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## KNOT DIRECTION IN A KHIPU/ALPHABETIC TEXT FROM THE CENTRAL ANDES

Sabine Hyland, Gene A. Ware, and Madison Clark

*Khipus are knotted-string devices that were used in the Inka Empire for communication and for recording information. We recently analyzed the names and associated khipu cords in a newly discovered hybrid khipu/alphabetic text from the Central Andes. Results indicate a significant relationship in the text between knot direction and a form of social organization known as moieties, in which S-knots correspond to the upper (Hanan) moiety and Z-knots correspond to the lower (Urin) moiety. This relationship suggests that knot direction was used to indicate moiety in Andean khipus and, as such, may represent the first decipherment of a structural element in khipus since the decoding of the number system in the 1920s.*

*Los quipu son dispositivos de cuerdas anudadas que se utilizaron en el Imperio Inca para la comunicación y para el registro de información. Nosotros hemos analizado recientemente los nombres y las cuerdas quipu asociadas a un quipu híbrido/texto alfabético recién descubierto en los Andes Centrales. Los resultados indican una relación significativa en el texto entre la dirección del nudo y una forma de organización social conocida como mitades, en la que los nudos con la dirección S corresponden a la mitad superior (Hanan) y los nudos con la dirección Z corresponden a la mitad inferior (Urin). Esta relación sugiere que la dirección del nudo se utiliza para indicar las mitades sociales en khipus andinos y, como tal, puede representar el primer desciframiento de un elemento estructural en quipu desde la decodificación del sistema numérico en la década de 1920.*

**K**hipu are knotted-string devices used for communication and recording information in the Andes during the Inka Empire (ca. A.D. 1400–1532), throughout the Spanish colonial period, and into the twentieth century. Inka khipu encoded quantitative bureaucratic accounts (e.g., tribute payments), as well as historical and narrative information (Urton 2003:3). Despite important advances, such as Locke’s 1923 discovery of how numbers were encoded on the cords (Locke 1923), there is still no consensus among scholars as to how khipu encoded such data.<sup>1</sup> This study examines how knot direction may have been used to indicate moiety affiliation, a fundamental organizing principle in Andean society. Our research is based on a unique, newly discovered text containing Inka-style khipu cords that correspond to written names. This correspondence between name and cord has enabled us to link particular khipu cords with specific

moieties, something not possible prior to the discovery of this text.

### The Mangas Khipu Board

In 2011, Hyland began researching a hybrid khipu/alphabetic text found in the colonial Catholic church in the Peruvian village of Mangas in the department of Ancash (Figure 1). The Mangas khipu board is the only known extant text containing Inka-style khipu cords with associated alphabetic writing. Another khipu board exists in Ayacucho, Peru, but its very simple cords lack the complexity of the Mangas ones.<sup>2</sup> The Mangas khipu board consists of a wooden board (63 cm high, 28 cm wide and 1 cm thick) covered with paper on which are 282 names, front (Figure 2) and back (Figure 3). Many of the names are faded or obscured by bat urine and dirt; however, through Ware’s multispectral imaging scans of

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Figure 1. Mangas Khipu board Side A (top).

the text, 246 names are totally legible, 26 are partially legible (i.e., either the first name or the surname is readable), and 10 are totally illegible.<sup>3</sup> Out of 282 names, 143 are female names (50.7 percent), 108 are male names (38.3 percent), and 31 names are of an unknown gender (10.9 percent) because the paper is damaged by the first name. Each full name occurs only once on the khipu board. Next to each name is a hole out of which comes, in many cases, an associated khipu cord. The cords, identified as sheep's wool by local informants, go through the holes in the board and have a single knot at each end of the cord. Except in cases where the cords are deteriorated, they fit very snugly in the holes; however, they are not attached to the board in any other manner. The cords exhibit Inka khipu color patterns, such as barber pole and mottled; their range of color, ply, and other characteristics are described further below.

