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Over two decades of technological and academic advances, numerous platforms and tools have been developed to help archaeologists visualize traditional data in new ways. The resulting products have ranged from realistic 3D models to virtual reality simulators to geographic information systems. In the field of digital archaeological visualization one of the main areas of development is to address the communication of the level of confidence and uncertainty in certain aspects of the visualizations. Quirigua is an ideal candidate to be used as the subject for the creation of a new digital visualization tool for archaeological sites that is designed to put to use some research materials, such as excavation photographs, largely ignored by digital archaeologists.

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THE SITE OF QUIRIGUA THROUGH TIME:
THE USE OF DIGITAL RECONSTRUCTIONS IN THE CONTEXT OF A COMPARATIVE PHOTOGRAPHIC PROJECT

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Abstract

Over two decades of technological and academic advances, numerous platforms and tools have been developed to help archaeologists visualize traditional data in new ways. The resulting products have ranged from realistic 3D models to virtual reality simulators to geographic information systems. In the field of digital archaeological visualization one of the main areas of development is to address the communication of the level of confidence and uncertainty in certain aspects of the visualizations. Quirigua is an ideal candidate to be used as the subject for the creation of a new digital visualization tool for archaeological sites that is designed to put to use some research materials, such as excavation photographs, largely ignored by digital archaeologists.
Maya Civilization

The Maya Civilization is both widespread and long-lasting. Descendants of the Maya live today, with a population of a several million people who still speak a dialect of Mayan as their primary language (Sharer 2006). These living Maya survive a civilization with a tremendous legacy of art, architecture, and political organization. Ruins of the Maya civilization are spread across an area of 125,000 square miles and serve as a testament to the ability of the Maya people to harness and exploit a wide range of different environmental zones (Sharer 2006). From as early as 1000 BC and as late as AD 1500, the Maya existed throughout portions of Central America and the very southernmost portion of North America. During peak levels of population in the mid-first millennium AD, people of the Maya civilization occupied much of the southeastern portion of what is now Mexico and most of upper Central America (Sharer 2006).

With a territory generally bounded by the Caribbean Sea, Gulf of Mexico, and Pacific Ocean, Maya people made extensive use of the different opportunities that varying climate and land provided. The terrain is incredibly diverse and did not present equal prospects for important activities such as agriculture throughout the Maya world (Sharer 2006). Altitude is highly varying with mountain ranges that reach heights of over 2,000 meters to expansive plains just above sea level. The climate generally reflects altitude, where lower elevations experience warm and more tropical conditions than the cooler high altitudes. The area occupied by the Maya civilization is also exceptionally notable for the broad presence of alluvial and volcanic soils perfectly suited for mass agricultural production. In areas where altitude, soil, and the presence of heavy seasonal rainfall combined for conditions conducive to agriculture, the Maya thrived (Sharer 2006).
The range of Maya civilization is generally divided into three separate geographic regions: the southern Pacific coastal plain, the volcanic and mountainous highlands, and the heavily forested lowlands to the north. The development of Maya civilization in these areas was never a constant, steady, or unified process. Rather, similar to the organization of the ancient Greek city-states, separate kingdoms throughout these three areas waged wars and made alliances to gain control over important sources of natural resources and trade routes (Sharer 2006). Unlike the city-states of the Greek world, however, the Maya kingdoms were never forced to unify as a single political entity. They operated in a constant context of conflict where the success and prosperity of one site was often best secured through the subjugation and domination of another.
Motagua Valley

The site of Quirigua ranges between 70 and 100m above sea level. This corresponds to a warm average temperature, most like the *tierra caliente* climate of the tropical lowlands (Ashmore 2007). Without a distinct dry season, precipitation at Quirigua’s main group and its periphery averages about 2000 mm annually (Schortman 1993; West and Augelli 1976). In contrast to the relatively poor soils of lowland Maya sites, Quirigua’s Main Group is situated to take advantage of the fertile floodplain of the nearby Motagua River. The presence of this rich alluvial soil, a warm climate, and moderate levels of annual rainfall marked the area as a region capable of and suitable for extensive cultivation of agriculture (Ashmore 2007).

In terms available natural resources, Quirigua’s inhabitants had access to “geological and geomorphic resources... [that more closely resembled] Copán and other southern locales” (Ashmore 2007:17). The area around the site of Quirigua was thus able to supply a wide range of different types of stones for trade and internal consumption. The abundant presence of rhyolite and schist deposits in the Site Periphery provided the inhabitants of Quirigua with groundstone implements and some building material (Ashmore 2007). As the material needs and political demands of Quirigua’s elite increased so did the need for them to import locally unavailable, like basalt and obsidian, from highland centers.
Physical Description of the Site of Quirigua

Compared to the largest Maya sites, the site of Quirigua was small both in terms of its population and the size of its buildings and overall site layout. Population estimates for the largest Maya sites in antiquity, Tikal and El Mirador, are as high as 100,000 (Sharer 2006). The site of Copán, although a majorly influential site culturally and artistically, had a peak population of only 20,000 in the Late Classic period which was spread over an area of 250 square kilometers. (Sharer 2006) In contrast, the site of Quirigua had only 1/10th the population of Copán. While the ruins ancient site of Quirigua cover roughly 4 square kilometers, the team of Penn Museum archaeologists defined “the immediate periphery of Quirigua within the area of some 95 [square kilometers]” (Sharer 1990:55).

All of Quirigua’s largest stone buildings are found in the 4 square kilometer area. This cluster of buildings, monuments, terraces, and stairways have been defined as Quirigua’s Main Group (Sharer 2006; Ashmore 2007; Looper 2007). The Main Group was greatly expanded in the century following the capture of Cauac Sky and the general arrangement of buildings and plazas was designed to roughly mirror the spatial organization present at Copán (Sharer 1990). The way in which the similarities between the layouts of the two sites is most apparent is in the subdivision of the Main Group. Copán’s acropolis was a private area with more restricted access, whereas its Great Plaza was a large area open to the public (Sharer 2006). Similarly, Quirigua’s Main Group consists of an acropolis complex with an adjacent plaza area.

Copán’s acropolis is relatively small in size and number of buildings. Eight masonry structures are laid out in a rectangular pattern which surrounds a depressed plaza floor. The acropolis buildings range in function from administrative to residential (Sharer 1990; Ashmore
The two largest structures, 1B-1 and 1B-5, were constructed during the reign of Quirigua’s last ruler (Sharer 1990). The most elaborately decorated building in antiquity was structure 1B-2, a small residence in the southwest corner of the acropolis. According to Sharer, it probably served as a residence in the mid-eighth century for Cauc Sky, Quirigua’s most powerful and influential ruler (1990).

To the north of the acropolis lies the public area of Quirigua. This public area is separated into two different plazas, the Great Plaza and the Ball Court Plaza. The Ball Court Plaza is much smaller and served fewer functional and ceremonial roles than the Great Plaza. The placement of the Ball Court Plaza mirrors that of Copán and its construction was meant to create more parallels between the layouts of the two sites (Martin and Grube 2008). The Great Plaza largely reflects the aspirations of Cauc Sky, who transformed the modest area into “the most extensive setting for royal monuments in the Maya area” (Sharer 1990:10). The monuments erected in the Grand Plaza almost exclusively commemorate Cauc Sky’s life and accomplishments, making numerous references to the defeat of 18 Rabbit in the year AD 736. Only two monuments were not commissioned by Cauc Sky and are both smaller and of lesser quality than the massive stelae created for Cauc Sky (Sharer 1990).
History of the Site of Quiriguá

The site of Quiriguá is situated in the lower Motagua river valley and has been occupied since the beginning of the Late Pre-Classic period, sometime between 400 B.C. and AD 100 (Sharer 1990). Prior to this settlement, little is known about human settlements in the Motagua valley. The rich, alluvial soils along the river valley that would make the region so valuable for agriculture in later periods also hide much of the archaeological record for the earliest human occupations (Sharer 1990; Ashmore 2007). According to Robert Sharer, an archaeologist who spent 5 seasons overseeing excavations at Quiriguá, human groups in some form or another almost certainly would have exploited this rich environment before the archaeological record can attest (1990). This proposal is lent credence by uncovered evidence of early hunters and gatherers to the north in present-day Belize who lived near this region by 9000 BC, suggesting that early human occupations exploited the valley for multiple thousands of years (Sharer 1990).

