Chapter 10

Sacred Valley Region

10.1 Introduction

Pachacuti celebrated his victory over the Cuyos by establishing an estate and palace at Pisac. Later he established Ollantaytambo after conquering the Tambos and apparently built Machu Picchu to commemorate further conquests in the Vilcabamba (Niles, 1999; Rowe, 1990). Pachacuti’s son, Topa Inca, established his royal estate at Chinchero and his grandson, Huayna Capac, in Urubamba. Machu Picchu is explored in Chapter 11, while the rest are among the sites examined with the field research presented in this chapter. All are well beyond the reach of the Cusco ceque system (Figure IV-1).

10.2 Chinchero

Chinchero is located at S13°-23.40’; W072°-02.78’ and 3790 masl.

Motifs and Features: Chinchero is a multi-faceted complex and was found to exhibit carved rocks, light and shadow effects, solstitial orientations, cardinal orientations, stairs, seats, niches, a water source, basins, caves, altars, animal replica stones, channels, and terraces.

One of the first tasks before each new Inca was the establishment of his royal residence (Niles, 1999). Topa Inca, the son of Pachacuti, claimed the Chinchero valley as the site for his estate and soon set about construction of its palace, courtyard, support buildings and agricultural terraces. Also at the site are several intricately carved rock huacas. The style of architecture and design suggests a view of nature similar to that of Pachacuti, in which natural rock and landscape features were included in structural forms.
The sites of Pachacuti are steeped with solstitial orientations, but his son may have included a different construction philosophy. The many walls and terraces of the Chinchero complex are oriented cardinally, north-south and east-west. This in itself represents a significant astronomical effort as the cardinal direction of south would first have to be determined by the shadow plot of a vertical gnomon. North, east and west would then follow geometrically. Alternately, east and west might be traced on the day of an equinox. There is no record that the Inca’s performed either of these exercises.

Chinchero was found to exhibit the most extensive cardinal orientations in my study, but Morris and Thompson (1985:60) tell of similar alignments at Huánaco Pampa. They describe an ushnu and gateways as being aligned approximately on an axis of 088° and mention this as being close to the direction of the equinox sunrise. Remains of a canal were found near the center of the gateways with a similar east–west orientation. Specific Inca interest in the equinoxes is subject to debate, however, as the Spanish chronicles make no mention of equinoctial observations on the horizon.

East-west cardinal alignments posed a recurring question for my research as they also align for the horizon positions of the rising and setting sun on days of the equinoxes. There is no historical record regarding Inca interest in such observations as there is for days of the solstices and the zenith and anti-zenith suns, but it still remains a possibility that this orientation was not lost upon them. The Incas may not have used equinox horizon observations with their calendar, but in a society that paid such close attention to the sun’s position it would seem that they could have been aware of the days when the sun rose along these cardinal orientations. For that reason I include them in my study.

There are two major carved rocks; the first to the south of the plaza, Titikaka, has two carved stairways, one of which leads upward to the top of the rock through a cave with an axis approximately north and south. On the top there are a series of cut rectangular trays similar to those of Kenko and Lacco. To the southwest is a second large carved stone, Chinkana, containing an elaborate stairway, enclosures, altars, and carved trays. At its lower end is a flowing stream beneath carved teeth. A triangular basin opens approximately toward sunset on the December solstice. Above and to the south are carved stones known as Mesakaka and Kondorkaka. In contrast to the solstitial orientations of the Cusco valley, the majority of the
features of Chinchero emphasize cardinal directions. Still, solstitial orientations are not totally absent. The two primary carved rock huacas, Titikaka and Chinkana lie near to the axis of the June solstice sunrise and December solstice sunset.

The primary entry to Chinchero opens onto a town plaza that serves as a market with a modern building situated on the edge of its lower western half. A Catholic chapel was built upon an earlier Inca structure on the eastern upper extreme. The upper and lower terraces of the plaza are separated by a retaining wall containing three doorways and twelve large niches (Figure 10-1). This wall is aligned with a true azimuth of 177.8°/357.8° along its length.

North of the town plaza and chapel are the remains of three rectangular structures oriented on a true azimuth of 087.8°/267.8° and beyond this is the great plaza that Gasparini and Margolies (1980) tell us is now called Capallanpampa (Figure 10-2). Their orientation is shown in Figure 10-3. Further to the east is an expansive system of agricultural terraces retained by walls of fine
masonry. These walls are also oriented 087.8°/267.8° true and the carved rock huacas of Chinchero surround them.

Figure 10-2: East-west structural remains and the plaza of Capallanpampa.
10.2.1 Cardinal Orientations

I found many solstitial orientations at the sites examined in the Cusco region. Chinchero is different, however, in that it includes cardinal orientations of north-south and east-west. Solstitial orientations exist as well for the June solstice sunrise and December solstice sunset.

