The Khipu: What Do The Knots Say?

By Bruce Kelley

What is a Khipu and How Do You Spell It?

The khipu was used by the administrators of the Inca Empire to record their statistical information such as census, taxes, crop production, inventory, and any other numerical information that would be useful. The word khipu, or kipu in some dialects, is the Quechua (the language of the Inca empire and still widely spoken by Native American groups in the Andes mountains) word for "knot or to knot". The khipus were prepared and interpreted by low level administrators known as khipukamayuq (knot maker or knot keeper in Quechua). The Spanish changed the spelling to Quipu and that is also the most common English spelling. Since the Inca and their predecessors invented the device, this paper will accept their spelling.

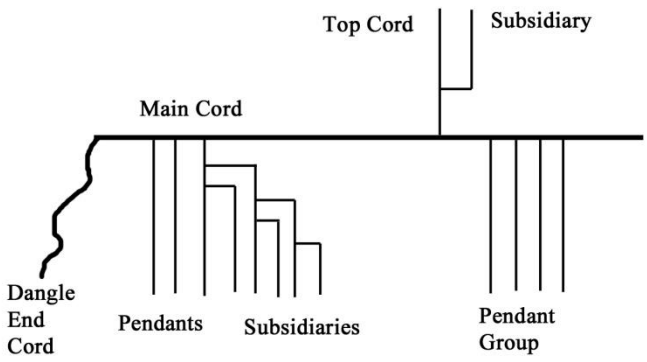

Figure 1: Khipu Construction (Adapted from Urton 2003, 4)

Figure 1 shows the basic construction of a khipu. It has a main cord or primary cord which is normally held or displayed in either a horizontal or circular position. There is often a dangle or end cord at one end of the main cord. Attached to the main cord are a number of pendant cords which normally hang down from the main cord. These pendant chords are often found in groups distinguished by spacing or color. The number of pendant cords can vary from a few to more than a thousand. Some khipus also have top cords which are attached to the main cord in such a manner that they would point in the opposite direction of the pendant cords. In addition, the pendant cords can have a number of subsidiary pendant chords attached to the primary pendant cords. Khipus can have up to 10 to 12 levels of subsidiary cords. The information is "written" on the khipu by tying knots in the pendant and subsidiary cords.

Europeans became aware of the khipu during the Spanish conquest in 1532. Fortunately, the Spanish kept written records and these are the source for much of what we know about the khipu. Francisco Pizarro, the Spanish conquistador who conquered the Inca Empire, noted that when his men took goods from an Incan storehouse, the record keeper would untie knots in one section of a khipu and tie new knots in another section. (Urton 2003) In the late 16th century, the leader of one Spanish travel group, Diego Avalos y Figueroa, reported finding an Indian trying to hide a khipu. The Indian claimed that the khipu contained a record of the conquistadors activities, "both the good and the evil" in the area. (Mann 2003, 1650)

The Spanish believed that some khipu contained historical information, religious stories, and other narrative information. Consequently, the Spanish believed the khipu was dangerous to have around,

and destroyed as many as they could. More than 800 (Urton and Brezine 2009) khipu survive today in museums and private collections.

Reading Numbers in a Khipu

The science historian, L. Leland Locke, is credited with deciphering how to read numbers in a khipu in 1923. Figure 2 shows the three types of knots used to record numbers and how to read them. A long knot is used to record the units. If a long knot has seven turns, it would represent the number seven in the units position. Since it is impossible to make a long knot with one turn, the number 1 is represented by a figure 8 knot. The units position is always at the end of the pendant cord furthest from the main cord.

The section of the pendant cord above the units position, records the tens. The numbers in all positions other than the units position are recorded with a simple knot. Thus if there were six simple knots in the tens area, it would represent 60. The hundreds are recorded above the tens position in a similar manner to the tens. The next group of simple knots would represent the thousands position, and so forth. Thus, the size of numbers that can be represented on a khipu is theoretically unlimited.

