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The Spaniards tell that Capt. García López de Cárdenas—*maestre de campo* of the advance party of the Coronado Expedition—reached the boulders in the Río Zuni above Ceadro Spring at Dangerous Pass with his small force of expeditionaries for the second time on the Julian Tuesday of 6 July 1540. Earlier that day, Capt. Gen. Francisco Vázquez de Coronado had sent the force to reconnoiter the area. After they reported their findings to Vázquez de Coronado, the captain general sent López de Cárdenas and his men back to Dangerous Pass to secure the passage while the advance party remained camped at Río Bermejo. In darkness, about a hundred warriors from Cíbola attacked the López de Cárdenas force, shooting arrows into some of the horses and turning others loose. After the startled Spaniards mounted their steeds, they drove the warriors away from Dangerous Pass. A messenger immediately galloped away to the Río Bermejo camp to apprise Vázquez de Coronado of what had happened. López de Cárdenas later reported that the Hawikku warriors "attacked like courageous men" during the brief skirmish. Chronicler Pedro de Castañeda de Nájera, who was not an eye witness, reported that some surprised Spanish soldiers were so disoriented that they put their saddles on backward.

The following morning Vázquez de Coronado and most of his starving, fatigued troops moved out in the best order they could. Heading toward Hawikku, they periodically saw smoke clouds alerting the warriors of the Spaniards' location. Once the invading men-in-metal army reached the

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expansive flats southwest of Hawikku, Vázquez de Coronado dispatched López de Cárdenas and Capt. Melchior Pérez; friars Juan de Padilla, Luis de Úbeda, and Daniel; scribe Hernando Bermejo; and some horsemen as an advance group with orders to deliver the revered *requerimiento*. Vázquez de Coronado and his accompanying horsemen, bearing trade goods, saw that the Hawikku warriors welcomed the advance group with nothing more than flying arrows. They joined López de Cárdenas and the others at a location the distance of a crossbow shot from Hawikku. The gilded metal men and the gray robes failed to engender homage from the warriors. During the second reading of the requerimiento, several hundred homeland defenders bearing shields and weapons confronted the captains and the clerics. These men threw dirt and stones at the Spaniards, and marked lines in the ground to declare a boundary not to cross before sending a hail of arrows into the invaders, wounding horses and piercing the robe of one of the friars.

The men in metal responded with a treble-phased attack. First, mounted lancers charged the defenders, who retreated into the walled pueblo of Hawikku, which was empty of women and children since they had been evacuated to safety days before. Second, the invaders approached the stone slab walls and again shouted the obligatory requerimiento, all the while ducking arrows shot by the defenders atop Hawikku roofs. When the men in metal rushed afoot to scale the walls, they were met by a barrage of rocks and arrows. The invaders' crossbows proved ineffective because their bastard strings broke when they hurried to cock their bows during the fracas, and the Spaniards' arquebuses proved too cumbersome to use in such close quarters. Last, repulsed by the homeland defenders, the men in metal backed away from the walls and bombarded the pueblo with crossbow and arquebus projectiles. During the salvo of metal arrows and lead shot, the defenders cleverly slipped away from Hawikku in a planned retreat from the invaders.

The captain general presented himself in flamboyant battle attire that day on 7 July 1540. His groom, Juan de Contreras, dressed the captain general in brilliant, golden armor and placed a fancy plume on his helmet. In this eye-catching habiliment, Vázquez de Coronado naturally became a marked man as he led the charge into Hawikku. After stone slabs slung by the defenders had twice knocked him down, Vázquez de Coronado was finally rendered inoperative when a sharp rock smacked him off a ladder as he tried to reach the flat roofs. The strike decorated his feathered helmet with a jagged dent and left him unconscious; he was hauled away and placed in a tent for about three hours, during which time befell the excitement of the light artillery fusillade and victorious seizure of Hawikku. Vázquez de Coronado suffered stone wounds on his head, shoulders, and legs; two facial gashes; and an arrow

puncture in his right foot. His greatest trauma, however, was his realization that, while lying supine and unconscious in an improvised field hospital, he had missed the drama of the triumph at Cíbola.[1]