The palace, terraces, and structure walls near the plazas tend toward east-west and most features of Chinchero seem to demonstrate awareness by Topa Inca of this cardinality (Figure 10-4). Other walls are north-south and the huacas of Mesakaka and Kondorkaka are aligned south of the Chinkana stone. South may be related to the Incas’ interest in the Southern Cross.
It is possible to determine east-west at times of the equinoxes when a gnomon casts its shadow in these cardinal directions. Finding true south is perhaps even more definitive by tracking the gnomon’s shadow over a period of time and recording the endpoint of its midday position each day, as described in section 7.5. A parabolic curve is the ultimate result, and while the Incas likely did not recognize parabolas as such, they certainly would have been able to recognize the point in such a curve closest to the gnomon. A line drawn from the gnomon through this point is aligned directly with true south. East and west could then be found as being perpendicular with this south-north axis, but there is no historical reference of them using such techniques.

10.2.2 Solstitial Orientations

The two primary carved rock huacas of Chinchero, Titikaka and Chinkana, are approximately aligned on the axis of the June solstice sunrise and December solstice sunset (Figure 10-5). Both of these huacas are very large and were carved in situ. The existence of this orientation was not lost upon the Incas while developing this site.
Figure 10-5: Titikaka and the direction of December solstice sunset as viewed from the top of Chinkana.
10.2.3 Zigzag Channel

Located near the main entrance to the town plaza is a carved zigzagged offertory/divinatory channel (Figure 10-6). It is reminiscent of the one found atop Kenko Grande, but this one might well have been transported from its original location. Liquids would have been poured into the cup on the upper side by the rock and then observed as they flowed to the opposite end.

Figure 10-6: The zigzagged channel at Chinchero.
10.2.4 The First Rock east of the chapel.

Once beyond the modern chapel heading to the east, the first carved rock exhibits a giant seat facing back to the southwest (Figure 10-7). The seat is oriented to a bearing of 253.0°, near enough to easily view the December solstice sunset, but the outcrop appears to exhibit no astronomically related orientations. The First Rock is located at S13-23.40°; W072-02.78° and 3790 masl.

Figure 10-7: The First Rock east of the chapel at Chinchero.
10.2.5 Kondorkaka

Continuing east and at the end of the upper terraces is a huaca called Kondorkaka (Figure 10-8). Kondorkaka is significantly eroded, but still exhibits carved seats facing generally north, northeast, and Nevado Chicon. Several seats were sculpted on this side of the outcrop, with one of them oriented to the mountain. Near the base are some carvings of animals. Kondorkaka is located at S13-23.35°; W072-02.61° and 3773 masl.

Figure 10-8: Kondorkaka.
10.2.6 Mesakaka

North of Kondorkaka and heading downslope is *Mesakaka* (Figure 10-9), a carved rock with many square tables or trays. In keeping with the predominant theme of Chinchero, these squares also are oriented on true azimuths of 001.3°/181.3° and 091.3°/271.3°. The view aligns perfectly to overlook Chinchero’s central valley and sunsets on the western horizon (Figure 10-10). Immediately on Mesakaka’s northern side is a smaller rock with a single seat. Mesakaka is located at S13-23-29°; W072-02.59° and 3744 masl.

![Figure 10-9: Mesakaka.](image)
Figure 10-10: The western view from Mesakaka.
10.2.7 Chinkana

*Chinkana* is an outcropping of limestone and is one of the two principle huacas of Chinchero (Figure 10-11). Chinkana lies low on the eastern end of Chinchero’s central valley and has been extensively carved on all sides with such as seats, stairs, shelves and niches. A stream was routed to pass beneath the base of the rock on its western side, likely to energize the huaca through camay (Figure 10-12). A niche by the creek faces 346.3° and a notch on the horizon that is inclined by 12.0° up. Chinkana faces Titikaka and the approximate direction of the December solstice sunset. Chinkana is located at S13°-23.27’; W072°-02.58’ and 3724 masl. The short distance between the GPS coordinates of Chinkana and Titikaka may be a factor in the discrepancy between the GPS azimuth and true azimuth.

**GPS azimuth from Chinkana to Titikaka**

**Calculated azimuth of December solstice sunset from Chinkana**

**Measured azimuth from Chinkana to Titikaka**

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Figure 10-11: The western face of Chinkana.
Figure 10-12: A stream runs along the base of Chinkana to the right of a niche.
On Chinkana’s lower northern face is carved a large but shallow niche with a row of what resembles teeth across its top (Figure 10-13). The niche is carved east-west and faces north. A functional staircase descends from the top of the huaca and winds from north around to the west as it descends to a balcony carved into the side of the stone. The balcony looks up the valley and faces 278.0° giving it a view of Chinchero sunsets.

Figure 10-13: A carving resembling teeth on Chinkana’s northern face.
A triangular basin exists on a separate stone immediately northwest of Chinkana (Figure 10-14) and faces a 236.2° true azimuth. This is only a general orientation toward the December solstice sunset. A seat carved on top of Chinkana at its northern edge faces Nevado Chicon.

Figure 10-14: The triangular basin.
10.2.8 Titikaka

Approximately 360 meters west of Chinkana and north of the great plaza of Capallanpampa is Chinchero’s largest carved outcrop, *Titikaka* (Figure 10-15). Titikaka displays many carvings including two prominent stairways, one external, and the other within a break in the center of the rock leading to its top (Figure 10-16). The central stairway exhibits figurative carving.