The main evidence presented for this chronology is the presence of fragmentary pottery vessels and figurines surface finds dating to the Late Pre-Classic period outside the Main Group of the site of Quiriguá (Sharer 1990). An unexcavated site with a set of mounds that are patterned in a Late Pre-Classic period layout has been identified in this same area. Although excavations have yet to take place here, the association of Late Pre-Classic material culture with a suspected Late Pre-Classic arrangement of mounds suggest the existence of a settlement in the area around Quiriguá by at least AD 100 (Sharer 1990).

The site of Quiriguá was established as an official Maya polity sometime during the Early Classic period of Maya civilization. The Early Classic period, dating from ca. AD 250-600, was a period of expansion for many Maya states (Sharer 2006). The development and growth of large
and powerful Maya states in the Petén region, geographically close to Quirigua, provided the impetus for the official settling at the site of Quirigua (Sharer 1990). The growth of major sites in the Early Classic period followed a period of the establishment of important political and trade ties between the Maya lowlands and southern areas that had begun a century earlier. Powers in the central Petén region, the so-called “heartland of Classic Maya civilization,” (Sharer 2006:20) recognized the strategic and economic importance of a site along the Motagua River. The site of Quirigua was almost perfectly situated between sources of important natural resources and the vital trade routes that transported these resources to the sites of the central lowlands in the north (Ashmore 2007).

The site of Quirigua was located near bountiful deposits of obsidian and jadeite, two of the most widely used types of rock in Maya art, rituals, and warfare (Ashmore 2007). The dramatic upsurge in the importance of state-level political organizations led to a comparable upsurge in the amount of natural resources necessary to support the growing elite populations. Securing access to both the physical location of the resources and trade routes to transport them north was a major concern for the Early Classic polities in the central Petén region (Sharer 2006; Ashmore 2007).

Clear archaeological evidence for permanent settlement at the site of Quirigua is directly tied to the expanding influence of the lowland Maya powers (Sharer 1990). The site of Tikal, located in the Petén basin, was the dominant power in the central lowlands at the beginning of the Early Classic period. Tikal benefitting from the collapse of some large Pre-Classical sites, like that El Mirador in the mid-second century AD to the north. As Tikal developed into the most active Maya site in the region it in turn stimulated the growth and development
of nearby Maya sites. The royal dynasty at the political center of Tikal was founded sometime around AD 100, during the period of El Mirador’s decline (Sharer 2006). The growth of the political center of Tikal in size and influence, as well as its growing class of elites and general population, required a secure channel to natural resources that some sites in the southeastern Maya lowlands could provide.

Both historical and archaeological evidence suggest that Tikal orchestrated a coup of the established dynasty at Copán in A.D 426 (Sharer 2006; Ashmore 2007). Textual evidence for this aggressive takeover is found on Altar Q from Copán. Commissioned in AD 776, the altar traces the dynastic history of the site and depicts each of Copán’s first 16 rulers. Altar Q recounts the installation of a warrior, who was likely born and raised in Tikal, as the new king of Copán. Although no explicit references are made to Quirigua, the stylistic similarities between the earliest known monuments at Quirigua and contemporary stelae at Tikal hint to a foundational link between the two (Sharer 1990). Because of the proximity of Copán to Quirigua, roughly 20 miles, Quirigua was established and managed as a subsidiary of Copán to control the resources and trade routes of the Motagua valley.

Further evidence from later in the Early Classic period implies a dependent relationship between Quirigua and Tikal. Tikal suffered a military defeat as a result of an alliance between Caracol and Tikal sometime in the sixth century and was unable to recover for the better part of two centuries (Sharer 2006). The beginning of this hiatus is considered to mark the end of the expansion of the Early Classic period, and its conclusion corresponds to the beginning of the Late Classic period. During this hiatus, construction of both buildings and monuments at Quirigua came to a halt. The best evidence for activity at Quirigua during the hiatus comes from
tests of ceramic vessels found in the tomb of the eighth ruler of Copán, which indicate that some had been made in the area around Quirigua (Reents-Budet et al. 2004). The eighth ruler of Copán was in power from AD 532-551, suggesting that Quirigua played some sort of tributary role to Copán into the sixth century.

The hiatus of the Middle Classic period marks the transition between the Early and Late Classic periods at Quirigua and the rest of the Maya world. The Hiatus is important for understanding the changing role of Quirigua throughout time. In the Early Classic period, Quirigua was founded as an official, established polity with a ruler and economic role to play in the context of the larger Maya economy of exchange. The Late Classic period at Quirigua, with the resumption of the substantial influence of Tikal and Copán, corresponds to the height of Maya civilization in terms of art and architecture (Sharer 2006). No large temples, associated strongly with Maya civilization, were ever constructed at Quirigua. However the frequency and size of construction projects did dramatically increase during the Late Classic Era. These construction programs, undertaken by the most powerful of Quirigua’s rulers, made drastic alterations to the Acropolis and Main Plaza (Sharer 1990; Ashmore 2007; Martin and Grube 2008). However, the impetus for these constructions was not solely due to the re-established power and influence of centers like Tikal, Copán, or other of the major Maya sites. Rather, an event that took place in the year AD 738 shook the foundation of Maya political rulership to the very core and allowed Quirigua to exercise previously unknown power and control over their site and the natural resources. While Quirigua during the Early Classic period was a diminutive and minor site, largely just a glorified outpost or satellite settlement which was subordinate to Copán, a single but severe military victory would transform Quirigua into a site that possessed
its own emblem glyph and constructed the largest monuments the Maya World ever produced (Sharer 1990).

In the archaeological record, the years leading up to this calamitous event offer tantalizing clues as to how such a turn of events could have taken place. Quirigua, with roughly 1/10 the resources and population of Copán, likely would have been unable to carry out such a high-risk mission without outside help. A brief but informative reference on Stela I, erected during the rule of Quirigua’s last king Jade Sky, mentions a visit by the ruler of Calakmul in the year AD 736 (Martin and Grube 2008). Although nothing else is known about the meeting and what took place between the rulers of the two sites, the indication of contact strongly suggests that Calakmul contributed to the defeat and capture of Copán’s ruler two years later. Sharer has suggested that support from Calakmul could have come in multiple forms; direct military assistance, for example providing manpower to bolster Quirigua’s armed forces, or more indirect aid in the form of politically backing Quirigua’s rebellion (1990). Whichever form Calakmul’s help took, the ruler of Calakmul had motivating reasons to strike a blow against Copán. Calakmul was engaged in a long-standing conflict with Tikal, one of Copán’s oldest allies (Martin and Grube 2008). The ruler of Calakmul might have seen an opportunity to gain access to the trade routes and natural resources of the fertile Motagua valley in supporting Quirigua’s coup, while the damage it would do to one of Tikal’s allies was either an added benefit or the main cause of support.

The details of the military event in AD 738 are sparse. Somehow, a military force from Quirigua was able to capture the ruler of Copán and bring him back to Quirigua. Monuments, both at Quirigua and Copán, do not tell us how many people were involved in the operation,
how it was accomplished (either by surprise or in open conflict) or exactly where it took place (Martin and Grube 2008). Numerous monuments at Quirigua contain references to an “ax event,” referring to the ritual beheading of Uxaclajuun Ub'aah K'awiil, popularly known as 18 Rabbit, Copán’s thirteenth ruler (Sharer 2006:482). The preponderance of references at Quirigua is fitting, for this single event changed the fortunes of the site more than any before it. Equally fitting is the fact that only a single reference to the defeat is found at Copán. A single, brief mention of the death of the thirteenth ruler by “flint and shield” (a reference to warfare) was recorded on Copán’s famous Hieroglyphic Stairway (Sharer 2006:482). Copán, a major power, was undoubtedly embarrassed by its stunning defeat and would not have made efforts to advertise the fact to its own citizens or outsiders. The goal of monument builders in the Maya world was not historical accuracy but rather to bolster the claims of Maya rulers to divine kingship.

