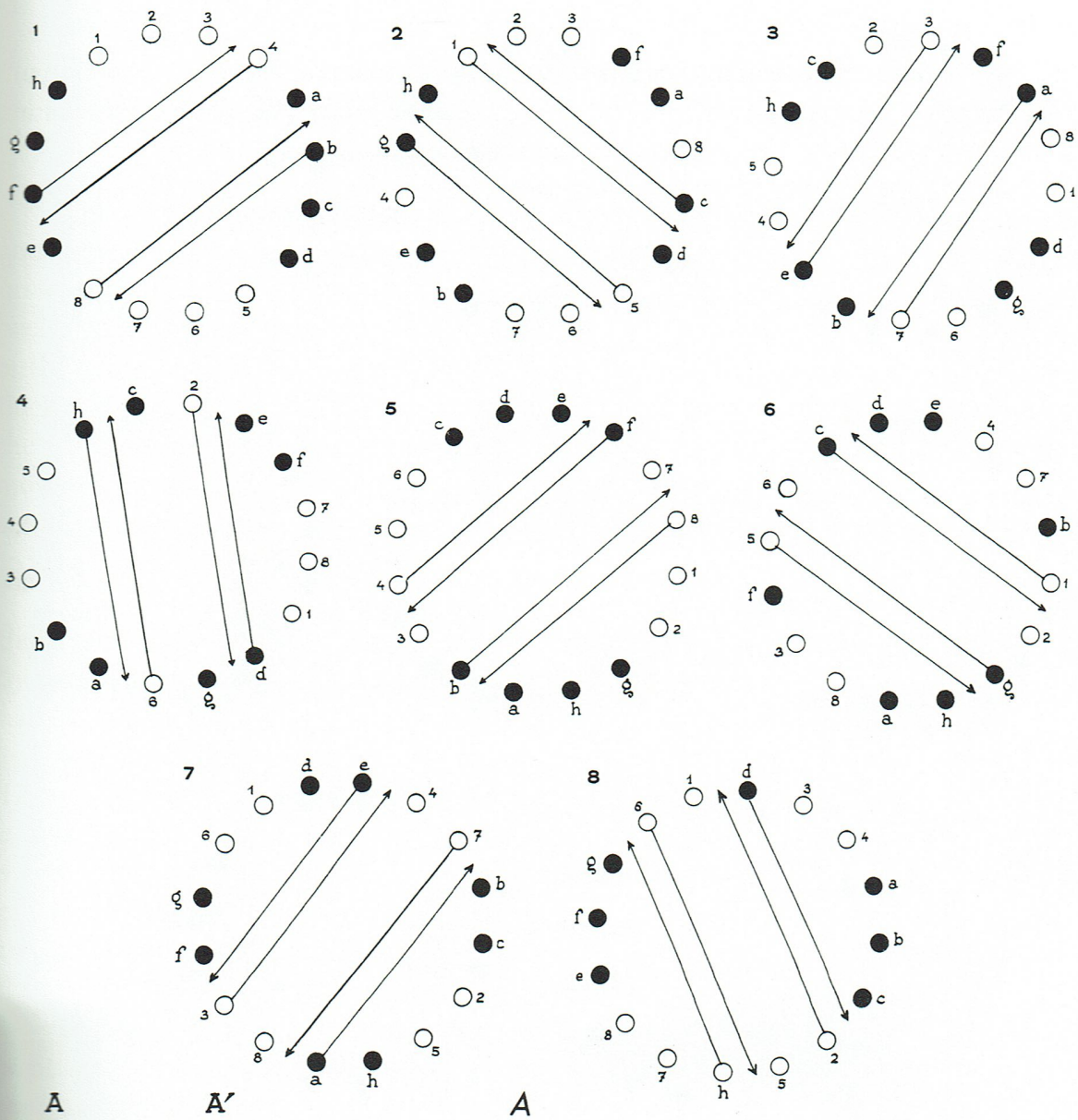


Figure 59. Plaiting with sixteen strands in two colors with round cross section producing chevron pattern. A: 1-8, successive positions of the strands; B: pattern produced by the movements