![Figure 10-15: Titikaka.](image)
The upper surface of the stone is extensively carved and displays several examples of seats or trays and animals such as a condor and a snake. Titikaka and Chinkana both lie on the approximate axis of the June solstice sunrise and December solstice sunset. There is a deep hole, perhaps to hold a pole for a textile banner, carved on the top of Titikaka that may have helped to mark this orientation. The bearing to Chinkana and the triangular basin as measured from this hole is near to the axis of the June solstice sunrise (Figure 10-17). Titikaka is located at S13°-23.35’; W072°-02.80’ and 3753 masl. The short distance between the GPS coordinates of Titikaka and Chinkana may be a factor in the discrepancy between the GPS azimuth and true azimuth.
GPS azimuth from Titikaka to Chinkana

Calculated azimuth of June solstice sunrise from Titikaka

Measured azimuth from Titikaka to Chinkana

GPS azimuth with Chinkana: 070.085°
Measured Azimuth: 068.0°
Magnetic Declination: 3.7° W
True Azimuth: 064.3°
Calculated JSSR Azimuth: 064.5°
Δ Calc JSSR Az & True Az: 0.2°
Δ GPS Az & True Az: 5.785°
Δ GPS Az & Calc JSSR Az: 5.585°
Measured Inclination: +5.0°

Figure 10-17: Chinkana aligns near to the June solstice sunrise as viewed from Titikaka. The hole is below the compass.
At the base of the rock, lower on the western side, are more carvings, a large crevasse and an opening to a shallow cave (Figure 10-18). The crevasse looks out on a 278.0° bearing and the cave opens to 254.5°. A large niche was carved near the mouth of the cave and looks out at 293.5°.

Figure 10-18: Crevasse and cave opening in Titkaka’s lower western face.
10.3 Pisac

Pisac’s Intihuatana is located at S13°-24.86’; W071°-50.64’ and 3390 masl.

Motifs and Features: Pisac is a multi-faceted complex that exhibits carved rocks, light and shadow effects, solstitial orientations, niches, a water source, fountains, platforms, and curved-wall structures.

Seventeen kilometers northeast of Cusco and high above the Vilcanota River lay the ruins of Pisac, with its impressive mountainside terracing, its many examples of fine masonry, water channels, and a carved shrine known as the Intihuatana. Niles (1999) states that Pisac was established by Pachacuti in commemoration of his defeat of the Cuyos.

Sites known as intihuatanas, or “hitching places of the sun,” (Hemming and Ranney, 1982) are also found at Machu Picchu (see Figure 11-5), the Urubamba River near Machu Picchu (see Figure 11-23), and Tipon (see Figure 9-53) and possibly were places of solar worship. “Intihuatana” seems to be a modern term that first began to appear in the 19th century (see section 5.6). In Pisac the intihuatana is a large, partially carved rock in the temple group that is enclosed by a semi-circular masonry wall adjoining a straight masonry wall in the form of the letter “D” (Figure 10-20). It displays a small carved cylinder on its flat upper surface within the walled enclosure. Dearborn and Schreiber (1986: 24-25) say that the intihuatana at Pisac exhibits more of a resemblance to the upper structure of the Torreon (see section 11.2.3 and Figure 11-10) at Machu Picchu. Like the Torreon, Pisac’s intihuatana was built upon a rock prominence with a view to the east. If upper wall sections at Pisac did exist they are no longer extant. Dearborn and Schreiber (1986: 25) also describe an edge in the primary rock of Pisac’s intihuatana to have been carved with a June solstice orientation similar to the carved ledge on the rock in the Torreon. Bernard Bell (personal communication) states that design similarities between Pisac’s intihuatana and Machu Picchu’s Torreon also suggest similarities of function (Dearborn and Schreiber, 1986: 24-25). Evidence for such usage is not conclusive, but both have D-shaped curved structures and each has a flat edge oriented toward the June solstice (Bernard Bell, personal communication).
Figure 10-19: Plan of Pisac’s Temple Group. (A) is the direction of the horizon point of June solstice sunrise from the Intihuatana. (B) is the direction of the horizon point of December solstice sunrise from the platform (modified from Hemming and Ranney, 1982).
Immediately to the east of the Intihuatana is a second rock enclosed by a circular wall. Bernard Bell (personal communication) relates this, too, as having an edge, in this case aligned for the direction of the December solstice sunrise. The intihuatana and this structure would then be noteworthy for their similarities with each other and with the Torreon. The alignment of edges at two different structures, one for each of the solstices, would serve to underscore the possibility of solar intent akin to that posited for the Torreon (Bernard Bell, personal communication).

While these similarities are clear for Bell, Dearborn and Schreiber they were not as distinct for me. The stone of Pisac’s intihuatana is different from the one at the Torreon and Pisac’s carved edges are much less pronounced. We also have no evidence that the curved walls at Pisac were ever high enough to have included windows similar to those in the Torreon. Even the use of a string and plum-bob in the Torreon’s southeast window for the observance of June solstice sunrise has yet to be generally accepted. Multiple interpretations are valuable tools, however, and the hypothesis that Pisac shared similarities of design and solar usage with the Torreon is intriguing.
10.4 Quespiwanka

Quespiwanka is located at S13°-18.05'; W072°-06.71’ and 2934 masl.

