Toward the Decipherment of a Set of Mid-Colonial Khipus from the Santa Valley, Coastal Peru

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Abstract. This article focuses on a linked pair of "documents" from mid-seventeenth-century coastal Peru. The analysis first examines a *revisita* (an administrative "revisit") carried out in 1670 in settlements around the town of San Pedro de Corongo, in the lower Santa River Valley. The revisit describes a census of the population of what are described as six *pachacas* ("one-hundreds") administrative/census units that usually coincided with *ayllus* (the Andean clanlike sociopolitical groups). The document identifies 132 tributaries distributed across the six ayllus, all but two of whom are identified by name. Tribute is assessed on this new census count. The information in the revisit is then compared to the organization of a group of six *khipus* (knotted-string recording devices) that were said to have been recovered from a burial in the Santa Valley. The six khipus are organized into a total of 133 color-coded groups of six cords. The knot values on the first cords of the six-cord groups total the same value as the tribute assessed in the revisit document, and it is argued on these grounds that the khipus and the revisit document pertain to the same administrative procedure. The attachment knots of the first cords of the six-cord groups vary in a binary fashion by attachment type (i.e., tied either "verso" or "recto"). It is argued that this construction feature divides the tributaries identified in the revisit into moieties; therefore, the khipus constitute a gloss on the social organization of the population identified in the revisit document. It is suggested that the names of the tributaries may be signed by color coding in the khipus.

Keywords. Khipu (quipu), Peru, decipherment, writing, administration

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Introduction

The Inka Empire (AD 1400–1532) is notable among the civilizations of the ancient world in its use of khipus — knotted string devices — for the storage and transmission of information. In the absence of a formal writing system, the Inkas filled the twists and knots of the khipus with data, including bureaucratic accounting measures such as tax assignments and census counts. After the Spanish conquest, many native khipu keepers learned the skills of reading and writing Spanish and often served as local scribes in their communities (see cover illustration). Our own and other scholars' efforts to determine how information was recorded in these devices are motivated by the desire to understand how the Inka Empire was organized and managed and how the Inka themselves thought about this extraordinary world of their own creation.[1] Tawantinsuyu ("the four parts intimately bound together"), the name by which the Inkas knew their empire, stretched along the spine of the Andes mountains from the present-day border between Colombia and Ecuador, in the north, southward to a couple of hundred kilometers south of Santiago de Chile, and from the Pacific coast to the west to the dense tropical forest of the Amazon basin to the east. Myriad peoples and environments were embraced within these boundaries, and the question that scholars have long sought to answer is exactly how the Inkas were able to organize an imperial state within such a diverse territory. The Spaniards, who conquered the Inkas beginning in 1532, had their own views of this question, and while the Europeans collected information from numerous native informants, their explanations always betrayed their own interests and presumptions about Inka state actions, principles, and values. The khipus contain the only indigenous accounts of how the Inka themselves viewed these matters. However, until we learn how to decipher these knotted cord records the Inka testimony on the economy, politics, religion, and other aspects of their civilization will remain mute and unavailable to us. This is the lacuna we seek to fill.

Leland L. Locke (1923) first proposed the base-10 numerical organization of what we could term "quantitative" khipus, whereby knots of different forms and positions correspond to decimal place values (e.g., 10s, 100s, 1000s, etc.).[2] This decimal organization is broadly characteristic of the corpus of Inka-era khipus — that is, roughly two-thirds of the 923 extant khipus in museum collections exhibit the quantitative schema. However, the remaining one-third of extant samples studied by the Harvard Khipu Database project lack a decimal layout.[3] The latter, the so-called narrative khipus, are thought to contain rich, nonnumerical information including, but not limited to, names, stories, and other accounts of Inka life histories

and cultural traditions.[4] Given the broad diversity of construction features of the knotted strings (e.g., variations in cord spin and ply, knot direction, etc.), a question arises: what types of information might remain undiscovered in the quantitative and narrative khipus? Khipu construction generally requires binary choices, pointing toward the encoding of such social organizational entities as moieties—dual social divisions (e.g., *hanan* [upper]/*hurin* [lower])—endemic to Andean communities from pre-Inka times through the twentieth century.

Sabine Hyland, G. A. Ware, and M. Clark (2014) have posited a correlation between knot direction and moiety affiliation on khipu cords. Their conclusions followed analysis of a nineteenth-century hybrid khipu-document board from the village of Mangas, in the central highlands of Peru. The artifact, one of few known examples of alphabetic text coupled with khipu cords, yielded an exact correlation between Z/S knot direction (see below) and moiety affiliation for fifteen indigenous surnames recorded on the khipu board. The remaining cords also exhibited a distribution of Z/S knots similar to the moiety groupings of the village under study.

Gary Urton's (2017) proposed match between a set of six linked khipus from Peru's Santa River Valley and a document from a Spanish colonial "revisita," from the region of San Pedro de Corongo, in the lower Santa Valley, presents a number of findings that expand the implications of binary construction features in khipu encoding. When considered alongside the findings of Hyland, Ware, and Clark (2014), the Santa Valley study prompts a number of observations concerning how information might have been encoded in the Inka khipus. This article contributes in the following ways to ongoing efforts to interpret information recorded in colonial and late pre-Hispanic khipus:

- The link between an "archive" of six Santa Valley khipus and documentation of a colonial revisita of the Recuay Indians in the region of San Pedro de Corongo discussed below constitutes the only known match between an alphabetic text and traditional Inka-like khipus.
- The proposed matching Spanish document and khipus from the Santa Valley predate the Mangas khipu board by over a century and constitute the earliest existing text believed to contain transcribed narrative khipu information. The census count/tribute reallocation recorded in the Santa document, which was carried out in 1670, predates the earliest provenance of the Mangas board by 130 years, providing an opportunity to examine khipus that are quite similar to those made under the Inka Empire.