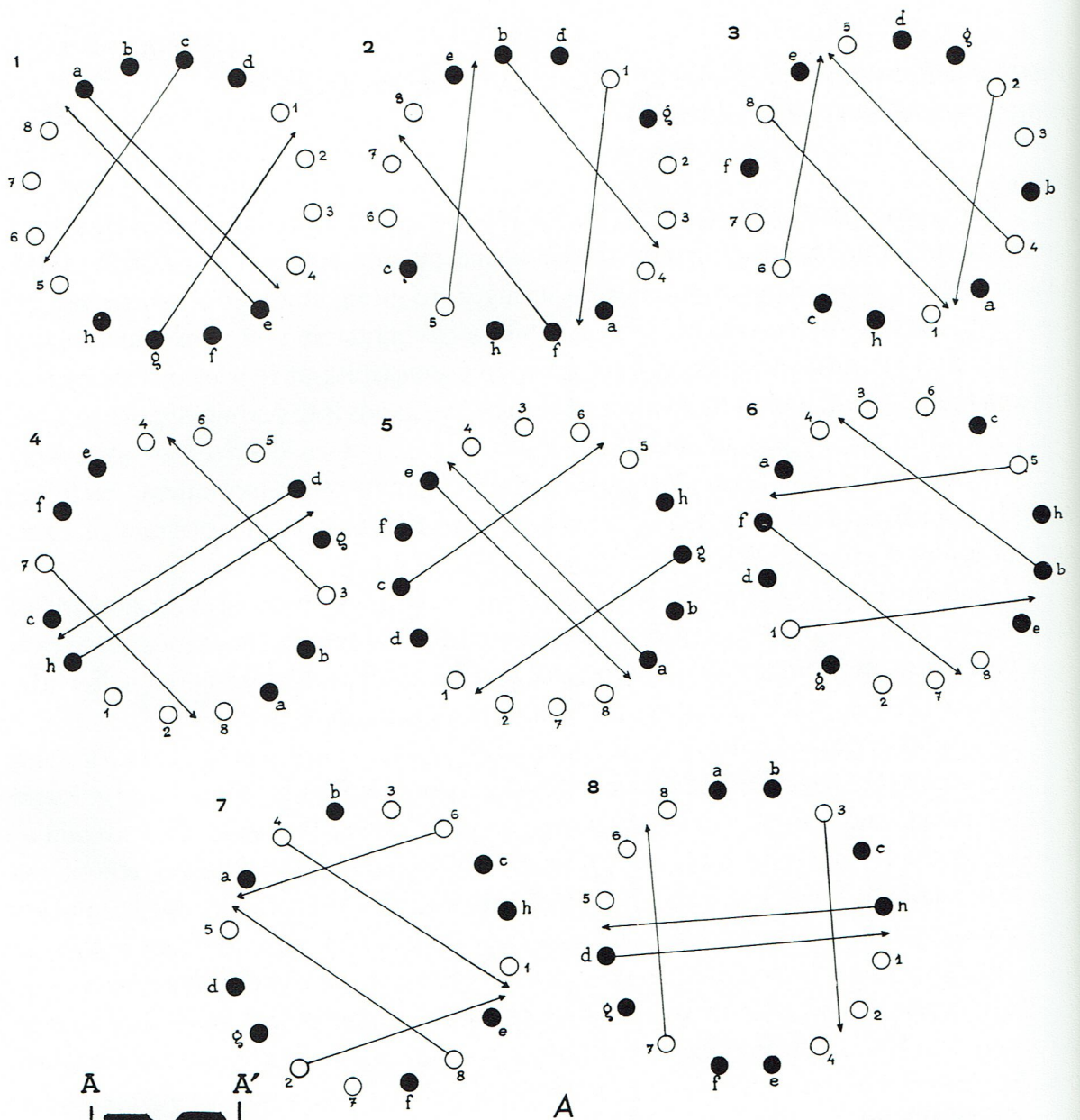


Figure 60. Plaiting with sixteen strands in two colors with round cross section producing lozenge pattern. A: 1-8, successive positions of the strands; B: pattern produced by the movements

Plaiting with twenty-four strands of three or four colors producing a round cross section and regular relief

This pretty plaiting (Fig. 61, B; Pl. 59, D) was especially in vogue at Nazca. It requires twenty-four strands of diverse thickness and of three colors. These varying thicknesses produce heavy relief symmetrically arranged, resulting in a special esthetic effect: twelve yellow strands consisting of two elements, eight gray strands of twice the thickness of the yellow strands, and, finally, four red strands consisting of four elements, each as thick as the yellow strands. The purpose of the yellow strands is to outline the motives and the pattern formed by the red and gray strands. The pattern is obtained by forty-eight movements, which have been illustrated in eight diagrams of six movements each; the strands in each diagram cross in a perpendicular direction those of the diagram that precede or follow it (Fig. 61, A).

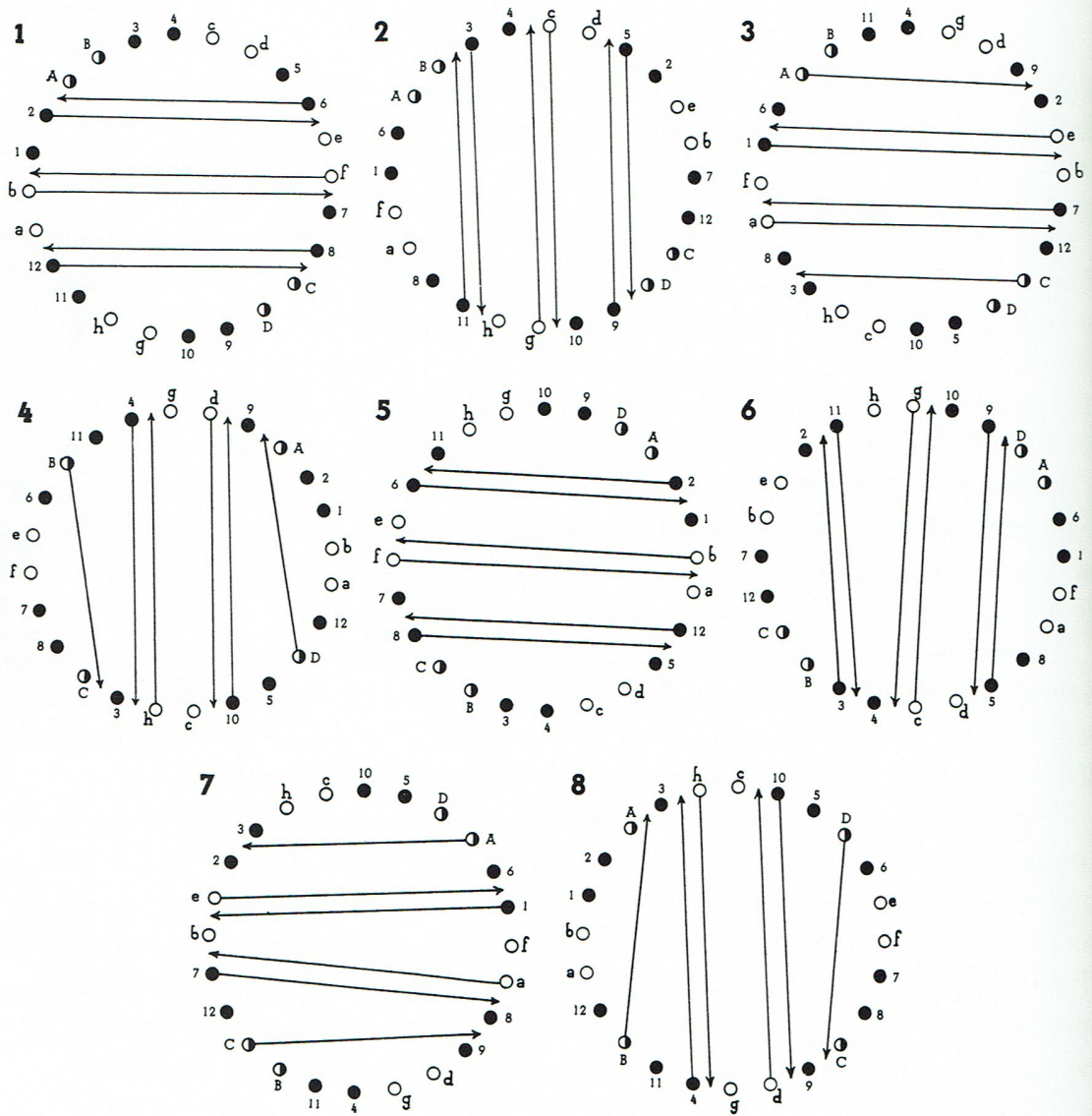
Diagrams 1 to 8 of Figure 61, A, illustrate the exact arrangement of the crossings and the displacements of the strands, which are represented as follows: the eight gray strands by small letters and a white disk; the four red strands by capital letters and a half-white, half-black disk; the twelve yellow strands by numbers and a black disk.