Motifs and Features: Quespiwanka is a multi-faceted complex and was found to exhibit a sacred rock, solstitial orientations, niches, a water source, pillars, double and triple jambed doorways and structures.

Niles (1999) made a detailed study of Quespiwanka’s physical designs as they appear in the archaeological record. Huayna Capac began construction of Quespiwanka some time prior to A.D.1499, three to four years after the death of his mother. At that time he was involved in a military campaign against the Chachapoyas, and the design of his royal palaces was apparently left to one of his half-brothers, Lord Sinchi Roca.

The estate spanned the Yucay Valley combining some 20 separate properties of maize fields, including both the valley floor and agricultural terraces (Farrington, 1995). Farrington identifies three sectors: (A) an agricultural zone to the north, (B) the structural zone, and (C) the zone south of the palace where the remains of a reservoir have been found. The majority of the palace grounds consisted of a great plaza (in sector B), at the center of which was a large white granite boulder (Figure 10-21) and, as suggested by Niles (1999), a platform which has now been replaced by a modern chapel (Figure 10-22). The eastern wall of the plaza was an impressive sight with twin double-jambed gate houses, a large ramp and a triple-jambed entranceway. As Niles (1999) describes it, the architectural design of the eastern face of the palace was designed to impress whoever approached. Upon entering the main gateway a visitor would first see the huge plaza, perhaps empty except for the white boulder and its adjacent platform. The platform was in the geometric center of the plaza, along the center-line of the triple-jambed entry portal, and it seems likely that the precise placement of the palace and the plaza was established by the location of the boulder. Niles suggests that a channel was designed to carry water from an area in the north to the boulder and its platform. The white granite boulder is located at S13°-18.05’; W072°-06.71’ and 2934 masl.
Figure 10-21: Plan of Sector B of Quespiwanka (modified from Niles, 1999).
10.4.1 Solar Pillars

On top of the Cerro Sayhua ridge (modern nomenclature) northeast of Quespiwanka there are two pillars long known to the inhabitants of the nearby modern village of Urubamba (Figure 10-23). There is ethno-historical description by Spanish chroniclers of similar pillars surrounding the city of Cusco (see chapter 8), but none of those structures remain. If Quespiwanka’s pillars were similar in design and intent to those that have been reported on the horizons of Cusco, then they would be two of the only extant examples. Although known to the local community and identified by Bauer and Dearborn (1995: 69) as “useful examples of what Inca solar pillars may have looked like,” the astronomical functions of these pillars had not been verified until recently. Zawaski in 2005 observed that the Urubamba pillars marked June solstice sunrise and I found in June 2007 that a large white granite boulder in the courtyard of Quespiwanka is approximately the point for viewing this phenomenon. The granite boulder may, in fact, be responsible for the Quechua name of the palace, Quespiwanka “meaning a shimmering or crystal sacred rock” (Farrington, 1995: 59). Stone-lined channels in the courtyard of Quespiwanka could have surrounded the boulder with water, and today a modern channel carries water past its flank. The boulder appears to be the approximate location for observing June solstice sunrise between the horizon pillars. Figure 10-24 shows the sun rising along the eastern pillar on 8 June 2008, nearing the end of a northward journey that culminates between the pillars at the time of the solstice. Theodolite measurements were through the courtesy of Mike Zawaski and his assistance in 2008.

Theodolite azimuth from the boulder to the center between the pillars (std dev 3’)

Calculated azimuth of June solstice sunrise from the boulder

Measured azimuth from the boulder to the center between the pillars

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Figure 10-22: The white granite boulder of Quespiwanka in front of a modern chapel.

Figure 10-23: The pillars on Cerro Sayhua.
Figure 10-24: Sunrise over the Cerro Sayhua pillars as viewed from Quespiwanka’s white boulder on 8 June 2008. On this date the sun rises at 057.3° and will move left 0.8° to 056.5° for the standstill. The pillars are 0.6° apart and the solstice sun will rise over the left pillar when viewed from the boulder.

The granite boulder sits near the center of the ancient plaza and immediately adjacent to the modern chapel which Niles (1999: 173) suggests was the location of Quespiwanka’s platform. As described in Figure 10-24 the June solstice sun will rise over the left tower when viewed from the boulder. To center the sun between the pillars the solstice sunrise would be viewed to the left of the boulder. It remains uncertain as to whether the sunrise was viewed between the pillars or over the left pillar with the right pillar serving as a warning of the upcoming standstill. The granite boulder is 5.15 meters long, 3.73 meters wide and 2.47 meters high.

Natural features on the ridgeline alone might have been sufficient for priests to determine the time of the approaching solstice. Construction of the towers underscores the importance that the Incas placed on the June solar event and the significant role that this site may have played in their
ritual. The pillars might have been designed as a visual element of Inti Raymi ceremonies held below.