In addition to being a colorful moment in history, the battle at Hawikku produced lead shot discharged from arquebuses. These nondescript artifacts contain isotope codes that can be measured and interpreted to predict the source of the lead used to mold the shot. In this report, I will show that the atomic signature of those little lead balls left at Kuykendall Ruins, Doubtful Canyon, Hawikku, Piedras Marcadas, and Jimmy Owens mark the trail traveled by Vázquez de Coronado and his invaders. Concurrently, I will present the historical context of Spanish explorations into New Mexico to illustrate that the presence of Spanish lead at these sites further confirms the presence of Vázquez de Coronado and his men in metal. Since September 2004, I have devoted my time almost exclusively to exploration, between the international border with Mexico and Zuni Pueblo in New Mexico, for evidence of the route of the Coronado Expedition, 1540–1542. During this time, I assembled an exploration team that remains active and experienced at the time of this writing. The *New Mexico Historical Review* has previously published three reports describing my team's methods and findings.[2] This fourth report provides an account of the exploration program to June 2010. Since this paper will focus on new information, I encourage interested readers to refer to the earlier publications as antecedent material.

Lead Isotope Ratio Analysis

In my 2009 report, "The Red House Camp and the Captain General: The 2009 Report on the Coronado Expedition Campsite of Chichilticale," I recommended that lead-isotope ratios be obtained for four lead balls my team discovered at Kuykendall Ruins, and that these ratios be compared to ratios from lead shot found at other accepted or proposed Coronado sites.[3] In 2010 my article, "Spanish Lead Shot of the Coronado Expedition: A Progress Report on Isotope Analysis of Lead from Five Sites," reported that geochemist Franco Marcantonio used Thermal Ionization Mass Spectrometry (TIMS) to measure isotopes of lead shot from the suggested Coronado sites of Kuykendall Ruins (Chichilticale), Doubtful Canyon (Advance Party Camp, 23 June 1540), Hawikku-Kyakima (Cíbola), and Jimmy Owens (the great hailstorm site in Blanco Canyon, Texas).[4] I also added to the dataset the isotope ratios presented by Charles M. Haecker for two lead shot found at the proposed Coronado site of Piedras Marcadas Pueblo in Tiguex (LA 290, Mann-Zuris site).[5] In total the team measured or examined twenty-seven

lead shot: four from Kuykendall Ruins, thirteen from Doubtful Canyon, four from Hawikku, two from Piedras Marcadas, and four from Jimmy Owens. Using published data, I assembled a database of worldwide isotope ratios to use as a baseline against which to compare my measurements. Following several robust statistical and visual analyses, the team determined that these twenty-seven shot were composed of lead from Spain, the Middle New World (hereafter defined as modern Mexico, Central America, and the Caribbean Islands), and the United States.

Intriguingly, shot composed of lead originating in Spain were present at all five proposed Coronado camps (see map 4 and table 1 insert). Although I anticipated finding lead balls at these sites because the written evidence suggests that firearms were present during and used by the Coronado Expedition, it is the finding specifically of Spanish lead that is compelling. Accounts of firearms with the expedition include 22 February 1540, in Compostela, in modern Tepic, Nayarit, Mexico, "the muster was made of all the people going [with Vázquez de Coronado] to the land newly discovered." I counted twenty-six arquebuses in this roll. In addition to the arquebuses fired at the battle of Hawikku, Castañeda de Nájera reported that the Spanish fired these weapons both at the fracas on the Río del Tizón (Colorado River), where "the arquebusiers also were making good shots," and at the siege of Tiguex, where Spaniards were "making good shots with arquebuses." Given the motive, means, and opportunity for shot to be a product of the expedition, my team interpreted the existence of Spanish lead as a nexus among these five otherwise disparate locations. Moreover, I concluded that Spanish lead found within specific geographical corridors is diagnostic of the route of the Coronado Expedition.[6]

Historical Support for Spanish Lead Found in New Mexico being of Coronado Origin

Isotope analysis strongly supports the conclusion that members of the Coronado Expedition carried shot that included balls made from Spanish lead sources. In addressing the issue of whether the Spanish lead found in New Mexico arrived with Coronado or with later Spaniards, I reason that lead from Spain arrived in Mexico less frequently after 1521 because of how the Spanish developed their local mineral sources. Indeed, Spanish lead exports to the Middle New World eventually ceased altogether.

