NEH Application Cover Sheet
Collaborative Research

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APPLICATION INFORMATION

Title: *Chocolate, Cylinder Jars, and Ritual in Chaco Canyon, New Mexico*

Grant Period: From 5/2013 to 5/2016
Field of Project: Archaeology
Description of Project: Recently discovered chocolate residues in cylinder jars raise questions about ritual activity in Pueblo Bonito, Chaco Canyon. Project activities include reexcavation of Room 28 in Pueblo Bonito to obtain dates and residues from the room that held a cache of over 60% of all known cylinder jars, and reanalysis of museum collections removed from that room in 1896. The project addresses the Bridging Cultures initiative by exploring ritual and cultural interaction in the past.

BUDGET

Outright Request	$108,828.00	**Cost Sharing**	$117,999.00
Matching Request	$15,000.00	**Total Budget**	$241,827.00
Total NEH	$123,828.00		

GRANT ADMINISTRATOR

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1. **Statement of significance and impact**

In 2009, the PI discovered residues of chocolate drinks in tall cylindrical ceramic vessels from Pueblo Bonito, the largest ruin in Chaco Canyon, New Mexico. The first evidence for chocolate north of the Mexico border, this discovery made worldwide news, but much remains unknown about how Chaco residents used chocolate and why they imported it from over 2000 km away. The proposed project places that discovery in context by further elucidating the nature of the drink preparation and rituals involving the cylinder jars in consuming chocolate. A second ritual entailed the caching and burning of 60% of all known cylinder jars in a single event at around A.D. 1140 apparently ending the use of cylinder jars in ritual activity. The proposed research will include excavations and analysis of materials recovered from one small room in Pueblo Bonito, Chaco Culture National Historical Park (CCNHP), a UNESCO World Heritage Site. Public interest in Chaco, ritual, and chocolate combine to make this study of importance to the general public, students, and scholars.

The first excavation in a Pueblo Bonito room since the 1920s, this project engages students and scholars in a careful examination of the contents of Room 28. The excavation will demonstrate how, why and when the room was abandoned, situating the ritual drinking of chocolate and the abandonment of the cylinder jars in the broader life history of Pueblo Bonito. Analysis of all of the artifacts previously excavated from Room 28 in the 1890s will enlarge our understanding of the suite of material used in chocolate preparation and consumption. The research will improve our appreciation for the social and cultural conditions surrounding the acquisition of chocolate from wealthier cultures in Mesoamerica.

This project also responds to the **Bridging Cultures** initiative by enlarging Americans' understanding of other times, cultures, and beliefs within American borders, focusing particularly on rituals that demonstrate the great historical depth of exchange of goods and ideas with Mesoamerican peoples. The project will have significant impact on the public interpretation of Pueblo Bonito, the most visited site in Chaco Canyon.

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3. List of Participants

Project Director

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Collaborators

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Parametrix, Inc.

Jeffrey Hurst
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Tim Ward
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Wetherbee Dorshow
PhD (expected 2012), Collaborator/Contractor – Geospatial Modeling
Earth Analytic, Inc.

Karen R. Adams
PhD, Collaborator/Contractor – Archaeobotanist
Independent Contractor

Susie Smith
PhD, Collaborator/Contractor – Palynologist
Independent Contractor

Narrative

Substance and Context

The focus of this proposal is a humanistic study of how Ancestral Pueblo populations in Chaco Canyon, New Mexico, performed two specific rituals that engaged long distance exchange for chocolate, special equipment and knowledge, and scores of participants. The first ritual involved consumption of chocolate drinks in tall narrow cylinder jars (Figure 1 in Appendix). The second included the caching and burning of most of the known cylinder jars. Both rituals are believed to date between A.D. 1000 and 1140. The proposed research will include excavations and analysis of materials recovered from one room in Pueblo Bonito, Chaco Culture National Historical Park (CCNHP), a UNESCO World Heritage Site designated as an outstanding example of world cultural patrimony (Figure 2 in Appendix). Visitation over the last decade averages 56,000 visitors per year, despite the isolation and less than optimal road conditions. Public interest in Chaco, religion, and chocolate combine to make this study of importance to the general public, students, and scholars. The PI's discovery of chocolate residues in cylinder jars from Pueblo Bonito (Crown and Hurst 2009) became international news and was featured in newspapers, magazines, websites, radio shows, and television broadcasts because it represents the first evidence for chocolate consumption in the prehispanic US. The proposed project places that discovery in context by further elucidating the nature of the rituals surrounding the use of cylinder jars in consuming chocolate as well as the ultimate termination of that ritual. The combined branches of the University of New Mexico are a Hispanic-serving Institution, an Institution with High Hispanic Enrollment (36% Hispanic students), and a Native American Serving non-tribal institution (11.6% Native American students) (http://www.unm.edu/~oir/factbook/2010fb.pdf). This project responds to the **Bridging Cultures** initiative by enlarging Americans' understanding of other times, cultures, and beliefs within American borders, focusing particularly on ritual that demonstrates the historical depth of exchange of goods and ideas with Mesoamerican peoples.

Ritual is a universal human behavior through which people express religious beliefs and bind one another in systems of shared performance and meaning. Ritual characterizes the lives of people

throughout the past and present. Gaining a fuller understanding of ritual activity in Chaco is particularly important because current interpretations of the archaeology of the Canyon emphasize the primacy of ritual activity in explaining the cultural florescence there. Many Chacoan scholars consider the canyon to have been a major religious center (Fritz 1978; Judge 1989; Lekson 2006; Sofaer 1997; Stein and Lekson 1992; Toll 1991), designating it a "rituality" (Yoffee 2001) with a "sacred economy" and evidence of "high devotional expression" (Renfrew 2001). The National Park Service promotes this vision in their visitor brochure, "From AD 850 to 1250, Chaco was a hub of ceremony, trade, and administration for the prehistoric Four Corners area--unlike anything before or since." Despite an almost universal acceptance of this view of Chaco, little scholarship has delineated the nature of the beliefs and rituals associated with any religion there. In other words, scholars recognize the importance of sites such as Pueblo Bonito in the ritual life of the Ancestral Puebloans who inhabited Chaco Canyon, but have largely been unable to identify the nature of actual rituals that occurred there.

Recent advances in methods and theory provide frameworks for evaluating ritual activities in the past. In particular, careful analysis of stratigraphic sequences and deposits often reveals processes such as dedication and termination rituals (Freidel and Schele 1989; Harrison Buck et al 2007; McAnany and Hodder 2009; Mills 2008; papers in Mock 1998; Pagliaro et al 2003; Stanton et al 2008; Walker et al 2000; Walker 2002). Advances in dating methods offer the opportunity to evaluate the timing of novel ritual behavior. Residue analysis demonstrates the presence of specific substances used in ritual activity. Combining multiple lines of evidence permits determination of when and how two types of ritual activity occurred in Chaco: consumption of chocolate drinks in cylindrical jars and termination ceremonies associated with the last use of these vessels.

To examine ritual in Chacoan society, the plan of work is to: 1) reexcavate Room 28 in Pueblo Bonito (originally excavated in 1896) where over 60% of all known cylinder jars were cached; 2) examine the stratigraphy that overlay the cylinder jar cache to determine the sequence of events surrounding the burning and collapse of the room; 3) extract datable material from the remaining archaeological material in the room; 4) extract pollen and macrobotanical material to search for ritual use

of plants; 5) determine if the original excavators found the floor of the room and excavate to that floor if they did not; 6) analyze all artifacts extracted from the 1896 and new excavations; 7) analyze organic residues from a sample of artifacts found in the room; and 8) interpret the nature of two rituals associated with Room 28 at Pueblo Bonito.

The Bonito phase (ca. 850-1140) in Chaco Canyon, N.M., is one of the most prominent and debated examples of rapid social transformation in the archaeology of North America (Altschul 1978; Bernardini 1999; Bustard 1996, 2003; Crown and Judge 1990; Kohler 1998; Lekson 1999, 2006; Mills 2002; Neitzel 1999, 2003; Vivian 1990; Wills 2001). Within a short period of time, perhaps only one to two generations, a regional population of dispersed farming households gave rise to aggregated settlements socially anchored by a dense cluster of massive stone buildings in Chaco Canyon called "great houses." Labor estimates for the construction of individual great houses exceed several hundred person-hours (Lekson 1984) and bear testimony to the unprecedented amount of energy and organization that marks a shift from small undifferentiated social networks to large segmentary corporate groups (Kantner 1996; Saitta 1997; Sebastian 1992). Archaeologists have studied this striking change for more than 100 years and since the 1940s have known with considerable confidence the span in calendar years during which great houses appeared, were occupied, and abandoned. Researchers have devoted great effort to understanding the role or function of great houses in their final or completed form (e.g. Cameron and Toll 2001; Heitman and Plog 2005; Plog and Heitman 2010; Renfrew 2001), but have been hampered by a limited number of excavations at great houses, primarily conducted before current standards of fieldwork were established, and sometimes inadequate publication of results.

Archaeologists consider Pueblo Bonito to be the center of the Chaco world (Neitzel 2003). The largest and most completely excavated of the Great Houses in Chaco Canyon also produced the largest assemblage of whole artifacts. Two major expeditions excavated most of the site in the 1890s and 1920s, providing extensive collections housed at the Smithsonian Institution and the American Museum of Natural History. These excavations revealed a concentration of objects never duplicated in excavations of other Great Houses (Heitman and Plog 2005:90). The collections form the basis of much of what is

known about the Chacoan material world. The site is then not only the center of the Chaco world, but also the center of the Chaco archaeologists' world. Discussions of subjects such as a possible Mesoamerican connection and ritual activity rely on this material, because the preponderance of clearly Mesoamerican objects and identifiable ritual objects in the Chaco world come from Pueblo Bonito.

Pueblo Bonito was excavated by two major expeditions. For the Hyde Expedition in the late 1890s, rancher Richard Wetherill worked with Harvard graduate student George Pepper to excavate approximately one-half of the rooms in Pueblo Bonito (Pepper 1905, 1909, 1920). They packed and shipped the artifacts from their work to eastern museums, and most are curated at the American Museum of Natural History in New York City, with a smaller collection at the National Museum of the American Indian in Washington, D.C. A second expedition funded by National Geographic in the 1920s excavated most of the remaining rooms in the site under the supervision of Neil Judd (1954, 1964). Those artifacts are curated at the National Museum of Natural History in Washington, D.C. Smaller projects have included opening two rooms by the Phillips Andover Academy in the 1890s (Moorehead 1906), stabilization and tree-ring sampling by the National Park Service (Windes and Ford 1992), and reopening of trenches placed through the trash mounds south of Pueblo Bonito by the University of New Mexico in 2004-2008 (Wills 2010; Crown 2010).

Room 28 in Pueblo Bonito offers an exceptional opportunity to examine two distinct and identifiable rituals: ritual consumption of imported chocolate and termination ritual. Room 28 is distinguished primarily by the recovery here of the largest cache of cylinder jars from any site in the American Southwest; indeed, over half of all known Chacoan cylinder jars came from room (Figure 3; Crown 2008). Cylinder jars are now known to have been used in consuming drinks made from chocolate brought over 2000 km from the tropics of Mesoamerica (Figure 4; Crown and Hurst 2009; Washburn, Washburn and Shipkova 2011). The Room 28 cache contained 111 cylinder vessels together with pitchers and bowls found in a discrete and apparently orderly pile. Other artifacts in the room include grinding stones and sandstone jar lids, together with a variety of apparently utilitarian objects (chipped stone knives, bone awls, bone "implements", a wooden stick, yucca cord, and a wooden "piece") and non-

utilitarian pigments and ornaments (shell beads, shell bracelets, a crystal, mica, ore, turquoise, and a copper object) (Pepper 1920:112-128). Further analysis of these objects offers the opportunity to examine the nature of the ritual surrounding cacao consumption in Chaco Canyon. Cacao was brought from Mesoamerica as beans or semi-processed tablets of chocolate, and additional processing of either form would be required to make chocolate drinks. Processing would include grinding the nibs or tablets to make a paste, then stirring water and other additives into the paste to make a drink followed by some means of creating a froth on the drink (probably by pouring from jar to jar). Because they were found together with the cylinder jars in the room, the groundstone and wooden implements found in Room 28 were likely used in preparing such drinks. Examination of these implements for evidence of cacao residues will help to determine the range of objects associated with cacao use in Chaco Canyon. While the drinking of chocolate in cylinder jars is roughly dated to around A.D. 1000-1140 based on the range of ceramic designs on the pots, refining the dating of the placement of the cache of cylinder jars will provide a stronger date for cacao use and exchange. PI Crown's ongoing analysis of the cylinder jars provides important additional evidence for the nature of cacao ritual use at Pueblo Bonito. The broader question in this case is what the material associated with this largest collection of cylinder jars tells us about ritual consumption of chocolate.