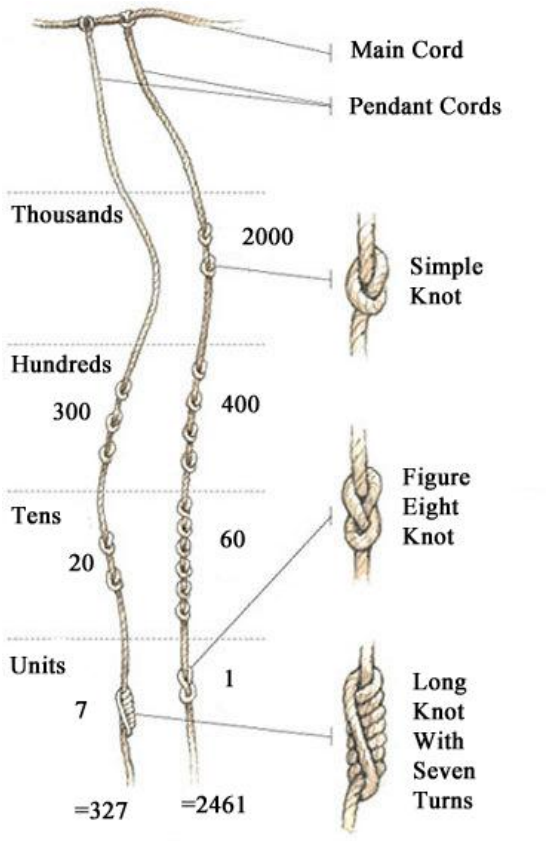

Figure 2: Reading Numbers in a Khipu (Adapted from Starrs 2006-9)

If you wanted to record the number 406, you would simply tie no knots in the area of the pendant cord in the tens position. It is important to note that the knot in the units position is always distinctive. It is either a long knot or a figure eight knot. Thus, you start at the end of the khipu cord attached to the main cord and work down the cord until you locate the units knot. You then know that the next group of simple knots above the units knot is tens, the next above that is hundreds, and so forth. Also, since the units knot is distinctive, it is possible to record more than one number on a single pendant cord.

Is the Khipu a Form of Writing?

Dr. Gary Urton of Harvard (Urton and Brezine 2009) has identified (as of January, 2010) 828 khipus and has studied 453 of them. Of the 453 he has studied, about two thirds contain numerical information in the form described above. The other third do not contain numbers that can be read using the above system. For instance, some long knots contain more than nine turns. Dr. Urton believes that the latter khipu contain narrative information. He has found some khipus that appear to have both numerical and narrative pendant cords in the same khipu.

In addition to knots, the khipu has a number of other characteristics which could be used to record information:

1. Material of Construction. The majority of khipus are made of cotton fibers and most of the rest are made of llama or alpaca fibers. Some khipus have some pendants made from cotton and other pendants made from llama or alpaca fiber. A few khipus are made from vegetable fibers or human hair.

2. Spinning and Plying. Fiber strands are twisted (spun) together to form threads. Several threads can then be twisted (plied) together to form strings. The spinning and plying can each be done in either a counterclockwise direction (S spun or S plied) or a clockwise direction (Z spun or Z plied) as illustrated in Figure 3. The direction of plying is generally opposite to the direction of spinning. The Inca showed an overwhelming preference for Z spun/S plied. However, some khipu use pendants that are S spun/Z plied and some khipu are mixed. The Inca preference for Z spun/S plied is in contrast to modern practice where Wikipedia states that most handspun fibers are S spun/Z plied.

Figure 3: S Spun and Z Spun (From Wikipedia, Spinning Textiles)

3. Attachment to Main Cord. The pendants are attached to the main cord by using a half hitch knot made by opening up the doubled end of the cord to form a loop and passing the pendant cord around the main cord and through the loop in the same manner you would attach a luggage tag to the handle of your suitcase. The knot can be made starting either with the loop in front of the main cord or with the loop behind the main cord. Urton calls these two possibilities "recto" or "verso". Urton found that some khipu are all recto and some are all verso, but most khipu are mixed. Urton believes that the recto and verso imparts some kind of meaning.