The pillars are 35.3 meters apart on either end of a level terrace and are constructed of sandstone (Figure 10-25). They are aligned with each other on an azimuth of 101.5° at an elevation of approximately 3860 meters. The eastern pillar has a height of 4.3 meters and a base 1.5 meters by 3.3 meters; the base of the partially restored western pillar is 1.5 meters by 3.4 meters (Zawaski, 2007).

![Figure 10-25: The eastern pillar above Quespiwanka.](image)
10.4.2 Viewing from the south wall of the palace

Quespiwanka’s courtyard may not have been an area intended for public ceremonies because the palace’s eastern wall contains a massive triple-jambed doorway (Figure 10-26) surrounded by two double-jambed gatehouses. Inca doorways with multiple jambs typically marked entry into a space used only by elites (Niles, 1999: 295). Cobo (1990 [1653]: 96) describes elite pilgrims as having to satisfy multiple conditions before being allowed to get close to the sacred rock on Lake Titicaca’s Island of the Sun. The courtyard in Quespiwanka may have been similar to the sanctuary of the Island of the Sun with non-elites being barred from entry (Dearborn, Seddon, and Bauer, 1998).

Figure 10-26: Remains of the triple-jambed entranceway in Quespiwanka’s eastern wall.

June solstice sunrise, however, would have also been viewable from outside the southern wall of the palace. The wall is oriented on a true azimuth of 108.2°/288.2° and Niles (1999) suggests that there were 40 double-jambed niches along its 190 meter length (Figure 10-27). The wall
faced an artificial lake and large granite boulders. This area may have been used for public viewing as a place where pilgrims and non-elites were allowed to observe the solstice sunrise between the pillars in a manner similar to ceremonies held on the Island of the Sun (Dearborn, Seddon, and Bauer, 1998). As with the platform alignments at the Island of the Sun, the public viewing area for the June solstice sunrise outside of Quespiwanka might have been designed to feature the sun rising over Huayna Capac, the ruling Inca and son of the sun, perhaps as he stood upon the platform proposed by Niles. This photo was taken on 8 June 2008 (Figure 10-28). A potential viewing location outside the southern wall is at S13°-18.08’; W072°-06.78’ and 2922 masl.

Calculated azimuth of June solstice sunrise from the point near the west end of the wall

Measured azimuth from the point near the west end of the wall to the center between the pillars

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Figure 10-27: Quespiwanka’s southern wall.
A potential third site for the June solstice solar ceremonies was the 40 meter-long terraced platform that was built between and around the pillars. Retaining walls, which are approximately one meter high, are on its northern and southern sides. Both ends of the sightline connecting the palace and the pillars appear to have been huacas. As part of the celebration a group of celebrants would have climbed the 950 meters from the valley to the platform where they could place offerings, make sacrifices, and celebrate the passage of the sun as it traveled across the sky from dawn to dusk.

The question arises as to how the Urubamba pillars escaped the Catholic extirpation of idolatries that destroyed the pillars of Cusco. It could be said that they were relatively modest features on the high horizon and escaped detection from below.
10.4.3 Other Orientations

The white granite boulder in Quespiwanka’s courtyard may also have been situated for other solar orientations with respect to natural features. The boulder is situated to approximately observe the December solstice sun to rise on the horizon near the 12 km-distant peak of Cerro Unoraqui (Figures 10-29). The photo in Figure 10-30 was taken on 20 December 2008. Cerro Unoraqui is discussed further in section 10.6 of this chapter. On the day of the December solstice the sun will rise 2.4° to the right of the peak. The following azimuths show that over the 12 km distance the compass and the theodolite readings were only 7’ apart.

As a possible solstice marker Cerro Unoraqui was not as precise as the pillars on Cerro Sayhua. The mountain is too distant to be practical for calendrical use, but could have served as a symbolic marker for the approximate rising point of the sun. Remains exist of what may have been two walls on the Cerro Pumahuachana Ridge (see section 10.5) in the foreground of Figure 10-29. These could have played a possible role in a December solstice observance. These theodolite measurements were also through the courtesy and assistance of Mike Zawaski.

![Cerro Unoraqui as viewed from Quespiwanka. Cerro Pumahuachana is the ridgeline in the foreground.](image-url)
Theodolite azimuth from the boulder to the Cerro Unoraqui mountaintop (std dev 3°)

GPS azimuth from the boulder to the Cerro Unoraqui mountaintop

Calculated azimuth of December solstice sunrise from the boulder

Measured azimuth from the boulder to the Cerro Unoraqui mountaintop

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<td>GPS Azimuth</td>
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<tr>
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<td>∆ GPS Az &amp; True Az:</td>
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<tr>
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<tr>
<td>∆ Theodolite Az &amp; Calc DSSR Az:</td>
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<tr>
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</tbody>
</table>

Figure 10-30: December solstice sunrise in the direction of Cerro Unoraqui as viewed from Quespiwanka’s white boulder.
Figure 10-31: Orientations from Quespiwanka’s boulder for the June solstice sunset (A), the June solstice sunrise (B), and the December solstice sunrise (C) (modified from Niles, 1999).