The second ritual of interest here involved the caching of the cylinder jars and other vessels in the room followed by burning of the room. It is possible that the cache represents only items stored in the room with accidental burning (Toll 1990; Crown and Wills 2003; although see Akins 2001). However, recent work suggests that the large cache of vessels is instead the remains of a ***termination ritual*** (Mills 2008). Common in Mesoamerica, termination rituals are rituals that brought permanent closure to rituals, objects, constructions, or features. Many cultures believe that some objects or buildings must be given life to empower them; termination rituals undid the activities and rituals that empowered those objects or buildings. They reversed the processes that originally animated or brought to life those same objects, rooms, and sites, through destruction and "decharging" (Stanton, Brown and Pagliaro 2008). They might involve the ritual retirement of objects considered too powerful to be discarded in the manner of normal

objects (Mills 2004, 2008) and/or deconsecration of ritual spaces (Creel and Anyon 2003; Walker et al 2000; Mills 2008). Termination rituals occur in ethnographic contexts under several different circumstances: when the last practitioner capable of performing a ritual dies, when a site is abandoned, in association with cyclical ritual destruction of objects or structures (as when a ritual cycle is complete) prior to rebuilding, and when enemies occupy/sack a site and wish to cleanse it. In all cases, the goal is to remove sacred power from objects and structures. The caching of objects found piled in Room 28 shares many features with termination ritual, but only the material part. The non-material parts of the ritual, including placement of the objects, burning the structure, and depositing additional material above them, can only be determined through careful analysis of the surrounding stratigraphy. Through such careful analysis, the project research can determine whether this was indeed a termination ritual, the type of termination ritual it was, and dates for when it occurred.

In order to answer these questions, it is necessary to reopen Room 28. First excavated in 1896 by George Pepper and Richard Wetherill, field notes, photographs, journals, and publications provide all of the information we have about this important room beyond the artifacts and a single tree-ring date. Unfortunately, these leave many issues unanswered. Photographs of the room, combined with George Pepper's (1920) published description of his excavations indicate a complex series of formation processes. We know the following events occurred in some order: room constructed and used, room partitioned, clean sand deposited in room, artifacts placed in room, door to adjoining burial room closed, room burned, room flooded, room filled with trash, upper partition wall built.

According to George Pepper (1920), supervisor of the 1896 excavation, the Room 28 fill was unremarkable. The fill included fallen walls and "accumulated debris." Pepper describes evidence of the room having burned: blackened walls, reddened plaster/adobe, red vitrified sand, and posts turned to charcoal. He noted that the western portion of the room had filled with sand that had both blown in and washed in BEFORE the ceiling fell, helping to preserve the ceramics in the room. He also notes though (1920:117) that the cylinder jars had been forced from their "well-laid pile" and sometimes crushed "by the weight of the debris that the burning of the ceiling beams precipitated upon them."

There are several reasons to question his interpretation of the events. First, photographs reveal a highly uneven surface with vessels sitting at various different depths on the undulating surface (Figure 3). Second, careful reading of the expedition artifact catalog at the American Museum of Natural History reveals that he found masses of broken cylinder jars both 3 feet (91 cm) above the "floor" and "a few feet below the surface". Because the "floor" on which the cache was found was only 1.22 m below the surface, the actual mass of pottery apparently extended from about 30 cm below the surface to 1.22 m below the surface; in other words, the cache may have been part of a much larger mass of pottery, the upper levels of which were crushed, sandwiched in a 1 m layer. Third, photographs reveal burned wooden beams in, around, and UNDER the mass of pottery in the cache. Fourth, examination of the cylinder jars in the cache show that most were exposed to fire, but that the fire damage is often on the underside of the pots rather than the surface facing up—note that it is possible to tell which surface faced up both from the photographs and from silt lines still visible on the unwashed pots themselves. Where charred wood is visible in the photographs, the pots in physical contact with the wood are burned on the vessel walls that contact the wood. All of this patterning suggests that the pots were originally resting on a wooden structure that burned while the pots were in contact with it. This raises the question of what the wooden structure was—was it a bin, shelving, or an upper story floor. In other words, were the pots actually placed in lower Room 28 or on the floor of upper Room 28? The answer to this question is critical for understanding the cultural and natural processes that created the cache and associated stratigraphy.

At this point, the only additional information we have comes from the photographs and from the descriptions of the adjoining Rooms 55 on the west and 28a on the east (Figure 5). Beginning with Room 55, the cache of cylinder jars partly underlies a mass of material that forms the foundation for a later masonry wall that partitioned an upper story of Room 28 into Room 28 and Room 55 to the west. Pepper had to partially undercut this mass of material to retrieve some of the cylinder jars. Thus lower Room 28 and lower Room 55 were once a single room space, making Pepper's description of what he found in lower Room 55 relevant here. In lower Room 55, Pepper (1920: 214-16) notes that the western wall was

debris, but that the remains of a floor was found 4' below the western (upper cross) wall—this was not an intact lower room floor, but an upper story floor that had collapsed into the room. Pepper found east/west beams, cedar bark covering and pieces of adobe that represented this fallen upper floor. Only sterile sand to a depth of 4' lay below these floor beams. The presence of this floor is interesting, because its depth seems to fit well with the level at which the cache of vessels were found in Room 28, again suggesting the possibility that the cylinder jars were originally resting on an upper story floor that collapsed during a fire.

Moving to Room 28a to the east of Room 28, Pepper found that this room was separated from Room 28 by a masonry partition wall that was 1.22 m high on the Room 28 side, but noted as 2.59 m high on the Room 28a side. In describing Room 28a, Pepper (1920:126) states that this dividing wall, "extended to the ceiling of the lower room which was 8 ½ feet [2.59 m] from the floor at this end. The base on which the wall rested was composed of large stones. The room was floored at this depth (8 ½ feet) and had been filled in, and another floor put down at the bottom of the dividing wall or at a depth of 6 feet [1.83 m] from the ceiling." If there were floors in Room 28a at 1.83 and 2.59 m below the former ceiling, it is possible that Pepper never reached the actual floors in Room 28. His published description of the room and his diary entries in the Chaco Research Archive indicate that on August 28, 1896, Pepper and Wetherill completed removed the cache of pottery from Room 28; on August 29, they packed up the pottery for shipment, measured the floor, and broke through a sealed door to adjacent burial Room 32. They then used Room 28 only as a location to temporarily throw backdirt while excavating Rooms 32 and 33. There is no indication that they ever excavated below the level of the cache in Room 28. Since the cache was only 1.22 m below the ceiling, there is a strong possibility that actual floors are still present in Room 28 .61 to 1.37 m below the level at which Pepper stopped working in this room.

From his description, it is clear that, although the room burned and many perishable objects may have been lost, preservation was fairly good, with charred posts standing almost a meter high and wooden objects buried in sand left uncharred. Pepper does not state whether he removed the charred posts or not, leaving open the possibility that they remain in the room and could be dated by tree-ring dating.

The later excavator of other portions of Pueblo Bonito, Neil Judd (1954:22-28), raised questions about Pepper's interpretation of Room 28 and provided a thorough reinterpretation of the series of events that led to the archaeological strata found by Pepper. PI Crown's interpretation of the notes, photographs, and artifacts is quite different from Pepper's and Judd's. All three interpretations are outlined in Table 1.

Determining the actual dating and sequence of events is critical for the following reasons: The large cache of cylinder vessels found in Room 28 was associated with the importation and consumption of cacao from Mesoamerica —it is the largest collection of these vessels from any site in the US. Dating the room, examining the other artifacts in the room, and searching for residues on those artifacts provides the best opportunity for enlarging our understanding of rituals involving chocolate consumption in Chaco Canyon. The charred material in contact with the jars offers the possibility to obtain information on room construction prior to the fire and a *terminus post quem* or date after which the cache must have been placed; radiocarbon dating of material overlying the main cache of jars might provide a *terminus ante quem* or date before which the cache must have been placed. Having both sets of dates will help bracket the cache. Finally, bracketing the placement of the cache also provides a date for the likely termination ritual involving the placement of the cache and burning of the room. Teasing apart the actual sequence requires examining the stratigraphy and presence of features, such as floors, in addition to obtaining datable material. Expectations for the three models are presented in Table 2.

	Pepper 1920	Judd 1954	Crown
Event 1	Room 28 constructed late 800s to early 900s	Room 28 constructed late 800s to early 900s	Room 28 constructed late 800s to early 900s
Event 2	Room 28 remodeled	Room 28 remodeled and construction debris pushed into room	Room 28 remodeled
Event 3	Partition wall built between 28 and 28a	Clean sand placed over debris and new floor laid at door sill level	Partition wall built between Rooms 28 and 28a
Event 4	Clean sand fills western half	Partition wall built between 28 and 28a	Drift sand blows into lower story room
Event 5	Cylinder jars and other objects placed in room	Cylinder jars and other objects placed in lower Room 28 A.D. 1025-1050	Doorway to adjacent Room 32 sealed
Event 6	Door to Room 32 sealed	Sand blows into room	Cylinder jars and other

		covering artifacts	objects placed in upper story room and room burned as termination ritual
Event 7	Room burned	Room burns	Room open to elements with evidence of wet silt deposited on vessels
Event 8	Room flooded	Door to Room 32 sealed	Additional debris dumped into room and upper story built creating Rooms 28b and 55 around A.D. 1083
Event 9	Room filled with trash	Upper story burned walls and roofing dumped into lower room thru an opening	
Event 10	Upper partition wall built between Rooms 28 and 55	Upper story walls rebuilt on south	
Event 11		Upper partition wall built between Rooms 28 and 55 A.D. 1071-1083	
Event 12		Corridor left in debris in lower Room 28 to access adjacent Room 51a to the north	

Table 1. Three interpretations of events in Room 28 of Pueblo Bonito from construction to abandonment

EXPECTATIONS	Pepper	Judd	Crown
Floor beneath cylinder jars	Clearly defined floor at level of cylinder jars	A clearly plastered floor at the level of the door sills	No evidence for a floor at the level of the cylinder jars
Stratigraphy	Clearly defined floor in the stratigraphy of the dirt between Rooms 28 and 55 at the level of the cylinder jars	A layer of blown sand below the level of the cylinder jars	Evidence that the debris from the falling, burned roofs was below the level of the cylinder jars as well as above
Posts	No charring of posts below level of cylinder jars	Burned material ABOVE the level of the cylinder jars, but not at or below that level	Burned material mixed in with the layers at which Pepper found the cache and charring of posts below the level of the cache

Lower floor	No evidence for a lower floor up to 1.5 m below the final excavation level	Lower floors likely exist	Evidence for lower floors at .3 and 1.3 m below the final excavation level

Table 2. Expectations of Pepper, Judd, and Crown models for burning and caching events in Room 28

In addition to determining the sequence of events that created the stratigraphy and artifact placement in Room 28, the proposed research will examine the nature of probable ritual activity associated with these events, including whether these were use/abandonment processes or part of a termination ritual. Some researchers have suggested that the vessels were simply stored in Room 28 between uses. The room might have burned with the vessels left inside, or the room might have been abandoned before it burned. In either event, the association of the cache, burning, and **abandonment** is coincidental in this case rather than purposeful. In contrast, other researchers have suggested that the cache represents a termination ritual (Mills 2008:108). It might either represent a **desecratory** termination ritual created when victors of a conflict or later occupants of Pueblo Bonito wanted to remove sacred power from the objects or site by piling the vessels up and setting the room ablaze. Alternatively, existing occupants of Pueblo Bonito might have held a **reverential** termination ritual if the last practitioner capable of performing the ritual associated with the cylinder jars died, as the population of Pueblo Bonito dwindled (Mills 2008:110), if abandonment of the site was planned, or in association with the cyclical ritual destruction of objects or structures prior to rebuilding. Determining which of these three scenarios is correct requires careful examination of stratigraphy, dating, residues on vessels, and marks on room walls. Table 3 presents the specific expectations for each scenario, based in part on models derived from reverential and desecretory termination ritual activity in Mesoamerica.

	Abandonment or accidental fire	Desecratory termination	Reverential termination

Burning	Accidental and later than placement of cylinder jars	Contemporary with placement of cylinder jars	Contemporary with placement of cylinder jars
Evidence for other ritual objects	Lack of other ritual offerings	Lack of clear scattering of ritual offerings (shell-turquoise) amidst cache	Scattered offerings (shell/turquoise) amidst the cache
Objects in cache	Collection of objects go together and are normal for the room context	Objects in unusual context and do not necessarily belong together as a coherent assemblage	Most objects belong together as an assemblage used in a single ritual
Treatment of objects	Objects complete as left	Objects broken and scattered, defaced	Objects complete and not broken prior to deposition or broken in place, not defaced
Surfaces and walls	Untouched	Surfaces and walls scarred, cut open, defaced	Surfaces and walls left untouched
Artifact origins	Normal range of items, mostly local	High percentage of exotic items	High percentage of exotic items
Deposition of clean material	No sterile sand or woodash deposited prior to burning	Sterile sand or woodash deposited prior to burning	Sterile sand or woodash deposited prior to burning

Table 3. Interpretive framework for evidence for abandonment, desecratory termination, and reverential termination ritual.

