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## Information Control in the Palace of Puruchuco: An Accounting Hierarchy in a Khipu Archive from Coastal Peru

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**THE CONTROL OF INFORMATION IS ONE OF THE PRINCIPAL WAYS OF** exercising power in human societies. This statement was as true for ancient cultures as it is today. There are numerous examples of information control in ancient societies: the hoarding of cuneiform tablets in temple archives, or the production, placement, and occasional defacing of commemorative stelae in Maya sites. There are few explicit examples of such practices from the Pre-Columbian Andes. However, recent research on the khipu, the principal record-keeping device used in the Inka Empire (Ascher and Ascher 1997 [1981]; Quilter and Urton 2002; Urton 2003), is beginning to produce new insights into the highly technical practices and strategies of information collection, control, and manipulation among officials at different levels within the state administrative hierarchy. In this study, we discuss what is perhaps the clearest example encountered to date of the form information may have taken and of how it may have been synthesized and manipulated in its movement between lower- and higher-level accounting centers in the Inka provinces. The corpus of samples discussed in this study makes up what we refer to as a khipu “archive.”

In 1949/50, the Italian national, but long-time Peruvian resident, Carlos Radicati di Primeglio published a study of a collection of eight khipus from the Santa Valley, on the north-central coast of Peru (1949–50: 276). In his monograph, Radicati referred to this collection of khipus as an “archive,” and went on to deal with them as written archival documents—that is, as records pertaining to the people in some locale who had an inter-related set of interests and common procedures for accounting. Applied to Inka record keeping, the archive paradigm, developed explicitly in a recent publication by Gary Urton (2005), is based on the proposal that khipus

with a common provenience or archaeological context should be thought of as accounts produced by either local khipu keepers or Inka accountants resident in that locale. In either circumstance, the records from any narrowly defined region may bear some historical and/or substantive relationship to each other. One possible consequence of such interrelationships is that khipus composing an archive will complement, duplicate, and possibly comment on each other. The sixteenth-century Spanish chronicler Martín de Murúa describes the complex types of information that might have been contained in a khipu archive:

Thus, the accountants have great heaps (*montones*) of these strings, in the form of registries, just as scribes have in their offices, and there they maintain their archives, and in that way, should anyone want to know something, they have to do no more than go to one of the *Quipucamayo* of these [records] and ask him how much this thing was, or which Inka made this law, [or] who conquered such and such a province, [or] who were his captains, [or] in which years was it dry and which fertile, [or] when were there pestilence and wars, [or] when did certain Indians rebel, [or] when did a certain volcano erupt, [or] when did a certain river flood and destroy the fields? Then, the accountant would take up his cords and give them a reading/interpretation (*daba razón de ello*), without making a single mistake. (Murúa 2001 [1590]: bk. 2, chap. 11, 360–361; translation by Urton)<sup>1</sup>

In addition to the event-based, historical information detailed by Murúa, we have numerous accounts stating that all statistical records concerning the business of the state—censuses, tribute levies, and performance—were retained on khipus stored in archives (Garcilaso de la Vega, 1966 [1609]: 50, 267, 274–275). In this article, we consider the question of the composition and use of khipu archives by focusing on a collection of samples from a single archaeological site and, presumably, accounting context. The site in question is Puruchuco, an Inka-period palace in the lower Rimac Valley, on the central coast of Peru (Jiménez Borja 1956; Villacorta Ostolaza and J. Ávila C. 1998; Wakeham Dasso 1976). We introduce the site of Puruchuco and its Inka khipus after commenting on relevant features of record keeping in the Inka Empire.

The chronicler Garcilaso de la Vega provided an important insight into Inka accounting practices when he noted that the number of khipu keepers in each community was in proportion to the population but that, however small, any given community had no fewer than four *khipukamayuyq* (“khipu-makers/keepers”). Garcilaso went on to note that the *khipukamayuyq* “all kept the same records” (1966 [1609]: 331). This suggests a strong element of checks and balances underlying Inka state record keeping, and has been the focus recently of a considerable

comparative analysis of various archives by the Khipu Database Project.<sup>2</sup> In the earlier publication on khipu archives, referenced above, Urton described numerous instances of “matching khipus”: multiple samples bearing identical or near identical numerical information. It was argued in that study that such matches represent duplicate accounts that may be products of the Inka system of checks and balances.

### **Inka Decimal Administration and Khipu Accounting**

Matching khipus help clarify the sharing of information horizontally, between record keepers at the same level of the Inka decimal administrative hierarchy. However, if this was a true system of checks and balances, we would also expect to find instances of the summation and partition (or subdivision) of information vertically, as information was transferred up and down the linked accounting levels. The horizontal and vertical components of Inka accounting are represented in figure 1, a schematic diagram showing the basic structure of the accounting categories constituting Inka administrative organization.

To a large degree, Inka administration was concerned with accounting for the labor time of state subjects. As has been well documented (D’Altroy 2002: 265–268; Murra 1980), tribute in the Inka state was levied in the form of a labor tax. Each “taxpayer” (i.e., state laborer) was required to work a specified number of days each year on state projects, which included the tending of the Inka’s herds of camelids; farming on state agricultural projects; building and maintaining storehouses, roads, and bridges; and performing other duties (for explicit testimony on this point, see Cobo 1983 [1653]: 209; and Garcilaso de la Vega, 1966 [1609]: 271, 273). The best explanation to date of how this labor-based system was implemented is Catherine Julien’s article, “How Inca Decimal Administration Worked” (1988). Julien’s study, based on a Spanish transcription of an Inka tributary khipu from Chupacho (Huánuco), in the central highlands of Peru, analyzes how Inka accountants assessed tribute levels and assigned tasks to different numbers of local workers. The procedures involved assessing numbers of laborers to perform tasks on the basis of percentages of a standardized accounting unit of four *waranqas* (4,000 tribute payers).

Unfortunately, the Chupacho tributary data are known to us only in the form of a Spanish transcription of the original khipu unaccompanied by its source khipu.<sup>3</sup> Therefore while Julien’s study is highly informative, her article cannot inform us how this information might actually have been recorded.<sup>4</sup> To suggest how khipus might record such data, we focus on two issues: How was the administrative system organized? And how did information move within this system?

The first question may be illuminated by examining the hierarchical organization of categories based on decimal groupings of tributaries.

Beginning at the bottom (fig. 1), we see that at the local level, tributaries were grouped into five accounting units of ten members each. One member of each of these groups of ten would have served as *Chunka Kamayoq* (“organizer of ten”). Five such groupings would make a unit of fifty tribute payers, under the authority of a *Pichqa-Chunka Kuraka* (“lord of fifty”). Two groups of fifty would be combined into a unit of one hundred tributaries led by a *Pachaka Kuraka* (“lord of one hundred”), and so on up the hierarchy (see Pärssinen 1992: 370–390 for a discussion of exact versus approximate decimal units in Inka administrative structure and labor [*mit’a*] organization).

Following a line of interconnections up the different levels of figure 1, it becomes clear that the decimal hierarchy was organized such that categories were formed from increasingly higher permutations of dual and quinary organization:  $10 \times 5 \times 2 \times 5 \times 2$ , etc. This accords with general Quechua/Inka decimal numerical principles (see Urton 1997: 214–217). Near the top of the decimal administrative hierarchy were the heads of the approximately eighty provinces, officials called *T’oqrikoq*. Each provincial official was under the direction of a Lord of the Four Quarters, who served directly under the Inka king in Cusco. Cieza de León, the great mid-sixteenth-century traveler and chronicler, gave the following description of the Inkan accounting hierarchy:

In each provincial seat there were accountants called *kipu*-keepers who, by their knots, had the record and accounting of what was owed as tribute by the people from that district, including silver, gold, clothing and livestock down to firewood and other, lesser items, and by means of the *kipu*, arriving at the end of the year, or of ten or twenty years, in the accounting of the one who was commissioned to make the accounting, there would not be lost [from the accounting] even one pair of sandals. . . . And in each valley today they keep such an accounting, and there are always in each place of habitation as many accountants as there are lords and every four months they close out [rectify] their accounts in the aforesaid manner. (Cieza de León, 1967 [1553]: chap. 12, 36–37; translation by Urton)<sup>5</sup>

Garcilaso stated that the governor of each province was required to keep a copy of the *kipu* account so that “no deception could be practiced by either the Indian tribute payers or the official collectors” (1966 [1609]: 275).

The head official of accounting units up to the level of the Lord of 1,000 could have been the same person. It is likely that the higher-level officials, such as the *Hunu Kuraka* (“Lord of 10,000”) and the provincial governors, the *T’oqrikoqs*, were appointed by the Inka in consultation with the appropriate Lord of the Four Quarters (Cobo 1983 [1653]: 199).