Whether or not Copán wanted to advertise its defeat, the effects it felt were nonetheless severe and long-lasting. After AD 738 no new monuments were constructed at Copán for 18 years, a period of inactivity that had not been seen in the Classic period since the Middle Classic period Hiatus (Looper 2003). More importantly, the capture of 18 Rabbit had a deleterious effect on the dynastic power exercised by subsequent rulers at Copán. While Quirigua was consolidating its own newfound power, the fourteenth ruler of Copán, K'ak' Joplaj Chan K'awiil or Smoke Monkey, began to decentralize royal authority (Sharer 2006). Smoke Monkey created new arrangements of power-sharing with other subordinate lords in order to prevent another disastrous event like that of 738 from taking place again (Sharer 2006). In
doing so, Smoke Monkey allowed these subordinate rulers to exercise more independence and in turn was forced to offer them greater incentives to ensure their allegiance.

At Quirigua, expansion and construction took place at a rapid pace for the next 70 years (Sharer 1990; Looper 2003; Ashmore 2007). Cauc Sky, the Quirigua ruler responsible for the capture and subsequent decapitation of 18 Rabbit, marked this victory and Quirigua’s newfound independence by enlarging and aggrandizing the core of the site. His building program was directed towards enlarging the relatively modest Quirigua Acropolis (Sharer 1990; Ashmore 2007). All buildings except for one, Structure 1B-2, were buried in order to make way for the new improvements of larger and more elaborate structures (Sharer 1990). Cauc Sky then began a prolonged period of monument building meant to establish Quirigua as a Maya site capable of producing some of the most impressive monuments ever seen in the Maya world (Sharer 1990).

The most substantial works undertaken by Cauc Sky during his 61-year reign were meant to draw upon styles and influences found at Copán while dwarfing them, literally, in size and scale (Martin and Grube 2008). In order to accomplish this, Cauc Sky first re-aligned the site, extending the plaza with the construction of an enormous earthen platform to the north of the Acropolis (Ashmore 2007). The plaza is the largest one found throughout the Maya world while the north-south orientation of the Acropolis and plaza was meant to mirror a similar layout found at Copán (Sharer 1990; Martin and Grube 2008). Some evidence suggests that Cauc Sky erected a marketplace at the southern end of the plaza (Sharer 2006). The presence of a marketplace may indicate that the newfound power of Quirigua was somehow positively reflected in the fate of its citizens and not just its ruler or site structure. The majority of the
plaza’s vast public space was reserved for the display of monuments bearing Cauc Sky’s likenesses and proclaiming his many achievements, in particular the military victory of 738 which had made the construction of these monuments possible.

Beginning in AD 746, Cauc Sky constructed increasingly large monuments to celebrate important period-ending rituals of the Maya calendar (Sharer 1990). The year AD 738 serves as a dividing line in the construction of monuments as a sharp contrast can be observed between the quality of construction before and after this date (Martin and Grube 2008). Cauc Sky dedicated his earliest known monument in AD 734, the modestly-sized Altar M, carved in the form of an animal head. The text on the Altar refers to Cauc Sky by the title of k’uhul ajaw, or holy lord, which signaled his intentions to break away from the control of Copán some years before the event would take place (Martin and Grube 2008). The earliest of the monuments constructed after AD 738, Stela S, was dedicated during the year AD 746 and represented the first instance of a huge stela being designed and erected at the site (Martin and Grube 2008). It stood nine feet high, somewhat impressive for a site of Quirigua’s size, but would later be dwarfed by each successively larger stela produced during the rest of Cauc Sky’s reign.

The most impressive of all of Cauc Sky’s stelae was Stela E, dedicated by Cauc Sky in 771, which stood at the far end of the northern half of the plaza (Sharer 1990; Martin and Grube 2008). Stela E is most notable for its immense size. At a height of 10.6 meters, not counting the buried portion of the base which served to stabilize the massive weight of the monument, Stela E is the largest known free-standing monument in the New World (Looper 2003:147). The rest of the stelae erected by Cauc Sky are not as tall but would nonetheless have been impressive sights for the citizens of Quirigua or visitors to the site, with the height of Cauc Sky’s other
seven stelae ranging from 16-25 feet (Looper 2003). While their sheer size were meant to impress and intimidate, the style of their carvings and decorations reflect a certain respect for the distinct artistic style exercised at Copán (Martin and Grube 2008).

Both sites enjoyed access to quarries that contained exceptionally malleable stone not found anywhere else in the Maya world. At Copán, sculptors had utilized volcanic tuft quarried from the hillside from at least the sixth century onwards (Miller 2004). They had discovered that sculpting the volcanic tuft was exceptionally easy shortly after the rock had been removed from the ground, allowing them to develop an elaborate style of portraiture on the stelae, creating an artistic tradition unique to Copán (Miller 2004). Under Cauc Sky’s reign, the sculptures at Quirigua began to take on many of the aspects of the Copán tradition. In particular, Stela H (from AD 751) and Stela J (from AD 756) show Quirigua’s earliest attempts to adopt the “wrap-around” style of portraying the ruler in considerable detail and deep-relief, rather than just as a two-dimensional portrait (Miller 2004).

For all their efforts, Quirigua’s stelae were never able to match the sophistication or quality of Copán’s best stelae (Miller 2004). Because of the sheer size of the stelae, such detailed carving may have been too time-consuming. The stelae at Quirigua were not carved out of volcanic tuft but rather rhyolite, a stone that lends itself well to carving but not quite to the same degree as the material available to Copán (Martin and Grube 2008). A third explanation may be that the sculptors themselves were less talented than those at Copán and simply were not able to execute such fine craftsmanship. Two earlier monuments erected by Cauc Sky between A.D 725 and 738, Altar M and N, reflected a number of stylistic similarities to altars found at Copán (Martin and Grube 2008). The overall quality of both altars was
significantly improved over that of Altar L, dedicated by the seventh century ruler of Quirigua, K'awiil Yopaat. Both the adoption of Copán-influenced Altar styles and the dramatic improvement in masonry technique suggests that some sort of cultural exchange took place between the two sites in the decades after Altar L was constructed, before the coup of AD 738. After AD 738, the enormity of Cauc Sky’s sculptures would have required a greater number of sculptors than he had previously been able to employ at Quirigua.

While Altar S was erected to mark the end of a bak’tuun, Cauc Sky would have required some time after his rebellion to equip enough craftsmen with the tools and skills necessary for such monumental undertakings. Looper has suggested that the infusion of stylistic elements from Copán before AD 738 suggests that sculptors were sent from Quirigua to train at Copán, after which they would have passed down such knowledge to successive generations of sculptures (2003). Another possible explanation is that sculptors were somehow captured or removed from Copán in the years following 18 Rabbit’s defeat and put to work on Cauc Sky’s stelae (2003). While is no direct archaeological or textual evidence supports or refutes either of these theories, later developments in Quirigua art and monument-making suggest that sculptors were interested in exploring new techniques and designs and, by elaborating and creating new forms of monuments, demonstrated their desire to not be restricted to styles found at Copán. This points to the existence of a corps of sculptors at Quirigua that developed a style distinct to Quirigua; knowledge of the site’s history and its surrounding resources would have been essential for these sculptors and such a familiarity is better explained by the presence of native, rather than transplanted, workers.
After the rule of Cauc Sky ended in AD 785 the grandeur of monuments was dramatically reduced (Martin and Grube 2008). Possibly as a result of the dwindling of sources of rhyolite for quarrying or the inability to muster substantial work forces, the fifteenth ruler of Quirigua, Sky Xul, abandoned the mammoth stelae in favor of the creation of gigantic zoomorphs (Sharer 1990; Martin and Grube 2008). While the zoomorph had been utilized by Cauc Sky to a limited degree during his reign, erecting only one, Sky Xul devoted the energy and resources of the site to the elaboration and aggrandizement of the zoomorph form. Sky Xul erected three of these monolithic monuments and two comparably admirable altars during his brief 10-15 year reign, representing some of the most interesting and impressive examples of Maya stoneworking (Martin and Grube 2008). However impressive his zoomorphs were, Sky Xul’s turn away from the massive stelae of Cauc Sky signaled a decline in the ability of Quirigua rulers to obtain massive amounts of stone and sculptors.

The monuments erected during the reign of Quirigua’s sixteenth king further illustrate this deterioration. While the reign of Jade Sky, who succeeded Sky Xul sometime between AD 795 and AD 800, marked a return to the tradition of stelae, his two stelae stand in sharp contrast to those of Cauc Sky. Both in terms of size and artistic quality, Jade Sky’s stelae are merely imitations of those erected between AD 746 and AD 775 (Looper 2007; Martin and Grube 2008). The failure of Jade Sky to produce stelae worthy of comparison to Quirigua’s earlier tradition reflected his, and Quirigua’s, severely diminished power. While he enlarged the Acropolis and constructed two of the largest buildings therein, the function of these buildings was not to intimidate or impress the power of the site to onlookers in the same way as Cauc
Sky’s Stela E. The last inscription of Jade Sky’s reign was recorded in AD 810 and no more hieroglyphic texts were produced at the site of Quirigua from that point on (Sharer 1990).