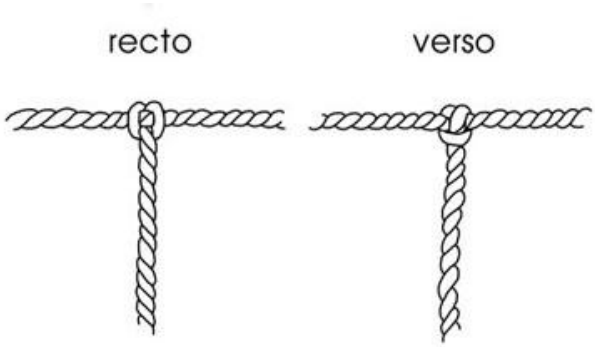

Figure 4: Recto and Verso Half Hitch Knots (Adapted from Urton 2003, 7)

4. Knot Directionality. The three knots used in a khipu (See Figure 2) can each be tied in an "S" or "Z" directionality as shown in Figure 5. The knot directionality is determined by the initial move in tying the knot. An initial counterclockwise move with the end of the rope passing behind the main rope or an initial clockwise move with the end of the rope passing in front of the main rope will result in a "Z" knot. The opposite moves will result in an "S" knot. Again Urton finds that some khipus have predominantly "Z" knots, some have predominantly "S" knots, and some have

a mixture of both. The question that has to be asked is whether such details as knot directionality are merely due to the preference or training of the khipukamayuq, the right or left handedness of the khipukamayuq, or are just random. Whether you are right or left-handed, it is equally difficult to learn to tie the knot in either direction. If the knot directionality is due to training, one would expect all knots on a khipu to be tied in one direction. If the knot directionality is random, I would not expect to find khipu with mixed directionality as each khipukamayuq would surely develop a habit of tying his knots in the same manner. Urton believes it is essential to consider knot directionality when attempting to interpret the khipu.

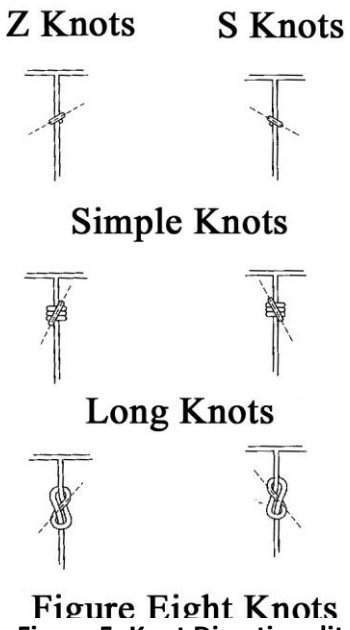

Figure 5: Knot Directionality (Adapted from Urton 2003, 77-8)

5. Color. One of the most obvious and most complex differences in khipu pendant cords is color. Color variations can be due to natural differences in fiber color and due to dyeing. Many of the colors found in khipus are shades of brown, but you can also find reds, blues, and other colors. In addition, not all cords are a solid color. Barber pole cords are achieved by plying together two threads of two different colors. Mottled cords are produced by spinning threads with two different colors held together, or by mixing the colors in the single threads, or by randomly mixing threads of different colors. Pendants can also change color in the middle. Such color changes are not created by dying but are accomplished in the weaving. Examples of color variations are shown in Figure 6.