Dualism was a pervasive principle in Inka political organization, and there is good evidence (e.g., Netherly 1993; Urton 2003, 2005) to suppose that dualism would have also been reflected in the sharing of authority at each level of this hierarchy of accounting categories and officials.

In her study, “The Nature of the Andean State,” Patricia Netherly (1993) described several features of Andean governance. Through analysis of the distribution of native officials in the north coastal polity of Chicama in early colonial times, Netherly derives an authority structure that incorporates both dualism and the redundant participation of certain individuals (high-ranking lords, or kurakas) in different levels of the Chicama governance structure (see fig. 2).

As Netherly notes regarding the repetition of individuals’ names on different levels in the hierarchical structure shown in figure 2,

[R]ulers, even the highest-ranking, did not govern alone. Though one ruler may have been paramount at any given level, his rule was limited by the fact that he directly controlled only part of the lower levels of the polity. The necessary presence of the lords of the other principal sections of the polity served as a check on unilateral action by the lord of the higher-ranking moiety. (Netherly 1993: 18)

We argue that a hierarchical, dualistic governance structure is compatible with the generalized administrative hierarchy of the Inka state and that it summarizes precisely a parallel structure that we will describe in detail later in this study. We note here Pärssinen’s suggestion that the

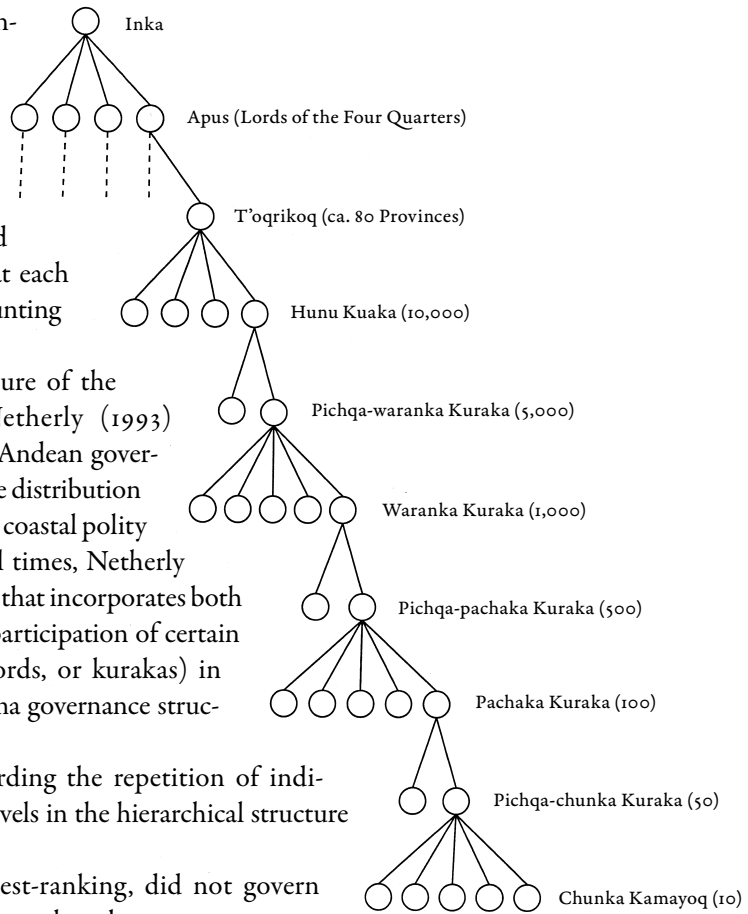


FIG. 1 Inka decimal administration

FIG. 2 Hierarchy and dualism in the administrative organization of Chicama (16th c.)

Don Juan de Mora							
Don Juan de Mora				Don Pedro Mache			
Don Juan de Mora		Don Alonso Chuchinamo		Don Pedro Mache		Don Gonzalo Sulpinamo	
Don Juan de Mora		Don Alonso Chuchinamo	Don Diego Sancaynamo	Don Pedro Mache	Don Diego Martín Conaman	Don Gonzalo Sulpinamo	

*parcialidades* (*ayllu*-like sociopolitical groups) and *waranqa* (accounting units of 1,000) in the Rimac Valley were divided in a dualistic manner (Pärssinen 1992: 342; Rostworowski 1978: 49–107). Given the dualistic nature of the administrative structure, it is reasonable to suppose that dualism, in the form of duplicates, or pairs of accounts, would have been a feature of the accounting system too.

The question that is of primary interest to us now with respect to the Inka administrative system is: how did information move between adjacent levels of this hierarchical administration? Figure 1 represents in schematic form the basic organization for the movement of two different, interrelated, types of information that were being passed in opposite vertical directions. The expectations of higher-level officials toward lower-level officials would have moved, via *kipus*, from the top down. *Khipus* containing such instructions from the state probably included at least two signing elements: identifiers and numbers. Identifiers would indicate the tasks to be performed, while numbers would represent the quantity of workers to be recruited. Information concerning expectations, moving downward, would be *partitive* in nature; for instance, assignments made to 1,000 tribute payers would be broken down into two groups of 500, the latter of which would be further reduced to five groups of 100, and so on (see Pärssinen 1992: 31–42).

In the reverse direction, we would expect that local accountants would pass data on accomplished tasks upward through the hierarchy. In this direction, information at each level would represent the *summation* of accounts from the level immediately below. These data would eventually arrive in the hands of the Cusco accountants, where the highest level of accounting went on. As Cieza described this situation:

That which was paid as tribute each period and contributed by the natives of these administrative seats, including gold, silver, clothing and arms, and everything else they gave, was all entered into the accounts of the officials who kept the *khipu*, and who were in all instances responsible for dispensing these items to the troops or distributing them to whomever the Lord ordered or of taking them to Cuzco; but when they came from the city of Cuzco to make the accounting [i.e., the audit], or when they [the local accountants] would go to Cuzco to do it, these same accountants supplied it [the accounting] with their *khipu* in such a way that there could be no fraud, but rather so that all was perfectly accounted for. (Cieza de León 1967 [1553]: chap. 20, 67; translation by Urton)<sup>6</sup>

Cieza's statement attests to the utility of incorporating an element of checks and balances. We have recently described several examples of "matching *khipus*," which, we believe, represent duplicate accounts from



the same level, probably in relation to the checks and balances feature of Inka record keeping. “Close matches” have also been identified; these have close but not matching data. Close matches may represent recounts of census or tribute records at different moments in time, or records made by different accountants who counted items differently, or relationships (often not exactly equivalent) between tribute labor credits and debits (Urton 2003:191–194; and 2005). Until now we had not identified a set of khipus related through summation/partition, such as we would expect to find if information was indeed moving up and down the administrative hierarchy. We believe the Puruchuco khipus that we turn to below embody this kind of reciprocal summing/partitive relationship.<sup>7</sup>

### The Archaeological Context of the Puruchuco Khipu

The archaeological site of Puruchuco is located on the south bank of the Rimac River, about 11.5 km northeast of the center of Lima, within the present-day district of Ate (fig. 3). Originally known as Vista Alegre, since it is located on land previously belonging to a hacienda of that name, Puruchuco was excavated and reconstructed by Dr. Arturo Jiménez Borja with Jorge C. Muelle, beginning in 1953 (Jiménez Borja 1973). Excavation took several years. The discovery of the khipu cache occurred on 9 August 1956. The site report from these excavations has not been published to date. Our comments on the archaeological context and disposition of the khipu are based on field notes written at the time of their excavation, and on information from the website of the Museo de Sitio Puruchuco—Arturo Jiménez Borja.<sup>8</sup> The text of this highly informative website was written

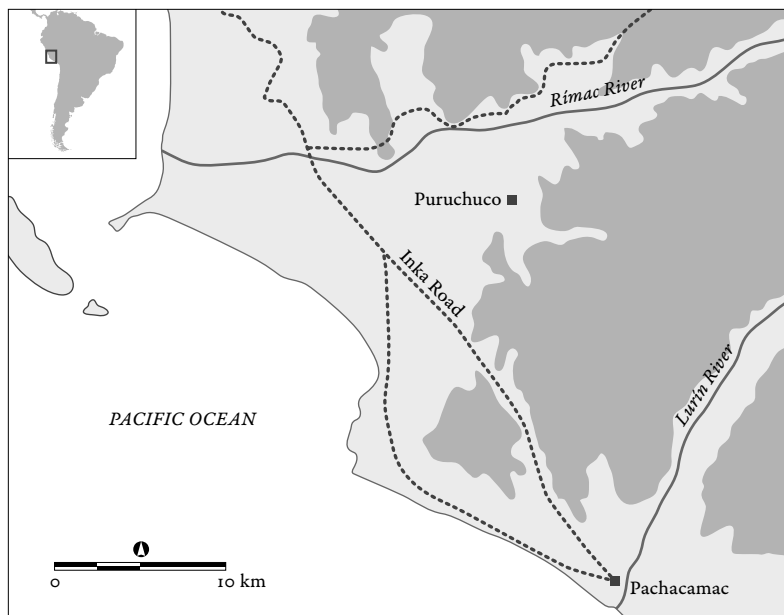


FIG. 3 The location of the site of Puruchuco, Rimac Valley (drawing by Karen Rasmussen, Archeographics, after Villacorta Ostolaza, Vetter Parodi, and Ausejo 2004: 67)