Because it was first established to exploit the trade route along the Motagua River, the general collapse of Classic Maya civilization, and its associated economy of exchange, had an immediate and drastic effect on Quirigua’s fortunes (Sharer 1990). When trade along the river ceased, so did the site of Quirigua’s quintessential reason for existing. The site was abandoned within a few years of the katun ending ritual jointly celebrated by Jade Sky and Yax Pac, Copán’s seventeenth ruler, in AD 810 (Sharer 1990). After a period of inactivity Quirigua was re-populated sometime during the Postclassic period. Sharer has suggested that this reoccupation was controlled by members of a sea-trading elite, whose interests in Quirigua lay in the fertile Motagua valley perfect for agricultural production and not in control over the Motagua river trade route (1990). Construction that took place during this period of occupation was constrained to some additions and alterations made to the acropolis; the plaza, which had been the focal point of activity at the site during its apogee, lay untouched and unchanged (Sharer 1990). No textual or archaeological information supports the dating of the final abandonment of Quirigua (Sharer 1990). After these peoples of the Post-Classic period left Quirigua, the jungle began to reclaim the land that had been cleared. A full millennia after this terminal desertion passed before documented evidence of human activity appears once again at Quirigua. By this time, Quirigua had passed into the hands of explorers and archaeologists rather than rulers and subjects.
**Excavation History at Quirigua**

Quirigua was rediscovered at the end of the eighteenth century by a Guatemalan surveyor who purchased 13 km² of land to develop into cotton and cacao plantations (Ashmore 2007). The surveyor, Juan Payes y Font, began exploring his massive landholdings with his sons in 1798 and happened upon the ruins of Quirigua some decades later. Because Juan Payes was not an archaeologist and had no incentive to make his findings known to the general public it was not until 1841 that preliminary information about Quirigua began to find its way out of Guatemala and into the popular consciousness of Maya archaeologists (Sharer 1990).

With the publication of *Incidents of Travel in Central America, Chiapas, and Yucatan* in 1841, John L. Stephens recorded the first description and sketches of Quirigua and its monuments. Stephens, along with the English illustrator Frederick Catherwood, visited Quirigua in 1840, guided to the ruins by one of Juan Payes’ sons. The two had not planned on an extended visit, and the hurried nature of Catherwood’s sketches reflects the duration of their stay. Catherwood was particularly drawn to the massive stelae of Cauc Sky and it was his sketches of Stela E and Stela F that interested other explorers and archaeologists to return to the site in later years.

The first was Alfred Maudslay, a British diplomat turned explorer and amateur archaeologist whose work at Quirigua would mark the beginning of a long career excavating at sites throughout the Maya world. Maudslay made four separate excursions to the site: he visited for three days in 1881, five days in 1882, an extended stay of three months in 1883, and a final return to the site for six weeks in 1894 (Sharer 1990). During his brief stays in 1881 and 1882 Maudslay began to prepare the site for excavation, enlisting the help of local laborers to
clear the tropical forest from buildings and monuments (Ashmore 2007). When he returned the next year, Maudslay and his team began the first scientific excavations at Quirigua (Sharer 1990; Ashmore 2007). During his longest stay Maudslay took photographs of the ruined buildings and monuments, the first ever taken at the site (Sharer 1990). He also made paper mache molds of many of the sculptures in an effort to guard against the further deterioration of text and decorations on the stelae and zoomorphs (Sharer 1990). During the 1883 season Maudslay also conducted the first archaeological excavations at Quirigua when he and his team dug a pit into the top of Structure 1A-11 and cleared some of the rooms of debris in Structure 1B-5 (Ashmore 2007).

Many techniques that Maudslay applied were innovative for his time. He had great attention to detail, taking reliable measurements and enlisting the help of experts to create the paper mache models and to accurately record hieroglyphic inscriptions (Sharer 1990). Maudslay used a dry plate camera, a new type of camera that relied on the invention of the gelatin dry plate in 1871, to take his photographs (Ashmore 2007). In contrast to Catherwood’s sketches, the portable camera allowed Maudslay to capture the Quirigua’s buildings and monuments exactly as they stood, imperfections and deterioration included. Although he drew many incorrect conclusions from the findings of his fieldwork, Maudslay’s work nevertheless drew increased and sustained attention to Quirigua (Sharer 2008).

For 16 years after Maudslay’s final visit to Quirigua, no new excavations were carried out at the site. Further archaeological investigations resumed in 1910 under the auspices of the School of American Archaeology (today, the School of American Research) and continued annually until 1914. The first season of excavations was led by Edgar L. Hewett and largely
consisted of expanding Maudslay’s clearing of the tropical forest, focusing on large trees that had grown near some of the sculptures (Ashmore 2007). A key aspect of the 1910 excavation was the creation of a 75 acre archaeological park (Sharer 1990). The park housed the building remains that Morley and Hewett referred to as the Main Group. This division of Quirigua’s layout had future implications for how the site of Quirigua was to be conceived (Sharer 1990). Although other sets of ruins were later found to exist outside of the Main Group, the ruins situated within archaeological park are equated with the Quirigua site.

During the second season the task of clearing the forest was extended to areas that were expected to contain significant archaeological remains, the Acropolis and other parts of the plaza (Ashmore 2007). With substantial tracts of tropical forest removed from around monuments and buildings it became possible to more accurately survey the site and Hewett’s team produced a second site map. Advances in camera technology, transitioning from plate to film technology, allowed the team to take extensive numbers of photographs to create a new photographic record of the monuments. The second season of excavations was also notable as one of the members of the team was Sylvanus Morley, an archaeologist in training who had recently received a Masters of Arts degree from Harvard in 1908. At the site, Morley studied the hieroglyphic inscriptions on monuments and worked for many years afterwards to decipher them (Morley 1935). In subsequent years Morley worked at sites throughout the Maya world, using his enthusiasm for the Mesoamerican culture to secure funding for further research.

The third and fourth seasons of Hewett’s excavations were centered on conducting the first large-scale excavations in Quirigua’s Main Group. Part of the excavations built upon Maudslay’s earlier preliminary work on clearing the rooms of Structure 1B-5. Hewett oversaw
other excavations in the Acropolis, clearing the debris from Structures 1B-1 and 1B-2 and reconstructing one of 1B-1’s wall (Sharer 1990). An additional building on the eastern side of the Acropolis, Structure 1B-6, was excavated as well. During the last season in 1914, some test pits were dug in the Ball Court Plaza and Great Plaza (Sharer 1990).

From 1919 to 1934, the Carnegie Institution of Washington sponsored several projects in Quirigua’s Main Group. Morley returned to the site in 1919 to supervise the excavation of two additional buildings in the Acropolis, Structures 1B-3 and 1B-4. In 1923 Morley helped to conduct some additional excavations in Groups A and B, marking the first time that significant archaeological work was conducted outside of the Acropolis or plazas since Hewett instructed Gerarde Fawke to examine an area outside the Site Core that he believed contained traces of “humble housemonds” (Ashmore 2009:7). Besides Morley’s work, the only other excavation outside Quirigua’s Site Core was done by Oliver G. Ricketson in 1933. He uncovered a wall lined with ceramic that stood one kilometer to the northwest of the archaeological park’s entrance, well outside the area of the Main Group. Ricketson additionally sunk a series of test pits in all of Quirigua’s plazas. Most importantly, Ricketson was the first to provide a detailed record of the many excavations throughout Quirigua’s history (Ashmore 2007).

The rest of the work done by the Carnegie Institution in 1934 was almost entirely constrained to the Great Plaza and its monuments (Ashmore 2007). Earl H. Morris and Gustav Stromsik oversaw the raising and fortifying of four stelae, including the largest stelae found in Quirigua’s Great Plaza, Stela E. While none of the other monuments posed a problem, the cable supporting Stela E’s weight snapped, causing it to break into two pieces upon falling back to the ground (Ashmore 2007). The Stela was repaired with concrete, which is still visible today, and
raised successfully on the second effort. Morris and Stromsik also retrieved the foundation caches of most of the monuments in the Great Plaza that had not previously been excavated (Ashmore 2007). While digging in front of Monuments 15 and 16 they uncovered two new sculptures, the companion pair of zoomorph Altars O and P. The only work that Morris and Stromsik conducted outside of the Great Plaza was to partially excavate Structure 1B-7, the ball court adjacent to the Great Plaza and to the north of the Acropolis.