Scholar Barbara Mills (2008) has argued that the Room 28 cache represents a reverential termination at the end of Pueblo Bonito occupation in the late 1100s. However, there are no absolute dates that support use of the room past the early 1100s. Only through additional excavation, careful examination of stratigraphy, and additional dates can we hope to resolve this ongoing debate concerning the dating of the room and cache. Recovery of pollen and macrobotanical materials will aid in evaluating the presence of perishable items or plants used in a termination ritual. It is particularly critical that all artifacts removed by the Wetherill/Pepper team be counted, analyzed, and examined for evidence of use and/or defacement at the time of their placement in Room 28.

In terms of **value to scholars and students**, the present study promises to enlarge our understanding of the social and cultural conditions surrounding the acquisition and consumption of chocolate in Chaco by investigating the ritual activities associated with the use and discard of cylinder

jars in one of the only locations where that will ever be possible, Room 28 in Pueblo Bonito. It will define the nature of ritual activity in the largest great house in Chaco Canyon, adding important insight into the social history of the site. It will provide training for graduate and undergraduate students in the context of multi-disciplinary research. The **value for general audiences in the humanities** includes enriching the public understanding of the historical depth of luxury food consumption, ritual activity, and Mesoamerican interaction among cultures located within the current US. It will strengthen public understanding of how exchange in luxury foods, such as chocolate and sugar, creates cultural entanglement and sometimes conflict. Through outreach and interpretive programs, this project will reach a large audience of tourists eager to know more about everyday life in Chaco Canyon.

History and Duration of the Project

PI Crown began research on the Chacoan cylinder jars in 1999 when she noticed that some had been renewed through reslipping/painting/firing over time and others had had their designs removed through abrasion scrubbing (Crown and Wills 2003). With internal funding from the University of New Mexico, she visited the collections at the American Museum of Natural History and Smithsonian National Museum of Natural History in 2002 and 2003. She then became co-director of the Chaco Stratigraphy Project (project website: http://www.unm.edu/~chaco/about.html), an NSF funded project (Wirt H. Wills, PI; BCS 408720) that reexcavated trenches placed through the trash mounds at Pueblo Bonito, which had been originally excavated in the 1920s. She helped supervise five seasons of field work from 2005-2007. She received NSF funding (2007-2010; BCS 0710733) to analyze the artifacts from those excavations, including additional analysis of the cylinder jars from the Pueblo Bonito rooms, conducted in 2007 and 2008. She supervised nine undergraduate and graduate students, and one high school student, analyzing approximately 250,000 artifacts from the trash mounds from 2007-2009 and she is currently editing the volume resulting from this project. The project revealed a number of fragments of cylinder jars in the trash mounds, indicating that these special vessels were sometimes discarded as normal household trash. Her research on the cylinder jars had led her to notice many parallels with Maya cylinder vessels (known to have been used to drink chocolate), and so she sent five sherds from the Pueblo Bonito trash mounds

for organic residue analysis, a project that revealed residues of theobromine and caffeine in ratios that indicate the consumption of chocolate in three of the five vessels tested (Crown and Hurst 2009). PI Crown and Jeffrey Hurst then received NSF funding (2009-2011; BCS 1012438) to expand the study of cacao exchange in the American Southwest, a project that will be completed by Summer 2012, with several publications planned.

All but two known Chacoan cylinder jars have now been photographed and recorded. The two remaining jars are at the Field Museum of Natural History in an exhibit case and are not available for study at the present time. In addition to the 2003 and 2009 publications, Crown presented a paper at the Society for American Archaeology on the cylinder jars in 2008 and delivered 30 public presentations on the cylinder jars and chocolate research to public audiences in Arizona, California, Colorado, New Mexico, Pennsylvania, and Texas. The research was featured in Science, Science News, the New York Times, the LA Times, National Geographic, Archaeology Magazine, and websites, magazines, and newspapers throughout the world. Chaco Culture National Historical Park has a Visitor Bulletin devoted to Crown's research on cacao use in Chaco (Figure 6).

Full understanding of the jars and their ritual use requires detailed examination of the other artifacts used in chocolate preparation and consumption, as well as the precise actions surrounding their disposal. Crown submitted a proposal to the CCNHP in May 2010 to reexcavate Room 28 in Pueblo Bonito, where 60% of all cylinder jars were found. After a round of revisions, the proposal was sent to the Tribal Consultation Committee, with 25 member tribes, for comments and to three senior Southwestern archaeologists for peer review. Crown received comments from representatives from Acoma Pueblo, the Hopi Tribe, Isleta del Sur Pueblo, and the Pueblo of Zuni. She also received comments from archaeologists Eric Blinman, Barbara Mills, and Steve Plog. At the request of the park, she revised the proposal based on these comments and resubmitted it for final approval by the CCNHP and the New Mexico SHPO's office. The work was approved by the CCNHP in October 2011 (see Appendix) and it is currently (November 2011) at the New Mexico SHPO's office. Documents in support

of this project are included in the appendices. The scope of work includes requirements from the CCNHP (for instance, funding to catalog artifacts for curation is a requirement of permitting).

Publications:

Crown, Patricia L. and W. H. Wills
2003 Modifying pottery and kivas at Chaco: Pentimento, Restoration or Renewal? ***American Antiquity*** 68:511-532.

Crown, Patricia L.
2008 Chacoan Cylinder jars. Paper presented at the Society for American Archaeology Meetings, Vancouver, March.

2010 Acquisition, Use and Discard of Red and Brown Wares at Pueblo Bonito, Chaco Canyon. Paper presented at the Society for American Archaeology Meetings, St Louis, March.

Crown, Patricia L. and W. Jeffrey Hurst
2009 Evidence of cacao use in the Prehispanic American Southwest. ***Proceedings of the National Academy of Sciences*** 106:2110-2113.

Project Staff

Project Director: PI Patricia Crown will act as Project Director. Her responsibilities will include supervising all aspects of the project, including excavation, artifact analysis, residue analysis and dating. She will directly supervise all fieldwork and oversee the specialized analyses. She will conduct the analysis of whole ceramic vessels from Room 28 in the collections at the American Museum of Natural History and the National Museum of the American Indian. She has 36 years of experience in southwestern archaeology and an extensive record of research and publication. She has worked with Chaco ceramics for the last 12 years and conducted field work in Chaco since 2005. She has collaborated on projects with scholars from Los Alamos National Laboratories, the Smithsonian Institution, the University of Arizona, Washington State University, the National Park Service, and the Hershey Corporation. She will devote 100% of her research time during the Summers 2013 and 2014 to this project and 20% of her research time during the Academic years 2013-2015.

Project Participant: Hannah Mattson, currently a graduate student at the University of New Mexico, will conduct the analysis of groundstone and other objects from Room 28 during collections research at the American Museum of Natural History and the National Museum of the American Indian. She has worked

with collections at both museum before and has already completed the analysis of the ornaments from Room 28 in these collections. Ms. Mattson plans to complete her dissertation on ornaments from Pueblo Bonito and Aztec Ruins by the Spring 2013, and so she will have her doctorate before the project begins.

Project Participant: Wetherbee Dorshow, currently a graduate student at the University of New Mexico, is President of Earth Analytic, Inc., a geospatial modeling company. Mr. Dorshow will conduct the LiDAR mapping of Room 28 and create the 3-D model of the room for the website. Mr. Dorshow has conducted LiDAR in Chaco Canyon of the trash mounds at Pueblo Bonito and of the entire ruin at Pueblo Bonito. He received NSF funding to have Airborne Laser Swath Mapping conducted of Chaco Canyon. His dissertation involves geospatial modeling of agricultural productive potential during the 10th and 11th centuries A.D. at Chaco Canyon, NM. He will complete his doctorate in 2012 before the project begins.

Project Participant: Dr. Jeffrey Hurst, Senior Research Chemist with the Hershey Corporation, will oversee the residue analysis of ceramics and ground stone objects. Dr. Hurst has conducted residue analyses of ceramics from the American Southwest and Maya area for twenty years. He will contribute approximately 40 hours of research time to the project.

Project Participant: Dr. Timothy Ward, Associate Dean of Sciences and Director of the Keck laboratory at Millsaps College, Mississippi, will oversee the High Performance Liquid Chromatography- Mass Spectrometry analysis of ceramics and ground stone conducted by undergraduate research assistants in his laboratory. He has been a principal contributor to the Crown-Hurst NSF-funded Cacao Exchange study.

Project Participant. Dr. Karen Adams, Archaeobotanist, will prepare and analyze all samples taken for charred plant remains. Dr. Adams analyzed the archaeobotanical material from the Pueblo Bonito trash mounds and has an extensive record of research and publication in this field.

Project Participant. Dr. Susie Smith, Palynologist, will prepare and analyze all pollen samples. Dr. Smith analyzed the pollen from the Pueblo Bonito trash mounds. She has worked on issues surrounding southwestern pollen for several decades and has an extensive record of research and publication.

Project Participant: A Graduate Research Assistant will be hired for one academic year to oversee the analysis of artifacts in the laboratory and assembling of all project records for delivery to the National

Park Service. This will be a .5 fte position for an advanced graduate student at the University of New Mexico. In addition, 5 undergraduate and graduate students will be hired to conduct the excavations at Pueblo Bonito. These individuals have not been identified yet because the project begins in 19 months. Every effort will be made to hire individuals from underrepresented groups within the discipline, particularly Hispanic and Native American students. Finally, 3 undergraduate students will be hired to complete the analysis of artifacts for twenty hours per week during the academic year 2013/2014, as well as catalog the artifacts for delivery to NPS.

Methods

Exploring ritual behavior at Pueblo Bonito requires multiple lines of evidence and a variety of different techniques. These are discussed in roughly the order they will be performed.

Excavation :

- Room 28 is 8.89 square meters in size and is estimated to be 3-4 meters deep. Backdirt from the original 1896 Hyde expedition excavations will be removed with shovels by a crew of five students under the supervision of PI Crown. All dirt will be screened using ¼" mesh. We do not know how the Hyde Expedition backfilled the room, whether with rocks or dirt, and it is unclear where any dirt in the room might have come from originally. However, at the request of the CCNHP, we will collect all artifacts. Photographs of the room in 1896 will be used to determine when we are approaching the original depth of the cylinder jar cache. At 20 cm above this level, we will switch to use of 1/8" mesh for the remainder of all excavations. The final 20 cm will be collected and bagged separately, and horizontal control will be provided by separating the roomspace into four quadrants.
- When the surface to which the Hyde expedition excavated is reached, excavation will stop and that surface will be documented in detail. The surface will be gridded in 1 m squares and geological and pollen samples will be taken from the each square. Photographs and drawings will be made of the surface and any remaining artifacts/features associated with it.
- Using the already-established quadrants, excavations will then proceed below the Hyde surface. Beginning in the NE quadrant, the excavation will proceed slowly following natural stratigraphy or in ten centimeter arbitrary levels if there is no visible stratigraphy, with complete documentation of any features encountered.
- Based on what is known of adjacent rooms 28a, 55 and 57, it is anticipated that any floor surface encountered will be distinguished by a change in texture and hardness. Floors may have been plastered or flagstone lined (as in adjacent Room 28a). By starting in the NE quadrant of the room, the relationship of the stratigraphy to the open doorway into Room 51a and to the partition wall between 28 and 28a should be clear. When a floor surface is encountered, excavations will move to the opposing quadrant (SW) to clear to the same level, in order to have stratigraphic

profiles across both room dimensions before removing the remaining two quadrants. After complete documentation of the floor, excavations will resume in the NE quadrant, following the same procedures. Once the lowest floor that can demonstrably be associated with the masonry walls is encountered, the extent of subfloor testing will be determined in the field in consultation with NPS personnel.

- Once the entire room is cleared, a total station will be used to map the room. A very high resolution terrestrial laser scanner (LiDAR) will be used to document all walls and features. This must be done for complete documentation of the room and at the request of the NPS for conservation purposes. CCNHP Archaeologists have stated that Room 28 will never be reopened again, so complete documentation will permit future generations to view the room walls and surfaces using the LiDAR images. PI Crown conducted a due diligence search of the Geospatial One-Stop Portal and there are no existing images of Room 28 available. Standard NPS wall documentation practices will be followed. Excavation forms, maps and photography will follow standard methods. Any charcoal encountered on the floor, in the debris underlying the partition wall (for Rooms 28b/55), or in architectural posts will be sampled for tree-ring dating and radiocarbon dating. Samples will be removed from the floor and debris underlying the partition wall for geological, pollen and macrobotanical analysis. The western stratigraphic profile will be documented in detail using standard procedures, including recording texture, color, inclusions, and organic content. OSHA regulations will be followed to shore walls as necessary for safety.
- If human remains are encountered, the CCNHP's policy on inadvertent discoveries will be followed. No human remains were recovered by the Hyde Expedition in this room, so we are not anticipating finding any.
- All of the artifacts, samples, and stratigraphic data required to address the research questions as outlined in Tables 1-3 above will be collected during the field work.