- As we will show below, the Santa khipu archive supports the theory that moiety affiliation was encoded within individual khipu cords. However, the Santa data point to a location for the notations not previously proposed for this information. That is, as we argue herein, cord attachment direction (recto/verso), rather than knot direction (Z/S), indicated moiety affiliation on the Santa Valley Recuay khipus. Groups of six cords encoded data pertaining to individual tributaries and included both numeric and narrative information. This constitutes the first instance of "reading" information from khipu attachment knots.
- The Santa document and khipus comprise a database of over 130 named individuals. This sizable data set should aid in the search for statistically significant correlations between text and khipu cords, as well as offer a potential context for cord decipherment.

These observations yield important insights into the complex workings of the Inka khipus. However, might the existence of different methods for recording moiety affiliation (knot direction vs. cord attachment) complicate the prospect of "deciphering" the khipus? We see no reason to think this was an either/or circumstance; that is, both methods might have been used, perhaps in different contexts or regional settings. Therefore, we do not see this difference as particularly problematic for investigating potentially alternative modes of signing moiety affiliation—a form of social organization that was virtually universal in settlements across the Andes.

In sum, the data below constitute a new look into the relationship between moiety affiliation and khipu recording in the Andes: in this case, a binary, attachment knot identification system.

The Recuay Document and the Santa Valley Khipus

What we have referred to as the Santa Valley revisita is a document written in 1670 in which a recount was made of the Recuay Indians who lived in several settlements in the region of what is today the town of San Pedro de Corongo. The modern-day town is located just north of the great bend in the Santa River, where the northward flowing waters turn westward, toward the Pacific Ocean. The document identifies 130 tributaries by name, although two additional tributaries are enumerated in the overall count of tributaries, making a total of 132 individuals accounted for in the document. The document states that the 132 tributaries are each required to pay an annual tribute (in specie) of 2 *pesos*, 7 *reales*, and 3 *quartillos*. The total tribute to be paid by the 132 tributaries is set at 367 *pesos*, one-quarter *real*

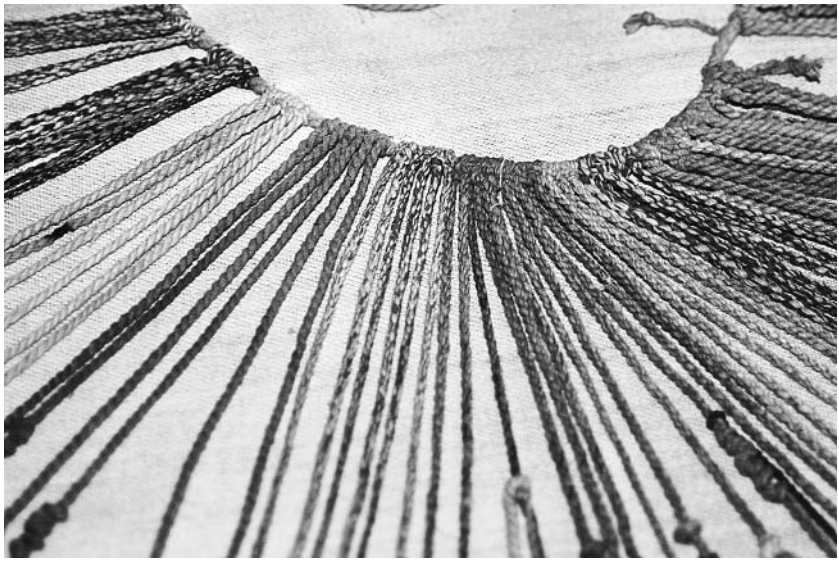

Figure 1. Six-cord color groups on a Santa Valley khipu (UR 89). Photo by Gary Urton

and one *quartillo*. At the end of the document, it is stated that, after the tribute assessment is read out to the natives "in the general language of the Inkas" (i.e., Quechua), it is to be entered into a *quipu* (khipu[s]).[5]

The six khipus from the Santa Valley described herein were in the collection of the great Peruvian-Italian khipu scholar Carlos Radicati de Primeglio at the time of his death, in 1990.[6] The six khipus are organized in what are termed "six-cord" color-coded groups. That is, in each khipu, one group of six cords of one color is followed by another six cords of a different color, the latter of which is followed by another six cords of a different color from the second group, and so on (fig. 1). Such color patterning is commonly referred to as "color banding."[7] The six khipus contain a total of 133 six-cord, color-coded cord groups.

Urton has hypothesized that the names of the 132 Recuay tributaries are encoded in the Santa khipu archive.[8] If so, then the question arises, how might one match the 130 names (recall that two names are unrecorded) enumerated in the document with the 133 six-cord groups in the Santa khipu archive? What other form(s) of identifying information, such as names and moiety affiliation, might be recorded in the khipus? If such narrative information is indeed encoded within the khipus, how might it

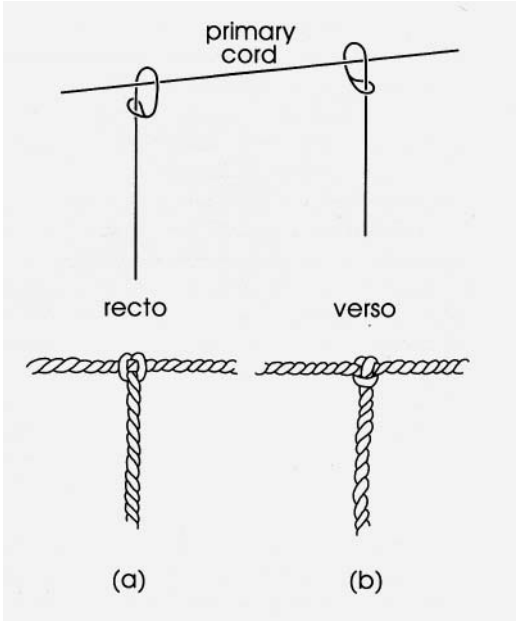

Figure 2. Attachment knot directions. Drawing by Julia Meyerson

have been recorded—for example, might it be located in knot or attachment knot direction, color, ply, or some other construction feature? These are the central questions we address in this article.