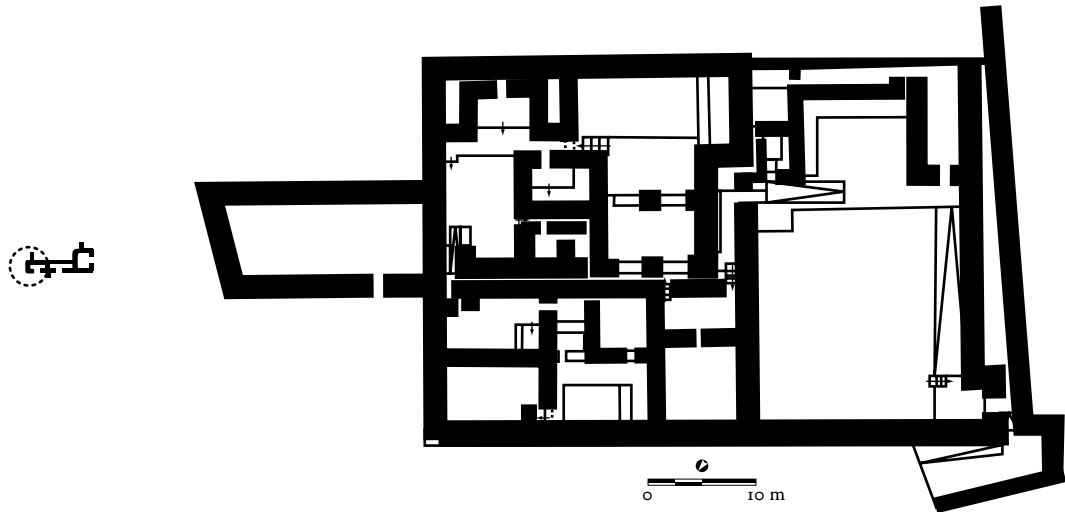


FIG. 4 Site plan of the palace of Puruchuco (drawing by Karen Rasmussen, Archeographics, after Villacorta Ostolaza, Vetter Parodi, and Ausejo 2004: 44)

by our friend and colleague Luis Felipe Villacorta Ostolaza, archaeologist and former director of the Puruchuco Museum (see also Villacorta Ostolaza et al. 2004).

The site is a roughly rectangular compound with high surrounding walls made of *tapia* (pounded adobe) construction. There is a single, sloping entryway granting access onto a large interior square plaza (fig. 4). A maze of narrow passageways led the occupants through two sectors composed of a mix of residential, administrative, and storage rooms. Villacorta Ostolaza suggests that this large structure was a “palace,” as the site seems to have been a center dedicated to the oversight of activities in the surrounding region. The presence of balances and *kipus* indicates that the site probably functioned as a center of local control and administration.

Around and in some cases abutted to the palace of Puruchuco were several smaller constructions. The cache of *kipus* was found under the floor of one of these smaller buildings, immediately to the west of the palace (see fig. 4). From its location, Carol Mackey, who first studied the Puruchuco *kipus* in the late 1960s, surmised that this building was the house of a *kipu*-keeper who served the lord occupying the palace (1970: 65–66). Fieldnotes from the day the *kipus* were discovered, written by Victor Salazar, provide a straightforward recounting of what was a highly significant event for *kipu* studies:<sup>9</sup>

9 August, 1956—The work consisted, as over the past three days, in removing “fill,” or dirt from the upper part of sector B to fill a pit in Platform A. . . . In the zone of extraction (Sector B, upper part) of the fill the workman Lizama encountered a narrow-necked urn (*cantaro*), semi-ovoid in form, covered with soot (*hollín*) and with an appliqué on the outer body in the form of

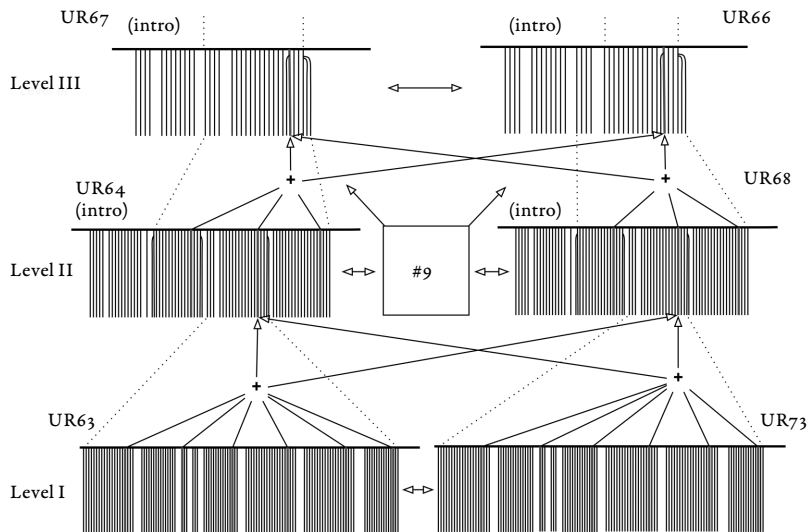


FIG. 5 The accounting hierarchy from the archive of Puruchuco

a serpent; its [i.e., the urn's] mouth was covered by a small lagenaria [bottle gourd], in the interior there were found 10 khipus of regular size, 3 of which had red/orange/yellow tassels, 11 medium-sized ones, and several loose pendant strings, all in a good state of preservation [translation by Urton].<sup>10</sup>

In her discussion of these khipus, Mackey notes that half of the twenty-one khipus found in the urn were in a “rolled condition” (1970: 66). These samples had their primary cords coiled around the pendant strings in the manner of khipus prepared for storage in archives (cf., Conklin 2002: 53–55).

### The Puruchuco Accounting Hierarchy

What we term the Puruchuco “accounting hierarchy” pertains to seven of the twenty-one khipu samples found together in the *olla*. Though not included in this analysis, several other khipus may have provided supporting documentation to these seven. The seven khipus are related in a hierarchical arrangement of three interconnected levels, designated levels I, II, and III, as shown in figure 5. Two of the seven khipus (UR63 and UR73) are on level I, the base; three khipus are on the second level (UR64, UR68, and #9 [see below]); and two (UR67 and UR66) are on level III.

Sample #9 was in the Puruchuco museum when Carol Mackey studied this collection in the late 1960s. At that time Mackey recorded numerical, color, and some structural data on the samples represented in figure 5. She labeled the three khipus on the second level as #3 [UR64], #9, and #2 [UR68]. When we restudied the Puruchuco khipu archive in the summer of 2004, the khipu sample designated #9 by Mackey was