Outreach:

- The PI will coordinate all outreach efforts with the Interpretive Rangers at CCNHP. Room 28 is located directly next to the path taken by visitors through Pueblo Bonito, so it is critical that some kind of ongoing outreach to Park visitors occur during the excavations. One crew member will be stationed at the ground surface to explain the project to the public throughout each day. The project will work closely with the interpretive rangers, so they are aware of the scope of the project and any ongoing results. Because Chaco is often described as having so many "mysteries" surrounding the occupation there, Park visitors often ask why there are no ongoing excavations. We know from our experiences excavating the Pueblo Bonito trash mounds that there will be an enormous interest in this project, particularly given the tie-in to the discovery of chocolate. PI Crown will give public talks at CCHNP in the evening lecture series each week of the project.
- The project includes outreach with Acoma Pueblo, which is being coordinated with Theresa Pasqual, Director of the Acoma Historic Preservation Office. Unfortunately, Ms. Pasqual was (b) (6) unable to formulate further plans for outreach. She has expressed interest in coordinating the outreach activities.
- PI Crown commits to multiple public presentations of this research. PI Crown will also incorporate the results of this research into her teaching.

Analysis:

- In consultation with Park Staff, all artifacts encountered in situ or in screening will be collected. Artifacts will be taken to UNM for processing, analysis, cataloging, and curation. Processing will be minimal to avoid disturbing any intact residues. Analysis will follow the same procedures established by the PI for the Chaco Stratigraphy Project. Cataloging will follow NPS procedures established for Chaco collections. Curation will be at the Hibben Center by CCNHP. Analysis

and cataloging will occur during the Academic year 2013/2014. Three undergraduate students will be employed to conduct the analysis under the supervision of the PI and RA.

- Samples will be sent to various specialists for analysis, including pollen and geological analysis during Year 2 of the project. A sample of artifacts will be sent for residue analysis, particularly cacao. Chronometric samples will be sent for radiocarbon dating and tree-ring dating. All laboratories and specialists contacted to undertake these specialized analyses are recognized experts in the field with years of experience with Chaco Canyon materials.
- During the Summer of 2014, PI Crown and Hannah Mattson will travel to the American Museum of Natural History and the National Museum of the American Indian to analyze all materials excavated from Room 28 in 1896. They have already analyzed all cylinder jars and ornaments, but must examine the remaining ceramics and groundstone. They will measure, document, and photograph each artifact, compiling a complete ACCESS database of all materials. They will select a sample for residue analysis, write a proposal for destructive testing to the museums, and, if approved, sample the artifacts for organic residues. It is estimated that the analysis will take three weeks.

Interpretation

- Using the interpretive frameworks outlined in Tables 1-3, PI Crown will collate all of the excavation and analysis results into a series of articles for publication. She will use the Academic year 2014/2015 to complete writing up this project. She will provide detail on the nature of the Room 28 deposits to determine how and when the cache of cylinder vessels was deposited there. She will interpret the kind of deposit this was and whether ritual activity was associated with its deposition. She will use the artifact analysis and residue analysis to further describe the nature of the cacao ritual performed using the cylinder jars at Pueblo Bonito.

Section 106 Review Process

As a historic property of the National Park Service, the CCNHP was listed on the National Register of Historic Places on October 15, 1966. The current project has obtained a Research and Collecting Permit from the CCNHP, an ARPA Permit. The proposed project has been through tribal consultation, peer review, and in-house review. Documents relating to permitting are in the Appendix. Dabney Ford, NPS Archaeologist for the CCNHP, will conduct the Section 106 review process for this project. She has begun the process already (November 2011), so the process should be concluded before the proposal review process is completed in 2012.

Final Product and Dissemination

As a project permitted by the NPS, all electronic files and data generated by this project must be turned over to the CCNHP. Electronic databases are available to the public and interested scholars through the NPS. The LiDAR imagery will be available through the NPS and also on a project website through the University of New Mexico. All artifacts and samples will be curated by the National Park Service in the Chaco Center on the campus of the University of New Mexico in Albuquerque. These are available for study by qualified scholars and to view by appointment by the public.

For scholarly audiences, The PI will publish articles in professional journals, such as *American Antiquity, Journal of Archaeological Science,* and *American Anthropologist*, all of which have on-line availability. She will make publications available to interested parties as pdfs through the project website. The project results will thus be available as widely as possible. The website will be hosted through UNM. The PI envisages 3-5 publications from this project. Results from the project will also be available through the NPS website.

For general and student audiences, the PI will offer public lectures on the project results as widely as possible. Lectures will be planned for CCNHP and in Albuquerque at UNM. The website will offer the public and interested students access to project results as well.

Work Plan

May-July 2013: Field Work. In the summer of 2013, we will conduct field investigations of Room 28. The CCNHP and SHPO have given permission for this work. This will require an estimated 6 weeks of field work with a crew of five experienced students. All personnel will be housed in Chaco Canyon. We will return to Albuquerque on weekends to pick up food and supplies and drop off artifacts. The crew will conduct initial sorting and inventory of artifacts in the field. When the room is completely open, LiDAR mapping will be conducted to record all walls, surfaces, and features. This room will not be opened again, so completion of this recording will provide future scholars with complete information on the room and provide the NPS with a condition assessment as of this date. Outreach activities will include daily tours for tourists and activities with Acoma residents. Personnel: PI Crown, five experience students.

August 2013-May 2014: Laboratory Analysis. During the Academic year, we will conduct analyses of artifacts and samples collected during the excavations. A Graduate Research Assistant will be responsible for overseeing this analysis, conducted by UNM undergraduate students hired and trained for this project. The PI will supervise all hiring, analyses, and training. Based on past experience, it is anticipated that three students can complete the analysis during this academic year. Outreach with Acoma residents will continue during this time period. Personnel: PI Crown, Research Assistant, three undergraduate students.

June-August 2014: Museum analysis. PI Crown and Research Collaborator Hannah Mattson will travel to the American Museum of Natural History and the Smithsonian National Museum of the American Indian to view the Hyde Expedition collections from Room 28. They will use standard analytic techniques and photography to record the dimensions, features, and any use traces (usewear or residues) on the objects removed from Room 28 in 1896. It is anticipated that this will require 2 weeks at the AMNH and 1 week at the NMAI. Personnel: PI Crown and Hannah Mattson.

September 2014 to May 2015: Specialized analyses. During this academic year, all samples and artifacts will be sent for specialized analyses. Datable materials will be sent to the Laboratory of Tree-ring Research or the University of Arizona AMS Dating Facility for radiocarbon dates. Pollen samples will be sent to the palynologist. Macrobotanical remains will be sent to the archaeobotanist for analysis. A sample of ceramics and groundstone will be sent for residue analysis. Personnel: PI Crown, Jeffrey Hurst, Tim Ward, Karen Adams, Susie Smith.

June 2015-May 2016. Write-up. During the final PI Crown will complete publications with the project collaborators based on the project during this time. PI Crown should have a sabbatical year during this time and sufficient time to complete a series of publications on the project results. No funding is requested during this year. Personnel: PI Crown, Hurst, Ward, Adams, Smith, Mattson.

Summary and Significance

Current interpretations of Chaco Canyon place ritual activity at the center of explanations for the cultural florescence in the 11th century, yet little is known of such ritual activity. The proposed research promises to enlarge our understanding of past ritual and beliefs within this part of America. The ritual that involved drinking chocolate drinks demonstrates the historical depth of exchange of goods and ideas with Mesoamerican peoples. It provides strong confirmation that luxury foods, such as chocolate, were an important part of the economic fabric of cultures within American borders long before Europeans set foot on American soil. The people of Chaco needed cacao for their rituals and relied on wealthier southern populations to provide the ingredients for success in their ritual activities.

Understanding the termination of cacao ritual at Pueblo Bonito will add important insight into the social history of the great houses in Chaco. On the one hand, termination signals the end of ritual chocolate consumption for some portion of the population and given the high-cost and likely status signaling accompanying this resource, cessation must have been a charged event, perhaps an actual crisis for the community. On the other hand, accurately dating the termination ritual and closure of ht room will make it possible to situate the vent in Pueblo Bonito's life history, allowing a more comprehensive

perspective connecting termination to episodes of building construction and destruction, possible cycles of ritual renewal, subsistence change, and perhaps even periods of abandonment.

Gaining greater understanding of the nature of actual ritual activities in Chaco will enhance NPS interpretative talks to the thousands of visitors who come to Pueblo Bonito each year. They have already incorporated discussion of chocolate drinks into their tours of the site, so that adding more information on the rituals associated with chocolate will enhance the visitor experience of this UNESCO World Heritage Site. Most importantly, it will create a greater appreciation for the variety of cultures that are encompassed American society together with the long-standing exchange of ideas and materials with cultures to the south.

NATIONAL ENDOWMENT FOR THE HUMANITIES

Applicant Institution: University of New Mexico
Project Director: Patricia L. Crown
Project Grant Period: 05/15/2013-05/14/2016

	Computational Details/Notes	(notes)	Year 1	(notes)	Year 2	(notes)	Year 3	Project Total
			05/15/2013-05/14/2014		05/15/2014 - 05/14/2015		05/15/2015 - 05/14/2016	
1. Salaries & Wages								
Project Director Patricia L Crown	Academic year salary:$(b) (6) (yr 1), $ (yr 2), $ (yr 3)	(b) (6)	$16,803	(b) (6)	$17,307	(b) (6)	$17,826	**$51,936**
Graduate Research Assistant	Academic year salary	.5 fte	$14,538					**$14,538**
Undergraduate Student Assistants	Academic year $10/hour, 20 hours/week	32 weeks	$19,200					**$19,200**
2. Fringe Benefits								
Project Director Patricia L. Crown	% of funded portion of salary	**29.20%**	$4,906	**31.80%**	$5,504	**32.90%**	$5,865	**$16,275**
Graduate Research Assistant	fringe 1% plus health insurance	1% plus $1587	$1,732					**$1,732**
Undergraduate student assistants	fringe 1%	1%	$192					**$192**
3. Consultant Fees								
Student Costs/Stipends	$500/week X 5 field workers	6 weeks	$15,000					**$15,000**

Research Assistant Hannah Mattson	(b) (6) (b) (6) hours X hour for research				$4,050			**$4,050**
4. Travel								
Field Vehicles	Enterprise Rental corporate rate 6/01/13-07/13/13 ($2506 each) plus gas 376 miles/week X .51/mile X 2 trucks	2 pickup trucks 6 weeks plus gas	$7,262					**$7,262**
Project Director Patricia L. Crown	per diem	Summer 40 days X $85	$3,400	14 day trip for research at American Museum of Natural History	$4,929			**$8,329**
Project Director Patricia L. Crown	per diem			7 day trip to National Museum of the American Indian	$2,234			**$2,234**
Research Assistant Hannah Mattson	per diem			14 day trip for research at American Museum of Natural History	$1,429			**$1,429**
Research Assistant Hannah Mattson	per diem			7 day trip to National Museum of the American Indian	$1,009			**$1,009**
5. Supplies & Materials								

Plywood sheet 8' X 4' X 3/4"	each sheet is $32	6 sheets	$192					**$192**
Tarp	each tarp is $169	2 tarps	$338					**$338**
plastic bags	assorted sizes from USPlastics	4000	$117					**$117**
miscellaneous supplies (paper, pencils, graph paper)			$100					**$100**
6. Services								
LiDAR mapping of Room	Earth Analytic, Inc.		$4,000					**$4,000**
Residue Analysis	Millsaps College Keck Lab, $65/sample			15 samples	$975			**$975**
Pollen Analysis	Susie Smith $260/sample			15 samples	$3,900			**$3,900**
Macrobotanical Analysis	Karen Adams $280/sample			15 samples	$4,200			**$4,200**
Radiocarbon dates	University of Arizona AMS facility, $550/sample			10 dates	$5,500			**$5,500**
Tree ring dates	University of Arizona laboratory of Tree Ring Research, $30/sample			10 dates	$300			**$300**
7. Other Costs								
Tuition for RA	required by UNM, 12 credit hours $3637		$3,637					**$3,637**
8. Total Direct Costs	**Per Year**		**$91,417**		**$51,337**		**$23,691**	**$166,445**

9. Total Indirect Costs	**Per Year**	mtdc= $72780	$37,118		$26,182		$12,082	**$75,382**
Indirect Cost Calculation:a. Rate: 51% of direct cost per year.b. Federal Agency: Health and Human Servicesc. Date of Agreement: 07/13/2009								
10. Total Project Costs (Direct and Indirect costs for entire project)			$128,535		$77,519		$35,773	**$241,827**
11 Project Funding								
a. Requested from NEH	Outright:							**$108,828**
	Matching Funds:							**$15,000**
	Total Requested from NEH:							**$123,828**
b. Cost Sharing	Applicant's Contributions:							**$102,999**
	Third Party Contributions:							**$15,000**
	Project Income:							**$0**
	Other Federal Agencies:							**$0**
	Total Cost Share:							**$117,999**
12. Total Project Funding								**$241,827**