The following is the order of the crossings and displacements: *b* and *f*, 2 and 6, 8 and 12 cross each other to alternate positions; *c* and *g*, 3 and 11, 5 and 9, then 1 and *e*, 7 and *a*, and *A* and *C* move to take positions on the opposite side of the circle; then 10 and *d*, 4 and *h*, *B* and *D*, and so forth. It will be noted that diagrams 5 and 6 are not repetitions of 1 and 2, nor are 7 and 8 of 3 and 4; in the latter diagrams, the strands cross each other respectively within the group, *but in a reverse direction*, which permits them to resume their original position before commencing another cycle of forty-eight movements.

In diagrams 1 and 2 the four red strands have not yet moved. In 3 and 4 they change positions, and later in the plaiting they occupy a position ninety degrees from the original one. In diagrams 5 and 6 they do not move either, but in 7 and 8 they change positions again in order to resume their original place in the cylinder that forms the cord. These red yarns, in addition to being four times thicker than the yellow, frequently come together as pairs in the design, and this accounts for their great prominence.

Once the cycle has been finished, it can be repeated as many times as the length of the cord necessitates.

The plaiting I have just described has a variant in which an additional color supplements the three others. The decorative lozenges in semirelief, instead of being in a single color (red in the case mentioned above), can be of two different colors: the sling shown in Plate 61, C, is dark green and yellow (part of the cord included between the center of the sling and the slender terminal cords is of one color only). If strands *A* and *C* are green and yarns *B* and *D* yellow, the small lozenges they form will be half green and half yellow.



A

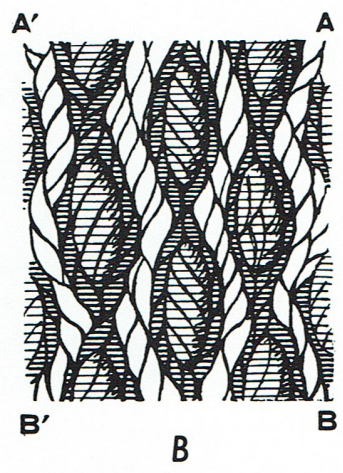
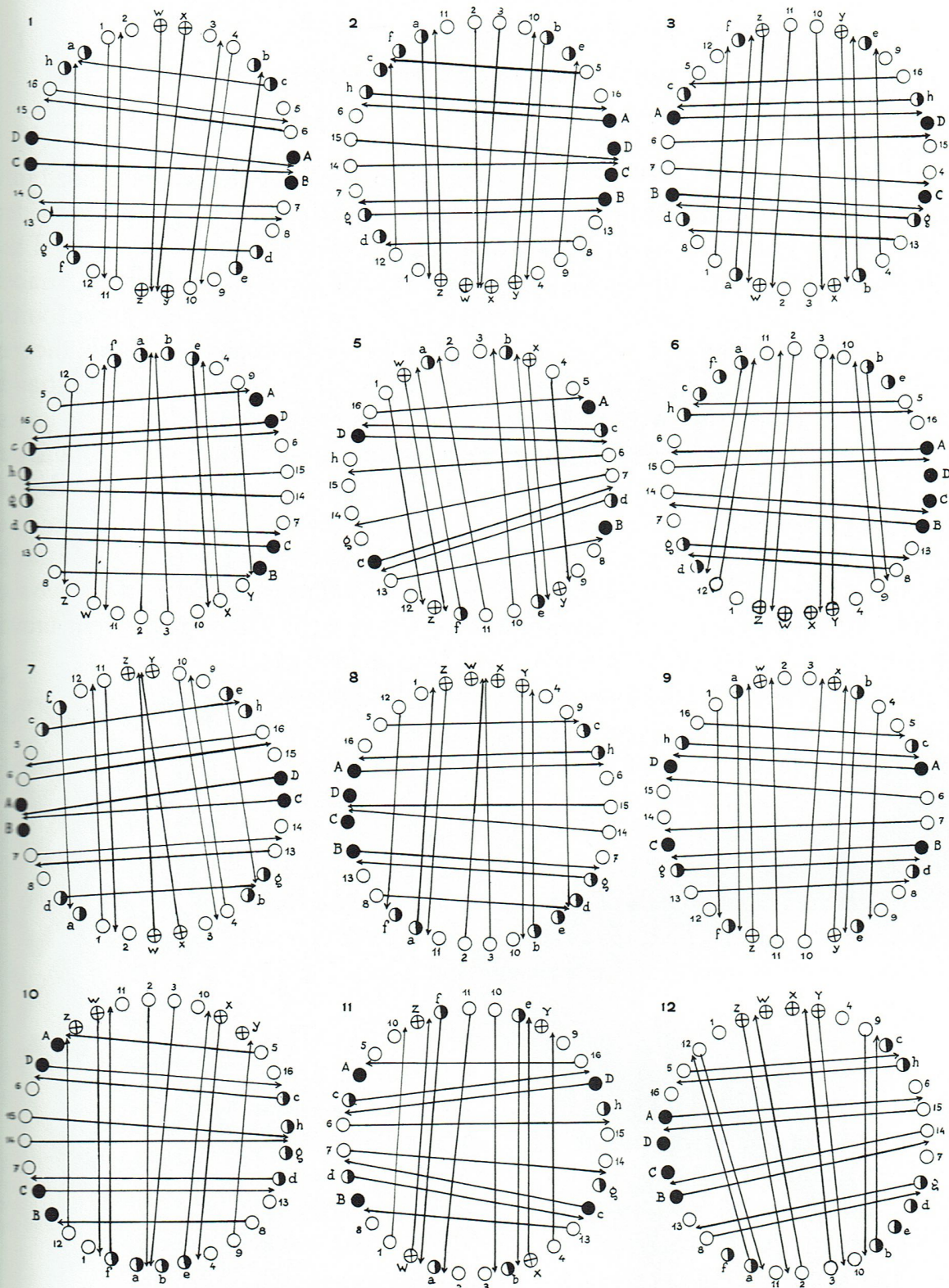