Attachment Knots and Moiety Affiliation

Of the 1,056 pendant and subsidiary cords that compose the six Santa Valley khipus, a total of 804 principal pendant cords form the 133 six-cord groups.[9] Quantitative information knotted into the pendant cords of the six-cord groups follows the base-10 numerical scheme well known for Inka khipus. Urton (2017) has recorded the numerical values encoded in the Santa khipus; those values will not be repeated here. However, analysis of attachment knots (a feature not analyzed previously by Urton) yields a possible glimpse into the set's extranumerical data. In order to identify the possible location of this additional information, it is necessary to explain the khipu construction feature known as "cord attachment."

During khipu construction, each pendant cord is attached to the primary cord with what is designated as an attachment knot. This maneuver

Table 1. First Cord Attachment Knot Data for the Santa Khipu Archive

Khipu	Recto Attachment	Verso Attachment
UR 87	48	0
UR 92	10	0
UR 88	0	9
UR 89	0	34
UR 91	0	15
UR 90	5	12
Totals	63	70

presents the khipu creator, or khipukamayuq, with two choices: one can loop the final tie from below, then up and around the primary cord toward the body, forming a verso knot; or one can perform the operation by moving the cord up and over the primary cord, away from the body, forming a recto knot (fig. 2).

It is important to bear in mind that the directional reading order for noting the recto/verso distinction along the primary cords of the six khipus follows the standard recording/reading procedure practiced by students of the khipus, whereby reading commences at the "head"—the knotted or tasseled end of the primary cord—and proceeds from left to right, terminating at the primary cord's dangling "tail." Following this standard direction of reading, one can record the occurrence of recto/verso attachment knots along the primary cords of the six Santa Valley khipus.

We began detailed study of attachment knot directionality by hypothesizing that the first cord of each six-cord group was the main "identifier" cord for that group—in other words, this cord should contain the moiety affiliation and the possible name notation (see below) for a tributary. Therefore, we focus in our analysis on the first cord of each six-cord group, read from left to right (as described above). This information is summarized in table 1.

It is evident from table 1 that five of the six khipus contain either all recto or all verso attachment knots on the first cords of their six-cord groups. For example, all forty-eight first pendant cords in khipu UR 87 are attached to the primary cord with recto knots. All thirty-four first pendant cords of UR 89 are attached with verso knots. However, one khipu, UR 90, is mixed: it contains five recto first pendants and twelve verso first pendants.[10] Summed across all six khipus (composed of a total of 133 six-cord groups), the result is sixty-three recto first pendant cords and seventy verso first pendant cords.

Table 2. Recuay Tributaries and Pachaca Affiliations

Pachaca	Number of Tributaries
Namus	18
Corongo	23
Cuyuchin	9
Cusca	7
Guauyan	41
Ucore	32
Total	130

How should we interpret these cord attachment knot patterns? A possible answer emerges when we compare the recto/verso attachment knot distribution to the tributary list—or *padrón*—contained in the revisita of the Recuay Indians from 1670. This document lists the names of 130 Recuay tributaries within their respective *pachacas* ("one hundreds"), a label which, in much of Chinchaysuyu, the northwestern quadrant of the Inka Empire (which includes the Recuay/Corongo region), designated *ayllu*-level groupings of tributaries. In fact, the two terms—*ayllu* and *pachaca*—are often used as synonyms in this region.[11] The information pertaining to the names of Recuay tributaries and their ayllu/pachaca affiliations is summarized in table 2.

There is ample documentation of moiety systems serving as a defining feature of Andean social organization, even after the Spanish conquest and into the nineteenth century.[12] Armed with the list of six Recuay pachacas/ayllus from the 1670 revisita, one can presume that each tributary would have belonged to one moiety or the other—that is, either to the *hanan* (upper) or *hurin* (lower) half—of the collection of villages around San Pedro de Corongo with which the document is concerned. Why is the moiety distinction important? Knowing that a pachaca/ayllu would correspond to either hanan or hurin, one can sum the membership of each pachaca recorded in the revisita and compare it to the recto/verso attachment knot distribution in the Santa Valley khipu archive. Might the total number and distribution (into presumed moieties) of recto/verso knots in the six khipus match or equal the sums of numbers of tributaries in a certain, hypothetical moiety-based combination of tributaries in the six pachacas/ayllus enumerated in the Recuay revisita document? Table 3 shows the proposed potential matches.

A summation of the six khipus yields the following hypothetical matches: there are seventy verso first pendant cords; we posit these were

Table 3. Attachment Knot Distribution and Proposed Ayllu Combination

Pachaca	Tributaries	Pachaca	Tributaries
Cuyuchin	9	Cusca	7
Namus	18	Corongo	23
Ucore	32	Guauyan	41
Total Tributaries	59	Total Tributaries	71
Recto Cords	63	Verso Cords	70

linked to the sum of the pachacas: Corongo, Guauyan, and Cusca, which contain seventy-one tributaries. On the other hand, there are sixty-three recto first pendant cords; we relate these to the proposed grouping of pachacas: Namus, Cuyuchin, and Ucore, which contain fifty-nine tributaries. In other words, three pachacas sum to within one of the number of verso attachment knots, and the remaining three pachacas sum to within four of the number of recto attachment knots. Were the distribution of recto/verso to be random, there would be less than a 5 percent chance of producing the observed correlation, implying a statistically significant result.[13] Nevertheless, the difference between the second tributary count (fifty-nine) and the number of recto-attached first pendant cords (sixty-three) may cause concern. In light of this potential complication, we make the observations below.