After the conclusion of the 1934 season, no further archaeological research was done at Quirigua’s ruins for almost 40 years (Sharer 1990; Ashmore 2007). Research on the data collected from earlier excavations lay dormant until 1962 when David Kelley examined some of Quirigua’s recorded inscriptions to reconstruct Quirigua’s history of dynastic succession. Kelley’s work was important for being the first effort of its kind undertaken to establish a definite Quirigua chronology, but unfortunately not for its accuracy (Looper 2003). He applied the theories of Yuri Knorosov, a Soviet epigrapher, and Tatiana Proskouriakoff to decipher recorded glyphs from Quirigua’s monuments. Unfortunately for Kelley, Quirigua’s short-lived history did not lend itself well to an easy reconstruction and his reconstructed chronology suffered as a result. His work did, however, contain a number of astute observations on relationship glyphs that would aid future researchers (Looper 2003).

Renewed interest in Quirigua’s function and little understood history in the early 1970s resulted in a collaboration between the University Museum of the University of Pennsylvania and the Guatemala Instituto de Antropologia e Historia for additional research at the site. The excavations took place annually between 1974 and 1979 to accomplish two main research goals. The first goal was to define Quirigua’s chronology and certain aspects of its layout.
Specifically, researchers were looking to be able to date Quirigua’s founding, period of fluorescence, and eventual abandonment as well as its general size and population density (Sharer 1990). These aims would directly contribute to answering the second research goal, which was to determine which types of activities were performed at Quirigua (Sharer 1990). In earlier years scholars had advanced a number of hypotheses about Quirigua’s function as a colony of Copán; as the center of a plantation system that exploited the rich soils of the Motagua valley and benefitted regional powers like Copán and Tikal, or as a trading outpost that had access to commerce that passed up and down the Motagua River (Ashmore 2007).

The Quirigua Project began on a limited basis in 1974, after which archaeological investigations were expanded and undertaken for the next five seasons (Sharer 1990). Over the course of the Quirigua Project’s excavations, eighteen separate places were excavated within Quirigua’s general periphery. Although these excavations were carefully documented, according to Sharer “most of these areas are now covered by banana groves” (1990:65). The rest of the excavations were focused on the 4 square kilometer area of Quirigua’s site core. Some of these excavations continued the work of earlier archaeologists like Morley and Hewett. The majority of the excavations were focused on the acropolis and adjacent plazas, the main constructions at Quirigua. The Quirigua Project also recorded the hieroglyphic inscriptions found on some monuments. Ultimately, by combining historical and new archaeological information, the efforts of the Quirigua Project would lead to creation of a much “fuller and more accurate reconstruction of events and activities at Quirigua during its occupation” (Sharer 1990:65).
**Virtual Archaeology and 3D modeling**

Ever since the term “virtual archaeology” was coined in 1990 by the computer scientist Paul Reilly (1991), archaeologists and academics have struggled to come to any general agreement regarding the utility of these new technology-driven practices. Initially, the virtual subcomponent of archaeology was primarily concerned with the creation of virtual reconstructions of archaeological sites throughout the world as they would have looked in antiquity. The computer specialists and digital artists working on these earliest reconstructions presented a theoretical window into the past, informed by excavation data and historical research. However, no amount of research or fact-checking could revive a long-dead civilization or site to fill in the gaps of knowledge that are the inevitable result of the destructive effects of time and erosion. Thus, these early reconstructions were the products of cold, hard data and the imaginations of the people that worked on them. The costs required to produce these early models were so high that the technology was restricted to private companies and the final products were not created by or credited to professional archaeologists (Frischer 2008).

The emergence of virtual archaeology as a tool that provided new ways to present data required archaeologists to assess the usefulness of these practices. In 2004, the information scientist Colin Ware identified ways that visualizations in general can advance our ability to comprehend and interact with data, and his list is directly applicable to virtual archaeological visualizations (2004). According to Ware, visualizations can aid our understanding in five ways:

1) Visualizations condense large amounts of data and make the data easier to read.
2) By presenting numerical information in a visual form, visualizations can reveal properties or relationships between data points that were not evident from examinations of the data itself.

3) Visualizations can expose problems with the data. Because visualizations rely on data physically collected from sites they make apparent errors or artifacts within the data, acting as an after-the-fact quality control.

4) Visualizations are equally useful for promoting the understanding of both small and large features of the data.

5) Visualizations can provide the basis for the formation of new hypotheses. (Ware 2004)

Bernard Frischer (2008) asserts that the models created in this formative period of virtual archaeology reflect examples of Ware’s first and fourth uses of visualizations (Frischer 2008). In some instances these early models helped users to understand archaeological remains in the context of a perfectly repaired state such as “how the hundreds or thousands of fragments of an archaeological monument can be fitted back together, as well as the relationship of a single fragment to the monument as a whole” (Frischer 2008:vii). Because the visualizations were produced by and for private companies, many of Ware’s other uses of visualizations were not able to be realized. The goal of these virtual archaeological visualizations was to create an attractive-looking model which could sacrifice informational accuracy to achieve the desired end product (Frischer 2008).

By the late 1990s, computing power became cheap enough to allow archaeologists to design and undertake 3D modeling projects of their own (Frischer 2008). As the production of
reconstructions began to take place in academic contexts, the volume of discussion of how these models could be used intensified. The focus of the efforts of archaeologists working in virtual archaeology shifted to the creation of a set of standard practices (Frischer 2008). This set of “best practices” (Frischer 2008:viii) not only described how to create the models themselves but also how to present the underlying data to users. Archaeologists, concerned over the visual presentation of incomplete or interpretive data, required that extensive documentation be kept from the beginning of the modeling process to the end. This scientific documentation could be transformed into metadata packaged along with the model to give users insight into how the model was created. An additional practice was the development of a set of visual cues or markers that would quickly and easily enable users to know whether an included feature of the model was attested in the archaeological record or if its existence was only inferred (Frischer 2008).

Since 2000, the use of 3D modeling in archaeological projects has steadily increased. Although 3D models have primarily been used for educational purposes, Sorin Hermon argues that they could serve a function in the chaîne opéraire of archaeology, “being perhaps after data classification and before data dissemination” (2008). Hermon contends that to this point, the major focus of 3D modeling has been attaining highest degree of artistic quality possible (Hermon 2008). When Patricia Lulof, an archaeologist at the University of Amsterdam, created a 3D model of the Satricum Temple in Rome in 2005, her reconstruction was meant to help address a theory she had developed about the role that images on these types of temples played in early Roman society (Ratto 2006). Her model was installed in a cave automatic virtual environment (or CAVE) which, in the case of the Satricum Temple, projected the model onto
the walls and floor of a small room (Ratto 2006). The 3D model was interactive, allowing users to virtually walk around a simulation of the temple as it would have looked in antiquity.

When Lulof presented her reconstruction to her peers she found considerable resistance to certain decisions she had made over the course of the 3D modeling process. In particular, her colleagues questioned the slant of the roof and her placement of the Perseus myth at the apex of the temple (Ratto 2006). The first of these complaints relates solely to the aesthetics of the model and is easily addressed. Lulof had already provided some documentation for how she made decisions throughout the process of reconstruction, highlighting which aspects are based on known information and which are inferred from little or no information (Ratto 2006). Because many other archaeologists, the group of people most qualified to assess the validity of the reconstruction, disagree with some of her decisions, the best recourse is to create multiple versions of the 3D model. Modeling, at the very least, a leading competing conception of the slant of the roof enables the user to engage with the reconstruction with an appropriate awareness that the slant of the roof is an aspect of the reconstruction that may not be legitimate. However, to present the temple entirely without a roof is equally, if not more so, disingenuous. The best compromise between the authenticity and usefulness of the model is to decide on a certain number of possible alternatives that are drawn from “a complex set of inferences and subjective (though expert) opinion” (Ratto 2006:38).