Figure 61. Plaiting with twenty-four strands of three or four colors producing round cross section and regular relief in pattern. A: 1-8, successive positions of the strands; B: pattern produced by the movements



A

Figure 62A. Plaiting with thirty-two yarns in four colors producing round cross section. 1-12, successive positions of the strands. Symbols: ○ white, ⊕ yellow, ● black, ◐ brown

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Plaiting with thirty-two strands (sixteen plus sixteen) in four colors producing a round cross section

This plaiting might well be called plaited-weaving, for the strands are divided into leases that alternately act as warp and weft in relation to each other. The strands are divided into four leases of eight strands each, placed opposite each other as if they formed the quarters of a circle (i.e., in Fig. 62, A, proceeding around the circle clockwise, strands *a* to *b* make up the first quarter; *c* to *d*, the second; *e* to *f*, the third; and *g* to *h*, the fourth; the first and third quarters constitute one set of two leases; the second and fourth, the second set of leases). The alternate crossing at right angles of the leases permits the strands of two leases to perform the office of weft for the crossing strands of the other two leases. Under these conditions, one might expect the plaiting to have a square cross section, but the elasticity of the wool, combined with slightly increased twisting of the strands that cross each other close to the edge of the lease, produces an almost cylindrical form. It is always the same sixteen strands (i.e., eight on each quarter of the circle) that constitute the two facing sections that intercross. There is never any interchange between the two sets of sixteen strands. Each set of sixteen yarns consists of eight white strands, four brown strands, four yellow strands in one set, and four black in the other. Each strand, whether it belongs to the first or to the second set of leases, makes six crossings before returning to its place. The plaiting is done in the following manner: (1) eight strands of the first set of sixteen cross each other (Fig. 62, A, 1): *c*, 16, 6, *D*, *C*, 7, 13, *d*; (2) eight strands of the second set perpendicular to the first set intercross (Fig. 62, A, 1): 1, 11, *W*, *X*, 10, 4, *e*, *f*; (3) the still unused eight strands of the first set intercross in their turn (Fig. 62, A, 2): 5, *h*, *A*, 15, 14, *B*, *g*, 8; (4) the still unused eight strands of the second set do the same (Fig. 62, A, 2): 12, *a*, *Z*, 2, 3, *Y*, *b*, 9.

The pattern produced is that shown in Figure 62, B. It is obtained by 192 movements, which will be found in the twelve diagrams of Figure 62, A, each number containing two complete series of perpendicular movements. Although this plaiting with thirty-two strands is much more intricate, it is a development of many of the methods described previously, and a knowledge of the simpler techniques must be assumed. The pattern, too, is only a variant in four colors of the patterns already described (see Pl. 59, E).