Budget Justification

1. Salaries and Wages
   - PI Crown will oversee all aspects of field and laboratory work. She will devote (b) (6) of her research time during the academic years of the project to this research. The salaries listed are her current salary for year 1, with a 3% raise for each subsequent year.
   - Graduate Research Assistant salary is based on .50 fte with the current rate ($13715) plus a 3% increase.
   - Student Assistants will conduct laboratory analyses during the Academic year 2013/2014. Undergraduate students will be hired at $10/hour, 20 hours/week.
2. Fringe Benefits
   - PI Crown's fringe benefits are listed at UNM rates for the Academic years as a percent of her funded salary.
   - Graduate Research assistant rates include 1% fringe benefit plus health insurance. These are required by UNM and the rates are set by UNM.
   - Undergraduate Student Assistant rates include 1% fringe benefit. This rate is set by UNM.
3. Consultant Fee
   - Students will receive a stipend of $500/week for six weeks in the field. This set amount is excluded from F&A Rate Calculation.
   - Research Assistant Hannah Mattson will receive a set $(b) (6)/hour (her current salary) for 150 hours of work conducting analyses at museums and helping write up the results.
4. Travel
   - Project will rent two pick-up trucks from Enterprise Rent a car using the UNM Corporate Rate. Rate quoted by phone on 11/26/2011 ($2503/truck). Gas is estimated based on one roundtrip from Albuquerque to Chaco per week at 276 miles, 50 miles per week within the Canyon, and 50 miles per week getting supplies within Albuquerque for a total of 376 miles X 6 weeks X .50/mile X 2 trucks=$2256.
   - For Year 1, Project Director Patricia L. Crown will receive a standard per diem rate of $45/day plus $40/day for housing in Chaco Canyon. The housing is necessary because the garage is used as a laboratory. The National Park Service charges $40/day for a duplex. For Year 2, Crown will travel to New York City to the American Museum of Natural History to analyze collections for 14 days. GSA rates are hotel ($250) and food ($71) for NYC. Current airfare averages around $400 roundtrip Albuquerque-New York City. Shuttle charges roundtrip $35. Crown will also travel to Washington, D.C. to analyze collections at the National Museum of the American Indian for 7 days. GSA rates are hotel ($175) and food ($71). Current airfare averages around $500. Metro charges roundtrip $12.
   - In Year 2, Research Assistant Hannah Mattson will accompany Crown on trips to NYC and DC. Costs for travel are the same as for Crown, except that there are no hotel charges since they will share a room.
5. Supplies and Materials
   - Field supplies include standard items. UNM provides most equipment. The room must be covered each night with plywood, 6 sheets at $32/sheet. Tarps are used with plywood to keep rain out of excavations. A 60' X 30' tarp is $169. This gives sufficient overhang to

prevent moisture from seeping into the room. Archival quality polyethylene ziplock bags are included in four sizes. They come in boxes of 1000 from US Plastics at $117. Miscellaneous field supplies include notebooks for notes, pencils, pens, graph paper, rubber bands.

6. Services

- LiDAR mapping costs come from Earth Analytic, Inc. The costs include rental of the Faro Laser Scanner, software rental and technical support for four days, data processing, analysis and 3D modeling for 6 days, and miscellaneous supplies. Rates are from Collaborator Wetherbee Dorshow.
- Residue analysis will be conducted at the Keck lab at Millsaps College in Jackson, Mississippi. Rates are from Collaborator Tim Ward. Ward trains undergraduate students in the procedures and analysis.
- Pollen analysis will be conducted by Susie Smith, an independent contractor. Dr. Smith has a standard rate of $260/sample.
- Macrobotanical analysis will be conducted by Karen Adams, an independent contractor. Dr. Adams has a standard rate of $280/sample.
- Radiocarbon dating rates come from the University of Arizona AMS Facility.
- Tree ring dating rates come from the University of Arizona Laboratory of Tree Ring Research.

7. Other costs

- UNM policy requires that RAs receive tuition. For 12 Credit Hours, the current rate in 2011/2012 is $3190.68. Assuming a 14% increase for 2013/2014, the rate is listed at $3637.

9. Total Indirect Costs

- UNM has negotiated a rate with the Department of Health and Human Services of 51% of direct cost up to Fiscal Year 2013. It is not known what the rate will be after this, so a constant rate of 51% is used. The modified total direct costs exclude the following: RA tuition and Student Stipends as stipulated in UNM policy.

11. Project Funding:

- $108828 is requested **outright** from NEH.
- An additional $15,000 is requested in **matching funds**.
- **Cost sharing** includes: **Applicant's Contributions** includes a percent of Crown's regular academic salary paid by UNM, a percent of Crown's fringe benefits paid by UNM, and the imputed indirect costs of these two contributions. **Third Party Contributions** include a planned request to the National Geographic Society for $15000 to cover some of the project costs, which, if funded, would be used to release the matching funds from NEH.

BIOGRAPHICAL SKETCH

A. VITA

PATRICIA LOUISE CROWN

Department of Anthropology
University of New Mexico
Albuquerque, N.M. 87131-1086
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e-mail: pcrown@unm.edu

November 22, 2011

i. Professional Preparation:

Certificate, 1984, Massachusetts Institute of Technology Center for Materials Research in Archaeology and Ethnography Summer Institute, Cambridge, MA, Ceramic Analysis

Ph.D., 1981, University of Arizona, Tucson, AZ., Anthropology

M.A., 1976, University of Arizona, Tucson, AZ, Anthropology

A.B., 1974, University of Pennsylvania, Philadelphia, PA, Anthropology *summa cum laude* with honors

ii. Appointment History - Principal positions

2008-present	Distinguished Professor, Department of Anthropology, University of New Mexico
1998-2008	Professor, Department of Anthropology, University of New Mexico
1993-1998	Associate Professor, Department of Anthropology, University of New Mexico
1992-1993	Associate Professor, Department of Anthropology, Arizona State University
1991-1992	Assistant Professor, Department of Anthropology, Arizona State University
1985-1990	Assistant Professor, Department of Anthropology, Southern Methodist University

Professional Honors and Awards

1994 Society for American Archaeology Award for Excellence in Ceramic Research.

1998 Gordon Willey Award from the Archaeology Divison of the American Anthropological Association.

2003 Gunter Starkey Award for Excellence in Teaching, University of New Mexico.

iii. PUBLICATIONS RELATED TO PRESENT RESEARCH

Crown, Patricia L. and W. Jeffrey Hurst
2009 Cacao Use in the Prehispanic American Southwest. Proceedings of the National Academy of Sciences 106(7):2110-2113.

Crown, Patricia L.
2007 Life Histories of Pots and Potters: Situating the Individual in Archaeology. American Antiquity 72(4)677-690. (submitted May 2006).

Crown, Patricia L., and W. H. Wills
2003 Modifying pottery and kivas at Chaco: Pentimento, Restoration, or Renewal? American Antiquity 68:511-532.

Mills, Barbara J., and Patricia L. Crown, editors
1995 Ceramic Production in the American Southwest. University of Arizona Press, Tucson.

Crown, Patricia L.
1994 Ceramics and Ideology: Salado Polychrome Pottery. University of New Mexico Press, Albuquerque.

iv. SERVICE ACTIVITIES

- 2009-present Sernior Research Panel, National Science Foundation
- 2008-present Executive Board, Society for American Archaeology
- 2009 Collaborative Research Panel, National Endowment for the Humanities
- 2007-2010 PI, Investigating Pueblo Bonito Mounds project
- 2005-2009 co-Director, Chaco Stratigraphy Project
- 2000-2007 Idyllwild Arts Center Native American Arts and Culture of California and the Southwest Program (program coordinator)
- 2001-2003 Chair, American Anthropological Association Archeology Division (1500 members)
- 2001-2004 Director of Graduate Studies, Department of Anthropology, U of New Mexico
- 1997-present Volunteer teaching archaeology in various public schools in Albuquerque

v. COLLABORATORS
a. collaborators/co-editors

Suzanne K. Fish, Arizona State Museum, University of Arizona
W. James Judge, Fort Lewis College
Barbara J. Mills, Department of Anthropology, University of Arizona
Deborah Nichols, Department of Anthropology, Dartmouth College
W. H. Wills, Department of Anthropology, University of New Mexico

b. GRADUATE STUDENTS AND POST-DOCTORAL STUDENTS

Elizabeth Bagwell	CRM Firm, Phoenix
Connie Constan	National Forest Service, Reserve
Kathy Helton Croll	CRM Firm, Durango
Valerie King	Ramah School District
Ruth Lambert	Private Foundation
Marit Munson	Trent University
Melissa Powell	Montgomery College
Kari Schleher	Laboratory Director, Crow Canyon Archaeological Center
Maria Sprehn	Montgomery College
Nieves Zedeno	University of Arizona

c. GRADUATE AND POST-DOCTORAL ADVISORS

Dr. Emil Haury	deceased
Dr. William Longacre	Department of Anthropology, University of Arizona (retired)
Dr. T. Patrick Culbert	Department of Anthropology, University of Arizona (retired)
Dr. Ronald Bishop	Conservation Analytical Laboratory, Smithsonian Institution

Hannah V. Mattson
Parametrix
(b) (6)

Education

2007 to present: Ph.D. Candidate (Anthropology), University of New Mexico (2012 expected graduation)
2002: M.A. (Anthropology), University of New Mexico
2000: B.A. (Anthropology), Oregon State University

Selected Professional Experience

Parametrix, Inc.
Cultural Resources Project Director/Principal Investigator April 2011-present

D Pennington & Associates
Cultural Resources Project/Field Director September 2010-April 2011

Criterion Environmental Consulting
Archaeology Project/Field Director, 2007 – April 2011

University of New Mexico
Part-time Teaching Associate, 2008 and 2010

University Of New Mexico
Research Assistant, 2004 – May 2009
Ceramic analyst with the NSF-funded Pueblo Bonito Midden Project (Dr. Patty Crown, PI) based at the University of New Mexico.

Office of Contract Archeology, University of New Mexico
Archaeology Crew Chief, June 2006 – August 2007

Aztec Ruins National Monument, NPS
GS-7 Archaeologist, July 2003 – present

SELECTED REPORTS AND PUBLICATIONS

Mattson, Hannah V.

2012 Ornaments and Individual Identity in the Prehistoric Southwest: the Practice of Personal Adornment. In *Marking Identity in the Prehistoric Southwest,* edited by Jill Neitzel. University of Utah Press. **In Press**

2011 Gray Ware from the Pueblo Bonito Mounds. In *Pueblo Bonito Mounds Research: Results of Artifact Analysis*, edited by Patricia Crown. **In Preparation**

Ornaments, Mineral Specimens, and Shell Specimens from the Pueblo Bonito Mounds. In *Pueblo Bonito Mounds Research: Results of Artifact Analysis*, edited by Patricia Crown. **In Preparation**

2010 Ground Stone Artifacts: Results. In *Final Data Recovery Report: Unser Boulevard Phase II, Farol Road to Progress Boulevard, City of Rio Rancho, Sandoval County, New Mexico.* Criterion Environmental Consulting.

2009 Ground Stone Artifacts. *Montano Pueblo Data Recovery Report,* prepared by G. Raymond. Criterion Environmental Consulting, Albuquerque.

2006 Early Chacoan Ornaments and Pigments: A Study of Basketmaker III and Pueblo I Assemblages. *Early Puebloan Occupations in the Chaco Region,* edited by Thomas C. Windes. Reports of the Chaco Center, No. 13, Branch of Cultural Research, Division of Anthropology, National Park Service, Santa Fe.

2007 Prehistoric Clay Use in the Lower Jemez Valley: Results of Ceramic Oxidation and Porosity Analyses. *Data Recovery Report, Mid-America Pipepline Western Expansion Project, New Mexico.* Office of Contract Archeology, University of New Mexico, Albuquerque.

Ornaments, Mineral Specimens, and Shell Specimens. *Data Recovery Report, Mid-America Pipepline Western Expansion Project, New Mexico.* Office of Contract Archeology, University of New Mexico, Albuquerque.

2004 A Preliminary Ceramic Sourcing Study for the Las Ventanas Area of the Cebolleta Mesa Region, El Malpais National Monument. *The El Malpais Archaeological Survey: Phase I,* edited by Robert Powers and Janet Orcutt, Intermountain Cultural Resources Management Professional Paper No. 70, Intermountain Region, National Park Service, Department of the Interior.

Worman, F. Scott and Hannah V. Mattson

2010 Arroyos and Agriculture: Geoarchaeological Investigations at Pueblo Pintado. *Kiva* 75(4).

CONFERENCE PRESENTATIONS

Grayware Ceramics from the Pueblo Bonito Mounds. Presentation at the 75th Annual Meeting of the Society for American Archaeology, St. Louis, April, 2010.