Historians Richard Flint and Shirley Cushing Flint point out "the collapse of the Spanish economy in the last half of the 1500s," after which "the country did not fully recover for about 400 years." The combination of influx

of American [New World] silver and [Spanish] military adventurism brought inflation followed by 'offshore out-sourcing' that nearly killed Spanish industry and mining on the peninsula and then caused three successive bankruptcies of the royal treasury." At the beginning of this economic failure there were active Spanish lead mines, but "when the economy collapsed, much mining in peninsular Spain simply stopped and didn't [resume] again until the very late 1700s. In the 1600s and at least the first half of the 1700s, much of the lead used in Spain was coming from England." Thus, they conclude, it is likely "lead balls from Spain at presumed Coronado route locations are from the 1500s and not later."[7]

Historian Clarence Henry Haring describes Spanish maritime transport from Spain to the Middle New World as irregular at best, eventually trickling to almost nothing. By 1526 French corsairs threatened Spanish maritime transport. In 1537 Spain sent a royal armada to the New World for the purpose of protecting the riches transported back to Europe. Five years later, the year the Coronado Expedition returned from Cíbola to Mexico City, Spain dispatched another armada, and the ships did not return to Spain until May 1543. In August 1544, the Crown decreed that protected fleets should sail annually to the New World, and by 1550, the Spanish instituted this policy. Commenting on the impact of these regular voyages, Haring states, "Annual sailings were not the invariable rule, although they were the ideal striven after, and sometimes achieved." After 1580, however, Spain began sending these ships perhaps once every two years. And "toward the middle of the seventeenth-century, as the monarchy declined, the sailings became more and more irregular." After 1651 Haring reports, "Mexico was no longer able to support an annual flota; and that whereas formerly the fleets attained to a size of eight or nine thousand tons . . . if one of three thousand could be dispatched every two years, it was considered a miracle." Haring's analysis of the Spanish fleet's activity confirms the decreasing supply of Spanish lead arriving in the Middle New World after the Coronado Expedition.

Despite the decreasing quantity of Spanish lead arriving into the New World, different forms of Spanish lead continued to arrive from Spain into Mexico until the mid-seventeenth century. In 1522 Spanish ships were required by ordinance to carry arms and ammunition. Haring writes, "For each large gun there were to be supplied three dozen shot, and for each of the *pasavolantes* six dozen, with molds and lead to make bullets for the *espingardas*. There were likewise two hundredweight of powder, ten crossbows with eight dozen arrows . . . none of this equipment might be sold or left [in the Middle New World]." The ordinance of 13 February 1552 required vessels, depending upon their tonnage, to carry twelve, twenty, or thirty arquebuses

and crossbows. Twenty to fifty lead balls were required for each gun. Haring reports, "molds for making lead bullets" were mandatory. The requirement of both lead shot and molds suggests that unfashioned lead was also likely carried on the ships. The Statement of Provisions for the Armada of Pedro de las Roelas, 1563–1564, lists "two hundredweights of lead for shot for the arquebuses," thereby providing evidence of crude lead aboard Spanish ships. Thus there is certainly a possibility that Spanish lead arrived in the Middle New World until at least the middle 1600s. Exactly how much lead actually made it off the ships and into Mexico, however, remains unknown.

In addition to the economic collapse of the latter sixteenth century, Spain's capacity to export lead to the New World was constrained by increasing domestic demand for the metal. Spanish mining historian Francisco Gutiérrez Guzmán details a number of factors that increased lead demand and subsequent shortages. He reports that beginning in 1514, the hulls of ships, especially those crossing the Atlantic, were lined with lead for the first time. Further increasing the demand for lead was a building-construction boom that occurred in Spain during the middle sixteenth century. During this time, lead was used frequently in the manufacture of roofs and conduits for water supplies. Spanish lead production, however, was so diminished that lead was purchased from Flandes (Flanders). In 1564 the fledgling Linares mining district in Spain produced such an insignificant amount of lead that the town was not named as a center. Instead, Linares was included in the Alcudia-Almodóvar district. Nonetheless, due to increasing demand for lead and the concomitant depletion of the Alcudia-Almodóvar lead mines, by December 1565, Linares had become the largest de facto lead producer in Spain and remained so through the last quarter of that century.