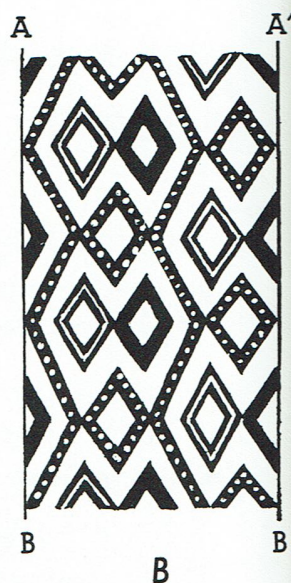
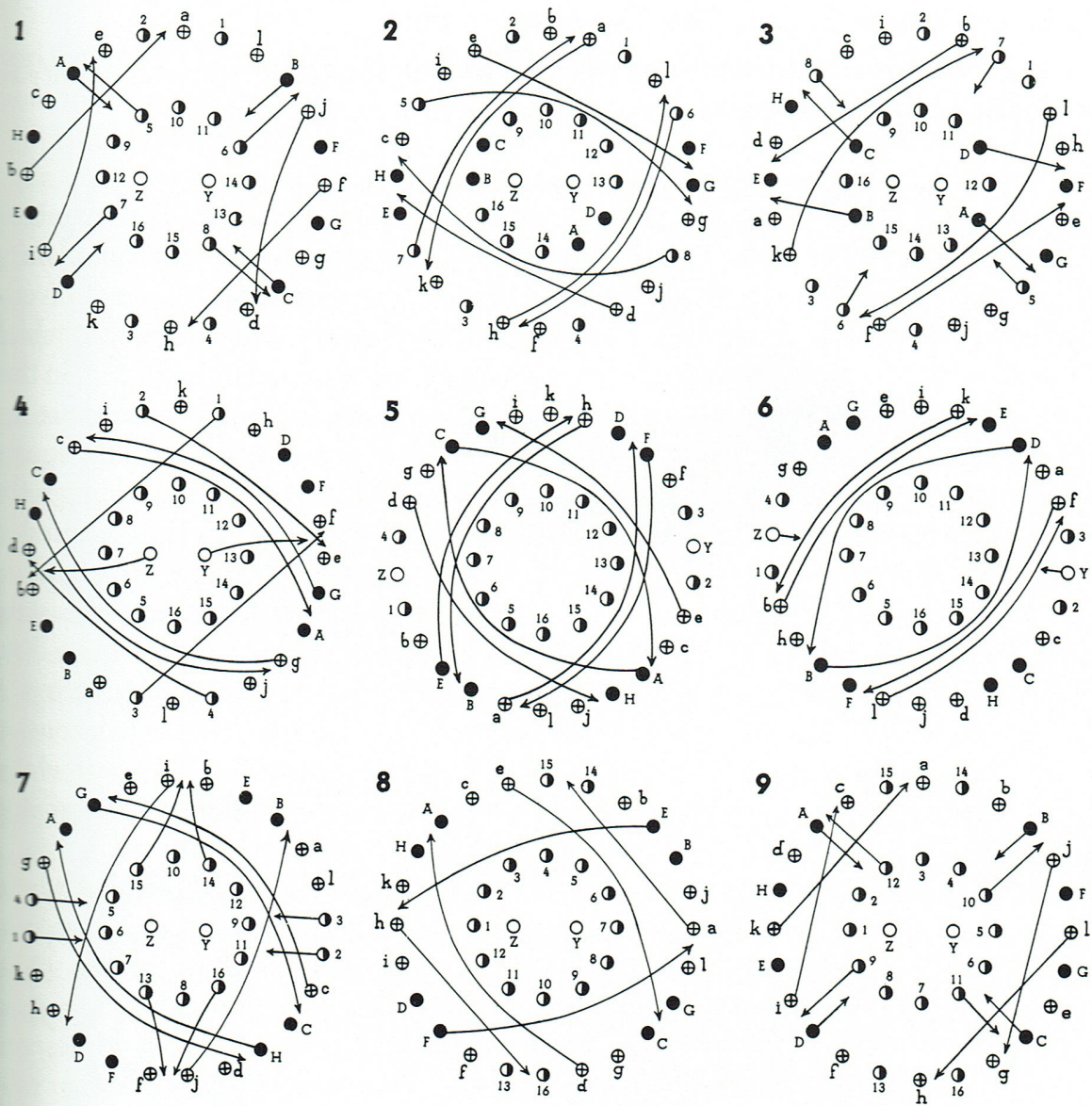


Figure 62B. Plaiting with thirty-two yarns in four colors producing round cross section. Pattern produced by the movements in A



A
 Figure 63. Plaiting with thirty-eight strands of four colors and varying thickness producing square cross section. A: 1-9, successive positions of the strands; B: pattern formed by the movements

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Plaiting with thirty-eight strands of varying thickness in four colors (grouped twenty-six and twelve or twenty-four and fourteen) producing a square cross section

The plaiting of the cord producing the pattern shown in Figure 63, B, is extremely complex. The specimen comes from Nazca and is of four colors. As in the case of plaiting with twenty-four strands described above, the strands, for esthetic reasons, are of diverse thickness. Furthermore, the method of plaiting applies the same principle as that which produces cords with plain sections of two alternating colors (see the sling in Pl. 62), in that certain of its surface strands change regularly with those which, in the center, comprise the core of the cord (see p. 99). Its cross section is definitely square; the corners of the square coincide with the vertical lines AB, CD, EF, GH, which in Figure 63, B, pass through the center of the lozenges (see Pl. 59, C) (as in preceding patterns, Fig. 63, B, is pictured as though the braid were cut along the line A-B, A'-B', and laid out flat).

The plaiting requires thirty-eight strands in all: two coarse white strands, consisting of six elements, designated by the capital letters Y and Z and represented by a white disk; eight red strands, less coarse, consisting of four elements, designated by capital letters A to H and represented by a black disk; sixteen yellow strands, thinner than the red, consisting of three elements, designated by numbers 1 to 16 and represented by a half-white, half-black disk; twelve yellow brown strands, consisting of a single element, designated by small letters a to l and represented by a white disk quartered by a black cross.

Because the cord has a central core, the strands of which share only momentarily in the crossings of the plaiting that is in progress on the periphery, the plaiting is accomplished with only twenty-four strands at a time (or with twenty-six when the two white ones are visible), while the core is made with twelve strands (or fourteen when the two white ones are hidden in the center). These twelve strands, whose position with respect to each other is immaterial, are alternately either all yellow or eight yellow and four red. The four red strands are always the same: A, B, C, D. The yellow yarns, on the contrary, change by groups of four. There are three series of changes made through the length of the plaited lozenge (Fig. 63, A), that is, six series for the entire cycle of the pattern, which equals the length of two lozenges. The following are the movements of the red and yellow strands from center to periphery and vice versa: in diagram 1, strands 5, 6, 7, 8 go to the outside, and strands A, B, C, D reach the center; in diagram 3, A, B, C, D go to the outside, and 5, 6, 7, 8 reach the center; in diagram 7, 13, 14, 15, 16 go to the outside, and 1, 2, 3, 4, reach the center; in diagram 9, 9, 10, 11, 12 go to the outside, and A, B, C, D, reach the center; diagram 11, which is not depicted, would show A, B, C, D moving to the outside, and 9, 10, 11, 12 reaching the center; diagram 15 would show 1, 2, 3, 4 going to the outside, and 13, 14, 15, 16 reaching the center; diagram 17 would repeat diagram 1.