First, the revisita document is incomplete. The recorded tributary list (table 4) includes only 130 names. However, the document states explicitly that the tribute established in the proceeding was assigned to 132 Recuay Indians: "son los d[ic]hos ciento y treinta y dos Yndios ausentes y presentes contenidos en la d[ic]ha lista y numeración . . . " ("these are the said 132 Indians, present and absent, contained in the said list and enumeration [of tributaries]").[14] In other words, there are two names unaccounted for in the registry. While there is not enough information in the revisita to determine with absolute certainty the ayllu affiliations of these two missing ("absent") individuals, we hypothesize that they might both have belonged to the same moiety—specifically, we suggest they belonged to the moiety signaled by recto attachment knots. This would result in a tributary moiety of sixty-one (=59+2) individuals, very close to the sixty-three recto-attached first pendant cords.

Second, the Santa khipus contain 133 six-cord groups, whereas the revisita speaks of 132 tributaries. While there is no way of knowing for certain to which khipu the extra six-cord group would have pertained, should it have appeared on one or the other of the three "recto" khipus,

Table 4. Padrón de Indios Tributarios Recuayes: Conchucos 1670

Pachaca Namus:

P^{o} ticlla condor
lorenso tapia
franc^{co} nuñes
Ju^{o} chauca
diego pardaue
diego xara
antonio de Roxas
P^{o} artiaga
ju^{o} salvador

ju^{o} de Roxas
franc^{co} rroxas
Andres Yapan
gabriel chuquimaygo
ju^{o} Bap^{ta} hijo del coxo
ju^{o} corongo hijo de simon
ju^{o} p^{o} haçaña hijo de coxo
p^{o} joseph hijo del coxo
ju^{o} chauca hijo de ju^{o} chauca

Pachaca de corongo:

don franc^{co} Ramos
don Migl carhuahuanca
marcos carhuayamoc
ju^{o} tantaruna
Benito colquixari
Antonio carhuahuanca
Nicolas colquixari
Ju^{o} Diego
Antonio ygnacio
p^{o} huaman
franc^{co} pomamango
franc^{co} salvador

phelipe paucarmango
ju^{o} chucimango
Ag^{n} Chuquimango
nicolas alexandro
joseph Roque
donmingo saluador
jacinto saluador
pedro pablo
jacinto de la cruz
ju^{o} de la cruz
esteban chuquimango

Pachaca de Cusca:

ju^{o} quispe
domingo quispi
joseph rincon
Alonso montoya

Joseph carhuapari
Ag^{n} montalbo
Ju^{o} belasques

Pachaca de Guauyan:

Alon^{s} chucho
luis pari
diego carhuahuachic
P^{o} Cochachin
Ag^{n} nunahuanca
Franc^{co} Pinedo
franc^{co} chuquinaupaico
franc^{co} incos
Germ^{o} Vilcayauri
Ag^{n} Rimanga
Ju^{o} Toribio
Ju^{o} Alonso
Alonso huanca
Joseph asencio
Pedro huanca
Marcos de la cruz
Jacinto Hanampa
Jacinto Collas
felipe Santiago
d. Nicolas lluyacpoma
Miguel llanqui

Ju^{o} carhuaxambo
Diego chuquihuanca
franc^{co} Asencio
Ag^{n} sebastian
domingo incos
Nicolas lara
Ju^{o} huaquin morales
joseph campos
Ju^{o} culquiyanac
domingo ancxito
ju^{o} bap^{ta} quispicondor
franc^{co} nunahuanca
Ag^{n} carhuacota
Ju^{o} cullquiyanac leon
Dom^{o} cullquiyanac leon
xpoval Tello leon
P^{o} julez
Felis cochachin
Nicolas Ocxac
ju^{o} chicho

Pachaca cuyuchin:

don juº chuquinaupa
juº carhuahuanca
Joseph colquimunan
diego tanta riexi
Alonso pon luis

juº Ramos rupay
juº cullquimunan
pº marcos
diego huaman

Pachaca de Ucore:

Francº rrojas
xpual tantayari
marcos Juares
juº rimaycachin
juº de la cruz
jacinto carhuamenta
juº Albares
Domingo chuquimango
juº rimay cachin
Alonso Baltazar
Andres yanac
domingo felipe
fabian Ramos
juº Antonio
juº quispe
jucº xpual

felipe parina
domingo garcia
domingo huacha
francº chuquicondor
felipe barbudo
Pº martin
Lorenso asnabal
Blas clemente cruz
Pº tomas pullic
Juº gaspar
Alonso yaulli fausto
Martin chuquirimac
Antonio carhuahuachic
juº francisco
juº de rroxas
bernabe principe

then adjusting the final count (i.e., by subtracting the additional recto-attached six-cord group) would yield the following: on the one hand, sixty-one tributaries ("recto" moiety) linked to sixty-two recto first pendant cords, and on the other hand, seventy-one tributaries ("verso" moiety) linked to seventy verso first pendant cords.