Figure 10-32: The orientation of Cerro Unoraqui as viewed across Cerro Pumahuachana from Quespiwanka in the direction (C) of the December solstice sunrise. (B) is the direction of the June solstice sunrise and (A) the June solstice sunset (modified from Hemming and Ranney, 1982).
The sun sets over a nearby peak on 7 June 2008 when witnessed from Quespiwanka’s white boulder (Figure 10-33). Natural features on the mountain could have made the point of sunset predictable, but are subtle enough to remain inconclusive. There is no evidence, however, of Inca interest in this June solstice sunset observation.

**Calculated azimuth of June solstice sunset from the boulder**

**Measured azimuth from the boulder to the mountain**

<table>
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<tr>
<td>Measured Inclination:</td>
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</table>

Figure 10-33: June solstice sunset from Quespiwanka’s white boulder.
I also examined the horizons around Quespiwanka for potential natural features marking the solar horizon positions of the December solstice sunset, equinox sunrise, equinox sunset, zenith sunrise and anti-zenith sunset. In each case a subtle landscape feature on the horizon could have identified the event, but none of the features stood out enough to support such usage.

**Calculated azimuth of December solstice sunset from the boulder**

**Measured azimuth from the boulder to a slightly raised terrain feature on the horizon**

- Measured Azimuth: 250.0°
- Magnetic Declination: 3.6° W
- True Azimuth: 246.4°
- Calculated DSSS Azimuth: 247.1°
- Δ True Az & Calc DSSS Az: 0.7°
- Measured Inclination: +5.0°

**Calculated azimuth of equinox sunrise from the boulder**

**Measured azimuth from the boulder to a raised terrain feature on the horizon**

- Measured Azimuth: 090.0°
- Magnetic Declination: 3.6° W
- True Azimuth: 086.4°
- Calculated ESR Azimuth: 087.0°
- Δ True Az & Calc ESR Az: 0.6°
- Measured Inclination: +14.0°

**Calculated azimuth of equinox sunset from the boulder**

**Measured azimuth from the boulder to a raised terrain feature on the horizon**

- Measured Azimuth: 273.0°
- Magnetic Declination: 3.6° W
- True Azimuth: 269.4°
- Calculated ESS Azimuth: 270.8°
- Δ True Az & Calc ESS Az: 1.4°
- Measured Inclination: +5.0°
Calculated azimuth of sunrise from the boulder on the day of the zenith sun

Measured azimuth from the boulder to a raised terrain feature on the horizon

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</thead>
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<td>Calculated ZSR Azimuth</td>
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</table>

Calculated azimuth of sunset from the boulder on the day of the anti-zenith sun

Measured azimuth from the boulder to a slightly raised terrain feature on the horizon

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<td>Measured Inclination</td>
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</table>
10.5 Cerro Pumahuachana

The center of Cerro Pumahuachana is located approximately at S13°-19.03’; W072°-03.92’ and 3575 masl.

Motifs and Features: Cerro Pumahuachana is a ridge that was found to exhibit structural remains and is situated along a sightline between Quespiwanka and Cerro Unoraqui.

Cerro Pumahuachana looms above the village of Yucay and the palace of Sayri Tupac. The ridge is oriented approximately on a bearing of 025.0°/205.0° (Figure 10-34) and includes the remains of two stone wall segments. A modern chapel is located on a crag above the ridge’s northern end. What is extant of these walls is at ground level and stretches over 200 meters along the top of the ridgeline. Local villagers relate that rocks from the walls were taken to the site of the chapel and were used in the construction of its base. While this chapel is modern, it may have been built on a site that was of interest to the Incas (Figure 10-35). As of yet such historical evidence has not been found.

Figure 10-34: Cerro Pumahuachana.
The chapel is clearly visible through the southern double-jambed gate house at Quespiwanka (Figure 10-36) and would be as well through the triple-jambed entrance if the view were not blocked by trees. Relatively little remains of the northern gate house.
When Cerro Unoraqui is viewed from the white boulder at Quespiwanka the line of sight crosses Cerro Pumahuachana (see Figure 10-29). The four ends of the two sections of wall remains are at GPS azimuths from the boulder of 109.11°, 109.82°, 110.56° and 110.64°. Cerro Unoraqui’s GPS azimuth from the boulder is 110.73°. The north wall is 66 meters long and the south wall is 19.4 meters in length. There is an 85 meter gap between the two wall segments. The crag and chapel are several hundred meters to the left of the sightline between the white boulder and Cerro Unoraqui.

North Wall – North End: S13° 18.987’ W072° 03.930’ 3592 masl
North Wall – South End: S13° 19.028’ W072° 03.921’ 3575 masl
South Wall – North End: S13° 19.071’ W072° 03.912’ 3572 masl
South Wall – South End: S13° 19.078’ W072° 03.904’ 3568 masl
10.6 Cerro Unoraqui

Cerro Unoraqui’s pillars are located at S13-20.36°; W072-00.44° and 4377 masl.

Motifs and Features: Cerro Unoraqui is a mountain that was found at its peak to exhibit pillars with a north-south orientation. It is on a sightline near to the December solstice sunrise as viewed from Quespiwanka.