Khipu boards were developed in sixteenth-century Peru by a Roman Catholic religious order, the Mercedarians, to keep track of Indians' reli-

gious duties, such as mass attendance (Porres 1953:182–183[ca. 1572–1579]). In his instructions about how to evangelize native parishes, Diego de Porres, the famed Mercedarian missionary, declared that missionaries must place in each church a “khipu” and “tabla”—which means a tablet or flat board—for all to see. This khipu tablet or khipu board should indicate the Church calendar and the religious obligations of the Indians, including observance of feast days and attendance at Sunday mass. Anyone who did not observe the days noted on the khipu boards, Porres wrote, should be flogged.<sup>4</sup>

Use of these hybrid texts spread throughout the Andes during the eighteenth and nineteenth centuries (Martínez Compañón 1985:53, 54 [1789]; Rivero y Ustariz 1857:72–84). They were displayed at public ceremonies where each member's performance of his/her obligations was acknowledged, and delinquent members punished. For example, in 1863, Friedrich Hassaurek, the American ambassador to Ecuador, observed khipu boards employed by parish assistants in Cotacachi



Figure 2. Mangas Khipu board Side A.

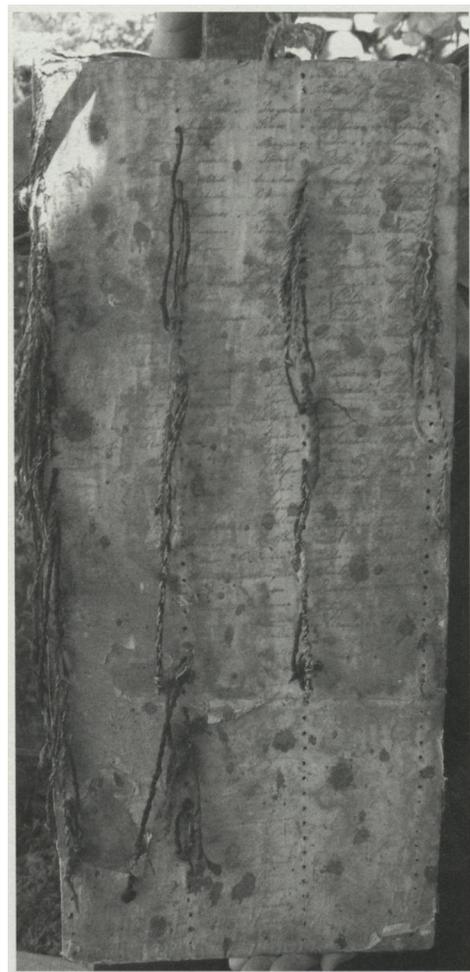


Figure 2. Mangas Khipu board Side B.

to indicate whether Indians had attended catechism class; those found wanting were given three lashes (Hassaurek 1967:176 [1866]). In 1923, Julio C. Tello witnessed a khipu board used by the Indian community in Casta, Peru, to keep track of the Indians' ritual obligations at their sacred irrigation canal cleaning festival. According to Tello, the multicolored cords on the khipu board recorded information not only about each person's attendance at the event, but also about the quality of the work, the use of specific ritual implements and special clothing, and even the degree of enthusiasm shown by each person. These native leaders maintained their khipu board without oversight from church or state officials (Tello and Miranda 1923).

Pablo Macera saw two khipu boards hanging inside the church in Mangas, Peru, in 1968 (Ro-

bles Mendoza 1982). Thirteen years later, Roman Robles Mendoza found only one khipu board remaining in Mangas, and he published a description of the object (Robles Mendoza 1982). When Robles returned to Mangas for more research, the khipu board was gone. In 2003, a local schoolteacher, Rebeca Arcayo Aguado, discovered the current khipu board in Mangas in a wooden trunk in the church sanctuary.<sup>5</sup>