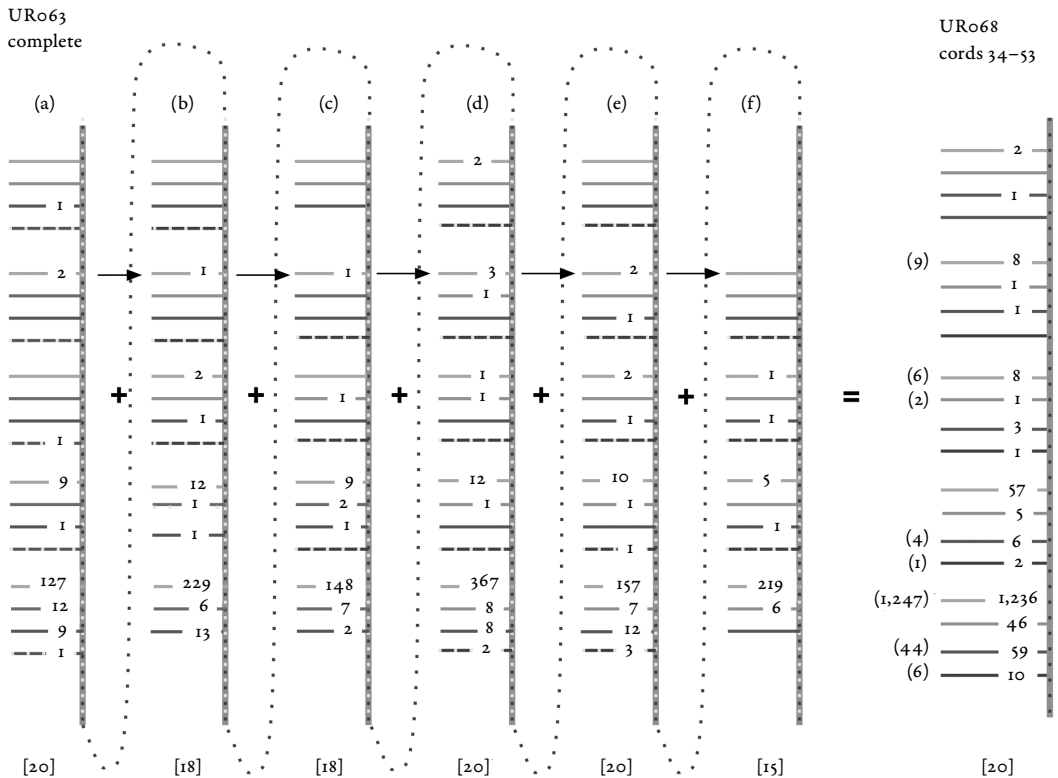
no longer in the collection. Current museum personnel could not tell us what had become of this sample. We were unable to restudy this khipu and thereby to add observations on spin/ply directions, attachment type(s), and knot directions. (A table containing all numerical and color values recorded by Mackey for what she referred to as samples #2, #9, and #3 appears in Urton 2005.)

The two samples at the top of the hierarchy, UR66 and UR67, are rolled up together into a single bundle. As Mackey first noted (1970: 79), these two khipus bear identical numerical values, and string colors that seem to be a subtle transformation from one to the other. Single knots on khipu UR67 are tied as Z-knots, whereas those on UR66 are tied as S-knots; all other knots on both khipus are tied as Z-knots (see Urton 1994). The possible significance of this is discussed in the interpretation section of this paper.

### **The Organization and Structure of the Accounting Hierarchy**

There are two principal aspects to the accounting hierarchy. First, khipus on the same level match, or closely match; that is, they display identical or very similar numerical sequences and color patterning. Second, values on khipus sum upward, and are subdivided downward. More specifically, the numerical values of certain groupings of strings (to be defined below) on the two khipus on level I sum to values tied onto certain groupings of strings on the three khipus on level II, and the numerical values of certain groupings of strings on the three khipus on level II sum to the values on the two khipus on level III. One can also consider the opposite direction: moving down the hierarchy, values on strings at higher levels are partitioned among groupings of strings on the next lowest level. Though simple in concept, the details of these relationships are complex. Before describing the summation/partitioning in depth, we provide an overview of relevant characteristics of this group of khipus.

Through cord color and spacing, each of the seven khipus is organized into different numbers of subunits. Khipus on level I break down into six subunits; those on level II contain three subunits (plus what we will call “introductory segments”); and the two khipus on level III have only one unit (plus “introductory segments,” see below). Inside these subunits, the khipu strings are further subdivided by a combination of spacing between strings and/or by the repetition of color patterning in groups of strings. The general color pattern is a four-string seriation. By seriation, we mean a sequence of colors—e.g., dark brown, medium brown, light brown, white—repeated multiple times (Radicati di Primeglio 1964; see also Salomon 2004: 252–255). The numerical values of the cords vary in magnitude in accordance with the color, with the four strings of each color-seriated set generally increasing in size through the sequence.



### Analysis of the Puruchuco Accounting Hierarchy

To describe more specifically the summation or partitioning between these khipus, we begin by examining an example of summation upward, between levels I and II. We note first that khipu UR73 has been broken; it bears only 69 of what we surmise were originally about 111 pendant strings. The similarity between UR63 and UR73 in color patterning and numeric values is very close; thus we feel confident in assuming that these were originally a matching pair.<sup>11</sup>

Because it is more complete, we choose UR63 as the exemplary khipu from level I; it remains to compare this to UR64 or UR68. In either case, the sums are close rather than exact. We focus on the relationship with UR68, illustrated in figure 6.

UR63 is organized by spacing and color seriation into six pendant string groupings, labeled a–f. The number of strings in each group is shown in brackets at the bottom of the columns. The six columns comprise: a) three sets of  $(5 \times 4 =) 20$  strings organized into five groups of four color-seriated strings; b) two sets of  $(3 \times 4 + 2 \times 3 =) 18$  color-seriated strings; and c) one set of  $(3 \times 4 + 3 =) 15$  color-seriated strings. The meandering dotted lines at the tops and bottoms of the columns of UR63, in figure 6, show how this sample is to be reassembled into its proper linear arrangement.

FIG. 6 Numerical and color correlations between khipu UR63 and the central section of UR68

The numerical values of string groupings in UR63 sum to values recorded on the middle of the three subunits of UR68. In figure 6, the color-seriated strings of UR63 are aligned across the six segments, and these groupings are aligned with the similarly color-seriated grouping of  $(5 \times 4 =) 20$  strings in the central subdivision (strings 34–53) of khipu UR68 (cf., figs. 5, 6). Summing across the aligned strings of UR63 results in totals equal or close to those recorded on the depicted section of UR68. The values knotted into the cords of UR68 are reported on the right; any number between parentheses immediately to the left of these is the actual sum of values on the strings of UR63 at that position. The parenthetical numbers represent values that should have been recorded if the relationship between UR63 and UR68 was a matter of strict addition. The presence of several close, rather than exact, matches suggests that there was some degree of flexibility or variance allowable in the accounting relationship between these two samples, or levels.

Continuing the summing relationship upwards, we next consider khipu UR68 (level II) and UR67 (level III). Their relationship is illustrated in figure 7. In this figure, UR68 is disassembled into its three color-seriated subdivisions (labeled A–C), which are shown aligned with the similarly color-seriated string groupings of khipu UR67. We are confronted in figure 7 with 20 strings in all subunits.

The summations between UR68 and UR67 are more exact than those between UR63 and UR68. Setting aside the broken string in UR67, the values diverge in only two instances, and in each case the discrepancies are small: 2,904 instead of 2,908 and 161 instead of 162. The variance present in the connection between levels I and II has been considerably reduced between level II and III. What is the significance of this?

The explanation may be related to an interesting distinction between values on the six subunits of UR63 (fig. 6) and the three subunits of UR68 (fig. 7). The numerical values on UR63 are relatively homogenous across any given set of aligned strings, while on UR68 the values on subunits (A) and (B) are in general noticeably larger than those on subunit (C). Therefore, on the one hand, considering the values to be the result of summation, it appears that UR68 records two groups of roughly equivalent size and one much smaller group. On the other hand, if UR68 is the result of values on UR67 being partitioned down the hierarchy, it seems that a total sum on UR67 was subdivided with the intent of creating three subgroups, two of which (columns A and B) were intended to be roughly equal, and a third (column C), smaller subgroup. The smaller group could have been subordinate to, or an adjustment of, the larger pair. It is not possible to determine which option is more feasible, because we lack complete information from level I.