Cerro Unoraqui is a 4377 masl peak on the southern side of the Urubamba River between Yucay and Calca (Figure 10-37). The mountain first drew my attention while examining the points of solar horizon events from the white boulder at Quespiwanka. Cerro Unoraqui was approximately oriented for the December solstice sunrise across the Cerro Pumahuachana Ridge and was a natural feature that could have been used to help locate the event. Through binoculars the mountain appeared to have structures on top that bore closer investigation.

Figure 10-37: Cerro Unoraqui from Cerro Pumahuachana.
We climbed to the summit and found three rock pillars. Local villagers claim that the site of the pillars was first established in the time of the Incas (Figure 10-38). The pillars are encircled by a low stone wall and are oriented on a true azimuth of 178.6°/358.6° with respect to one another. Such north and south orientations may possibly relate to Inca interest in the Southern Cross and certain Inca dark constellations within the Milky Way.

Figure 10-38: Pillars on top of Cerro Unoraqui.
The wall around the pillars is oval in shape with its longer axis 10.70 meters and the shorter 7.80 meters. The walls of the oval average 0.80 meters in height. From south to north each pillar is on slightly higher ground. The south pillar has a base of 1.60 meters and is 1.73 meters high. The mid pillar’s base is 1.80 meters and its height is 1.70 meters. The north pillar is 2.30 meters wide and 2.20 meters high. The north and mid pillars are 1.10 meters apart and there are 0.70 meters between the mid and south pillars. The north and south pillars are each 1.60 meters from the oval wall along its long axis. On the short axis mid pillar is 4.20 meters from the east wall and 3.60 meters from the west. With regard to these rock and mud pillars on top of Cerro Unoraqui, Ian Farrington (personal communication) noted that they look like what he would expect for the core of pillars that have had their exterior stones removed for other purposes. Quespiwanka is on a 290.316° GPS azimuth from the peak of Cerro Unoraqui.

![Figure 10-39: Plan of Cerro Unoraqui Pillars.](image)
Dominating Cerro Unoraqui’s northern horizon is the Cordillera Urubamba, including the 5530 meter Nevado Chicon and the 5818 meter Nevado Ccolque Cruz (Figure 10-40).

Figure 10-40: Cerro Unoraqui pillars aligned north-south.
10.7 Choquequilla

Choquequilla is located at S13°-17.53’; W79°-13.93’ and 3627 masl.

Motifs and Features: Choquequilla is a complex that was found to exhibit a carved rock, a solstitial orientation, niches, a water source, a cave and terraces.

Above the Rio Huarocondo, 5 km southeast of Ollantaytambo and 14 km west of Urubamba, are the ruins of Choquequilla. This remote huaca lies within the mouth of a cave opening to the approximate direction of the December solstice sunrise. The intricately carved shrine faces inward toward the cave, away from the horizon, and is flanked to the south by a wall constructed with two rows of four double-jambed niches, emphasizing the site’s significance. The roof of the cave is formed by two relatively flat stone faces that form an inverted “V” (Figure 10-41). Light from the December solstice sun as it rises above the opposing horizon brightly illuminates the cave and huaca.

Figure 10-41: The cave of Choquequilla.
The cave is situated on the mountainside above agricultural terraces that have fallen into disuse. A central staircase ascends the terraces and at the top a trail proceeds north to the cave. A small masonry structure with a door and windows is situated immediately to the cave’s north. The carved rock of black granite (Figure 10-42) is said to be among the finest examples in existence and exhibits great symmetry and exquisite carving (Paternosto, 1996). The sculpting greatly resembles that of the Baño de la Ñusta at Ollantaytambo (Figure 10-50), but the Choquequilla rock was damaged by looters.

![Figure 10-42: The carved black granite rock and wall with niches at Choquequilla.](image)

Paternosto (1998: 89) calls this “the cave of Choquequilla, the Golden Moon,” and Van de Guchte (1990: 191) calls it the “Moon Temple” of Choquequilla. The cave opens to the December solstice sunrise and the carved stone is slightly offset at 130°. The horizon is inclined +32.0°. The rise of the sun on 20 December 2008 illuminates the cave brightly (Figure 10-43). The light of a rising moon could create a dramatic effect.
Calculated azimuth of December solstice sunrise from the cave

Measured azimuth through the inverted V in the cave’s roof to the horizon

Measured Azimuth: 114.0°
Magnetic Declination: 3.6° W
True Azimuth: 110.4°
Calculated DSSR Azimuth: 109.5°
Δ True Az & Calc DSSR Az: 0.9°
Measured Inclination: +32.0°

Figure 10-43: The December solstice sunrise is oriented to brightly illuminate Choquequilla’s cave.
10.8 Ollantaytambo

Ollantaytambo is located at S13°-15.95’; W072°-16.03’ and 2818 masl.

Motifs and Features: Ollantaytambo is a multi-faceted complex that was found to exhibit carved rocks, light and shadow effects, solstitial orientations, zenith orientations, seats, a water source, fountains, gnomons, structures and terraces.