Addressing the second complaint is a more complicated issue that reflects some of the limitations of 3D modeling to address certain types of archaeological questions. The placement of the Perseus myth at the apex of the temple was a decision that Lulof made and is not
confirmed by information from the archaeological record (Ratto 2006). In contrast to the slant of the roof, however, the location of the Perseus myth was not solely an aesthetic decision but also one that directly influenced her reading of the 3D model as it related to her thesis. Her colleagues did not only question whether or not the Perseus myth was located at the apex of the temple in antiquity; they questioned her conclusions about the association between the visibility of images and their uses for political propaganda as well (Ratto 2006). In making this decision and drawing conclusions from the resulting 3D model, Lulof had advanced the role of 3D modeling that was established in the early 1990s from solely representative to interpretive. The main problems with Lulof’s interpretations of her 3D model are clear. If a number of her colleagues disagree with the certainty of locating the Perseus myth at the apex of the temple, the act of digitally recreating the temple in the manner that Lulof decided to does not simply settle the debate. Her decision does offer a glimpse into one possible reality and provides interesting insights into the role the temple played in early society, relating to Ware’s second use of visualization. However, in attempting to draw concrete conclusions from the 3D model, Lulof has imparted her interpretations with an undue sense of legitimacy. In contrast to Ware’s 5th use of visualization, Lulof has attempted to use the model to prove her hypothesis rather than to “[facilitate] hypothesis formation” (Ware 2005:4). This use of a reconstruction is an especially dangerous application of 3D modeling as it delegitimizes other ways that virtual archaeological visualizations might contribute in academic contexts. Lulof’s 3D model and subsequent interpretations were well-intentioned but also, by not anticipating the backlash from her peers, equally misguided.
In 2009, the multi-disciplinary MayaArch3D project set out to establish “new digital tools and a virtual ‘research laboratory’ for access to, and analyses of data on Maya archaeology” (Richards-Risetto et al. 2012). The project was started by two colleagues at the University of New Mexico and is focused on providing virtual access to the huge wealth of information that has been collected from the Maya site of Copán for teaching and research purposes. Initially the team was comprised of an art historian and archaeologist and has since expanded to include a wide range of specialists. According to their website, the project has combined the efforts of “art historians, archaeologists, cultural heritage managers with experts in remote sensing, photogrammetry, 3D modeling, geodatabases, and Virtual Reality” (UNM 2012:n.p.).

In contrast to Lulof’s project, MayaArch3D attempts to increase the user’s access to a wide range of data collected from the site of Copán. To accomplish this, MayaArch3D developed an entirely new digital tool which they have named QueryArch3D. Although QueryArch3D is still in beta version, it has the potential to act as a type of tool that Frischer suggested needs to be developed to progress the role of digital illustration and virtual archaeology. These tools will allow the utility of virtual environments in making contributions to academic questions in archaeology to expand, allowing virtual environments to turn into “places where we can run experiments, collect new data, and empower the enduser to question or build on our work in a way that would simply not otherwise be possible” (Frischer 2008:xiii). QueryArch3D lacks many of the aspects of functionality that Frischer proposes such as the integration of immersive sounds, a physics engine, people and animals to populate the
virtual environment, and the ability to analyze the structural engineering properties of a 3D model (2008).

However, if the stated aims of QueryArch3D are ultimately realized, the platform will serve as a tool that accomplishes some of Frischer’s goals. One of the main purposes of QueryArch3D is to increase the transparency between models and their underlying archaeological documentation. Frischer contends that improved transparency is one of the most widely applicable aspects of digital archaeology in general, building off of the ability of “digital technology generally to make links and connections” (2008:xii). The design and proposed functionality of QueryArch3D can be seen as a reflection of the professional variety of researchers running the MayaArch3D project. Because their respective fields span information and knowledge outside of archaeology, QueryArch3D is meant to facilitate a new and potentially revolutionary way of viewing and accessing this varied information.

QueryArch3D presents the wide range and depth of information through multiple forms of digital data visualization. One of the main components of the project is the creation of digital models of the architecture, monuments, and layout of the site of Copán. The digitally reconstructed model of Copán contains “models of over 3,000 ancient structures” in a 24km² virtual landscape based on GIS data (Richards-Rissetto et al. 2012:1). The larger representation of all of Copán’s buildings was created from ESRI ArcGIS data imported into Google SketchUp and represent only rough approximations of what the spatial organizations of buildings would have looked like after the ninth-century construction program of Copán’s sixteenth ruler. The general appearance of the buildings is unelaborate. Rather than attempt to recreate the ornamentations and colored decorations that were undoubtedly present on major buildings,
the color palette of the model is currently restricted to five distinct hues. Stone buildings are represented by a dark red while brown indicates structures where stone serves as a foundation for other materials. These other materials, which appear in the model mainly in the roofs of small residential structures, are designated as grey. Platform surfaces are given a uniformly white color and the ground is represented as a completely flat light-green layer. The hilly topography beyond the extents of the 24km$^2$ area is simply rendered but serves to situate the model in the context of a digital landscape that roughly approximates the real life geography surrounding Copán. Ultimately, the purpose of the model is to present the spatial distribution of buildings and monuments in an interactive virtual setting rather than attempting to recreate the site as it would have looked in antiquity to as photorealistic degree as possible.

While the SketchUp model is currently rather plain, one of the primary objectives of the MayaArch3D project moving forward is the elaboration of the SketchUp model. The current model will continue to serve as a base for the reconstruction but the addition of other content is intended to enhance the believability of the virtual Copán environment. The three specific steps to accomplish this are:

1. Replace or enhance current 3D architectural models with textured SketchUp models.
2. Replace terrain with VR environment of vegetation and hydrology.
3. Segment and add more reality-based, high resolution models. (UNM 2012)

The creation of realistic-looking models, while not yet implemented throughout the SketchUp model, is one of the main objectives of the MayaArch3D project and QueryArch3D tools. This component of the project consists of the creation of two different types of realistic models to test both the technological limitations of the QueryArch3D and their possible
applications in education and conservation. Temple 22 was chosen as a candidate for the creation of “the most complex and highly detailed 3D [model] possible” (UNM 2012:n.p.), based on data acquired from laser-scanning the exterior surfaces of the temple. A hybrid model that combines the data obtained from laser-scanning with a 3D CAD reconstruction of the structure of the temple was created “to test out various hypothetical reconstructions of Temple 22’s facades and to visualize how the building might have looked” (UNM 2012:n.p.). The team stresses that while the resulting model will reflect the synthesis of two types of data it will still be necessary to create multiple possible reconstructions to reflect different hypotheses.

Another focus of the QueryArch3D project is the creation of an urban landscape created with the Geographic Information System software. This GIS database served as the foundation for the QueryArch3D tool to contextualize the digital in an accurate digital representation of the landscape (UNM 2012). The level of detail and accuracy of the geographical features is thus much higher than that found in the SketchUp model. The topography of the GIS model “features over 24 square kilometers of Copán archaeological, modern, and natural features” (UNM 2012:n.p.) which are linked to a high resolution Digital Elevation Model (or DEM) of the 24km² site area as well as the surrounding landscape. This landscape DEM is overlaid by an Urban DEM which combines the natural and archaeological features into a single surface. Because both the SketchUp and this multi-faceted GIS models make use of the same building templates the two appear very similar. However, the applications of the GIS model are different than those already discussed for the SketchUp model. The researchers plan to demonstrate the way that the MayaArch3D GIS can “help people to interact with and understand data and to
reveal complex relationships, patterns, and trends that are not evident when using traditional, or non-spatial, databases” (Richards-Risotto et al. 2012:5).

Although the MayaArch3D project is far from complete and the QueryArch3D tool is still in development, the models created for the project thus far are promising indicators. Most importantly, the goals of the MayaArch3D project reflect just how far the field of archaeological visualization has advanced in two decades. The process of creating the 3D models employed by the MayaArch3D project makes use of technology that has only become more widely available in the past decade (such as laser-scanning) and was designed to increase their academic and educational utility rather than their aesthetics. The results of this directed focus can already be seen in the 9 publications already produced by the project’s researchers. Once the project is completed, the volume of academic discourse will certainly expand greatly as QueryArch3D is put to more rigorous and general uses for research and educational purposes.

