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The Question of Symmetry in Andean Textiles

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Considering the various mathematical ideas we've been exploring briefly, how might these differ in textiles from ancient Peru?

In the ancient textiles that I study, Andean people seem to have made conscious use of the math embedded in textile processes for generating several kinds of graphic codes. You may have heard about a device called the *khipu*: it is a bunch of colored and knotted cords that looks like a string mop, but it is really an ancient record-keeping device. The knots stand for numbers in the base 10 system. Long knots were used for numbers from 2 to 9, while clusters of single knots stood for the 10's, 100's, and 1000's. The colors of cords were likely used for categories of things, and the direction of the twist for another kind of distinction. Although no one can read a *khipu*, we have a pretty good idea of how the fiber qualities and structures mathematically encoded information such as census figures or quantities of goods collected through taxation during the Inka period, c. 1500 A.D.

Two thousand years ago, people on the South Coast of Peru were embroidering mantles that look something like *khipus*. Some Linear-style mantles from the site of Paracas Necropolis have many parallel bands with reverse-curve snakes repeated within them. The snake-like patterns usually alternate three colors, and look like three-ply cords. In an example from the Museum of Fine Arts, Boston (1972.353), all of the band patterns twist in the same direction, except for one. The number of colors and bands, and the twist direction, are no doubt significant, as they vary from mantle to mantle in this style.

It is fairly clear that fiber structures were used as a model for some visual codes that we see on Andean textiles in different periods – particularly those patterns that have a geometric appearance. Headbands from the mummy bundles excavated at the site of Paracas Necropolis sometimes look like cords made of five plied elements. Other headbands from different bundles show from two to eight plied elements in their patterns.

Cord patterns are not the only fiber structures that occur. Braid structures made with three, four, or eight ends also occur as patterns on the headbands.

The first question is, how do we approach these geometric patterns that look something like fiber structures? I propose that we look at them in the way that the ancient people likely looked at them: as three-dimensional structures that are made into flat images (fig. 1).

This diagonally banded pattern, which alternates six colors, can be visually untwisted to show the mathematical content, when it is viewed as a replied cord. The six-color pattern corresponds with three bi-color plied yarns that are replied into a single cord. I think that Andean people, who were spinning yarns and cords every day of their lives, could not help but register the diagonal pattern on the tapestry as a multi-ply cord.

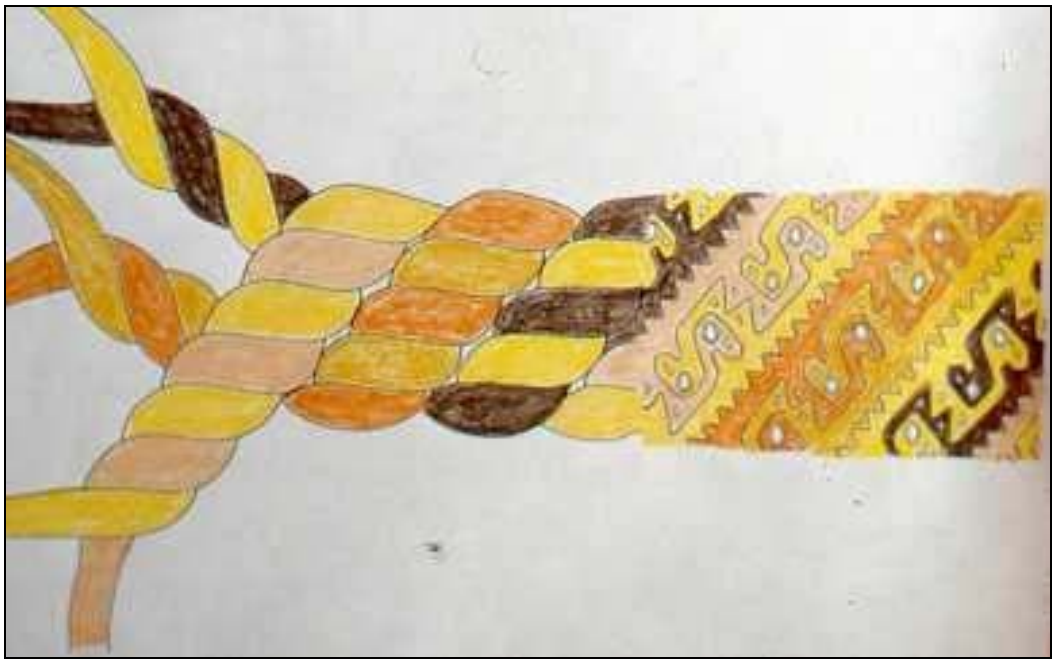

Fig. 1: Pattern from a Chancay tapestry border and its relation to a replied cord.

You might be wondering how the patterns intersected with the daily life of the people who wove them? I suggest that a pattern such as this could have been a formula for organizing a rotating activity like, say, access to irrigation water. If a community was composed of six groups (or *ayllus*, as they are called in the Andes) and the *ayllus* were organized in pairs (as they often are) that were located on either side of the canal, the graphic formula in this cord pattern might map a program for water distribution that was both fair and rational. On Day 1, the pair of *ayllus* in the upper reaches would get the water; on Day 2, the pair in the middle reaches would get the water; and on Day 3, the pair in the lower reaches would open the sluices, and so on. The number of colors and their organization in pairs could correlate with a spatial idea (the number and location of the paired *ayllus*), while the color repetition and symmetry could correlate with a temporal idea (the rotating sequence). The formula could apply to any rotating activity among a group of six.

Although this is a hypothetical example, the math embedded in a pattern conceptualized as a cord structure has the potential to organize human activities in space and time. Math is so intermeshed with the processes of fiber technology and the patterns based on fiber structures that it is hard to say whether math or fiber technology came first in ancient Peru – the proverbial chicken and egg.