The twelve yellow brown strands remain always on the periphery and do not cease

working; their role consists in outlining the various areas of the pattern and separating them from each other.

Until the momentary disappearance of the four red strands is required by the decorative motive, the intermingling of the two groups of four yellow strands seems justified only by the desire to make the core and its covering more compact, and thus the cord more attractive.

Diagrams 1 to 8, Figure 63, A, give the crossings and changes that are necessary to form the design of a completed lozenge, that is, half of the entire cycle. It seems unnecessary to give the movements of the strands for the second lozenge since these movements follow the rules of the first exactly. To diminish the number of schematic diagrams, from four to eight crossings, as well as the changes between the center and the periphery, have been grouped in each drawing. It will be noticed that the movements are symmetrical (one in each half of the circle). The following is the order of the movements of the brown and yellow brown strands shown in the diagrams: (1) *b, f, i, j* move; then the changes from center to periphery and vice versa of the other colors occur; (2) *e, d; 5, 8; a, h; 6, 7;* (3) changes of strands from center to periphery and vice versa of the other yarns; then *b, f; l, k;* (4) *G, H; 2, 4; c, g; 1, 3;* then *Y* and *Z* move to the periphery; (5) *E, F; h, a; e, d; C, A;* (6) *D, B; b, f; k, l;* then *Y* and *Z* return to the center; (7) *c, g; H, G; i, j;* then movements from center to periphery and vice versa of the other yarns; (8) *E, F; d, e; a, h;* (9) *i, j; k, l;* then movements from the periphery to center and vice versa of the other yarns.

The complete cycle is executed in 156 movements: the fine yellow brown strands make sixty crossings; the yellow strands make thirty-two changes from center to periphery and vice versa and sixteen crossings; the red strands make sixteen changes and twenty-four crossings; and the white strands make eight changes.

Plaiting-weaving with sixteen strands having the role of warp and with four or eight strands having the role of weft

This method, by means of which a thick flat braid is formed, partakes of weaving in that it uses two different elements, a warp and a weft, and of plaiting in that the strands of warp yarns, which have been arranged in groups of four of the same color, pass by and around each other, moving always in the same direction, between the passages of the cross strands or weft yarns. The four successive positions that are occupied lead to the assumption that the warp yarns are either free at the end opposite the plaiting or are freed periodically so that they can be untwisted. If the yarns were fastened at their two ends, plaiting would have to be accomplished with periodic reversals of the direction of the twisting of the yarns; this will be found in the third example that follows.

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I have already given a preliminary analysis of this technique among the special methods of weaving (pp. 47–49). With the complete analysis of additional specimens, there is here given a new description of the technique with drawings; these will, I hope, make the preceding explanation simpler and clearer (see the slings in Pl. 32, A, C).

In the example used, the warp consists of the sixteen strands used to form the cords of the sling. They are divided into two leases of eight strands each. Theoretically, however, the warp can have a much larger number of strands, in which case a wider braid will result. The weft consists of four strands used, to begin with, at their center (as in Fig. 27), that is, with eight strands formed by their two free ends. These eight strands, generally of two colors, alternate row after row, making groups of four crossing together, two from right to left and two from left to right. The four yarns that do not move as weft are concealed between the warp yarns and in consequence are invisible, but at the edges of each row they appear in the border of the braid. By their alternation of crossing with the other four weft yarns that formed the preceding row and will form the following row, as well as their arrangement in two colors, they share in the formation of the pattern on the edges of the braid. The pattern in the central part will vary with the arrangement of the colors in the warp yarns and the rule of crossing of these yarns. Three examples of patterns are set forth below. In the first two, the yarns, in groups of four, always turn in the same direction around each other, maintaining successively four adjacent positions, two in the upper lease and two in the lower lease. In the third example, the direction of the twisting of the

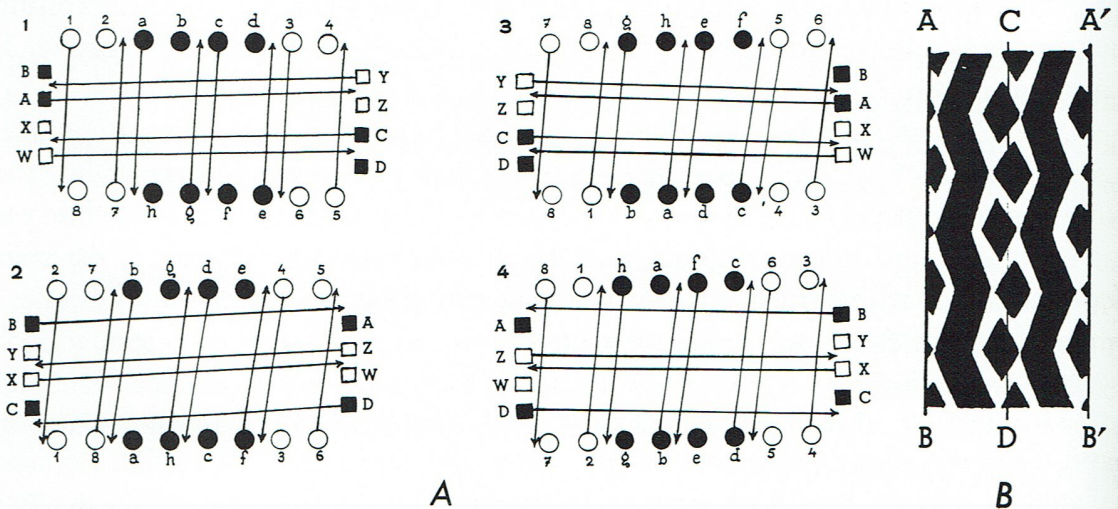


Figure 64. Plaiting-weaving with sixteen strands as warp and eight strands as weft. A: 1–4, successive positions of the strands; B: pattern formed by these movements

yarns is reversed after the fourth movement; their twisting is thus suspended periodically. In each movement and weft passage there will be only eight yarns out of sixteen that cross, the other eight yarns crossing with the following row. This results in a simple twill 2/1 construction.