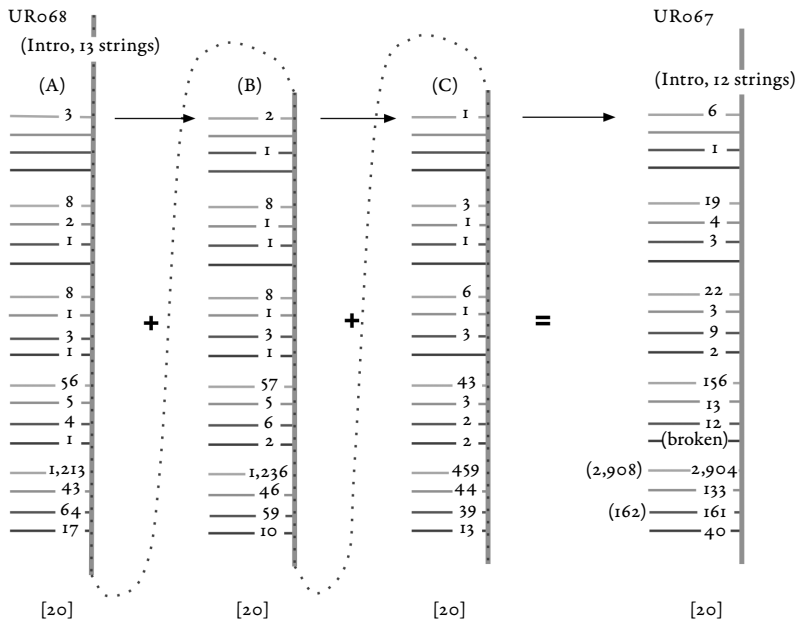


FIG. 7 Numerical and color correlations between khipus UR68 and UR67

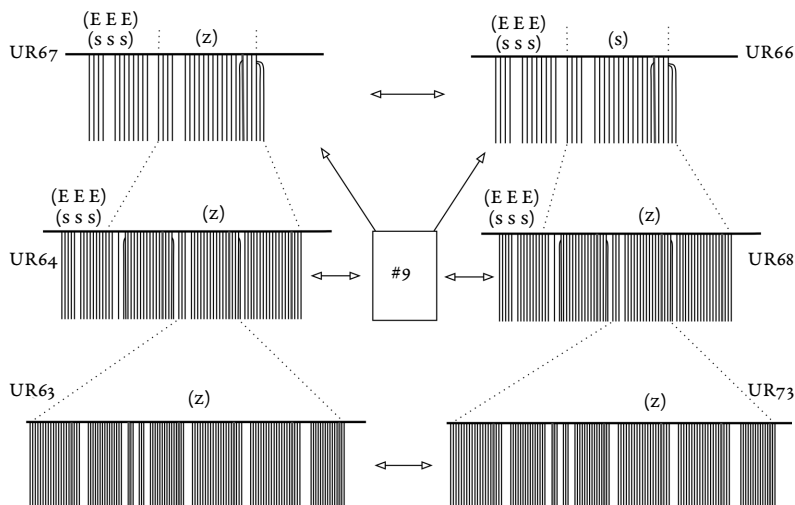
### The Boundaries of Summation/Partition

It will be noted that pendants between dotted lines in Figure 5 are implicated in the summation/partition relationship. The pendants on level III outside of the dotted lines, and those to the left of the dotted lines that protrude from the tops of the khipus on level II, form what we call “introductory segments.” We discuss each of these features in turn.

The dotted lines in figure 5 encompass all the pendants on level I khipus but only the middle subunit of level II khipus. That is, complete summation of level I khipu accounts for only a portion of the values recorded on khipus on level II. The other values on level II khipus (subunits A and C in figure 6) are not accounted for by the currently known level I khipus UR63 and UR73. Thus, there may have been four additional level I khipus with the information for these two additional subunits on level II. One pair would have summed to the left-most subunits on level II, while the other would have produced sums recorded on the right subunits. Except for the introductory segments, all strings on level III are involved in the summation relationship.

It appears that the original structure of the Puruchuco accounting hierarchy contained six paired khipus on level I, whose values were summed to produce those on the three subunits of the three khipus on level II, whose subunits, in turn, were summed and recorded on the two khipus on level III. Thus, information was either being funneled and synthesized upward or subdivided and distributed downward among the three levels of khipus.

FIG. 8 Puruchuco introductory segments



### Introductory Segments

We assume that the accounting hierarchy shown in figure 5 was a set of records for use both within and outside Puruchuco. The use of this information at a wider level, perhaps regional or provincial, would have been connected with the reporting function of some or all of these khipus. For example, khipus on level III could represent either a set of instructions issued to the lord of Puruchuco from the provincial governor, or reports on local Puruchuco resources to be sent to the provincial governor. In either of these scenarios, one of the requirements would have been that the khipus bear an indication of their destination or origination. Records consulted wholly within the local community may not have needed to carry a provenience/destination label, although they may have borne labels of local relevance, such as the names of ayllus.

If numerous khipus were coming into a central archive for storage or were being dispersed from that archive to disparate places, it would have been helpful, if not essential, to have place identifiers encoded within each khipu. We suggest that the introductory segments on level II and III khipus represented just such identity labels (see Pärssinen, 1992:39–43).

The numerical values knotted onto strings within the introductory segments on level II and III khipus all contain arrangements of just three figure-eight knots (denoted E) tied onto three separate strings (see fig. 8). Figure-eight knots normally signify the numerical value one (1), however it is important to note that the numeric values on these introductory segments are neither derived from nor implicated in the summation/partition relationship.

The introductory segments in all cases occur near the short, doubled end of the primary cord, which is usually taken to be the beginning of a khipu account. We hypothesize that the arrangement of three figure-



eight knots at the start of these khipus represented the place identifier, or toponym, “Puruchuco.” Three figure-eight knots tied onto a few of the dozen or so strings is not a lot of information by which to signal a toponym. It is difficult for us to explain otherwise, however, the purpose of these parallel sets of strings, which do not figure in any discernible way into the summation/partition relations. We suggest that any khipu moving within the state administrative system bearing an initial arrangement of three figure-eight knots would have been immediately recognizable to Inka administrators as an account pertaining to the palace of Puruchuco. This implies that there ought to be place identifiers relating to khipus from other archives as well, though we are not prepared to suggest other such labels at this time.

Why don't level I khipus bear introductory segments? Perhaps UR63 and UR73 were not intended to travel away from Puruchuco; instead they were local accounts, drawn up by the resident khipukamayuq for accounting purposes within the palace. If the seven khipus register demands for service received from outside Puruchuco, meaning that if the relationship among them is one of partition, then the level I khipus would have represented the reorganization of the mandate from outside in relation to the availability of resources at the local level. In this scheme, level I khipus would have pertained only to local accounting matters and it would have been unnecessary to attach the place identifier. However, if the overall relationship is one of summation, and these khipus were prepared as a report on local conditions for dispatch outside Puruchuco, then level I khipus would represent the “raw” tables of local information that served as the foundation for constructing level II and III khipus. Level III khipus, the summary reports, would have been sent to a distant administrative center.

### **Local Accounts or Remote Instructions?**

We suggest that khipus may have contrasting number qualities depending on whether they represented instructions coming from the state administration to a local accounting center, or records produced within a local accounting center with regard to existing community resources. In the first circumstance, we suspect that khipu values would have tended to be even decimal values or calculations of values in standard proportional shares.<sup>12</sup> If a khipu account was compiled from within some local administrative center to be sent upward to higher-level officials, counts of resources could be expected to have reflected the vagaries of the natural distribution of items in society. Such numbers are less likely to be whole and rounded or perfectly proportional.<sup>13</sup> This is partly because there are many more “interdecimal” values (e.g., 41, 89, 53) than there are full decimal ones (e.g., 10, 20, 100).

Returning to figures 6 and 7, it seems on the surface that the values on the multiple string segments of UR63 and UR68 are overwhelmingly of the interdecimal, historical, on the ground accounting type. There is not a high incidence of full decimal values, nor do these numbers at first appear to be the products of complex arithmetic calculations aimed at producing standard, proportional values. There are, in fact, some remarkable numerical features on both these khipus, which suggest that they may, in fact, have been produced in a more standardized, calculated manner than is initially apparent.

Each of the six segments (a–f) of UR63 (fig. 6) are organized into four-string, color-serialized sets. The colors are:

- 1) White (W)
  - 2) Medium Brown (MB)
  - 3) Grey-Green (GG)
  - 4) Grey-Green and White Mottled (GG:W)
- [repeat]

The largest numerical values in each set are knotted onto the white, top-most strings. The four-string set with the largest numerical values is in all cases at the bottom of the column. Closer examination reveals an extraordinary numerical relationship between the values on the bottom-most sets of strings and the values on the white strings of all sets: the sum of values on the bottom-most set of strings is roughly equal to the sum of values on all white strings within that column. The sum of all values on the penultimate four-string group is equal to all values knotted onto all the medium brown strings on that column. The same relationship obtains for each four-string group, moving up the four-strings sets and down the serialized colors within each column.

The clearest example of the phenomenon described above occurs in column f, figure 6. The sum of all values in the bottom four-string set is  $(219+6=) 225$ ; the sum of all white strings is also  $(1+5+219=) 225$ . The sum of the next-to-last four-string set is  $(5+1=) 6$ , which is also the sum of the one value tied onto a medium brown string. The sum of the third set from the bottom is  $(1+1=) 2$ , equal to the sum of values on grey-green strings. However, this relationship does not hold in all cases. In some columns, combinations of more than one four-string set are equal to combinations of values on more than one string color type. For instance, in column b, the sum of the bottom and third from the bottom four-string sets is  $(248+3=) 251$ , which is also the sum of values on all white and medium brown strings,  $(244+7=) 251$ . In this same column, the sum of the second and fourth four-string sets from the bottom is  $(14+1=) 15$ , which is the sum on all grey-green and white mottled strings,  $(1+1+13=) 15$ .