Ollantaytambo is located about 90 km from Cusco in the Urubamba River valley. Niles (1999) states that Pachacuti developed the area after defeating the Tambos and that both Huayna Capac and Manco Inca made subsequent improvements. This was the site of one of the few great victories of the Incas over the Spaniards when Manco Inca had the plain below flooded, thus miring the conquistadors’ invading horses (Hemming and Ranney, 1982).

10.8.1 Terraces

The most striking feature when first approaching Ollantaytambo is a magnificent set of 17 stone terraces that ascend the hillside (Figure 10-44). The extensive terraces of Pumatillis face out to the rise of the December solstice sun and, in the opposite direction, face in toward and frame nicely the June solstice sunset. A staircase begins right of center and continues along the left side of the terraces. The terraces would have provided an excellent platform for a large group of people to view the sunrise during the time of Capac Raymi.
Figure 10-44: The terraces of Pumatillis at Ollantaytambo.
10.8.2 Temple of the Sun

What is known as Ollantaytambo’s Temple of the Sun (Figure 10-45) was extensively damaged by the Spanish in their purge of indigenous religion, however a foundation and a wall of six monoliths survives (Hemming and Ranney, 1982). The wall faces the Pinkuylluna mountain (see Figure 10-47), which from this location is close to the orientation of the rise of the June solstice sun. The exact purpose for viewing the solstice sunrise from this vantage point remains uncertain. The photo in Figure 10-46 was taken from the plaza below the terraces on 20 June 2007.

Figure 10-45: Ruins known as the Temple of the Sun.
Figure 10-46: June solstice sunrise over the Pinkuylluna mountain.

10.8.2 Pinkuylluna Mountain

The Pinkuylluna mountain (Figure 10-47) lies opposite Ollantaytambo to the northeast and aligns with the June solstice sunrise as viewed from the Temple of the Sun. The mountain exhibits two structures and a face on its side (Figure 10-48).
Figure 10-47: Pinkuylluna mountain.
Figure 10-48: The face on Pinkuyluna mountain.
10.8.4 Incamisana

Paternosto (1996) says while the Temple of the Sun was the primary site for ceremony in Ollantaytambo’s hanan, or upper, sector, that the Incamisana was its ceremonial counterpart in the lower hurin sector (Figure 10-49). Horizontal gnomons project distinct shadow effects at two times of solar significance. My field assistant, Carlos Aranibar, related that at the time of the equinoxes a face is projected toward the lower left in shadow by the gnomons and rock. The face is said to be that of a man playing a quena, or flute. On the December solstice at local noon the shadow of one of the gnomons is said to reach down and “insert” itself to fill a carved triangular notch in the base below. At the time of the zenith sun the shadows of the three lower gnomons are said to touch each of the three lower steps.

Figure 10-49: The horizontal gnomons of the Incamisana.
10.8.5 Baño de la Ñusta

The Baño de la Ñusta, or “Bath of the Princess,” is a striking fountain set in Ollantaytambo’s lower urban sector (Figure 10-50). Ollantaytambo contains many water channels and fountains and the Baño de la Ñusta is noteworthy for its sculptural similarity with the 5 km-distal black granite rock at Choquequilla (Figure 10-42).

![Figure 10-50: The Baño de la Ñusta](image)

10.9 Summary

In my research of sites in the Sacred Valley I continued to find examples of astronomical orientations. Chinchero’s many masonry walls exhibit cardinal orientations of north and south that may have been determined by astronomical means. The site’s two major huacas also take advantage of an orientation for the June solstice sunrise and December solstice sunset. The significant interest in this sunset is evidenced by a balcony carved on Chinkana that faces it, by a
nearby triangular basin that is appropriately aligned, and by the shelves or trays of Mesakaka that are oriented in this direction as well.

Pisac displays a carved stone called the Intihuatana that has a cylindrical carving on its top and an edge said to be aligned for the June solstice sunrise. A nearby platform has a potential orientation with the rise of the sun on the December solstice. Bernard Bell suggests that both bear similarity to the Torreon of Machu Picchu.

The finely carved huaca of Choquequilla is located in the mouth of a cave that is oriented with the December solstice sunrise and is brilliantly illuminated at that time. Ollantaytambo’s outstanding terraces of Pumatillis align for the December solstice sunrise and June solstice sunset, while the site’s Temple of the Sun is oriented for a commanding view of the June solstice sunrise over the nearby Pinkuylluna mountain. The gnomons of Ollantaytambo’s Incamisana exhibit interesting shadow effects.

The most significant astronomical orientation in the Sacred Valley, however, is that of the solar pillars above Quespiwanka. These structures are extant examples of a type of horizon astronomy reported in the Spanish chronicles to have existed around Cusco. The pillars are aligned so that the sun will rise over them on the morning of the June solstice as viewed from the vicinity of the palace’s white granite boulder. It is also possible to view the December solstice sunrise over the distant Cerro Unoraqui from this same location. Non-elites may have viewed the June sunrise from a separate location outside the palace’s southern wall as entry to the main plaza would have been restricted to elites only by virtue of the double and triple jambed entries.