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First example. The warp yarns are arranged in the following manner: four white yarns, eight black yarns, four white yarns; each group is divided into two leases that are opposite each other (Fig. 64, A, diagram 1). The pattern will be a black vertical band between two narrower white bands; actually this band zigzags a little toward the right, then toward the left (Fig. 64, B)⁴ because it is displaced alternately to the right and left by the crossings on its edges of four weft yarns, which form small lozenges. This zigzag

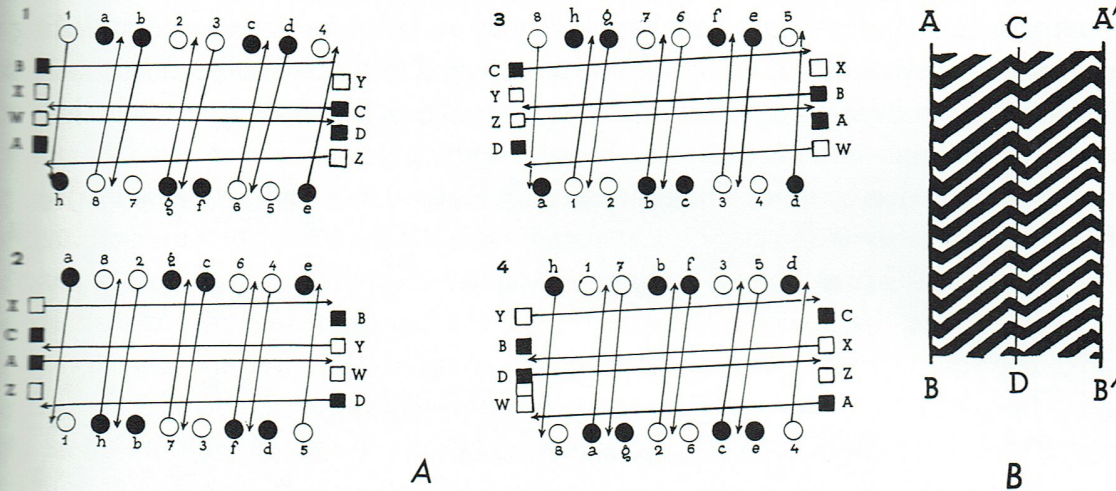


Figure 65. Plaiting-weaving with sixteen strands as warp and eight strands as weft. A: 1-4, successive positions of the strands; B: pattern formed by the movements

tends to disappear when the tightening of the weft yarns lessens. The order of crossing of the yarns is as follows: (diagram 1) wefts A, C, Y, W; then warps 1, 7, a, g, c, e, 3, 5; (diagram 2) wefts B, D, X, Z; then warps 2, 8, b, h, d, f, 4, 6, and so forth.

Second example. The warp yarns are arranged as follows: one white yarn in a lease across from a black yarn in the opposite lease; two black yarns across from two white yarns; two white yarns across from two black yarns; two black yarns across from two white yarns; one white yarn across from one black yarn. By this arrangement, the color of the braid is displaced after each weft passage, and consequently parallel diagonals in two tones are formed (Fig. 65, B); near the edges the weft yarns intervene in order to form a hook at the ends of the diagonals. The order of crossing of the yarns is as follows (see Fig. 65, A): wefts B, C, W, Z, then warps 1, 8, b, g, 3, 6, d, e; wefts X, Y, A, D, then warps a, h, 2, 7, c, f, 4, 5, and so forth.

Third example. The warp yarns are arranged as in the second example above, but the movement of the warp yarns is such that the eight left-hand yarns turn around each other from the left to the right, and the eight right-hand yarns turn in reverse direction. After four movements, the direction of rotation is reversed for the two sides (Fig. 66, A, diagrams 4-8). The number of weft yarns, instead of being eight, is here reduced to four

⁴ In this and the two figures that follow, the two faces of the braid are shown set out one after the other. Actually, the pattern should be folded at lines C-D; A', B' would thus join A, B.

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(two white and two black). The rule of crossing of the strands is as follows: wefts A and B, warps 1, 8, b, g, f, c, 5, 4; wefts Y and Z, warps a, h, 2, 7, 6, 3, e, d.

The handsome sling of Plate 64 is plaited in this method, but the order of crossing of the yarns is a little different, giving it a pattern that is a slight variant of Figure 66, B.

The examples of plaited cords that I have just given will suffice to show the ability and inventiveness of the workers who did the plaiting, to which the number of strands and the complexity of the crossings bear witness. In Plate 56, A, will be found a plaiting in the course of construction, in which can be seen, rolled into small balls, more than forty-two strands of wool (of a single color in this case) used in the plaiting of the braid.