How should we interpret this pattern and its variations? We suggest that it may have functioned as a type of internal checking mechanism, but

it is not clear exactly how such a verification system would have worked. What is interesting and potentially significant is that the numerical values in UR63 are not entirely random; rather, there is some element of manipulation involved in the arrangements of numbers in the six segments of this sample.

Do similar patterns hold for the three subunits on UR68? At first glance they appear to be similar to those of the six subunits of UR63; the distribution of magnitudes by color and by four-pendant set is roughly the same. However, UR68 does not contain any discernable pattern of matching sums between pendant groups and pendants of the same color. Thus, are the values on UR68 of the historical, local accounting type? Though it is impossible to be certain, we suggest that they are not. The sum of values on all columns on UR68 is 3,498. It seems likely that the accounting value intended here is 3,500, or three and one-half waranqa (1,000s) accounting units. The khipu may be attempting to show a “close match” between columns A and B; column A sums to 1,430 and column B sums to 1,447. Each of these would represent approximately two-fifths of the sum of all values on the khipu, which is 1,400 (i.e.,  $3,500 \div 5 = 700$ ;  $700 \times 2 = 1,400$ ). In this interpretation, column C, which sums to 621, could have been intended as an approximation of one-fifth of the total value ( $3,500 \div 5 = 700$ ). However, column C shows evidence of another pattern as well. The sums of each four-pendant set, beginning from the top, are 1, 5, 10, 50, 555; a clear decimal progression. The three subunits of UR68 could represent an ideally matched pair, columns A and B, augmented by corrective or standardized values registered in column C. In either interpretation, the numbers do not appear to have been the result of a natural counting process, but of calculated, proportional values.

The above interpretations of UR63 and UR68 suggest that the most likely direction of action in the Puruchuco accounting hierarchy was partitioning downward from the pair of khipus on level III (received from outside authorities), to a reapportionment achieved in the three khipus of level II to an on-the-ground assignment recorded in the pair of khipus on level I. The six-part organization of UR63 and UR73 could have represented the local assignment of tasks or resources among six groups (e.g., ayllus); the values assigned would have been subject to an internal system of checks and balances by means of the summing of values up the four-string sets and down the color-seriated string groups.

Alternatively, we could argue—although this interpretation seems less compelling to us than the one just given—that figure 5 represents the organization of a bottom-up accounting among six on-the-ground ayllu-like groups. The resources or labor time of these groups are represented on the bottom four-string sets of each column of khipus UR63 and UR73 (perhaps made by two different khipukamayus). The values recorded on

these two khipus are subject to an internal checks and balances regimen as described above. As previously explained, values on the level I khipus are summed to result in the middle subunit of khipus on level II. If this is the case, how does it happen that subunits A, B, and C appear to be organized into  $2/5$ ,  $2/5$ , and  $1/5$  of the total on khipu UR68?

Subunit B, under this scenario, is known to be the result of information passed up from level I. Subunit A could be the product of two other (now lost) khipus that would have been organized like UR63 and UR73 and that would have accounted for some other six-part grouping of ayllu-like accounting units in the Puruchuco area. This implies that level II khipus would have synthesized information from a total of twelve different groups (e.g., ayllus) that were the responsibility of the khipukamayuc at the palace of Puruchuco. The remaining subunit (column C on UR68) could have been from a smaller set of (now lost) khipus, or it may have represented a scaled set of decimal values that were in some way linked to the paired six-part accounts in columns A and B.

In either case, the values in columns A, B, and C are all summarized in level-III khipus UR66 and UR67. These would have been intended as local records for export to the next-highest accounting authority. As the sums registered in the Puruchuco accounting hierarchy are in the thousands (warankas), the next accounting level would have been at a place supporting either a Pichqa-waranka Kuraka (“Lord of 5,000”) or a Hunu Kuraka (“Lord of 10,000”).

### **The Link to the Outside**

In either of the two scenarios proposed above, the pair of khipus on level III occupy a critical position between the Puruchuco accounting hierarchy and the outside world. Whether information was moving down from level III to level I, or up from level I to level III, UR66 and UR67 would represent the point of contact between the Puruchuco administrative district and the next highest accounting level. The two samples would either have been received from outside, or they would have been prepared to be sent outside. Are there any features of these two khipus that might privilege one over the other? Two such possible markers will be explained in relation to the representations of UR66 and UR67 provided in figure 9.

Figure 9 shows that UR66 and UR67 have their pendant strings laid out in a manner similar to the level I and II khipu discussed earlier (see figs. 7, 8). Pendants on these two samples are organized in groups of four. From left to right, each group is composed of three solid-colored strings followed by a mottled string. This pattern is repeated throughout the khipu with slight variations in one group near the middle, where a mottled pendant is introduced in the third position, and in the final pendant group, which includes subsidiaries. A similar color range is used in both khipus: white,

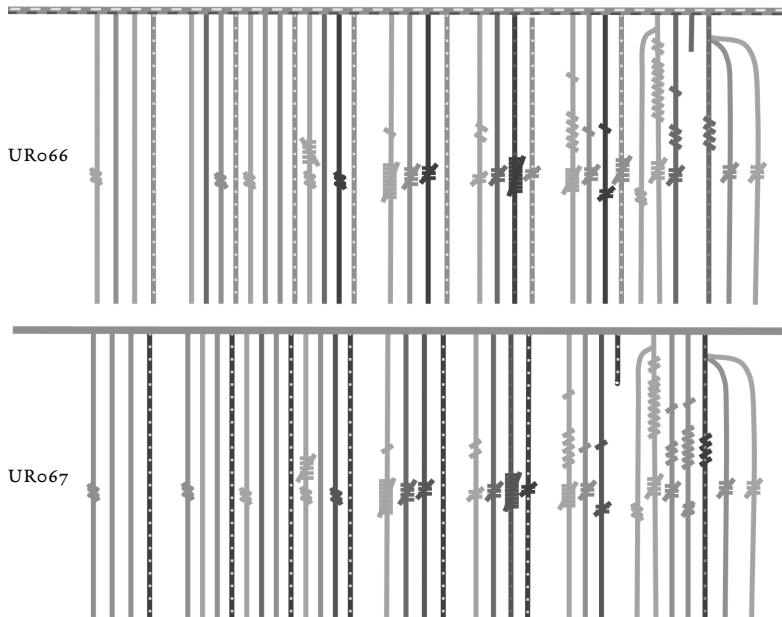


FIG. 9 The paired khipu (UR66 and UR67) from the Puruchuco accounting hierarchy (level III)

light brown, medium brown, and dark brown are the predominant colors. In UR66, dark brown falls on the third pendant of each four-pendant group. In UR67, this color is replaced with grey-green. The same color substitution occurs in UR63 (Level I): final cords of the four-pendant groups in sections b–f are dark brown and white mottled, while cords in correlating positions in section a are grey-green and white mottled.

We argue that the color transformations between UR66 and UR67 were intentional and meaningful. In a distant accounting center, these khipus would be recognized as two distinct records relating to Puruchuco. To return to an example discussed earlier, the two level-III khipus may have differed in the same way that the two upper halves of the local administrative hierarchy in Chicama (see fig. 2) were understood to differ: as a dual, asymmetric (e.g., hanan/upper and hurin/lower) pair. If this was the case, is there any evidence to suggest which of the pair may have been upper and which lower?

There is an interesting pattern of knot-directional variability (see Urton 1994) between the two level-III khipus. On UR67, all knots, with the exception of the three figure-eight knots on the introductory segment, are tied as Z-knots. On khipu UR66, all of the single knots (on the upper portions of the pendants) are tied as S-knots, but the long knots are tied as Z-knots. In earlier studies, Urton (1994 and 2003) demonstrated that Z-knots are about twice as common as S-knots across a sample of 169 khipus. On these grounds, Urton suggested:

the knot pattern displaying Z-type single, long, and figure-eight knots is roughly twice as common as the pattern displaying

S-knots in all three positions. Thus, in the surviving khipu samples, Z-knots might have been used to signify unmarked semantic categories, social statuses, symbolic values, or other properties in opposition to their more narrowly specified (marked) counterparts, the latter of which would have been signed by means of S-knots. A relevant datum here (though producing different directional/markedness values), again, is Salomon's material from Tupicocha in which a khipu with predominantly Z-spun/S-plied threads belongs to a senior ayllu of a pair, the junior ayllu of which curates a khipu with predominantly S-spun/Z-plied threads. (Urton 2003: 153)

Under this paradigm, khipu UR66, with its greater proportion of S-knots, would have represented the senior (hanan/marked) member of the pair. We think this suggestion is supported by the construction of the primary cord on UR66, which is spun in a distinctive complex arrangement of light brown, white, and grey-green, in contrast to UR67's simple solid-color primary cord. Primary-cord patterning such as that on UR66 is rare outside Puruchuco.