What might be the source of these inconsistencies—the extra cords and the unlisted names? These differences may be reasonably attributed to the on-the-ground "noise" endemic to local accounting practices.[15] While the khipus and the document do not match exactly, it is important to remember that one is looking at records taken by two different record-keepers—one in threads and knots, the other in alphanumeric script. If there is any reason for counts to differ, it might well arise in a situation where an indigenous khipukamayuq is making a khipu for indigenous use and a Spanish census-taker is allocating Spanish tribute labor.

What can this proposed match between attachment knots and moiety affiliation contribute to the study of the Santa khipu archive? Under Urton's theory, that each six-cord group corresponds to a tributary, moiety information essentially "splits" the data set into dual moiety groups, aiding the effort to match tributaries with cords.[16] In what we believe to be a first in the history of khipu studies, we propose that a set of khipus is here enriching our understanding of an alphabetic text, rather than the reverse. That is, a division of the six Recuay pachacas into moieties, which is not evident in the written document, is arrived at on the basis of information recorded on khipus that appear to be historically related to the proceeding from which the document was drawn up. While the absence of textual recording of a local moiety system in the document may be more a reflection of Spanish indifference to indigenous social customs rather than an inadequacy in Spanish accounting methods, the reconstruction proposed herein underscores both the complexity and the potential historical significance of information encoded in Inka and early colonial khipus.

Attachment knot as a sign of moiety affiliation also allows us to propose a preliminary explanation of the on-the-ground logistics of a Spanish revisita. Knowing that a tributary's primary information consisted of his name, ayllu, and moiety affiliation, as well as his tribute contribution, it might well follow that moiety affiliation was an *initial* designation that would have been made in the attachment of each pendant string to the primary cord. One can think of few other pieces of identifying information that might have been signified by the recto/verso attachment knot distinction. Names and ayllu affiliations would not fit this feature because they are not binary. It seems unlikely that a distinction between tribute "paid" and "not paid" was signified in the case at hand, as this would imply that

roughly half of the Recuay tributaries had not yet paid their dues at the time of the writing of the document. In addition, it is clear that the actual payment of the designated tribute amounts would have occurred (or not) after the production of the revisita; such documents were statements of what *should be* paid in tribute, henceforth, by the group of tributaries named in the list. On the other hand, moiety affiliation—that is, the designation of whether each tributary belonged to the upper or lower moiety—would have invited a binary notation and would have resulted in a near-equal split of the tributaries into halves. In light of the almost total lack of diversity in knot direction or final cord ply direction (S/Z)—two other binary construction features that could have been used to record moiety affiliation—it seems clear that, in the Santa Valley khipus, this important binary distinction was encoded in attachment knots.

Further Directions

These conclusions raise a number of questions, inviting further inquiry into the proposed khipu-document match. To begin with, why is there a discrepancy between the number of six-cord groups in each khipu and the number of members of each Recuay pachaca/ayllu?

For example, the largest pachaca (Guauyan) contains forty-one tributaries, yet the largest khipu (UR 87) contains forty-eight six-cord groups. What might account for this difference? One possibility is an accounting error. A second potential explanation, based on first cord values, might be that within moieties, tribute contribution was given consideration when sorting the Recuay tributaries.

Urton has already hypothesized that the first pendant cords of six-cord groups recorded the amount of tribute owed by tributaries.[17] If so, then the different values encoded on the 133 first cords would provide evidence for what appears to have been a graduated tribute system among Recuay tributaries. Figures 3a and 3b organize the first cord numerical data according to the proposed moiety division—in other words, the "verso" moiety vs. the "recto" moiety—of the six khipus.

One finds a variety of tribute assignments, ranging from what we propose to have been payments of between zero and thirteen pesos. Do the recorded values support or complicate the theory that each khipu encoded tribute payments owed by tributaries within an ayllu? If, indeed, first cord values recorded what was to be paid by each tributary, then all forty-eight individuals recorded on UR 87, for example, would have paid one peso in tribute. Yet, how likely is it that *every member* of Guauyan (or any pachaca) would have possessed the same means and thus would have paid the same

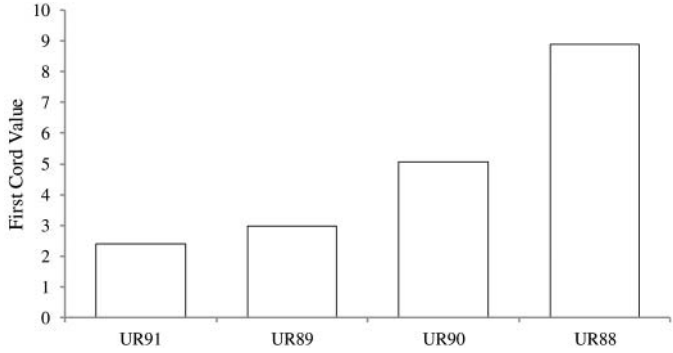

Figure 3a. Average first cord values for "verso" moiety

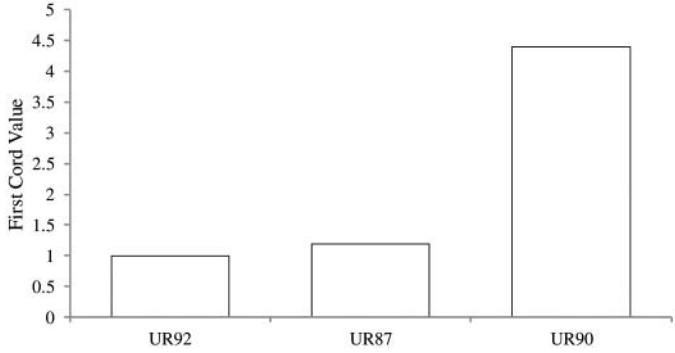

Figure 3b. Average first cord values for "recto" moiety

amount? Ayllus were not homogeneous bodies; that is, each ayllu, just as in the diversity within any other community, would have been composed of some affluent individuals and some less affluent ones. The repeating first cord values imply that there was a general intention to record similar payers on the same khipu. If so, then it is unlikely that the khipus (which gave consideration to tribute payment) and the document (with its strict division by ayllu) would match perfectly. Rather, the Santa khipus delineate complementary tripartite subdivisions of the Recuay moieties. That is to say, there are three khipus/pachacas in each proposed moiety, but a tributary paying uniquely little compared to other members in his own ayllu, for example, may have been entered into the khipus in an ayllu of similarly low-paying members, even if not his own.