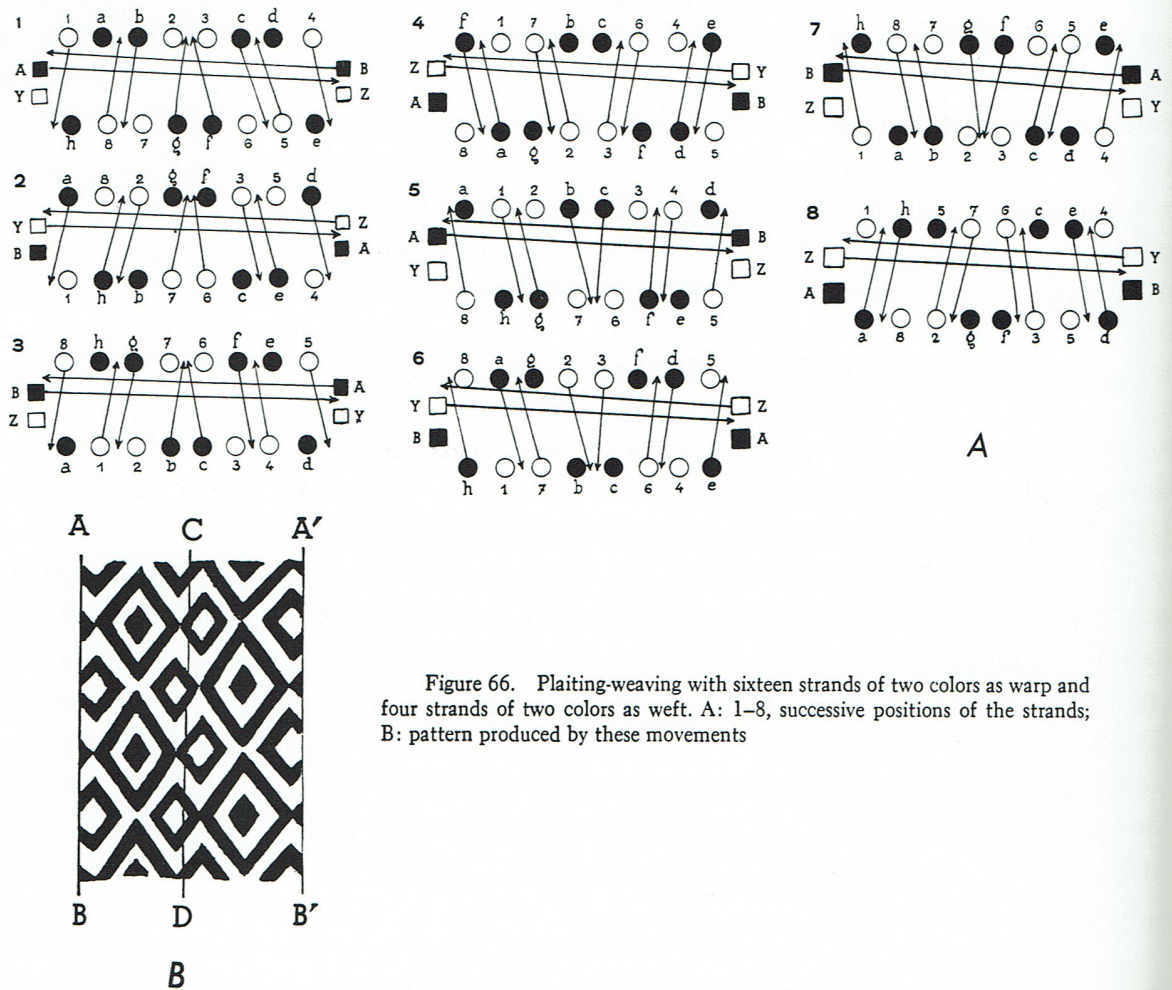


Figure 66. Plaiting-weaving with sixteen strands of two colors as warp and four strands of two colors as weft. A: 1-8, successive positions of the strands; B: pattern produced by these movements

Ordinary cords made of twisted fiber are sometimes wrapped or covered with plaiting quite comparable to that of modern drapery cords. The yarns of this covering are arranged around the central core in an even number sufficient to cover its surface, and they are fastened in this position by a circular tie. Plaiting is begun by moving alternately one yarn to the right and one yarn to the left, and proceeds by the method of simple crossing already

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described (see the cords of slings B and C in Pl. 61). In ceremonial slings, after the cover is plaited the central cord may be withdrawn, leaving only the tubular covering (see the sling in Pl. 63).

I mention again a special feature of this technique: the core of the cord, instead of consisting of yarns that are momentarily inactive in the plaiting, exists independently, and the strands not used in the plaiting are placed between the core and the wrapping.

Cords are found in which the wrapping is plaited in two colors, for example white and brown (Pl. 62), which succeed each other alternately for the length of the braid. They are made in an ingenious manner: the central core is made of a number of brown or white adjacent strands, which correspond to the number of yarns required for the plaiting of the wrapping. After the plaiting has been carried to a certain length, the yarns in the center are substituted yarn by yarn for those of the wrapping, which in its turn re-forms the core, while the new yarns, on the periphery, resume the plaiting of the wrapping. The operation continues with the regular alternation of the yarns of the central core and of the wrapping in their exchange of roles. This principle of substitution between the elements of the core and of the wrapping has already been applied in the plaiting with square cross section in four colors with thirty-eight strands of diverse thickness (Fig. 63, A, B).

Plaiting of soles for sandals

The first method of plaiting of sandal soles was discussed on p. 65. The second method (Pl. 60, B), which is quite different from the first, consists of superimposing one braid of three strands upon a second (with reversed direction of plaiting). The work is begun in the center of the sole by folding the braids back upon themselves at a distance of 7 or 8 centimeters [3 inches] from their ends; from this fold, the braids continue building the sole by wrapping the plaits in tight spirals. Thus there is obtained an elliptical surface whose shape is maintained by means of two yarns passed, as in the preceding method (p. 65; Fig. 41, B), through the thickness of the warped braids with long needles; hence these soles are sewed. By the tightening of the two yarns the sole is given a definite shape and firmness. This method corresponds to that which was used in Europe since neolithic times to make the soles of espadrilles. This was not a borrowing by the Peruvian Indians, for many pre-Columbian specimens attest its antiquity. It is a matter of independent invention.

Both these sandal soles and the ones discussed earlier are finished with a needle-made edge, described on page 136.