Although the two khipu boards are similar, the current Mangas khipu board does not match the description of the khipu board studied by Robles. The khipu board studied by Robles had 110 names on the front (Side A), whereas the current khipu board has 150 names on Side A (Figure 2). The number of holes in the two boards is different: 209 holes in the board seen by Robles and 207 holes in the current board. Likewise,

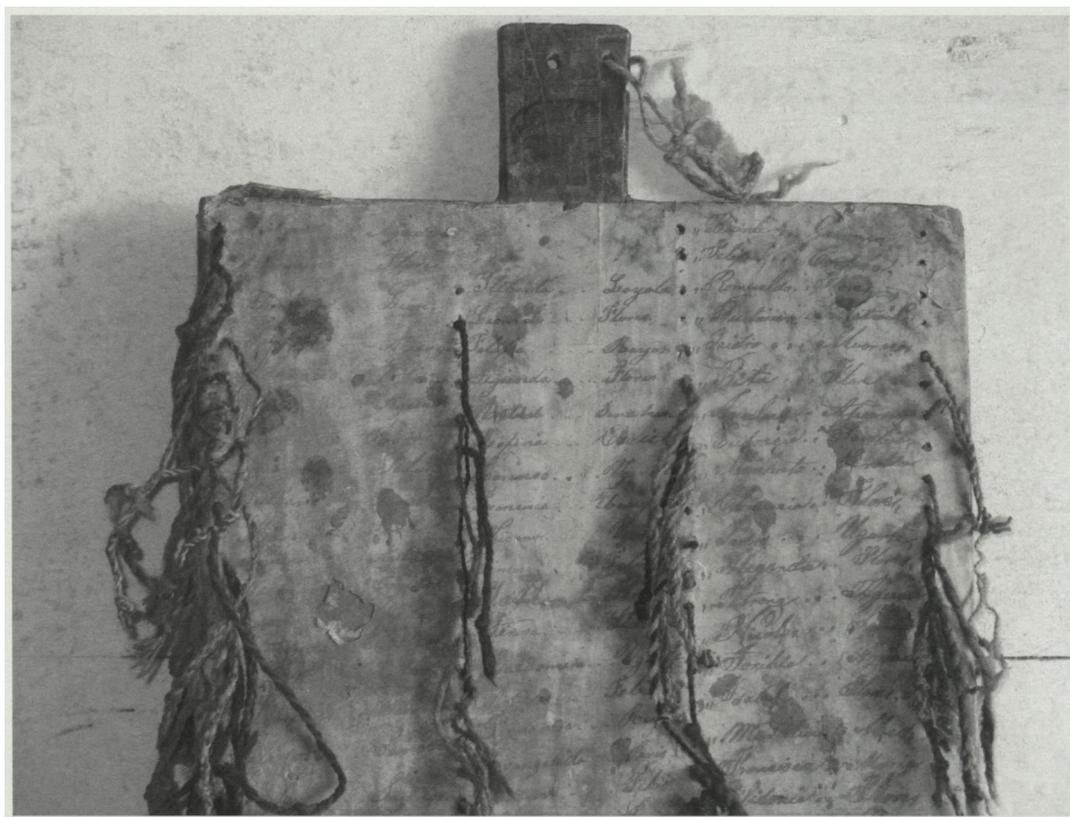


Figure 4. Mangas Khipu board Side B (top).

Robles found that the names on the back (Side B) of the khipu board he studied were entirely illegible; however, 97 full names on Side B of the current khipu board can be read easily, while an additional 25 names can be read for either their first name or surname (Figure 4). In column 1, Side A, of both khipu boards, the first 22 names are the same, but they diverge radically after that. Possibly the current khipu board is the one seen by Macera in 1968 but whose whereabouts were unknown in 1981.