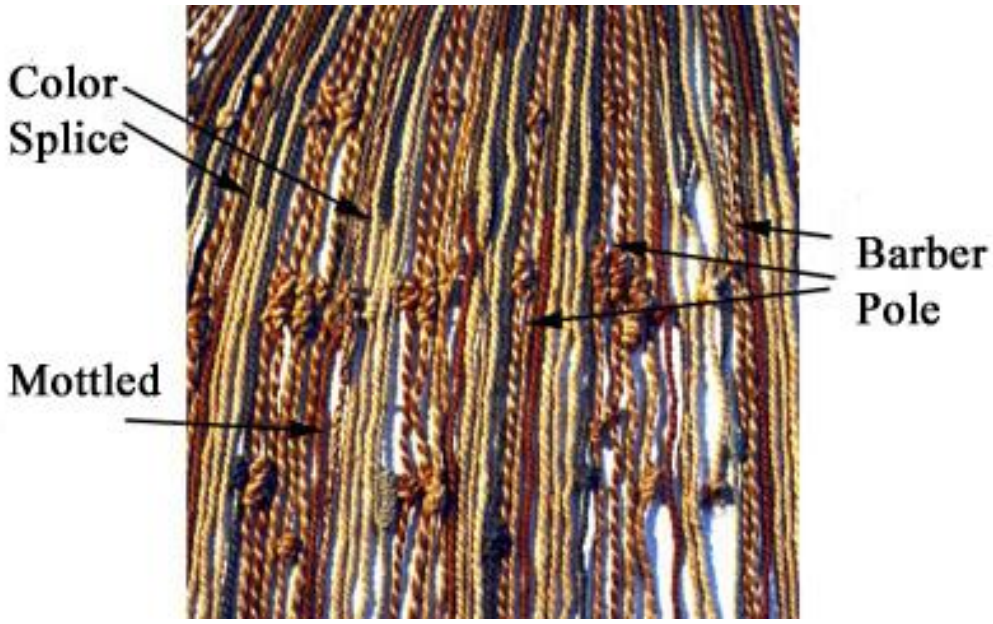

Figure 6: Color Variations from Museum für Völkerkunde, Berlin, Germany. (Photo by Gary Urton)

The Khipu Database Project

Khipu researcher Gary Urton of Harvard University undertook the creation of a khipu database in 2002. The goal of the project was to enter the data on all known khipu in the world into a single relational database. A complete description of this project and some of the preliminary findings can be found on the Web site for the project: http://khipukamayuq.fas.harvard.edu/.

The database had to be designed with infinite flexibility so a khipu could have an infinite number of pendants and an unlimited number of subsidiary pendants on each primary pendant. For each khipu, the database contains all levels of cords (main, pendant, subsidiary). For each cord, the database contains fiber, final twist, end treatment, length, and color. Similarly, for each knot on a pendant the database contains a position on a particular string, a type, directionality, and a numerical value. The organization of the database is shown in Figure 7.

The database can be used to compile statistical data about khipus such as the percentage with all "Z-knots", but it can also be used to look for khipu with identical information or related information. Gary Urton and Carrie Brezine used the computer to study a collection of khipus found in a single building at Puruchuco, an Inca archaeological site located 11.5 km northeast of Lima, Peru (Urton and Brezine 2005, 1065). Such a collection of khipus is referred to as an archive.

In order to understand the relationship of the khipus, it is necessary to understand the Inca administrative system. Everyone paid their tribute or tax to the Inca state in the form of labor for state projects. These tribute payers or tax payers were grouped into level 1 units of 10 with a leader for each group of 10. Five groups of 10 would be organized under a level 2 leader responsible for the 50 people under his direction. Two groups of 50 would be grouped together under a level 3 leader of 100 tribute payers and so on up the ladder. The top leaders would be the leaders of the approximately 80 provinces. These provincial leaders reported to one of the four Lords of the Four Quarters. These four lords then reported to the Inca king in Cusco.

This administrative arrangement would require the preparation of a lot of khipus if the king in Cusco wanted a record of the tribute hours paid. At the lowest level, the khipukamayuq for each level 1 group of 10 workers would have to prepare a khipu for his 10 workers. The khipukamayuq for the level 2 group would presumably prepare a summary khipu for his 50 workers, and so forth up the administrative ladder.

A computer analysis of seven of the khipu found at Puruchuco show a hierarchical relationship. The two khipu that are level 1 have similar numerical sequences and color patterns. Groups of cords on these khipu are formed by spacing between strings and/or by repetitive color patterns. Even more compelling, groupings of cords on the level 1 khipu sum to numbers recorded on the three khipu in level 2; and, in turn, these groups of cords sum to the values recorded in groups of cords in the two level 3 khipu. It is impossible to know whether these khipu represent information being collected on the lowest level and summarized for higher administrative levels or they represent information from outside Puruchuco and subdivided for use at the lowest administrative level. In either case, the study tends to confirm the record keeping use of the khipu.