Ornaments from the Pueblo Bonito Mounds. Presentation at the School for Advanced Research Seminar "New Archaeological Research at Pueblo Bonito: Reopening the National Geographic Society Excavations", Santa Fe, March 9-12, 2010.

Macroregional Variation in Turquoise and Shell Ornaments in the Southwest: An "Untidy" View of Identity and Interaction. Presentation at the 74th Annual Meeting of the Society for American Archaeology, Atlanta, April, 2009.

An Investigation of Ornaments from the Pueblo Bonito Middens. Presentation at the 73rd Annual Meeting of the Society for American Archaeology, Vancouver, BC, March, 2008.

Chacoan Ornament Production and Consumption During the Basketmaker-to-Pueblo Transition: Jewelry as Social Signaling. Presentation at the 68th Annual Meeting of the Society for American Archaeology, Milwaukee, April 2003.

BIOGRAPHICAL SKETCH

A. VITA

WILLIAM JEFFREY HURST Analytical Research and Services Technical Center
The Hershey Company
P.O. Box 805
1025 Reese Ave
Hershey, PA 17033

i. Professional Preparation:

1969	AB	Chemistry	Ohio University
1975	MS	Chemistry	Youngstown State University
		A Clinical Evaluation of the RAST Procedure for IgE Antibodies-	
1984	Ph.D.	Chemistry	Columbia Pacific University
		Application of HPLC to Food Analysis-	

ii. Appointment History - Principal positions

2008- Present	Principal Scientist, The Hershey Company
1991-2008	Sr. Staff Scientist, Analytical Research and Services, Hershey Company
2001-Present	Clinical Professor of Comparative Medicine MS Hershey Medical Center Hershey, PA
1991-2001	Clinical Associate Professor of Comparative Medicine, MS Hershey Medical Center Hershey, PA
1987-1991	Staff Scientist, Hershey Company
1983-1987	Group Leader, Hershey Company
1983-1991	Clinical Asst. Professor of Comparative Medicine MS Hershey Medical Center, Hershey, PA
1981-1983	Senior Scientist, Hershey Company
1977-1981	Scientist, Hershey Company
1976-1977	Associate Scientist, Hershey Company
1969-1991	US Air Force, Retired as Major

Professional Honors and Awards

1981	Fellow, American Institute of Chemists
2001	Fellow, Royal Australian Chemical Institute
2000	Fellow AOAC International
1986	Pioneer in Laboratory Automation Award from the International Symposium of Laboratory Robotics

iii. PUBLICATIONS RELATED TO PRESENT RESEARCH

Hurst, W.J.; Stanley, B.; Glinski, J.A.; Davey, M.; Payne, M.J.; Stuart, D.A.
2009 Characterization of Primary Standards for Use in the HPLC Analysis of the Procyanidin Content of Cocoa and Chocolate Containing Products. *Molecules* 2009, 14, 4136-4146

Crown, P. and W. J. Hurst
2009 Evidence of Cacao Use in Prehispanic Southwest. *Proceedings of the National Academy of Sciences* 106(7):2110-2113

Henderson, John S., Rosemary Joyce, Gretchen Hall, W. Jeffrey Hurst, and Patrick McGovern

2007 Chemical and archaeological evidence for the earliest cacao beverages. ***Proceedings of the National Academy of Sciences*** 104:18937-18940.

Hurst, W. Jeffrey
2007 The Determination of Cacao in samples of Archaeological Interest. In ***Chocolate in Mesoamerica***, edited by C. L. McNeil, pp. 105-113. University Press of Florida, Gainesville.

Prufer, Keith M. and W. Jeffrey Hurst
2007 Chocolate in the Underworld Space of Death: Cacao Seeds from an Early Classic Mortuary Cave. ***Ethnohistory*** 54:273-301.

Hurst, W. Jeffrey, Stanley M. Tarka Jr, Terry Powis, Fred Valdez Jr. and Thomas Hester
2002 Cacao usage by the earliest Maya civilization. ***Nature*** 418:289-290.

iv. SYNERGISTIC ACTIVITIES

1987-2001	Editor ***Laboratory Robotics and Automation***
1987-present	Editorial Board ***Journal of Liquid Chromatography***
2000-present	Contributing Editor ***Scientific Computing and Instrumentation***
Present	Board of Directors, Southern Maya Project for Archaeology
Present	Member, FAMSI Botanical Working Group
Present	Reviewer, Estonian Science Foundation

v. COLLABORATORS
a. COLLABORATORS/CO-EDITORS

John Henderson	Department of Anthropology, Cornell University
Rosemary Joyce	Department of Anthropology, U California, Berkeley
Patrick McGovern	MASCA, University of Pennsylvania Museum
Keith Prufer	Department of Anthropology, University of New Mexico
Bob Sharer	University of Pennylvania Museum
Cameron McNeil	CUNY
Grant Hall	Texas Tech
Mike Coe	Yale University
David Stuart	Vanderbilt
Mike Collins	UT-Austin (Texas Archaeological Research Lab TARL)

b. GRADUATE STUDENTS AND POST-DOCTORAL STUDENTS

John Young,	DVM, Penn State
Pat Fritz,	DVM, Penn State
Kathleen Moody,	DVM, Penn State
Susan Harper,	DVM, Penn State
Aline Dimitri,	The Application of FTIR in the Analysis of Chocolate, McGill University (PhD in Food Science)
Robert Cocciardi,	The Application of Different Sampling Handling Methodologies in the Analysis of Foods by FTIR, McGill University (PhD in Food Science)
Sejal Iyer,	Intergrated Microwave Extraction: A Replacement for Soxhlet Duquesne University (PhD in Chemistry)

c. GRADUATE AND POST-DOCTORAL ADVISORS
Doctoral Advisor Peter Schmidt

Abbreviated Curriculum Vitae

Timothy J. Ward
Department of Chemistry, Millsaps College, Jackson, MS 39210

Professional Experience

- Associate Dean of Sciences: Millsaps College, January 2007 - present.
- Acting Associate Dean of Sciences: Millsaps College, June 2004 -2005.
- Chair and Professor: Department of Chemistry, Millsaps College, 2002-2006.
- Chair and Associate Professor: Department of Chemistry, Millsaps College, 1996-2002.
- Assistant Professor: Department of Chemistry, Millsaps College, 1990-1996.

Education

- **Ph.D.**, Analytical Chemistry, February 1987; Texas Tech University, Lubbock, Texas. Ph.D. Dissertation: Cyclodextrins and Micelles in Separations.
- **B.S.**, Chemistry, American Chemical Society Certification, August 1981; University of Florida, Gainesville, Florida.

Teaching and Research Awards

- Outstanding Contributions to Science, Mississippi Academy of Sciences, **2002**
- Chemist of the Year, Mississippi Section of the American Chemical Society, **2001**
- HEADWAE (Higher Education Appreciation Day-Working for Academic Excellence), awarded by Mississippi State Legislature, **2000**
- Exemplary Teaching at a United Methodist Institution of Higher Education, General Board of Higher Education United Methodist Church **2000**
- Distinguished Professor Award, Millsaps College**, 1999**

Selected Publications (Undergraduate Student Authors*)

1. "Chiral Separations: A Fundamental Review," Timothy J. Ward and Karen D. Ward, *Analytical Chemistry*, **82** (12) 2011.
2. "Vancomycin Molecular Interactions: Antibiotic and Enantioselective Mechanisms," Timothy J. Ward, Aprile Gilmore, Karen Ward and Courtney Vowell, in *Chiral Recognition in Separation Methods: Mechanisms and Applications*, pp 223 – 240, Springer-Verlag Berlin, ed. by Alain Berthod, 2010.
3. "Chiral Separations: A Fundamental Review," Timothy J. Ward and Beth Ann Baker*, *Analytical Chemistry*, **Vol. 80** (12), 2008.
4. "Chiral Separations: A Fundamental Review," Timothy J. Ward, *Analytical Chemistry*, **Vol. 78**, June 15, 2006.
5. "Chiral Separations: A Fundamental Review," Timothy J. Ward and Daisy Malloy-Hamburg*, *Analytical Chemistry*, **Vol. 76**, No. 12, 2004.
6. "Chiral Separations Using the Macrocyclic Antibiotics in Capillary Electrophoresis," Timothy J. Ward and Colette Rabai*, in *Chiral Separations - Methods and Protocols,* **Vol. 243,** 255-263, Humana Press Inc., Totowa, NJ, edited by Gerald Gübitz and Martin Schmid, 2003.
7. "Synergistic Chiral Separations using the Glycopeptides Ristocetin A and Vancomycin," Timothy J. Ward, Brad Farris* and Kellie Woodling*, *Journal of Biochemical and Biophysical Methods,* **Vol. 48**, 163-174 (2001).
8. "Chiral Separations Using the Macrocyclic Antibiotics: A Review," Timothy J. Ward and Brad Farris*, *Journal of Chromatography A,* **906**, 73-89 (2001).
9. "Chiral Separations by High Performance Liquid Chromatography," Timothy J. Ward and Tanya

M. Oswald*, *Encyclopedia of Analytical Chemistry: Instrumentation and Applications,* edited by R. A. Myers, 11316-11334 (2000).

Selected Honors Theses of Undergraduate Students

1. "A Comparison of Digestion and Laser Ablation Techniques for the Analysis of Archaeological Artifacts using ICP/MS", James Thompson, Millsaps Chemistry Department, Jackson, MS (2011).
2. "Chiral Recognition using the Macrocyclic Glycopeptides," Jason Eastlack, Millsaps Chemistry Department, Jackson, MS(2006).
3. "The Chemical Causes and Economic Effects of Obesity in the State of Mississippi," Mackey Sugar, Millsaps Chemistry Department, Jackson, MS. Co-advisor with Pat Taylor, Millsaps Else School of Business (2004) .
4. "Separation of Dansyl Amino Acids Using 18-Crown-6 Ether and Vancomycin in a Capillary Electrophoresis System," Colette Rabai, Millsaps Chemistry Department, Jackson, MS (2002).

Selected Professional Presentations by Dr. Timothy Ward

June 2010	"W.M. Keck Center: A Facility for Instrumental and Biochemical Analysis of Archaeological Artifacts," Oxcutzcab, Mexico.
Dec. 2009	"Instrumental and Biochemical Analysis in Cross-Cultural Comparative Archaeology," Department of Antiquities, University of Tirana, Albania.
April 2009	"Modern Instrumental and Biochemical Analysis for the Comparative Archeology of Old World and New World Cultural Systems, Department of Chemistry," University of Wyoming.
March 2009	"Characterization of the Geochemical Composition of Pottery and other Artifacts using ICP-MS," Pittcon 2009, Chicago, IL.

Selected Undergraduate Student Research Presentations

1. "Comparison of LA-ICP-MS, Solution-Based ICP-MS, and XRF Inorganic Analysis Techniques in Iron and Copper Ore Provenance Studies", J. Thompson and T. J. Ward, 241st ACS National Meeting, Anaheim, CA, March 2011.
2. "Provenance of Metal Artifacts Based on ICP-MS, LA-ICP-MS and Portable X-Ray: An Evaluation of Techniques", J. Thompson, J. Gu, T. J. Ward, Pittcon 2011, Atlanta, GA.
3. "Synthesis of and Investigation of Enantioselective Properties of Covalently Linked Vacomycin Dimer," M. Oglesbee, K. Parsons, E. Redman, B.A. Baker and T. J. Ward, 235th ACS National Meeting, New Orleans, LA, April 2008.
4. "ICP-MS for Geochemical Characterization of Pottery and Ceramics: Comparative Archeology of Old and New World Cultures," Erin Redman, Keith Parsons, Griffin Collums, and Timothy Ward, 40th ACS Southeast Undergraduate Research Conference (SURC), Clinton, MS, April 2008.

Curriculum Vitae (Abbreviated)
Wetherbee Bryan Dorshow

Earth Analytic, Inc.
227 East Palace Ave
Santa Fe, NM 87508
(b) (6) [redacted]

PROFESSIONAL PREPARATION:

University of Vermont	Anthropology	B.A. 1989
University of New Mexico	Anthropology	M.A. 1996
University of New Mexico	Anthropology	PhD Candidate; degree expected 05/2012

APPOINTMENTS:

2000-present	President, Earth Analytic, Inc., Santa Fe, NM
1992-2000	Project Director, Southwest Archaeological Consultants, Inc., Santa Fe, NM

REFEREED PUBLICATIONS

n.d. Modeling Agricultural Potential in Chaco Canyon during the Bonito Phase: A Predictive Geospatial Approach. Wetherbee Bryan Dorshow. *Journal of Archaeological Science*. Submission pending review.

In press Shabik'eschee Village in Chaco Canyon: Time to Move Beyond the Archetype. *American Antiquity*. Accepted; to be published in Jan. 2012 edition.

In Press Chaco Great House Communities and Agricultural Productivity: Revisiting Pueblo Alto. *Journal of Anthropological Archaeology*. Accepted, to be published in 2012.