This assignment of asymmetrical, unequal payments allows us to envision tribute allocation as a result of a highly organic negotiation process. Perhaps a good deal of political negotiation would have filled the days leading up to the production of the revisita. During this process, poorer ayllu members might have approached affluent members, seeking tribute assistance; or, since paying someone else's tribute put that person in a subordinate position to the person paying the tribute, thereby increasing the client/dependent base of more affluent ayllu members, wealthy individuals might have been the more active agents in the negotiations. However the relationship was established, the debtor would have been obliged to provide on-call labor for the wealthy donor. Such nonreciprocal labor arrangements, broadly referred to as "minka," are known to have characterized relations between individuals in the Inka Empire, and to have continued under Spanish rule.[18]

Why do some first cords reflect large tribute payments while the remaining first cords are split fairly equally into payments in the range of 4s, 5s, etc.?

In light of increasing economic differentiation in mid-colonial Andean communities, most variety in tribute payments would have come in the form of larger amounts paid by those at the top of the socioeconomic ladder. In this regard, one can imagine a payment distribution pattern similar to that of modern tax brackets: wealthy individuals would have made large payments while the poor would have paid little, if anything. Such a payment spectrum appears in the historical record. For instance, a 1576 revisita from the Pairija (in present-day Bolivia) tax district states that "[wealthy Indians] pay more tribute and the remainder is divided and paid in equal parts by the remaining Indians, who have fewer goods."[19]

The preponderance of *tasa* (taxation/tribute) data contained in colonial documents states that tributaries are assessed a fixed amount of tribute, thereby suggesting that all tributaries paid the same amount. However, such assertions only represent the administrative ideal. How were these payments actually worked out, on the ground, within communities? We suggest, on the basis of the extraordinary evidence in the San Pedro de Corongo revisita and the matching khipu data, that actual tribute payments would have varied much more than the ideal stated by colonial officials. That is, we suggest that tribute levels in colonial communities would have been determined through a highly organic and interpersonal process, whereby negotiation among tribute payers would have both reflected and cemented increasing economic stratification.[20] Much, if not all, of this local negotiation would have been out of sight of, and probably of little interest

to, Spanish overseers. Therefore, we can expect that the results of such negotiations will have been encoded in local (i.e., khipu) accounting records, whereas the Spanish written accounts would only contain what was expected to be paid by the community in toto. Further support for our hypothesis awaits additional evidence that can only come from future document/khipu correlated data.

Why does one of the khipus contain a mix of recto and verso first cords? It is notable that first cord attachment knots on five of the six Santa khipus—representing 116 out of a total 133 first cords—are either all verso or all recto. The remaining seventeen first cords appear in UR 90. Of its seventeen first cords, twelve are attached with verso knots, while five are attached with recto knots (see table 1). This raises a question for our moiety-based interpretation of attachment knots: if attachment knots indicated moiety affiliation, why would the cord keeper have distinguished 116 Recuay tributaries by moiety on five of the six khipus, but recorded a mix of hanan/hurin affiliations for seventeen individuals on one of the khipus? We do not have a convincing explanation for this circumstance. However, UR 90 invites the following set of observations:

- It has already been noted that the number of six-cord groups in each khipu does not match the number of tributaries in each Recuay pachaca (see above). Should attachment knots have indicated moiety affiliation, then the mixed recto-verso UR 90 may explain this discrepancy. Indeed, a mixed khipu—a combination of tributaries from both moieties—would make improbable a one-to-one match between khipu and pachaca. For example, if we suppose that the seventeen tributaries recorded on khipu UR 90 were the only remaining individuals who had not yet paid their tribute, then, setting aside UR 90, the five other Santa khipus contain fifty-eight recto- and fifty-eight verso-attached first cords. This observation would seem to point to UR 90's seventeen six-cord groups as constituting some sort of "remainder" category—an outlier/exceptional status group.
- UR 90 is second only to UR 89 in terms of its cord color diversity, with twelve different options (including solid, mottled, and barber pole) across its seventeen first cords (UR 89 exhibits nineteen different color schemes across its thirty-four first cords). However, UR 90 possesses a greater *percentage* of distinct colors/color combinations across its cords than does UR 89 (71 percent vs. 56 percent). UR 90 contains the only triple-color mottled first cord among the