## Conclusions

Inka khipu studies began almost a century ago with the seminal research by L. Leland Locke (1912, 1923). Locke provided important insights into the Inka conventions of recording numbers with different types of knots in a hierarchical arrangement. The next major contribution to khipu research was the work of Carlos Radicati di Primeglio (1964, 1979, 1984, and 2006). Working with a collection of eight khipu samples from the north-central coastal Peruvian valley of Santa (1949–50), and other samples in his private collection (Urton 2006), Radicati recorded numerical and structural data and paid particular attention to the analysis of colors. He argued that the key to khipu decipherment lay in samples bearing color-seriated pendant strings, similar to those we have described here from the archive of Puruchuco. Radicati's focus on seriation did not produce a breakthrough, but his work was critical in calling attention to the potential significance of color coding.

The next major advance in khipu studies was the monumental research undertaken by Marcia and Robert Ascher (1997 [1981]). The Aschers recorded detailed information on more than 250 khipu samples in museum and private collections in Europe and North and South America.<sup>14</sup> In addition to producing tabular descriptions of numerical, color, and certain structural features, the Aschers made many valuable observations on numerical and color patterning in the Inka khipus. Their work has taught us that close study of the physical and symbolic characteristics of khipus reveals a wealth of information regarding the logic

behind khipu record keeping in the Inka Empire. Like Locke and Radicati, the Aschers focused on numerical and color patterning within individual khipu. A recent heir to the Aschers' primarily numerical-based analyses of khipu is the Peruvian engineer, Hugo Pereyra (1990, 1996, 2001).

The study of khipu structural properties has been advanced in recent years by the research of Bill Conklin (1982, 2002) and Urton (1994, 2003). The focus on structure has heightened awareness of the degree of variability and patterning in spin/ply direction, attachment type, and knot-direction variation (see esp. Urton 2003: 74–88). These studies have recently been augmented by the groundbreaking work of Frank Salomon (2002, 2004), in his careful, inspired ethnographic research on a set of patrimonial khipu in the village of Tupicocha, in the central highlands of Peru. Salomon's studies are of particular interest here because he concluded that color seriation of a type similar to that found in Puruchuco (Salomon 2004: 252–256) is an important strategy in the organization and classification of information in the Tupicochan archive. In this regard, it is important to note that Tupicocha lies within the Andean highland watershed that leads down to the central coast of Peru, in the region of Puruchuco. We suggest that the Tupicocha and Puruchuco khipu archives may have been connected in a highland-coastal accounting tradition in Inka times.

Despite the numerous advances highlighted above, to date we have made very little progress in determining how khipukamayūq signified different objects or categories in these devices. Because previous studies have focussed on individual samples, we have had no evidence about how information was synthesized or partitioned as it moved between accounting levels. The Puruchuco accounting hierarchy is, we believe, the first example indicating how information moved either up or down the Inka administrative hierarchy.

Are the Puruchuco khipus recording a process of data synthesis or data dispersement? There is not sufficient evidence to allow us to give a definitive answer to this question, although we are inclined to see these khipus as related in a partitive manner, as though they represent a set of mandates for local compliance that came to Puruchuco from the outside. Further investigation is needed on this point, however, both of the Puruchuco archive, and of the other archives now recorded in the khipu database at Harvard University. It is hoped that identifying this one, highly complex accounting hierarchy will provide new interpretive insights as well as strategies for identifying similar phenomena in other khipu archives from both the coast and the highlands of Peru.

Careful study of the Puruchuco and other khipu archives may provide the foothold needed for addressing the most difficult question facing students of the Inka khipu: How did the khipu-keepers of the Inka administrative system record the identities of objects—people, animals,

produce, manufactured goods, etc.—in the three-dimensional forms of their knotted-string records?

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## Notes

- 1 “Así tenían los contadores grandes montones destes cordeles, a manera de registros, como los escribanos los tienen en sus escritorios, y allí guardaban sus archivos y de tal manera que el que quería saber algo, no tenía más que hacer sino irse a un Quipucamayo de éstos, y preguntarle cuánto ha que sucedió esto, o cuál Ynga hizo esta ley, quién conquistó tal provincia, quiénes fueron sus capitanes, cuando fue el año seco o abundante, cuándo hubo pestilencias y guerras, cuándo se rebelaron tales indios, cuándo sucedió tal terremoto, en qué tiempo reventó tal volcán, cuándo vino tal río de avenida, destruyendo las chacaras. Luego el contador sacaba sus cuerdas y daba razón de ello, sin faltar un punto” (Murúa 2001 [1590]: 360–361).
- 2 The Khipu Database Project, which is located in the Department of Anthropology, Harvard University, is described fully at the project website: <http://khipukamayuq.fas.harvard.edu/>.
- 3 To date, no such correlation between a khipu transcription and its source khipu has been identified.
- 4 Ascher and Ascher (1997) have urged the use of what they term “encipherment”—i.e., the construction of hypothetical khipu from textual data—as a possible means for approaching the study of the organizational principles that may have been employed in the actual construction of khipu samples (see also Platt 2002). We are less sanguine about the value of such an approach, as it is based on what we see as the rather dubious proposition that the Inka administrators would have resorted to the same strategies of delineating and organizing various classes of data as the present-day researcher.
- 5 “En cada cabeza de provincia había contadores a quien llamaban quiposcamayos [sic], y por estos nudos tenían la cuenta y razón de lo que habían de tributar los que estaban en aquel distrito, desde la plata, oro, ropa y ganado, hasta la leña y las otras cosas más menudas, y por los mismos quipos se daba a cabo de un año, o de diez o de veinte, razón a quien tenía comisión de tomar la cuenta, tan bien que un par de alpargatas no se podían esconder. . . . Y en cada valle hay esta cuenta hoy día y siempre hay en los aposentos tantos contadores como en él hay señores y de cuatro en cuatro meses fenescen sus cuentas por la manera dicha” (Cieza de León, 1967 [1553, chap. 12]: 36–37).
- 6 “Lo que tributaba cada término destas cabeceras y contribuían los naturales, así oro como plata y ropa y armas, con todo lo demás que ellos daban, lo entregaban por cuenta a los camayos que tenían los quipos, los cuales hacían en todo lo que por éste les era mandado en lo tocante a despender estas cosas con la gente de guerra o repartillo con quien el Señor mandaba o de llevarlo al Cuzco; pero cuando de la ciudad del Cuzco venían a tomar la cuenta, o que la fuesen a dar al Cuzco, los

misimos contadores con los quipos la daban o venían a la dar a donde no podía haber fraude, sino todo había de estar cabal” (Cieza de León, 1967 [1553, chap. 20]: 67).

7 A shorter version of our description and analysis of the Puruchuco accounting hierarchy appeared in *Science* (Urton and Brezine 2005).

8 The Puruchuco website address is at: <http://museopuruchuco.peru-cultural.org.pe/>.

9 Thanks to Julio Tello Solis for his transcription (10 July 2004) of the notes from the excavation field reports detailing the discoveries of khipus at Puruchuco.

10 “9 de agosto 1956—El trabajo consistía, desde hacía tres días, en extraer ‘desmante’ o tierra de la parte superior del conjunto B para rellenar un pozo de la plataforma A. ‘. . . En la zona de extracción (conjunto B, parte superior) de desmante el obrero Lizama encontró un cántaro de forma semiovoide, cubierto de hollín, con una figura plástica de serpiente, tapado en la boca por una pequeña lagenaria, en su interior contenía 10 quipus de tamaño regular; 3 con borlas rojo, naranja y amarillo; 11 medianos y varias pitas suplementarias sueltas, todas en buen estado de conservación.”

11 See the tabular data from khipu UR73 at: <http://khipukamayuq.fas.harvard.edu/> (click on “Khipu Data Tables”).

12 The classic example of a khipu transcription containing predominantly even, proportional numbers is found in Julien’s study of the Chupacho khipu transcription (1988).

13 See Murra’s study (1975) of the “ethnocategories” of data recorded in a khipu transcription from Xauxa; these data display primarily uneven numbers, detailing the goods given and “stolen” (rancheado) by the Spaniards passing through Xauxa in the mid-sixteenth century.

14 The tabular data recorded from khipu studies by the Aschers since the 1970s may be found online at: <http://instructi.cit.cornell.edu/research/quipu-ascher/>.