At the end of the sixteenth century, especially from 1572 through 1579, demand for lead by military and maritime interests increased despite the low output of Spanish mines. In 1578 the Spanish Crown's demand for lead from Linares was so great that national projects consumed all the lead produced there. This situation was also repeated between 1593 and 1598. By the seventeenth century, the output of Spanish mines had so declined that Spain was forced to buy ships from Holland, copper from Germany, and tin and lead from England. Spain was cast into the dubious posture of being wholly dependent on foreign imports to satisfy its metal requirements. These shortages continued into 1752, when lead production had declined to the extent that only one of Linares's thirty lead mines remained active. In 1778, in an example of the desperation of this situation, the general administrator of maritime mail in Havana, Cuba, requested from Spain lead plates for preservation of mail ships. The request was denied because there was no

more lead of such dimensions in the government stockpile. Under conditions of restrained domestic supply and hindered maritime transportation, it seems likely that little, if any, lead was exported by Spain to Mexico after the middle of the sixteenth century. Given this history, coupled with the route followed by post-Coronado travelers to New Mexico, it is more likely than not that Spanish lead found in New Mexico originated with the Coronado Expedition.[8]

Developments at Kuykendall Ruins since Autumn 2008

Isotope analysis identified two shot of Spanish lead and two of midwestern U.S. lead at Kuykendall Ruins, located in modern-day southeast Arizona (table 1). In a previous report I suggested that the Coronado Expedition visited this site and that Spaniards did not return to the Chichilticale region until about 1690, some 170 years after the Spaniards conquered Mexico City.[9] This hiatus in Spanish presence, coupled with evidence of a diminishing or terminated supply of lead from Spain, suggests that the shot of Spanish lead found at Kuykendall Ruins originated with Coronado expeditionaries, rather than with one of the few travelers arriving after 1690. This reasoning reinforces the association of Kuykendall Ruins with Chichilticale.

My team continued metal detecting at Kuykendall Ruins in 2009. On 25 March, the Geronimo range fire burned 2,600 acres in Cochise County, Arizona, including the sites of Kuykendall Ruins and FF:2:6.[10] Six days later, two team members and I conducted field reconnaissance and observed that areas previously occupied by tall sacaton and catclaw had been almost totally cleared by the blaze. During the next several weeks, strong spring winds swept the exposed surface clean, creating a unique opportunity to pull our Blennert sleds across terrain previously inaccessible due to obstructive vegetation. On 19 April, eight team members from three states converged on Kuykendall Ruins and conducted a three-day search of conscientiously selected locations in Ruins Arroyo, Ruins Plain, and Clearings Arroyo. The team employed two Blennert sleds in the gridded search areas, and utilized handheld metal detectors where burned catclaw stumps prevented sledding.

On the north bank of Ruins Arroyo in a burned catclaw thicket, team member Loro Lorentzen discovered an iron staple of the La Isabela style. Two iron staples of this fashion found at Kuykendall had been discovered and reported previously.[11] Figure 1 shows three La Isabela-style iron staples found at Kuykendall Ruins.

Previously I wrote that optically stimulated luminescence (OSL) dating "should be conducted on a significant number of thermal features (piles

Table 1. Lead Isotope Ratios from Coronado Sites

Name of lead shot	Caliber	Lead origin	Pb 206/204	Std. Dev.	Pb 207/204	Std. Dev.	Pb 208/204	Std. Dev.
Kuykendall Gill	0.31	SW Spain (Rio Tinto-Huelva)	18.12780	0.0013	15.59590	0.0011	38.04520	0.0029
Kuykendall Cimarron 57-01	0.33	SE Spain	18.89940	0.0011	15.69280	0.0011	39.15260	0.0037
Doubtful Canyon CZ	0.54	SE Spain (Alhamilla)	18.63580	0.0008	15.68940	0.0008	38.90180	0.0025
Doubtful Canyon 3	0.39	NE Spain (Catalonia)	18.55904	0.0009	15.71299	0.0007	38.79154	0.0019
Doubtful Canyon 4	0.39	NE Spain (Catalonia)	18.49978	0.0017	15.75690	0.0021	38.84021	0.0067
Doubtful Canyon 9	0.39	NE Spain (Catalonia)	18.49489	0.0008	15.70518	0.0008	38.70205	0.0038
Doubtful Canyon 10	0.43	NE Spain (Catalonia)	18.42655	0.0014	15.67229	0.0018	38.55515	0.0062
Hawikku 29	0.54	SE Spain (Cabo de Gata)	18.89900	0.0009	15.71080	0.0009	38.96260	0.0024
Jimmy Owens AT-02	0.43	SE Spain	18.82620	0.0016	15.75100	0.0018	39.03580	0.0059
Piedras Marcadas Small Lead*		SC Spain (Ossa Morena)	17.69383		15.54506		37.86281	