The front of the current Mangas khipu board is titled “Padron de las personas del pueblo de Mangas se empezó a empadronarse en el año de 1800” (“Register of the persons in the community of Mangas; the registry was begun in the year 1800”) (Figure 1). In the Andes today, the word “padrón” refers to a multivariate chart with a list of personal names or households, followed by spaces for multiple categories, such as “type of labor contributions, dates of labor within type, and completion or non-completion of task” (Salomon and Niño-Murcia 2011:93). Other vari-

ables can potentially be charted in a “padrón,” such as food or livestock contributions, special clothing, particular dances performed, etc. It is most likely that the khipu boards were a “padrón” of this type, in which the cord data—color, spin, ply, thickness, and number of threads—referred to the variables concerning each individual’s contributions. Khipu boards with complex cords, like those on the Mangas khipu board, probably recorded multiple categories, while those with very simple cords, like those on the Ayacucho khipu board, may have recorded only a single variable, such as mass attendance.

Underneath the title are written three columns of names, for a total of 150 names on Side A (Figure 2). Preceding each name is a hole in the board from which comes, in many cases, a knotted khipu cord. There are four columns of khipu cords; the rightmost column of cords does not correspond to any names on the front but instead corresponds to the first column of names on the back of the khipu board (Side B). Side B has three columns of names, totaling 132; each name



blue, white, moderate purple, and deep pink strings plied into a four-colored barber-pole style construction; each of these cords is made up of two Z-spun moderate blue *hilasa* strings S-plied together, two Z-spun white *hilasa* strings S-plied together, two Z-spun moderate purple *hilasa* strings S-plied together, and two Z-spun deep pink *hilasa* strings S-plied together; all four strings were then Z-plied together. Three cords share the following construction in which a *jerga* string and a *trama* string are plied together: one moderate brown S-spun *trama* string and one mottled light violet and white S-spun *jerga* string are Z-plied together. Out of 87 cords, there are 33 different constructions. The most common construction (14 cords) is a deep pink and black cord comprised of one S-spun *trama* deep pink cord and one S-spun *trama* black cord Z-plied together; this is associated with individuals, both men and women, of nine different surnames. The repetition of cord construction suggests that the variables of construction, such as color, thickness, and ply, may have been keyed to specific contributions, such as cloth, wood, food, etc.<sup>7</sup> If each cord were unique, one would expect that the designs on the cords pertained to specific individuals; however, this does not seem to have been the case for the Mangas khipu board.

The khipu board was made between A.D. 1800–1900<sup>8</sup> and likely records the fulfillment of ritual obligations for major community festivals. In the seventeenth century, the two most important celebrations in Mangas were the feast of Corpus Christi in June and the feast of St. Francis on October 4 (Burga 1988). By the 1980s, however, the two primary celebrations were the feast of Masha in November—a two-week festival of dancing and ritual movement through the countryside (Robles 1982)—and the feast of the Virgin of the Rosary of Zaragoza in October. The Feast of the Virgin of the Rosary of Zaragoza, lasting for days, included a procession of the Inka emperor, his generals, and their ladies, along with the Spanish captain and his soldiers. A highlight of the ceremony was a mock battle between Inkas and Spaniards. Burga has noted that participation in the festival not only required specialized clothing, but also incurred large expenses. In the 1980s, everyone's participation in, and contributions to, the yearly festivals were carefully marked in note-

books kept for the purpose (Burga 1988). Hyland was able to acquire such a festival notebook, kept by Don Cirilo Aguado, for the year 1963. This notebook contains lists of individual names, both male and female. Noted next to each name is a promised contribution, such as cash, a special hot rum drink, a bolt of fine cloth, or a log of eucalyptus wood. Sometime after the ceremony, a check mark was placed by each item if it actually had been given. Salomon has observed that community accounting in Tupicocha is done in a similar manner; a “performance proof,” such as the word “cumplido” (“fulfilled”), is written next to an individual's name to demonstrate that a promised obligation was fulfilled (Salomon 2004:188). In Don Cirilo's notebook, virtually every name occurs only once throughout the year (Hyland, personal collection, Cuaderno of Don Cirilo Aguado, 1963). This is similar to the Mangas khipu board, in which there is no repetition of any name from front to back.