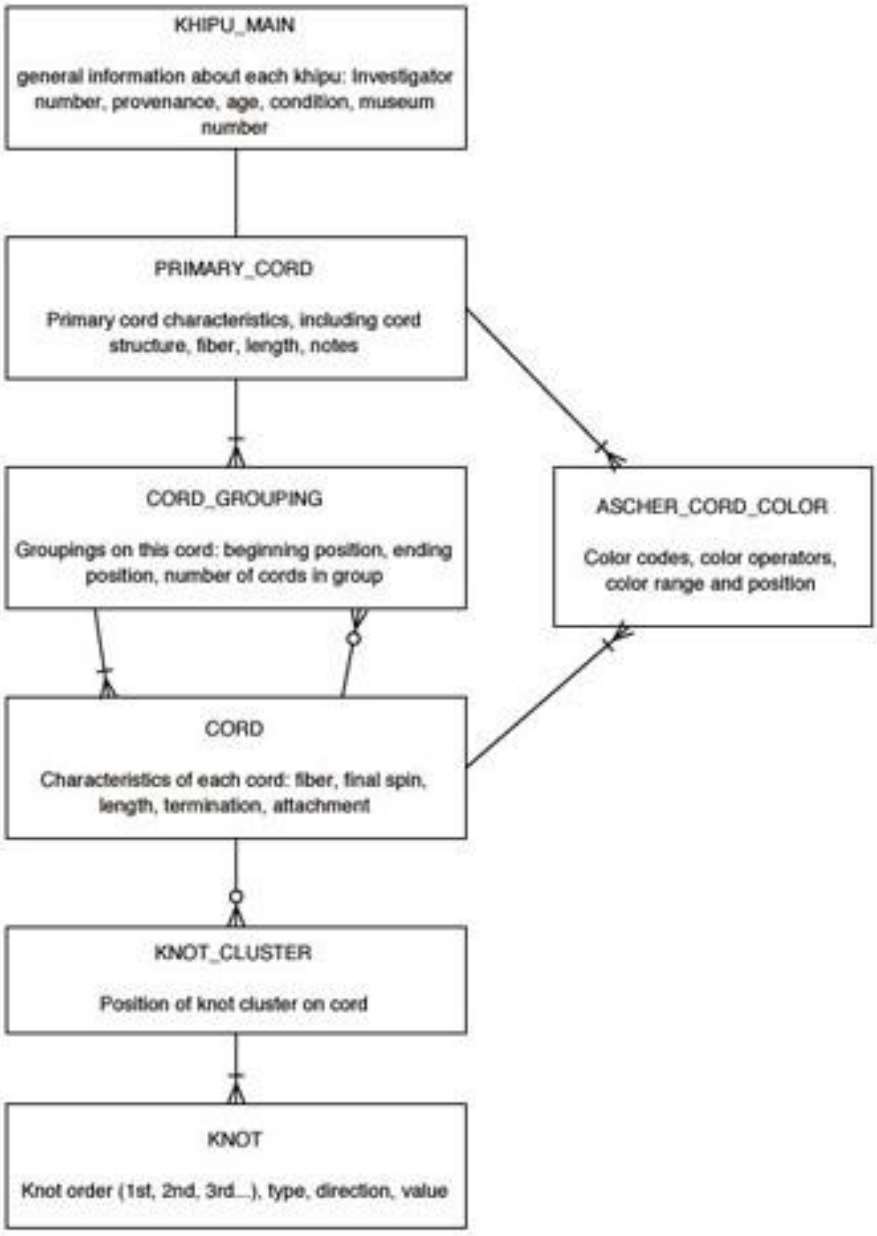

Figure 7: Khipu Database Structure
Urton and Brezine 2009

But there is perhaps a more exciting discovery from the study of these khipu. The level 2 and level 3 khipu all contain identical "introductory segments". These introductory segments all contain three figure eight knots tied on three separate cords. Urton and Brezine postulate that these introductory segments represent the name of the administrative unit where they were found, Puruchuco. Level 1 khipu would not require site identification since they probably never left the site. However, higher level khipu which were presumably sent to (or received from) distant administrators would require some identification to distinguish them from all the other administrative districts. It is exciting to think that these knots may be a clear indication that the khipu contain words as well as numbers.