SYNERGISTIC ACTIVITIES:

• PhD Candidate in Anthropology at the University of New Mexico; doctoral research involves geospatial modeling of agricultural productive potential during the 10th and 11th centuries A.D. at Chaco Canyon, NM.

• President and P.I. of a well-established GIS and environmental consulting firm specializing in GIS-enabled natural and cultural resource management; responsible for successful completion of over 150 projects for corporations, NGOs and both State and Federal agencies.

• Professional archaeologist with deep experience (24+ years) in cultural resource management and academic research projects in the Northeast and Southwestern US, Anguilla, and Costa Rica.

• Experienced geospatial professional with extensive training in GIS (400+ hours of Instructor-led ESRI courses), terrestrial LiDAR, and RTK GPS Survey.

• Author or Co-author of more than 75 technical archaeological and geospatial analysis reports summarizing collaborative research conducted as project director (Southwest Archaeological Consultants)

and P.I. (Earth Analytic, Inc.)

- Recipient of a National Science Foundation NCALM grant for a proposal entitled Simulating Dynamic Hydrological Processes in Archaeological Contexts: A Proposal for Airborne Laser Swath Mapping (ALSM) at Chaco Canyon.

- Collaborator with the University of Vermont and University of Maine on the development and implementation of the Vermont Archaeological Sensitivity Model, a statewide archaeological sensitivity analysis and interactive mapping system. The project team received a Significant Achievement in GIS Award from Environmental Systems Research Institute in 2006.

- Collaborator with University of Vermont research in Fountain Cavern, in Anguilla, West Indies. The project entailed terrestrial laser scanning (LiDAR) of spelioglyphs and surrounding cave contexts for documentation and 3d visualization purposes.

- Collaborator with the University of Hawaii and Garcia and Associates at Ahu a Umi, a 16th century heiau on the high plateau between Hualālai and Mauna Loa, Island of Hawai'i. The project entailed terrestrial laser scanning and integrated geospatial mapping of this isolated and very significant Hawaiian site, which is listed on the US National Register of Historic Places. Responsibilities included the training of undergraduates in the use of LiDAR, total station, and GPS equipment in the field.

COLLABORATORS & OTHER AFFILIATIONS:

Collaborators:
Dr. John G. Crock (University of Vermont),
Dr. Ellie Cowie (University of Maine at Farmington Archaeological Research Center)
Dr. Timothy Wawrzyniec (Western Colorado College)

Graduate and Postgraduate Advisors:
Dr. Wirt W. Wills, University of New Mexico (Doctoral Committee Chair)
Dr. Patricia Crown, University of New Mexico
Dr. Keith Prufer, University of New Mexico
Dr. Timothy Wawrzyniec, Western Colorado College

Karen R. Adams, PhD

Archaeobotanist

Professional Preparation

1968 B.A. Miami University, Oxford, Ohio (Anthropology)
1988 Ph.D. University of Arizona (Ecology and Evolutionary Biology; Minor: Geosciences)

Appointments/Positions

2007-present Research Associate, Crow Canyon Archaeological Center, Cortez, CO.
2003-present Coordinator, Borderlands Ecology Project, Mexico-North Research Network, Inc., San Antonio, TX.
1997-present Archaeobotanical Consultant, Gila River Indian Community, Sacaton, AZ.
1990-2006 Archaeobotanical Consultant, Crow Canyon Archaeological Center, Cortez, CO.
1980-present Full-time Consultant in Archaeobotany in the United States Southwest and northern Mexico, including for: Arizona State Museum, Arizona State University, Crow Canyon Archaeological Center, National Park Service, Statistical Research, Inc., Utah State Historical Society, University of Arizona Departments of Anthropology and Classics, University of Calgary (Canada), University of Delaware, Lakehead University (Canada), Desert Archaeology, Gila River Indian Community, Logan Simpson Design, Inc., University of Texas at San Antonio, SWCA, Inc., others.

Professional activities: (1) development of innovative techniques and methodologies for the analysis of archaeological plant remains; (2) participation in archaeological project research in all major Southwestern culture areas (Ancestral Puebloan, Hohokam, Mogollon), including an extensive list of publications in the peer-reviewed literature and the archaeological contract literature available upon request; (3) planning and implementation of programs to make the results of archaeological research in the southwestern United States and northern Mexico more accessible to the general public; (4) thirty years of service to the Society of Ethnobiology in various official capacities, most recently as President (2001-2003).

Some Key Publications

Adams, K. R. 1994. A Regional Synthesis of *Zea mays* in the Prehistoric American Southwest. *In* S. Johannessen and C. A. Hastorf, eds., *Corn and Culture in the Prehistoric New World*, pp. 273-302. Boulder: Westview Press.

Adams, K. R. 2001. Looking Back Through Time: Southwestern U. S. Archaeology at the New Millennium. *In* R. I. Ford, ed., *Ethnobiology at the Millennium: Past Promise and Future Prospects*, pp. 49-99. Anthropological Papers No. 91, Museum of Anthropology, University of Michigan, Ann Arbor.

Adams, K. R. 2004. Anthropogenic Ecology of the North American Southwest. *In* P. E. Minnis, ed., *People and Plants in Ancient Western North America*, pp. 167-204. Washington, D. C.: Smithsonian Books.

Adams, K. R., 2006. Through the Looking Glass: The Environment of the Ancient Mesa Verdeans. In *The Mesa Verde World: Explorations in Ancestral Pueblo Archaeology*, pp. 1-7. David Grant Noble, editor. School of American Research Press, Santa Fe, NM.

Adams, K. R. and V. L. Bohrer. 1998. Archaeobotanical Indicators of Seasonality: Examples from Arid Southwestern United States. *In* T. R. Rocek and O. Bar-Yosef, eds., *Seasonality and Sedentism.*

Archaeological Perspectives from Old and New World Sites, pp 129-141. Peabody Museum Bulletin 6, Peabody Museum of Archeology and Ethnology, Harvard University, Cambridge, MA.

Adams, K. R. and S. K. Fish, 2006. Southwest Plants. *In* William C. Sturtevant, general editor., Douglas H. Ubelaker, volume editor, and Bruce D. Smith, subsistence sub-editor, *Handbook of North American Indians*, Vol. III, Origins, Subsistence, and Population. Smithsonian Institution, Washington, DC.

Adams, K. R. and R. E. Gasser. 1980. Plant microfossils from archaeological sites: research considerations and sampling techniques and approaches. *The Kiva* 45(4):293-300.

Adams, Karen R., Cathryn M. Meegan, Scott G. Ortman, R. Emerson Howell, Lindsay Werth, Deborah A. Muenchrath, Michael K. O'Neill, and Candice A.C. Gardner. 2006. MAÍS (*Maize of American Indigenous Societies*) Southwest: Ear Descriptions and Traits that Distinguish 27 Morphologically Distinct Groups of 123 Historic USDA maize (*Zea mays* L. ssp. *mays*) Accessions, and Data Relevant to Archaeological Subsistence Models. Manuscript available on: http://farmingtonsc.nmsu.edu, Projects and Results, Collaborative Mais Project.

Bohrer, V. L. and K. R. Adams. 1977. Ethnobotanical Techniques and Approaches at Salmon Ruin, New Mexico. *Eastern New Mexico University Contributions in Anthropology* 8(1).

Collaborators and Co-Editors (last 5 years): Adams, E. C.; Adams, R. K.; Altschul J. H.; Baldwin, S. J.; Bar-Yosef, O; Bohrer, V. L.; Borradaile, G.; Bowyer, V. E.; Brown, M. L.; Ciolek-Torrello, R. S.; Dean, J. S.; Dickson, J.; Drabek, A. S.; Ebbesmeyer, C. C.: Evans, T.; Ezzo, J.; Fish, S. K.; Ford, R. I.; Fralick, P.; Fritz, G.; Gottardo, C.; Graham, J. B.; Hanselka, K. J. ; Hard, R. J.; Homburg, J. A.; Hovezak, M. J.; Huber, E. K.; Ingraham, Fr., W. J.; Kelley, J. H.; Klucas, E. E.; Kuckelman, K. A.; LaMotta, V. M.; Lightfoot, R. R.; Loendorf, C; MacKenzie, A.; MacWilliams, A. C.; Merrill, W. L.; Mills, B.; Minnis, P.; Muenchrath, D. A.; Murray, S. S.; Neff, L. C.; Neily, R. B.; Palacios-Fest, M.; Peterson, K. L.; Phillips, Jr., D. A.; Pierce, C.; Rainey, K. D.; Ravesloot, J. C.; Raymond, G.; Rice, G.; Riggs, C. R.; Rocek, T. R.; Roney, J. R.; Schwindt, D. M.; Shelley, S. D.; Smith, S. J.; Soren, D.; Soren, N.; Stewart, J. D.; Toll, M. S.; Van West, C. R.; Vanderpot, R.; Varian, M. Da.; Vint, R. W.; Waters, M.; Webster, D. L.; Wegener, R. M.; Welch, J. R.; Wilshusen, R. H.; Winter, J. C.; Woodson, K. M.

National Park Service
U.S. Department of the Interior

Chaco Culture National
Historical Park

P.O. Box 220
Nageezi, N.M. 87037

505-786-7014 phone
505-786-7061 fax

Research Authorization

This authorization grants permission in accordance with the attached general and/or special conditions.

Authorization Number: CHCU-10-04 Start Date: 1/1/2012 Expiration Date: 12/31/2015

Name of principal investigator: Dr. Patricia L. Crown
Name of institution represented: University of New Mexico
Additional investigators:
Project Title: Reinvestigating Room 28 at Pueblo Bonito
Purpose of study: To obtain stratigraphic and chronometric information for understanding the sequence of room construction and use relative to the use of ceramic vessels found in this room first excavated in 1896.
Research methods: Excavation will proceed using standard archaeological field recovery methods, including hand tools and basic recording. It is unclear how the room was backfilled, so no material will be screened until the last 20 cm is reached. The last 20 cm of room fill will be screened using 1/8" mesh. The opened room will be documented completely. A total station will be used to map the room. LIDAR will be used to document all walls. Standard NPS wall documentation practices will be followed. Excavation forms, maps and photography will follow standard methods. Any charcoal encountered on the floor, in the debris underlying the partition wall (for Rooms 28b/55), or in architectural posts will be sampled for tree-ring dating and radiocarbon dating. Samples will be removed from the floor and partition wall for soil, pollen and macrobotanical analysis.
Specific conditions or restrictions: The attached Research and Collecting Permit Restrictions and Conditions are incorporated into this Research Authorization.
Recommended by (park staff): Dabney Ford Date: 11-2-11 Dabney Ford Title: Chief, Cultural Resources
Approved by park official: Barbara J. West Date: 11/2/11 Barbara J. West Title: Superintendent
I agree to all conditions and restrictions of this permit as specified above and in the attached conditions. (not valid unless signed and dated by the principal investigator) Patricia L Crown 11/3/11 Principal investigator's signature Date

AMERICAN MUSEUM OF NATURAL HISTORY
DIVISION OF ANTHROPOLOGY

November 9, 2011

Patricia L. Crown
Distinguished Professor of
Anthropology
Department of Anthropology
MSC01 1040
University of New Mexico
Albuquerque, NM 87131-1086

Dear Dr. Crown:

I have read with great interest your plans to reopen Room 28 at Pueblo Bonito. This is terrific news, and we are most willing to assist in this important research program.

Specifically, I understand that you will be applying for NEH support to carry out this research. As you state, a complete reanalysis of the previously-excavated Room 28 materials would contribute significantly to the project. We have the Room 28 materials in our research storage here at the American Museum of Natural History, and we would be pleased to welcome you (again) to work in these collections.

Please be assured that all of us in the Division of Anthropology are anxious to cooperate in any way possible to help facilitate your innovative new research program at Pueblo Bonito.