The surnames on the Mangas khipu board occur in loose clusters. There are frequent groupings of three individuals with the same surnames one after the other, such as Espirita Estrada, Paula Estrada, and Laucadio Estrada; there are also male/female pairs, such as Enrique Arcayo followed by Patila Arcayo; there are also groupings of surnames broken by other names, such as the sequence José C. Taicas, Niculasa Concepción, Obispo Taicas, Francisca Taicas. This type of kinship clustering suggests local festival sponsorship. This contrasts with the names on the Ayacucho khipu board, which are written in an unvarying male/female/male/female sequence, probably by a priest or parish assistant (Figure 5).

### Operation of the Khipu Board

Hassaurek, who witnessed the use of khipu boards in 1863, described how the cords were left hanging down next to each person's name until the ceremony of public accounting. If a man or woman had fulfilled their obligation to attend catechism class, their cord was pulled tight to the board, held in place by the knot at the end of the cord (Hassaurek 1967:176 [1866]); those whose cords were left hanging down were flogged. Martínez Compañón's watercolor of the ceremony of public accounting, the *huayrona*, shows the khipu board

held up, cords pulled tight, so that all could see who had completed their obligations (Martínez Compañón 1985:54 [1789]). Presumably the Mangas khipu board was used in this manner. When individuals agreed to various obligations, their names were written down and the corresponding cords were inserted. Then, when the public accounting of obligations occurred, the cords were pulled tight for public display (over time, the cords have shifted in their holes). On two occasions on the Mangas khipu board, first names were overwritten in pencil with another name—for example, Lucia written over Santaloya—as if a relative had fulfilled an obligation.

Such a use of the khipu board presupposes that only one side could be used at a time, despite the fact that names are on both sides of the board. Because the cords go through the board, the names of the second and third columns of Side A and of the second and third columns on Side B were arranged in such a way that they shared a common cord. However, there appears to be no relationship between the names that share a common cord, either in surname, gender, or moiety. Our hypothesis is that the khipu board was used for two separate occasions, with each side corresponding to an event. When the obligations for the first feast were agreed upon, three columns of khipu cords were inserted into Side A next to the corresponding names (Figure 2). After the event, when determining who had fulfilled their obligations, the cords were pulled tight to the board. Then, when the contributions for the second event were determined, the board was flipped onto its back (Figure 3). The first column of holes on Side B was empty, and was filled with cords corresponding to the names on Side B, column 1. Then the cords in the next two rows were removed and replaced with new cords that corresponded to the names on Side B. The rightmost column of cords on Side B were left in place, perhaps because it is difficult to pull the cords out; those cords on the rightmost column of Side B correspond to names on Side A, column 1, from the first event.

If the khipu board was used in this manner, then the names with cords in the final or “active” position are Side A, column 1; Side B, column 1; Side B, column 2; Side B, column 3 (this column has only 34 names); and Side A, column 2, no.

35 and no. 36 (these last two cords occur after the last name on Side B, column 3). The non-corresponding or “inactive” columns are the cords in Side A, column 2 (except for nos. 35 and 36) and in Side A, column 3. The cords in these columns do not correspond to the names next to them because these cords are associated with the names on Side B. Likewise, the cords on Side A, column 4, Side B, column 4, and Side B, column 3, nos. 35 and 36, are “inactive” and do not have a name next to them; these cords correspond to names on the other side of the board.