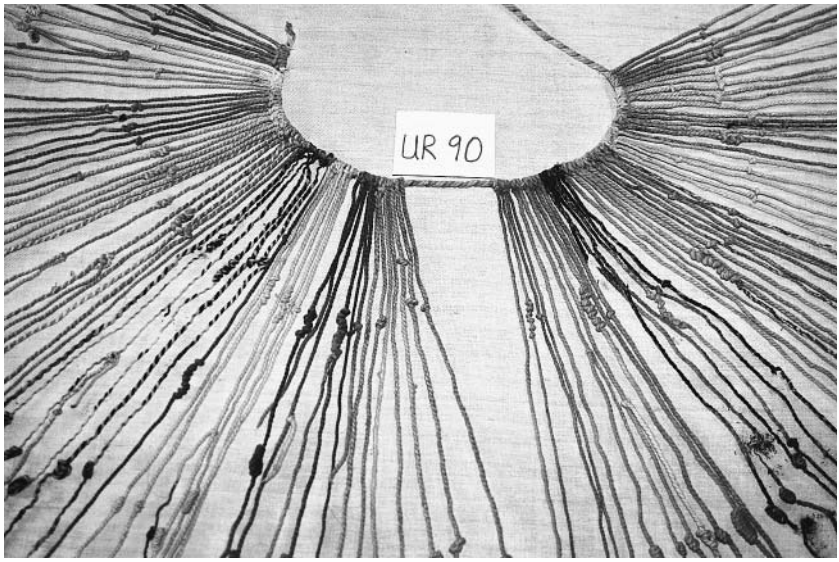

Figure 4. Primary cord gap in UR 90. Photo by Gary Urton

entire archive. Might this first cord color complexity point to UR 90 constituting a repository for specially designated ayllu members? If so, the distinguishing characteristic(s) of the UR 90 tributaries remains to be determined.

- UR 90 contains a gap between two groupings of pendant cords. That is, near the middle of the primary cord, there is a space without attached pendant cords; this gap is flanked by six-cord groups on either side (fig. 4).

Only one other khipu exhibits a gap in its cord spacing. UR 91 has a gap before its last six (of fifteen total) six-cord groups. The physical separation of these last six groups is likely to have signaled a meaningful difference between individuals on UR 91: tribute contribution. Following Urton's premise (explained above) that the first pendant cords of six-cord groups recorded tribute contribution, we see that the first nine six-cord groups of UR 91 record payments of four pesos, while UR 91's last six six-cord groups record payments of zero. Might the similar split in UR 90 be evidence of an intentional division within the members of this group as well? Perhaps, rather than a division by tribute payment, as is proposed with UR 91, the UR 90 gap separated the Recuay by moiety (and hence

attachment knot). At the very least, the separation of recto and verso in UR 90 supports the theory that attachment knots were meaningful indicators of information in the Inka khipus.[21]

Might the proposed attachment knot-moiety link imply that language was encoded in pendant cord colors?

The strong likelihood of reading moiety information from attachment knots demonstrated above raises the possibility that other forms of personal identification may have been encoded within the khipu cords as well. Put another way, if a khipukamayuq recorded the moiety affiliation of each Recuay tributary, might there not also have been an equal interest in encoding the name of each individual? If such information was indeed recorded, it seems most likely that it would have been in some multitermed element, such as color, rather than in one of the binary construction features, such as attachment knot, spin/ply, or knot direction. Indeed, pendant cord color is one of the few nonbinary khipu components complex enough to encompass linguistic information. In fact, Hyland (2017) has recently argued convincingly that color was used to sign qualitative information—including possible logosyllabic and phonetic signing units—in two eighteenth-century khipus she has studied in a village in the central Andean highlands.

As we have seen, the Santa khipu archive exhibits an astounding amount of color diversity. This includes solid color cords (such as light brown, dark brown, white), as well as mottled and barber pole cords. Mottled cords are created by spinning two or more colors together, creating a speckled appearance, while barber pole cords are comprised of two distinct, interlaced colors, creating the color spiral from which the design derives its name.[22] How many color combinations exist in the entire Santa archive? Summed across all 133 first pendant cords, there is a total of thirty-two different colors/color combinations. Of these, seventeeen appear only once on a first pendant cord (i.e., these have frequency 1).

How might these color totals intersect with the list of 130 named Recuay tributaries (see table 4)? Were tributary names to have been signed by cord color, how might the Recuay have been divided into some thirty-two "color groups?" We find the most probable solution to this question to be first names (the recorded last names, whether patronyms and/or matronyms, produce a much higher number).

Under the proposition that cord color records first names, both "diego tanta riexi" and "diego huaman" would have been recorded in the Santa khipus with the same color on their first pendant cords. Reducing the 130 tributaries to groups by first names yields thirty different names. Of these, fourteen appear only once. The numerical comparison between numbers of

first names in the document and numbers of colors in the khipus yields thirty tributary names and thirty-two pendant color/color combination options. There are fourteen Recuay with unique first names and seventeen color combinations that appear only once. We add to these totals two observations:

- The highest frequency first cords have solid color schemes.
- All seventeen cords with unique color schemes are mixed (either mottled or barber pole).

Might the simple, solid-color cords have signed tributaries with the most common first names? And might the tributaries with uncommon first names have received more complex mottled/barber pole colors simply because those were the only options left for a khipukamayuq who had already exhausted his single-color name assignments?

These questions depend, however, on a viable count to link cord color and first name. Thus, while the discrepancy observed above may be cause for concern, it also lends further support to the idea that an on-the-ground "noise" was endemic to local accounting initiatives. Further inquiry is needed to attempt to match cord colors with individual tributaries and to test other ways that 130 Recuay names may have been encoded within the Santa khipus, if at all. Nevertheless, the proposed link between attachment knot and moiety implies the existence of further information residing in the Santa khipus.

Conclusions

This article has presented what we believe to be the first evidence of moiety information encoded by means of Inka-type khipu attachment knots. Following Hyland, Ware, and Clark's 2014 conclusion—that pendant cord knots signed moiety in the Mangas hybrid khipu board—the Santa archive promises to expand on Hyland and her colleagues' study to khipus that are more than 130 years older than the Mangas hybrid board and cord samples that more closely resemble the khipus from the height of the Inka Empire. We have synthesized preexisting theories, ranging from Urton's hypothesis (2003) that pendant cord knot direction signed hanan and hurin, to Hyland, Ware, and Clark's.[23] Data analysis of the Santa khipu corpus suggests that binary recto/verso attachment knots encoded the moiety affiliations of the Recuay tributaries. Summing the knot directions of 133 khipu first cords, we have also proposed moiety groupings for the administrative pachacas/ayllus of the Santa Valley. This would constitute the first instance of "reading" nonnumeric moiety information from the attachment knots of Inka-type khipus.