The goal of my project is to demonstrate the educational use of a particular combination of virtual archaeology, digital illustration, and real-life photography could provide. The site of Quirigua, both for its significant role in Mayan history and the wealth of photographic documentation throughout its many periods of excavation, is an ideal candidate for such a project. I propose to turn the process of conveying attested or inferred archaeological information into an interactive and visual process, rather than one achieved through reading metadata or other documentation. The main sources of my photographic information are photographs contained in the Archives of the University of Pennsylvania Museum of Archaeology and Anthropology (Penn Museum) and my own photographs taken on a trip to Quirigua during the Summer of 2012. One of the main purposes of my trip to Quirigua
was take a series of photographs that, as best as I could manage, recreate the same viewpoints as some selected images from the thousands taken during the excavations overseen by the Penn Museum. The manipulability of the viewpoint of the 3D recreated model of Quirigua, to produce a rendering of the site from any angle, makes possible the recreation of the viewpoint of both the excavation images and my own photographs with a good degree of accuracy.

The first step of my project is to determine the best way to combine excavation and personal photographs taken during my trip to Quirigua, and the 3D model of Quirigua. The use of all three sources will help to facilitate the transmission of certain knowledge to the user more easily than through text. Visually demonstrating the appearance of the site of Quirigua during different periods of its history imparts a sense of the change in the appearance of the site over time. Many of the excavation images depict at least portions of Quirigua as it looked before restorations were performed. Thus, an examination of the continuity between images taken during excavations and afterwards will convey information directly to the user about decisions made during the reconstruction.

My proposed use of virtual archaeology is not present in the MayaArch3D or any other project involving digital models of sites. One of the main reasons for the development of the QueryArch3D tool is meant to add “transparency... to highlight reconstructions vs. reality-based models,” (UNM 2012) and the goal of my project is to address this issue with a more visual approach and using different data types. Some of the goals of my project have already been peripherally addressed. A digital reconstruction project took place from 2000 to 2004 towards the creation of a digital model of the ruins of a late antique church in Syria. The 3D model was designed to “[visualize] the preserved standing structures” and “not at building a
reconstruction based on the results of the Project” (Beaudry and Rajala 2010:76). In addition to demonstrating the usefulness of modeling ruins for heritage management, this project was created “to enhance visualization of the relationship between the church and its settlement context” (Beaudry and Rajala 2010:76). The goals of my project can thus be seen as presenting a hybrid process to address the issues of data transparency and contextualizing the relationship between ruins and the landscape around them.

The creation of a 3D CAD model of Quirigua has been a main project of Christopher Jones, an archaeologist from the Penn Museum who served as a main member and overseer of the Penn Museum’s excavations at Quirigua in the late 1970s. The model, currently, is not geo-referenced like the Copán model for the MayaArch3D project. The recreated buildings exist in their own coordinate system which is not linked to the real-life counterparts. The integration of GIS data into the model would make the process of reconstructing certain viewpoints easier. However, the model enables the viewer to manipulate the point of view (POV) to a sufficient degree to allow for the recreation of desired viewpoints.

The data behind the 3D model was collected by the Penn Museum’s research project. The layout of buildings and other archaeological features was based off of floor plans created during the project and thus represent the most accurate basis for reconstruction that is available. The main aspect currently missing from the model is the presence of monuments. While the 3D model of the site represents the site’s layout over many different periods of occupation, the only articulated archaeological features are buildings, steps, and platforms. The monuments, for which Quirigua is so famous, are not present. This allows the changes in the
arrangement of the site to be more easily observed but is an issue that, if addressed in the future, would benefit comparisons made of the site across time.

The direct comparison of images from the same viewpoint at the site of Quirigua at different points in its history facilitates new archaeological and contemporary understandings of the site’s relationship to the surrounding landscape. A comparison of the appearance of the site early on during its period of excavations in the late 1970s and the 3D reconstruction of the site is especially informative. In an archaeological context, this comparison allows for the user to better understand the process of physically reconstructing the site of Quirigua. Many people find it difficult to envision the site as it looked in antiquity. Additionally, however, a comparable difficulty exists in conceiving how ruined sites are reconstructed from jumbled piles of stones to resemble the best interpretation of their former appearance.

Many virtual archaeological projects, some of which have been discussed in this paper, attempt to address this difficulty through extensive metadata or the creation of additional 3D models. I believe that the easier, more honest, and inclusive approach is the design of a new tool that enables the user to engage with the concept of change over time at an archaeological site in a purely visual manner. In helping to create a more concrete link between the digital model and its real-world counterpart, this tool permits the user to decide the degree of legitimacy that the reconstruction possesses. By expanding the critical gaze of the user, this tool might encourage discussion and debate over certain aspects of the reconstruction. The tool’s primary use, however, is to play an educational role in heritage management. To see a rough approximation of how the site looked in antiquity, the process by which it was restored, and its
present state of repair reveals both the economic and archaeological benefits of physical and digital reconstructions.
Archaeological Illustration

The use of illustration in archaeology has a long, varied, and at times problematic history. Joanne Pillsbury argues that images of archaeological illustrations are equally or more influential than the archaeological texts they accompany, even though they have not been discussed or examined to anywhere near the same degree (2012). To explain their significance, which has been changing and evolving for over half a millennia, is to understand the motivating reasons behind the different traditions of archaeological illustrations. By the 19th century, illustrations informed, shaped by, and in large part derived from the practice of the illustration of archaeological illustration in Europe that stretched as far back as the fifteenth century (Pillsbury 2012).

The earliest archaeological illustrations were imbued with the particular perspective of the people that created them and reflect many of the prevailing beliefs of their time. Many decades removed from the existence of archaeology as an established science, the creation of archaeological illustrations were initially motivated by personal interest. In Europe, they were inspired by what the artists saw around them every day: dilapidated Roman ruins that only hinted at their former grandeur (Pillsbury 2012). Drawing these ruins was a way for some to try to come to terms with the role that these ancient buildings and monuments had to play in the modern age.

As a result, the illustrations were never meant to be wholly accurate. Even when they were produced as a form of documentation, to capture monuments or buildings before they were destroyed or suffered further damage, the end goal was not to precisely record what the eyes of their maker could see and reproduce it with 100% fidelity (Sellen 2012). Rather, the
illustrations were and have always been prejudiced sources of information (Pillsbury 2012). Pillsbury notes that treating them “transparent conveyers of visual information” (2012:15) is inaccurate. Bryan Just also points out the limitations of illustrations as similar likenesses, by definition imperfect and reductive (2012:243). Centuries later, these same limitations remain. Training and standardization of practice can limit some of these problems, yet ultimately the ability of the human eye and human hand to commit images to paper by pen or pencil is imprecise.

As most would agree, the illustrator typically does not set out with the goal to deceive the viewer. Inconsistencies between the real-life scene and the reproduced illustration are often the result of visual, rather than informational, preference. When Pirro Ligorio produced his famous map of Ancient Rome in 1561, his focus was on presenting the site in its entire possible splendor (Pillsbury 2012). Buildings that were constructed centuries apart are portrayed in similar pristine states, projecting a view of the ruins as unchanging entities rather than as functionary parts of a living site that would certainly suffer from the wear and tear of ages and neglect. In addition, Ligorio included many buildings that had, at the time, no archaeological evidence to substantiate their existence (Pillsbury 2012). By relying solely on textual evidence, Ligorio had left the realm of the real and the concrete. His map of Rome thus became much more imaginative and idealistic than it was strictly accurate or demonstrable.

If every viewer were made completely aware of the pitfalls of archaeological illustration, perhaps their influence could be mitigated. As the history of hundreds of years shows us, however, illustrations have shaped the thinking of archaeologists and viewers alike on a fundamental and formative level towards the understanding of archaeological subjects.
Archaeological reconstructions, which Stephen D. Houston refers to as “the ultimate representations,” (2012:391) are particularly biased sources of information which do not always acknowledge their own reliability. Houston charges that reconstructions “are created with the explicit aim of enhancing the tourist potential of sites,” (2012:391) and not in presenting the most reliably accurate depiction of the unobservable past. This disingenuous guiding force behind the creation of reconstructions impacts the understandings and expectations of the public while also influencing what an archaeologist expects to uncover at an excavation (Houston 2012).