*Isotope ratios by Charles M. Haecker.

of burned rocks) suspected to be Coronado campfires. The number of dates obtained must be sufficient to provide a statistically relevant conclusion."[12] To evaluate the feasibility of expensive OSL dating of a meaningful number of samples, I submitted two burned rock fragments from the ruins for test dating. OSL is sometimes effective in determining the most recent date that a rock reached a temperature sufficient to reset it from geological time. The fragment taken from a buried fire near where the iron bolthead was found (bolthead fire) dated between 1642 and 1712. The fragment from a surface fire near where several iron hooklets were found (hooklet fire) tested as ">9000: insufficient heating." This result means that the hooklet fire rock had not reached a temperature sufficient to reset the geological date. I have suggested that many of the thermal features in the region were "fires of only a brief duration" because they were Coronado Expedition fires. The OSL result for the hooklet fire cautiously supports this assumption. The bolthead fire cannot be excluded as a Coronado fire because post-Coronado visitors may have reheated the rocks.[13] As we cannot make any strong conclusions from these findings, we have delayed any further OSL-dating efforts.

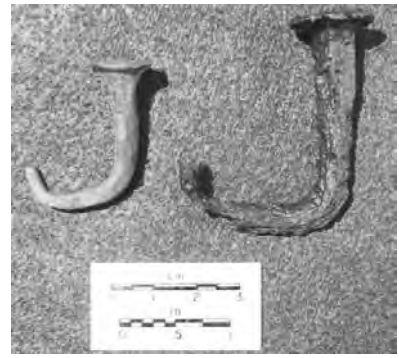
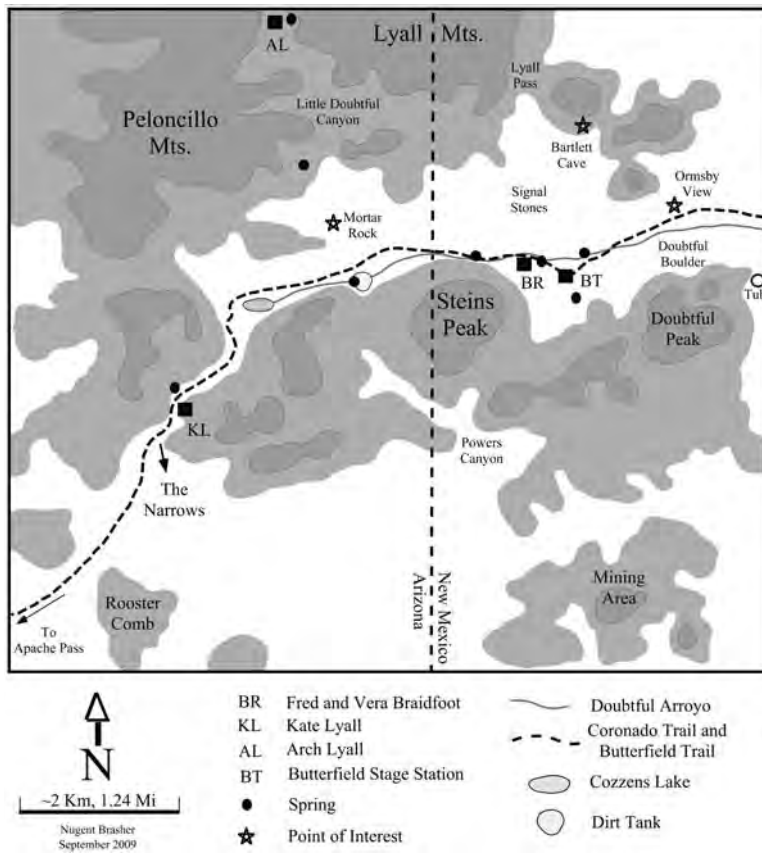


FIG. 1. LA ISABELA STYLE STAPLES FROM KUYKENDALL RUINS
For a discussion of this style see Nugent Brasher, "The Red House Camp and the Captain General," New Mexico Historical Review 84 *(winter 2009): 24 fig.12, 25.*
(Photograph courtesy author)