### Moiety and Knot Direction

An upper (*Hanan*)/lower (*Urin*) moiety system was fundamental to Inka social organization and remained the central organizing principle of Andean village life into the late twentieth century. Traditionally, Mangas had a strong moiety system in which villagers belonged either to the upper moiety, *Cotosh* (primarily farmers), or to the lower moiety, *Allaucay* (primarily herders) (Burga 1988:10–24). During the festivals of Masha and of the Virgin of the Rosary, the appropriate ritual dress, dances, and behavior were determined largely by one’s moiety affiliation. According to local informants, moieties were strictly endogamous until the 1990s; therefore, certain surnames pertained to only one of the two moieties. Interviews with the four oldest community members established that 18 (36 percent) of the 50 different surnames on the Mangas khipu board could be associated with one of the two moieties. Of the 282 names on the khipu board, the moiety affiliations of 62 can be determined as follows: 64.5 percent (40) *Cotosh* and 35.5 percent (22) *Allaucay*. The preponderance of *Cotosh* is not surprising; because of the demands of herding livestock on mountain slopes, herders (*Allaucay*) have lower rates of participation in village affairs.

Can moiety affiliation be linked to an element on the Mangas khipu cords, specifically the direction (Z or S) in which the knots are tied? The knots typically found on khipus can be constructed in such a way that they slope either to the left or to the right when viewed from the front (Ascher 2005). In other words, in a Z-knot, the dominant diagonal axis of the knot as it crosses the plane of the pendant string goes from upper

right to lower left (/). In an S-knot, the dominant diagonal axis goes from upper left to lower right (\) (Urton 2003:75).

Urton and Brezine have hypothesized that the direction in which knots are tied on Inka khipu may reveal moiety affiliation (Urton and Brezine 2007). When discussing the paired khipu (UR66 and UR67) in the Puruchuco archive, they speculated that the khipu with predominantly S-knots (UR66) may represent the upper (*Hanan*) moiety, while its partner with mainly Z-knots (UR67) may represent the lower (*Urin*) moiety. This accords with Urton's earlier theory that S-knots represent the more highly ranked marked half of a semantic pair (such as the *Hanan* moiety), while Z-knots represent the lower ranked unmarked half (such as the *Urin* moiety) (Urton 2003: 86–87, 143–160).

For the “active” cords on the Mangas khipu board, there are 15 surnames with a moiety affiliation and an undamaged associated cord containing a knot. For these names, there is a 100 percent (15 out of 15) correlation between knot direction and moiety, indicating a strong association between moiety and knot direction: S-knots = upper moiety (Cotosh) and Z-knots = lower moiety (Allaucay).<sup>9</sup>

Furthermore, if we examine the 83 knots whose direction can be determined in the “active” columns of the Mangas khipu board, we find a distribution of S-knots to Z-knots that mirrors the distribution of Cotosh (64.5 percent) to Allaucay (35.5 percent) names. Among the “active” cords, 63.9 percent (53 knots) were S-knots, while 36.1 percent (30 knots) were Z-knots. This reveals a highly significant relationship between moiety and knot direction on the Mangas khipu board, exactly what we would expect if S-knots indicated upper moiety and Z-knots indicated lower moiety. Statistically, if the knot direction were random, there would be less than one percent likelihood that the knots would have this distribution.

### Conclusion

The uniqueness of the Mangas khipu board is that, for the first time, there exists a single text with both alphabetic writing and associated khipu cords. This has allowed us to link specific khipu cords with particular moieties, something which

had not been possible before the discovery of the Mangas khipu board. Analysis of the khipu board reveals a significant correlation between moiety and knot direction, where S-knots = upper moiety and Z-knots = lower moiety. This relationship provides strong evidence in favor of Urton's hypothesized link between moiety and knot direction on Inka khipu, and may represent the first decipherment of a semantic element in khipu since Locke discovered how numbers were encoded. It also suggests at least a partial continuity between Inka-period and nineteenth-century khipu. It is hoped that, as more khipu boards come to light, more insights into khipu methods of signification will be revealed.

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*Data Availability Statement.* The data on which this article is based are held by the authors and are available to all interested researchers upon request to the lead author.