The Mint Museum of Art (Mint) Khipu

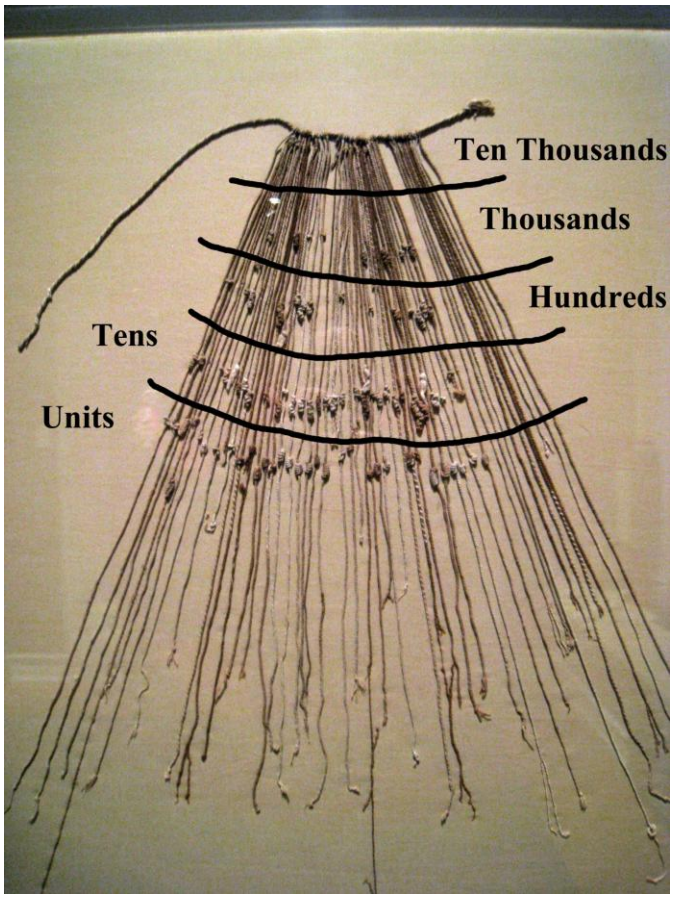

Figure 8: Mint Khipu Showing Numerical Divisions (Photo by Bruce Kelley)

The Mint khipu is a relatively simple khipu with a main cord and fifty-five pendant cords arranged by spacing in groups from left to right of 21, 24, and 10. One of the center pendant cords is very short and it is possible that other pendant cords are missing. Several other pendant cords appear to have lost a portion of their original length. There are no subsidiary pendant cords. All pendant cords appear to be "S" plied. The pendant cords are shades of brown with some barber pole cords. The khipu appears to contain numerical information. Figure 8 shows the areas of the Mint Khipu showing units, tens, etc. There are some knots on the pendant cords immediately below the main cord which I take to be numerical knots showing tens of thousands. Several pendant cords change color in the units section. Two of these are highlighted in Figure 9 where the cord changes from solid brown to a barber pole. I did not see any cords that changed color outside of the units section.

When you see drawings explaining how to read a khipu, the knots in the tens, hundreds, etc. sections are drawn as separate distinct knots. In reality, the knots in these sections are tied so they are immediately adjacent to each other. This makes it much harder to count the knots. This is especially true when you can't touch the cords to examine them from all directions and the threads in the knots are slightly frayed. I have attempted to count the knots and read the numbers on a few of the pendant cords in the Mint khipu. These results are shown in Figure 9.