In the specific subset of Maya archaeology, archaeological illustrations of sites and monuments have often reflected accepted contemporary notions of the presentation of ruins and the audience for which the illustrations were created. In the times of Frederick Catherwood and Tatiana Proskouriakoff, two influential and respected early illustrators of Maya civilization, informational accuracy was often sacrificed in order to evoke certain feelings from the reader, in turn imparting a created and possibly fallacious understanding of the Maya civilization and its people. Both Catherwood and Proskouriakoff absorbed these influences and transmitted them through the rest of their life’s work. Catherwood and Proskouriakoff’s artistic talents were undeniable. In applying these talents to the field of archaeology they provided invaluable services while also creating and encouraging incorrect or unsubstantiated interpretations in those who took their art as fact.

Catherwood’s drawings of Maya sites, produced in the 1830s and 40s, were directly influenced by their intended audience. As Khristaan Villela observes, none of the early illustrative works on Mesoamerican sites in the early 19th century were “sponsored by a
national government or institution, and... none resulted from what we would recognize today as a scholarly project” (2012:144). Thus, none of the produced works would have conformed to a set of particularly rigid scientific or scholarly guidelines in their creation. Instead the works were produced to be consumed as public entertainment, and the public was not interested in reality (Villela 2012). A simple example is one the most famous images produced by Catherwood during his work at the site of Copán.

In the Broken Idol at Copán, Catherwood’s original sketch included the broken monument as found among the surrounding, encroaching jungle environment. In his final painted version, Catherwood sacrificed accuracy to embellish the drama of the scene (Villela 2012). Catherwood added a number of elements that were not present in his original sketch and thus can be inferred to not have been observed personally by Catherwood when he sketched the monument and its surroundings (Pillsbury 2012). These elements included a reflecting pool of water in which the monument lies half submerged, a deer in mid-stride in the foreground, and a bolt of lightning striking ominously in the background. Catherwood’s illustrative techniques involved the use of a camera lucida to project the image of an object onto his paper. In using this technique Catherwood assured that his reproduction of the monument was accurate and faithful; with the embellishment of superficial elements, his reproduction of the surrounding environs is not.

By presenting the ruins in this way, drawn by a professional architect who actually traveled to the site and sat in front of this particular broken idol, Catherwood imparted a sense of realism and authenticity to his reproductions that cannot be ignored by the viewer. None of this discussion is undertaken to discount the impact that Catherwood’s paintings had on the
public’s growing interest in Mesoamerica and the remnants of its civilizations. The publication of *Views of Ancient Monuments in Central America, Chiapas and Yucatan* (1884), a collection of Catherwood’s watercolor works, was well-received and stimulated further exploration of ruins in Mesoamerica. However, the contributions of Catherwood’s work to Maya archaeology must also be considered in the context of the influences his drawings had on future researchers and artists. In this sense, Catherwood and other early artists working in Mayan contexts incorporated earlier historical archaeological illustration traditions. Most significantly, Catherwood’s paintings reflected a decidedly Romantic-style influence where facts and data are often obscured or ignored in favor of elements that produce a more emotive viewing experience.

The drawings that Tatiana Proskouriakoff created nearly a century later suffer from some similar problems of representation. Unlike Catherwood, Proskouriakoff drew mainly reconstructions of Maya buildings. In her drawings, Proskouriakoff made many assumptions about the appearances of these buildings that were not always backed up by archaeological evidence. Stephen D. Houston identifies this main drawback of archaeological illustration as the “representation of unreliability” (Houston 2012:417). Although the term was coined in relation to representational problems in digital archaeological illustration, Houston maintains that the problem has persisted since archaeologists have provided their own architectural vision of the past, in an explicit reference to Proskouriakoff’s drawings (Houston 2012). The representation of unreliability refers to the fact that archaeological remains are rarely, if ever, fully intact. Inferences about structurally important elements, such as wall height, must sometimes be made when sufficient archaeological or textual evidence does not exist to corroborate any
decision. Another noted issue with Proskouriakoff’s illustrations is the “misleading emphasis on straight lines and spotless buildings in fine states of repair” (Houston 2012:404). For all their intentions of symmetry and exactitude, Maya builders were not always able to execute building construction perfectly. Earthen platforms and building walls often deviate from perfectly straight orientations in response to topography or other environmental factors. Thus, Proskouriakoff’s reconstructions impart a sense of perfection and precision that did not exist in antiquity.

A final critique of Proskouriakoff’s work is her representation of the daily life and activity that took place in major ceremonial centers, the main focus of her work. Her drawings contain few human figures to the point of suggesting a low level of occupation and activity. The few figures that do appear in her work are often added as solitary figures, acting simply as scales to reflect the enormity of surrounding buildings (Houston 2012). Houston has suggested a number of explanations for the lack of human figures. A possible explanation offered by Houston is that Proskouriakoff, an accomplished architectural illustrator, did not feel comfortable in her ability to draw people (2012). Proskouriakoff also may have wanted to avoid over-interpretation of the function of a site or the activities that took place there, especially as the beliefs of the time stipulated that Maya settlements supported only small populations (Houston 2012). Houston’s final explanation is that the institutions that commissioned Proskouriakoff to create her illustrations were interested in architecture and architecture alone and would not have been interested in any other details (2012). Whatever her reasons, Proskouriakoff’s illustrations had strong implications for how audiences would interpret the functions of these settlements. By limiting the number of people, Proskouriakoff limited the scope of activities that once took
place. A small population could not support the vibrant rituals and ceremonies now known to have taken place at semi-regular intervals in the major Maya settlements. If taken for representations of the truth, one would not be able to reach this same conclusion through a study of Proskouriakoff’s drawings.
Digital Project Process

To demonstrate the feasibility of my project, I recreated a viewpoint in the 3D model of Quirigua which correspond to a set of photographs taken from the same location, comprised of excavation images and my own images. Because of the incomplete nature of the 3D model, the background does not contain a recreated jungle landscape. An appropriate digital tool for the display of these images would overlay them and allow the user to adjust which layers are more or less transparent via three separate slider controls. The best recreation of this effect on page is simply to print the set of three images in a side by side by side organization, as seen in Figures 1-3 at the end of the paper.
Results and Interpretations

Although the 3D model theoretically offers the ability to recreate any viewpoint, I found navigation in certain software difficult and unwieldy. Since the 3D model was created in AutoCAD 2012, that program allows for the easiest manipulation of and navigation through the model. In another program used to adjust the 3D model, 3DS Max, navigation did not permit fine tune adjustments of the viewpoint.

The recreated viewpoint in Figure 1 demonstrates a rough approximation of the goal of my project. The 3D model, although it only consists of simple 3D wireframe buildings, facilitates a visualization of the degree of accessibility of Quirigua’s Great Plaza. As can be seen in both photographs, jungle vegetation now obscures site lines between certain buildings and monument that were observable in antiquity.

One unfortunate drawback to the 3D model is the lack of human figures. Just as some of Proskouriakoff’s drawings were negatively impacted by the absence of human representations, the lack of human figures in the recreated 3D model makes it more difficult to establish a general scale of reference. The presence of some workers in the excavation photograph provides a scale that can be roughly applied to the 3D model, although a more exact ruler for measurements would help to emphasize the size of the Plaza and its monuments.
**Conclusion**

To more concretely demonstrate the usefulness of such a digital tool to virtual archaeologists, the 3D model of the site of Quirigua must be elaborated. The technological limitations of the project do not allow for the integration of laser-scanning data to increase the accuracy of reconstructions as in the MayaArch3D project. However, the appearance of the model would be greatly enhanced by the following future changes:

1. The addition of textures to the buildings and monuments to reflect their polychrome decoration.
2. The addition of additional monuments from Quirigua, including stelae, zoomorphs, and altars.
3. The addition of a jungle landscape in the background to provide visual context.
4. The addition of models of human figures to provide visual points of reference.

While the incomplete nature of the 3D model limits the strength of the conclusions that can be drawn, I believe that Figure 1 best demonstrates the value of integrating real-life photographs of a site with its virtual reconstruction. A more complete 3D model might allow for the applications of this type of visual comparison to extend beyond educational contexts and into theory formation.
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Figure 1: Comparison of images from three different periods of Quirigua’s history - Excavation (© Quirigua Project), Modern day (July 5 2012), Antiquity (AD Eighth-century)
Figure 2: Comparison of images from three different periods of Quirigua’s history - Excavation (© Quirigua Project), Modern day (July 5 2012), Antiquity (AD Eighth-century)
Figure 3: Comparison of images from three different periods of Quirigua’s history - Excavation (© Quirigua Project), Modern day (July 5 2012), Antiquity (AD Eighth-century)