## References cited

- ASCHER, MARCIA, AND ROBERT ASCHER  
1997 [1981] *Mathematics of the Incas: Code of the Quipu*. Dover Publications, New York.
- CIEZA DE LEÓN, PEDRO DE  
1967 [1553] *El Señorío de los Incas*. Instituto de Estudios Peruanos, Lima.
- COBO, BERNABÉ  
1983 [1653] *History of the Inca Empire* (Roland Hamilton, trans. and ed.). University of Texas Press, Austin.
- CONKLIN, WILLIAM J.  
1982 The Information System of the Middle Horizon Quipu. In *Ethnoastronomy and Archaeoastronomy in the American Tropics* (Anthony F. Aveni and Gary Urton, eds.): 261–281. Annals of the New York Academy of Sciences 385. New York Academy of Sciences, New York.  
2002 A Khipu Information String Theory. In *Narrative Threads: Accounting and Recounting in Andean Khipu* (Jeffrey Quilter and Gary Urton, eds.): 53–86. University of Texas Press, Austin.
- D'ALTROY, TERENCE N.  
2002 *The Incas*. Basil Blackwell, Malden, Mass. and Oxford.
- GARCILASO DE LA VEGA, EL INCA  
1966 [1609–1617] *Royal Commentaries of the Incas* (Harold V. Livermore, trans. and ed.). University of Texas Press, Austin.
- JIMÉNEZ BORJA, ARTURO  
1956 Puruchuco: Una morada de la Lima prehispánica. *Fanal* 12 (47): 15–18.  
1973 *Puruchuco: Planos, cortes y elevaciones de Mary Jiménez Freeman Morris*. Editorial Jurídica, S.A, Lima.
- JULIEN, CATHERINE J.  
1988 How Inca Decimal Administration Worked. *Ethnohistory* 35 (3): 257–279.
- LOCKE, L. LELAND  
1912 The Ancient Quipu, A Peruvian Knot Record. *American Anthropologist* (14): 325–332.  
1923 *The Ancient Quipu, or Peruvian Knot Record*. American Museum of Natural History, New York
- MACKEY, CAROL  
n.d. Knot Records in Ancient and Modern Perú. Ph.D. dissertation. Department of Anthropology, University of California, Berkeley, 1970.

**MURRA, JOHN V.**

- 1975 Las etno-categorías de un khipu estatal. In *Formaciones económicas y políticas en el mundo andino*: 243–254. Instituto de Estudios Andinos, Lima.
- 1980 *The Economic Organization of the Inka State* [1956]. JAI Press, Greenwich, Conn.

**MURÚA, MARTÍN DE**

- 2001 [1590] *Historia general del Perú* (Manuel Ballesteros, ed.). Crónicas de América. Dastin, S.L., Madrid.

**NETHERLY, PATRICIA J.**

- 1993 The Nature of the Andean State. In *Configurations of Power: Holistic Anthropology in Theory and Practice* (J. S. Henderson and P. J. Netherly, eds.): 11–35. Cornell University Press, Ithaca and London.

**PÄRSSINEN, MARTTI**

- 1992 *Tawantinsuyu: The Inca State and Its Political Organization*. Studia Historica 43. Gummerus Kirjapaino Oy, Helsinki.

**PEREYRA S., HUGO**

- 1990 La yupana, complemento operacional del quipu. In *Quipu y Yupana* (Carol Mackey et al., eds.): 235–256. Consejo Nacional de Ciencias y Tecnología, Lima.
- 1996 Acerca de dos quipus con características numéricas excepcionales. *Bull. Inst. Fr. Études Andines* 25 (2): 187–202.
- 1997 Los quipus con cuerdas entorchadas. In *Arqueología, antropología e historia en los Andes: Homenaje a María Rostworowski* (Rafael Varón Gabai and Javier Flores Espinoza, eds.): 187–198. Instituto de Estudios Peruanos, Lima.
- 2001 Notas sobre el descubrimiento de la clave numeral de los quipus incaicos. *Boletín del Museo de Arqueología y Antropología* 4 (5): 115–123.

**PLATT, TRISTAN**

- 2002 “Without Deceit and Lies”: Variable *Chinu* Readings During a 16th-Century Tribute-Restitution Trial. In *Narrative Threads: Accounting and Recounting in Andean Khipu* (Jeffrey Quilter and Gary Urton, eds.): 225–265. University of Texas Press, Austin.

**QUILTER, JEFFREY, AND GARY URTON (EDS.)**

- 2002 *Narrative Threads: Accounting and Recounting in Andean Khipu*. University of Texas Press, Austin.

**RADICATI DI PRIMEGLIO, CARLOS**

- 1949–50 *Introducción al Estudio de los Quipos*. Documenta 2. Editorial Lumen S.A., Lima.

- 1964 *La seriación como posible clave para descifrar los quipus extranumerales*. Biblioteca de la Sociedad Peruana de Historia. Monografías 6. Universidad Nacional Mayor de San Marcos, Lima.
- 1978 *Señoríos indígenas de Lima y Canta*. Instituto de Estudios Peruanos, Lima.
- 1979 *El sistema contable de los Incas: Yupana y quipu*. Librería Studium, Lima.
- 1984 El secreto de la Quilca. *Revista de Indias* 44 (173): 11–60.
- 2006 *Estudios sobre los quipus* (Gary Urton, ed. and intro.). Fondo Editorial Universidad Nacional Mayor de San Marcos and COFIDE, Lima.

**ROSTWOROWSKI DE DIEZ CANSECO, MARÍA**

- 1978 *Señoríos indígenas de Lima y Canta*. Instituto de Estudios Peruanos, Lima.

**SALOMON, FRANK**

- 2002 Patrimonial Khipus in a Modern Peruvian Village: An Introduction to the “Quipocamayos” of Tupicocha, Huarochirí. In *Narrative Threads: Accounting and Recounting in Andean Khipu* (Jeffrey Quilter and Gary Urton, eds.): 293–319. University of Texas Press, Austin.
- 2004 *The Cord Keepers: Khipus and Cultural Life in a Peruvian Village*. Duke University Press, Durham and London.

**URTON, GARY**

- 1994 A New Twist in an Old Yarn: Variation in Knot Directionality in the Inka Khipus. *Baessler-Archiv*, Neue Folge, Band 42: 271–305.
- 1997 *The Social Life of Numbers: A Quechua Ontology of Numbers and Philosophy of Arithmetic*. University of Texas Press, Austin.
- 1998 From Knots to Narratives: Reconstructing the Art of Historical Record-Keeping in the Andes from Spanish Transcriptions of Inka Khipus. *Ethnohistory* 45 (3): 409–438.
- 2001 A Calendrical and Demographic Tomb Text from Northern Peru. *Latin American Antiquity* 12 (2): 127–147.
- 2002 Recording Signs in Narrative-Accounting Khipus. In *Narrative Threads: Accounting and Recounting in Andean Khipu* (Jeffrey Quilter and Gary Urton, eds): 171–96. University of Texas Press, Austin.
- 2003 *Signs of the Inka Khipu: Binary Coding in the Andean Knotted-String Records*. University of Texas Press, Austin.
- 2005 Khipu Archives: Duplicate Accounts and Identity Labels in the Inka Knotted-String Records. *Latin American Antiquity* 16 (2): 147–167.

2006 “Carlos Radicati di Primeglio: Patrocinador de los estudios sobre los quipus.” In *Carlos Radicati di Primeglio: Estudios sobre los quipus* (Gary Urton, comp. and intro.): 39–54. Fondo Editorial Universidad Nacional Mayor de San Marcos, COFIDE, and Instituto Italiano di Cultura, Lima.

**URTON, GARY, AND CARRIE J. BREZINE**

2005 Khipu Accounting in Ancient Peru. *Science* 309: 1065–1067.

**VILLACORTA OSTOLAZA, LUIS FELIPE, AND J. ÁVILA C.**

1998 *Perspectiva histórica del Distrito de Ate*. Serie Documentos de Trabajo 2. Convenio Municipalidad de Ate, Ministerio de Educación, Lima.

**VILLACORTA OSTOLAZA, LUIS FELIPE, LUISA MARÍA VETTER PARODI,  
AND CARLOS E. AUSEJO CASTILLO**

2004 *Puruchuco y la sociedad de Lima: Un homenaje a Arturo Jiménez Borja*. CONCYTEC, Lima.

**WAKEHAM DASSO, ROBERTO**

1976 *Puruchuco: Investigación arquitectónica*. Departamento de Arquitectura y Urbanismo. Universidad Nacional de Ingeniería, Lima.

**ZUIDEMA, R. TOM**

1989 A Quipu Calendar from Ica, Peru, with a Comparison to the Ceque Calendar from Cuzco. In *World Archaeoastronomy* (A. F. Aveni, ed.): 341–351. Cambridge University Press, Cambridge, England.