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- levels of thickness; this is probably related to differences between the characteristics of wool (highland khipus) vs. cotton (coastal khipus).
7. Hyland will analyze ply direction and other cord features and their relationships to gender and moiety in future publications. She is currently undertaking a khipu board research project involving investigations in Casta and Cotacachi as well as research in Mercedarian archives.
8. The earliest possible date for the khipu board is 1800, based on the title's statement that "se empezó a empadronarse en el año de 1800." However, the khipu board could have been created many years after that. When Robles was in Mangas in 1981, he asked the villagers whether they remembered when the khipu board that he saw was created, but no one knew anything about it (Robles 1982). The memory of those villagers dated back to around 1900. Conservatively, therefore, we can state that the Mangas khipu board was created between 1800 and 1900.
9. In the final position ("active") columns, the 15 names with an associated moiety and a cord with a knot whose direction can be determined are:
- Illegible Abad (BI, 15) – Allaucay – Z-Knot  
Pablo Alejo (BI, 24) – Cotosh – S-Knot (first knot),  
S Knot (second knot)  
Susana Alejo (AI, 15) – Cotosh – S-Knot  
Rofina Calistro (BII, 6) – Cotosh – S-Knot  
Rosario Calistro (BII, 43) – Cotosh – S-Knot  
Faustino Leon (BI, 3) – Allaucay – Z-Knot  
Salome Marques (AI, 13) – Allaucay – Z-Knot  
Illegible Mesa (BI, 28) – Cotosh – S-Knot  
Evangelista Peris (BII, 16) – Allaucay – Z-Knot  
Baltasar Santos (BI, 12) – Cotosh – S-Knot  
Illegible Santos (BI, 13) – Cotosh – S-Knot  
Josefa Santos (BI, 18) – Cotosh – S-Knot  
Ynocencio Santos (BI, 16) – Cotosh – S-Knot  
Pedro Ugarte (BIII, 11) – Cotosh – S-Knot  
Pablo Villafuerte (BII, 19) – Cotosh – S-Knot
- There is one additional individual with a known moiety affiliation (Cotosh) and a knotted, corresponding "active" cord—Mariana Santos (BI, 10). Mariana's cord has a Z-knot, which does not fit the pattern of S = Cotosh/Z = Allaucay. The Z-knot occurs close to the board; the rest of the cord, which extends for three inches beyond the knot, is badly frayed and damaged. There is no doubt that there originally was another knot at the end of Mariana's cord. On the khipu board, there are ten "active" cords with two knots, instead of only one knot, in addition to Mariana's cord. If we calculate the percentage of S-knots to Z-knots on the "active" cords (that is, on the cords that correspond to names, whether the moiety is known or not) and, in the case of active cords with two knots, use only the second knot (i.e., the end knot furthest from the board), we find: S-knots (48) = 64.9 percent; Z-knots (26) = 35.1 percent, which is still a close relationship to the proportion of Cotosh = 64.5 percent to Allaucay = 35.5 percent.

### Notes

1. For a summary of khipu theories, see Frank Salomon and Mercedes Niño-Murcia (2011): 71–79; also Brokaw (2010).
2. The Ayacucho khipu board has three layers of paper, one glued over the other, each with writing in different hands. It clearly was reused on at least three separate occasions. The Ayacucho khipu board has no provenience.
3. Ware's and Clark's MSI scans enabled us to identify 26 first names, 18 surnames and one middle initial that are illegible to the naked eye (Hanny and Ware 2012). The names that are still illegible occur in column 1 of Side B, where the paper is torn.
4. Brokaw suggested that Porres's instructions imply that the priest oversaw the creation of the khipus and might have made them himself (Brokaw 2010).
5. Images of the current Mangas khipu board appear in the appendix of Rojas (2010).
6. There are three main areas of difference between Mangas khipu cords and Inka-period khipu cords. First, like the modern patrimonial khipus in Rapaz (Salomon et al. 2011:361), many Mangas khipus have elaborate multiple plies. Second, the Mangas khipus exhibit a wider range of red and purple hues. Third, the strings comprising the cords in Mangas have three

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