This proposal adds new directions to the search to "decipher" the Inka khipus. Moiety information encoded in colonial-era khipus has effectively allowed us to split the data set into two parts, raising the prospect of a one-to-one match between khipus and Spanish text. The success of this operation suggested the possibility that tributary names may be signed in the Santa collection. Following this premise, we hypothesized that the Recuay tributaries were identified with colors in the Santa archive, with each tributary assigned a first pendant cord color depending on his first name. Summing these totals across the khipus and comparing them to the colonial revisita from San Pedro de Corongo, we arrived at a significant correlation between first cord color and tributary first name. This raises a possible trajectory for deciphering the khipus—that is, using color information to match pendant cords with identifying, "narrative" information.

It is important to acknowledge that the proposals above raise as many questions as they answer. For instance: Why, if six-cord groups signed individual tributaries, do the sizes of the khipus not align with those of the pachacas in the colonial document? If attachment knots signed moieties, why are five of six khipus uniform (all "recto" moiety or all "verso" moiety), while one khipu (UR 90) is mixed? Why do "high payment" khipus also include a handful of small tribute amounts? These questions remain to be addressed in future studies.

We have engaged with these preliminary questions by analyzing the 804 pendant cords of the Santa khipu archive. Nevertheless, further inquiry is needed on this complex body of information—it seems that for every fact the Santa khipus reveal, another horizon appears. The search for a khipu "translation" is an organic one, requiring constant experimentation and openness to error. Research continues on the Santa khipu archive with the premise in mind that, while the Santa Valley khipus may not yet have been shown to constitute the "Rosetta khipu," assigning such a status to this remarkable collection remains a distinct possibility.

Notes

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1 See Hyland 2016, 2017; and Salomon 2004.
2 For the most comprehensive treatment to date of the mathematical properties of the khipus, see also Ascher and Ascher 1997 [1981].

3 The Khipu Database project (KDB), which was begun in 2002, aims to consolidate all known data regarding the khipus into a single online repository. All data pertaining to the samples discussed in this article are available as Excel spreadsheets at the KDB website: http://khipukamayuq.fas.harvard.edu/.
4 See the collection of arguments for such content in Quilter and Urton 2002.
5 Zevallos Quiñones 1991: 61–64.
6 Radicati de Primeglio 2006: 158.
7 See Hyland 2016.
8 Urton 2017: 237.
9 The observant reader may notice that 804÷6=134, which differs from the proposed 133 six-cord groups. This discrepancy is accounted for in UR 90, which we propose contains the remaining six cords. Cords 31 and 38 of UR 90 do not belong to six-cord groups. The four additional cords (63–66) are part of a single grouping of ten cords within UR 90 (cords 57–66). This grouping is warranted for the following reasons: the second position pendant cord encodes a large numerical value across almost all of UR 90's six-cord groups. This pattern is consistent with a single grouping of ten cords, as proposed. Furthermore, the ten pendant cords are of identical color. Thus, splitting this quantity into two groupings of five would require repeating a color across consecutive cord groups, which is inconsistent with UR 90's color banding pattern.
10 One of UR 90's first cords (#45) is broken at 15.0cm. While we can still read its attachment knot (verso), any former numeric knots are missing. For all subsequent counts, we assign this cord the numeric value "5." This is justified, given that UR 90's first seven first cords encode "5," as does the subsequent first cord. In other words, #45 is flanked by first cords of this value.
11 Espinoza Soriano 1981: 114; Rostworowski de Diez Canseco 1981: 39; and Rostworowski de Diez Canseco and Remy 1992: 72–73.
12 D'Altroy 2015: 46–7; Hyland, Ware, and Clark 2014; Zuidema 1964.
13 A random recto/verso distribution yields 134 possible distributions, each with equal likelihood of occurring. Because attachment knots are binary, an increase in one quantity implies a decrease in the other. Options include: 0 verso, 133 recto; 1 verso, 132 recto; . . . 132 verso, 1 recto; 133 verso, 0 recto. The proposed moiety-attachment knot link yields a maximum error of 5 (59 tributaries vs. 63 recto first cords; 71 tributaries vs. 70 verso first cords). Thus, we sum the probabilities of distributions with this maximum error. This includes the six ordered pairs (verso, recto)={(70, 63), (71, 62), (72, 61), (73, 60), (74, 59), (75, 58)}. The probability P is 6÷134=0.0448=4.48%.
14 Zevallos Quiñones 1991: 64 [Urton's translation].
15 Urton 2017: 97.
16 Ibid., 228.
17 The 133 first cord values (see figs. 3a and 3b) sum to 359. Adding in values for broken first cords, the archive totals 367/368, which aligns with the 367+peso-tribute assigned to the Recuay Indians.
18 See D'Altroy 2015: 315.
19 Presta 1991: 255.
20 These and related litigation issues have recently been explored by Puente Luna (2015).

21 While this observation holds largely true of UR 90, the khipu does not exhibit a perfect recto/verso split. Its seventeen first cords, although generally separated, are attached in the following order, with R=Recto and V=Verso: V, V, V, V, V, V, V, V, V, V, R, R, R, V, V, R, R.
22 Urton 2017: 238.
23 See ibid. and Urton 2003: 145–49.

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