At this time, the Mint khipu does not show up in the Khipu Database Project. However, Dorie sent the information to Gary Urton some time ago, and Gary is waiting for an assistant to become available to enter the data.

The khipu is an amazing device used to record numerical data. It is exciting to think that the khipu may also be used to record narrative data. This would remove the stigma that the Inca were an advanced civilization with monumental architecture, technology, urbanization, and political and social structures but no writing system.

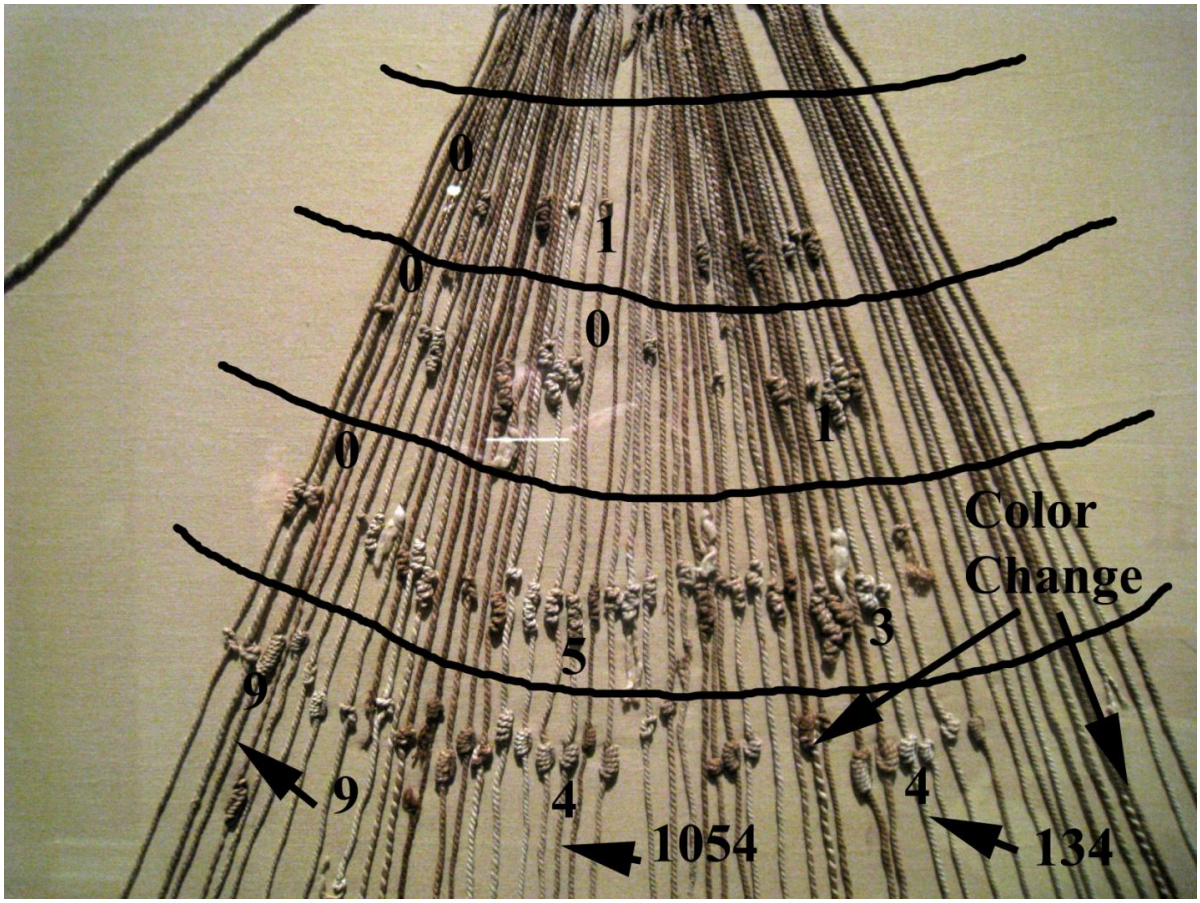

Figure 9: Mint Khipu With Some Number Interpretation (Photo by Bruce Kelley)

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