Sincerely,

David Hurst Thomas, Ph.D., D.Sci.
Curator of Anthropology
thomasd@amnh.org

CENTRAL PARK WEST AT 79TH STREET
NEW YORK, NEW YORK 10024
PHONE: 212 769-5890 • FAX: 212 769-5334

Figure 1. Cylinder jar from Pueblo Bonito, Chaco Canyon, New Mexico. Photograph by Patricia L. Crown

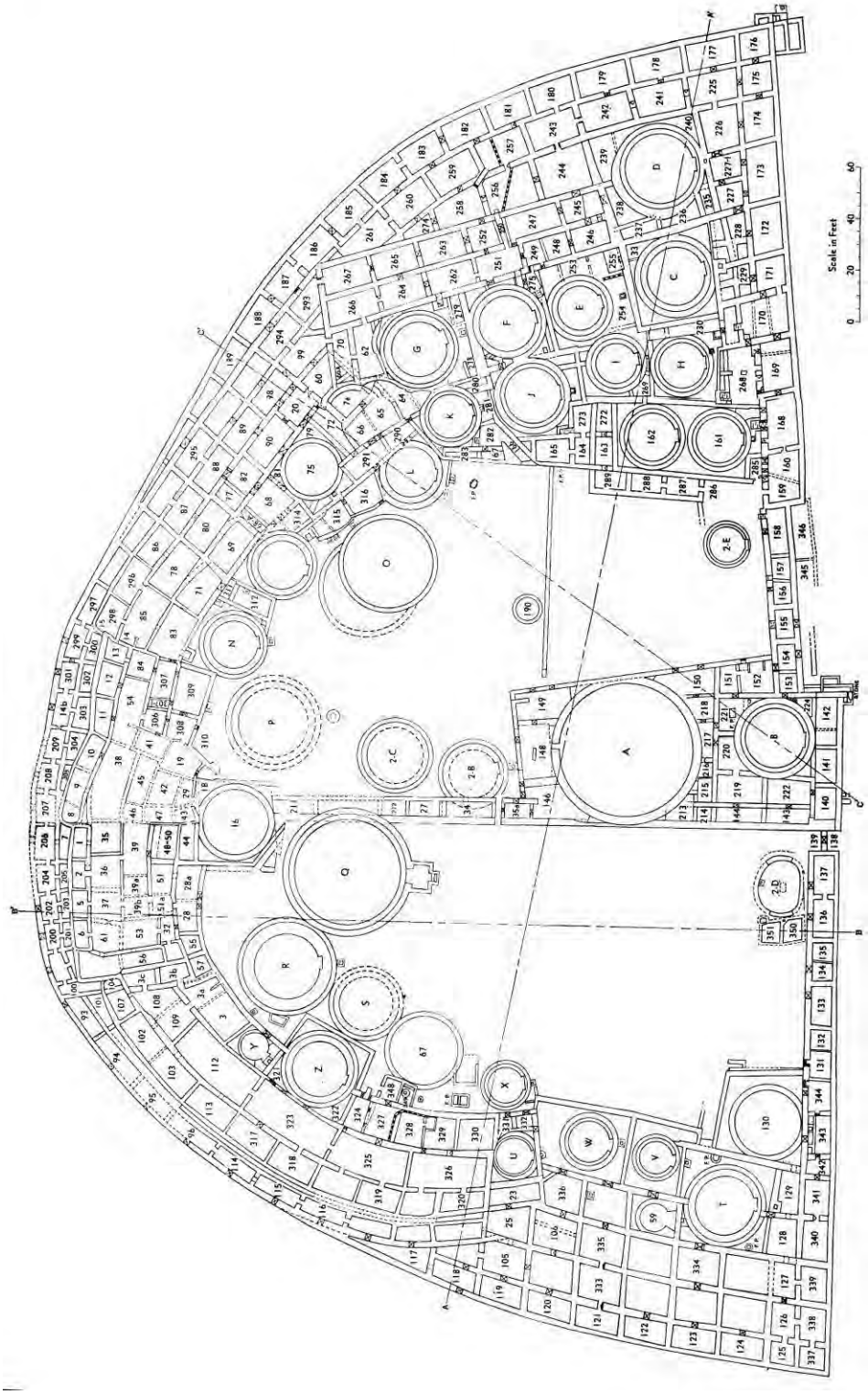

Figure 2. Pueblo Bonito, Chaco Canyon, New Mexico. Room 28 is just north of Kiva Q.

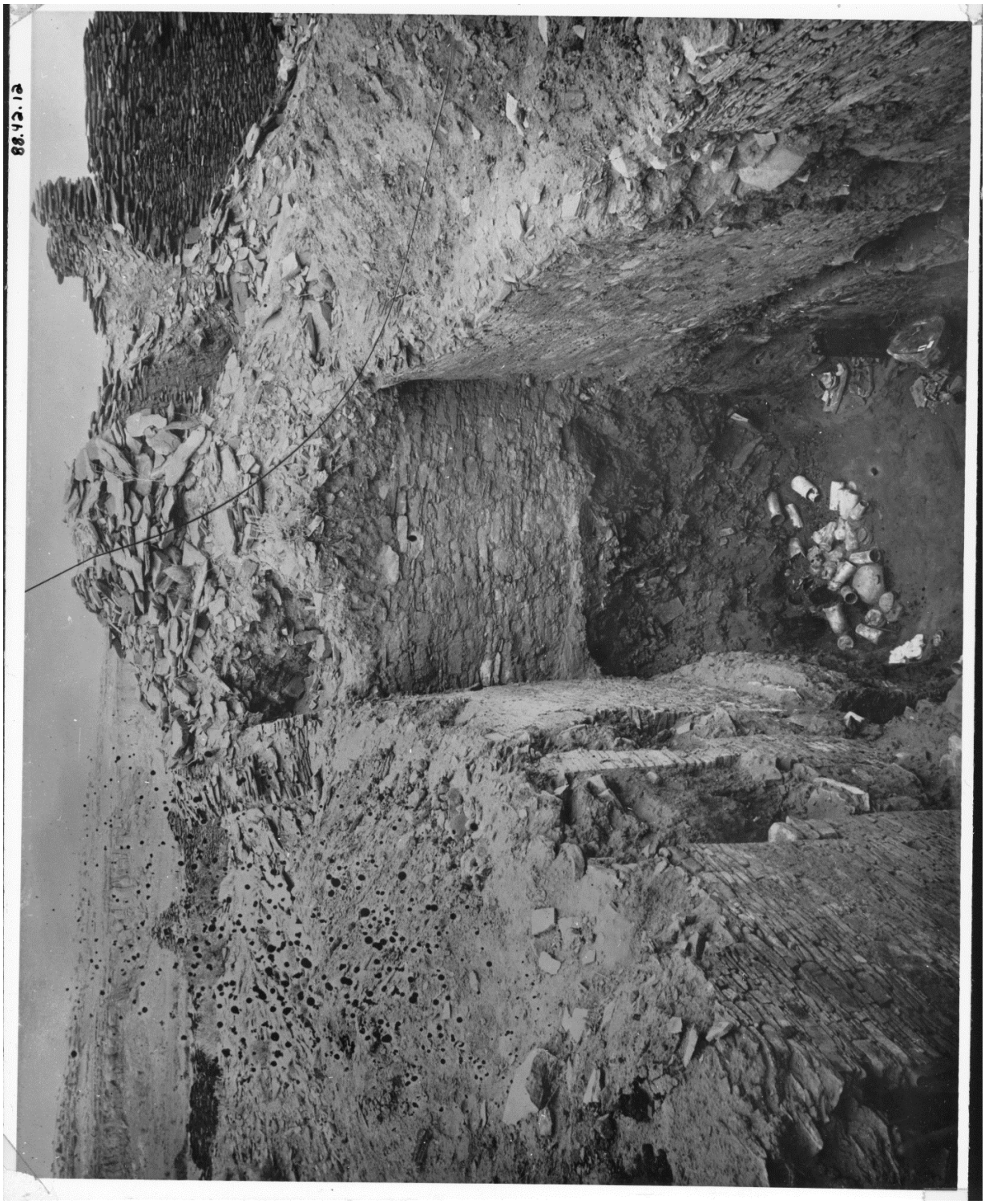

Figure 3. Room 28 as excavated in 1896. Note cache of cylinder jars with overlying dirt supporting later partitioning wall. Cylinder jars were partly under the dirt/rock strata. Burned beams are visible along north (right) wall. Photograph from American Museum of Natural History.

Figure 4. Chaco Canyon location relative to cacao growing areas of Mesoamerica.

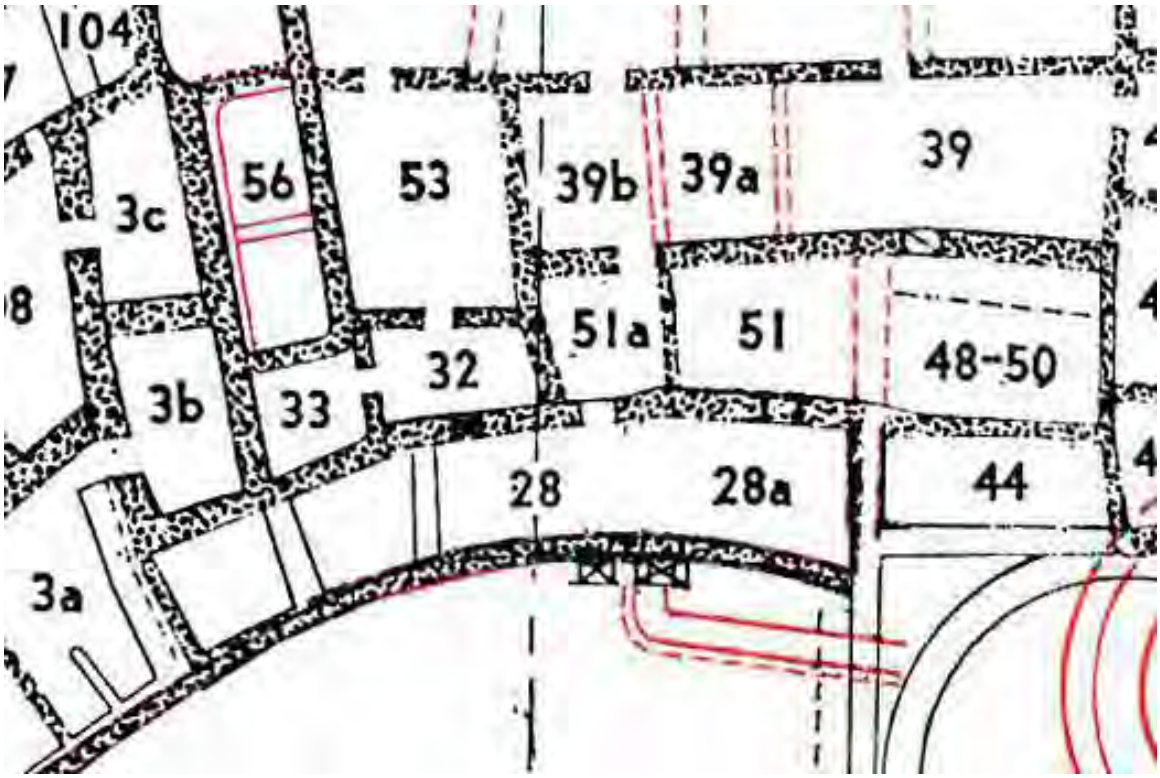

Figure 5. Close up of Room 28. A masonry partition wall lies between Rooms 28 ad 28a, although it is not shown on this planview of Pueblo Bonito.

Pre-Columbian Chocolate Discovered at Chaco

Dr. Patricia Crown examining a cylinder jar, photo contributed by Dr. Crown.

Though the National Park Service rarely sponsors archaeological excavations today, archaeologists and other researchers are still learning new things from the material remains of ancestral Puebloan culture all the time. Technologies like LiDAR photography (an optical remote sensing technology) and ground penetrating radar give us new eyes on the resources at Chaco. Very recently evidence of cacao (chocolate!) was discovered in cylinder jars, a pottery style found almost exclusively in Pueblo Bonito, using a tiny sample of ground pottery sherd. The process is called organic residue analysis.

Roasted cacao bean, photo courtesy of Sifu Renka.

In the late 1800s Richard Wetherill and his assistant George Pepper, the first archaeologists to work in Chaco, excavated 111 cylinder jars from one particular room at Pueblo Bonito. These men knew they had found something special, though they could not have imagined what we would learn from the jars 100 years later. Over the course of subsequent excavations, archaeologists have gained a deeper understanding of just how unique these vessels are. Fewer than 200 have been found in the entire American Southwest, including those in Room 28 at Pueblo Bonito.

Scholars have long known that a drink made from cacao was consumed in ancient Mesoamerica. Some Maya cylinder jars even incorporate paintings of the precious liquid being poured for rulers and gods, though average people sometimes consumed it as well. The Maya ground the beans; mixed them with spices, chilies, and water; and frothed the drink for consumption either hot or cold.

Most of the jars found in the famous cache at Pueblo Bonito are more than twice as tall as they are wide and painted with black designs on a white background. Because of their distinct shape and exclusive locations, archaeologists have typically agreed that they were used ritually. Ideas about their use include that they were storage for turquoise or prayer sticks, or that animal skins were stretched over them to create drums. Almost all of these jars are housed today in the American Museum of Natural History in New York City, making prolonged study logistically difficult.

Cylinder jars from Pueblo Bonito, photo courtesy of the American Museum of Natural History.

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United States Department of the Interior

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IN REPLY REFER TO:
M2417

To Whom It May Concern:

Chaco Culture National Historical Park is responsible for ensuring that compliance under the National Environmental Policy Act and the National Historic Preservation Act is completed before any undertaking on park land. The park does not delegate this responsibility. Accordingly, the park will do NEPA and Section 106 compliance for Dr. Patricia Crown's proposed project, *Reinvestigating Room 28 at Pueblo Bonito*, at such time as she has the funding in place and is ready to move forward with fieldwork.

Dabney Ford
Chief of Cultural Resources