The Captain General in Doubtful Canyon

My team has found thirteen lead balls at Doubtful Canyon, which is located on the Arizona–New Mexico state line, northwest of Lordsburg, New Mexico. Subsequent analysis of these artifacts has shown that five of these shot are composed of Spanish lead (table 1). That this shot originated in Spain supports assertions suggesting Coronado camped in Doubtful Canyon during his expedition. This discovery was predicted by my original exploration model of the expedition (map 1). In January 2005, my team decided to explore Doubtful Canyon before Whitlock Cienega (Cienega Salada) as the next camp north of Apache Pass. I suspended consideration of Whitlock Cienega after local ranchers, mountain lion hunters, and prospectors declared that a climb onto the Mogollon Rim through the Summit Mountains would have been unattainable for Vázquez de Coronado. These same natives proclaimed that Blue



MAP 1. TOPOGRAPHY AND PLACE NAMES IN DOUBTFUL CANYON IN SOUTHWESTERN NEW MEXICO AND SOUTHEASTERN ARIZONA
(Map by and courtesy author)

Creek is the only place such an expedition could climb onto the Mogollon Rim and proceed toward Cíbola. Compelled by my model, I obtained exploration permission from the private landowners of the canyon, and in February 2005, I began a handheld-metal detector search at the western end of Doubtful Canyon on the Mary Honorhea Braidfoot homestead. On 9 March 2005, I discovered lead shot ID number Doubtful Canyon CZ, which analysis later revealed is composed of Spanish lead (table 1). This single lead shot was the only artifact of interest I found during my few, brief metal detector searches of the western canyon in 2005. In January 2006, my team began exploration at another Coronado site, Kuykendall Ruins, which temporarily suspended any further activity at Doubtful Canyon.[14]

In January 2009, we recommenced our search at Doubtful Canyon. At that time, four Kuykendall Ruins-exploration veterans searched a portion of

the canyon's eastern end, located on the Fred and Vera Braidfoot homestead at a unique spot called *Tsisl-Inoni-bi-yi-tu*, which in the Apache language means "Rock-white-in-water." This locale is appropriately named because geological conditions there cause white, impervious rhyolite lava (ignimbrite) to outcrop in Doubtful Arroyo, creating surface bedrock and forcing water to spring, resulting in white rocks in spring water. I recognized the site in 2005, when my field exploration had discovered a series of six widely spaced piles of white signal stones aligned to indicate an extinct trail from Lyall Pass on the north side of Doubtful Canyon to Doubtful Arroyo. This triumvirate of favorable geological conditions for water, signal stones marking a trail, and an Apache place name recognizing the waterhole, suggested this site is an old, reliable, and well-known fountain, one suitable for the Coronado Expedition and worthy of exploring for signs of the captain general.[15]

During the search at Rock-white-in-water, the team discovered twelve lead shot. Isotope analysis subsequently identified four of these shot as being composed of lead from a Spanish-source location. Closely associated with three of these Spanish lead shot (Doubtful Canyon 3, 9, 10) the team also found seven wrought iron nails. I sent these nails to the South Carolina Institute of Archaeology and Anthropology, where collections specialist James B. Legg examined the pieces and reported their similarities in form, function, and craftsmanship with sixteenth-century nails found at Santa Elena, on modern-day Parris Island, South Carolina (figs. 2–6). The Doubtful Canyon nails also showed similarities to nails found at Bayahá, a sixteenth-century settlement in modern-day Haiti (fig. 7).

Additional exploration at Doubtful Canyon in September 2009 resulted in the discovery of three wide, round-headed, short-shanked tacks. Historian and nail expert Eugene Lyon identified these as *estoperoles*. These nails exhibit

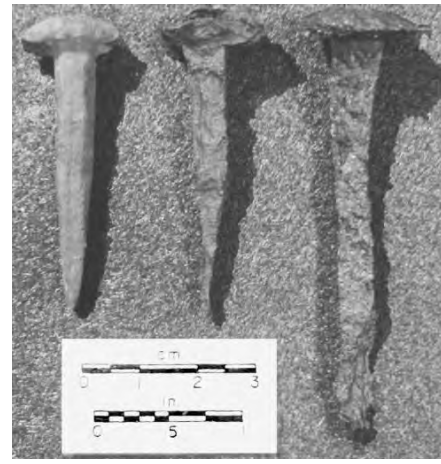


FIG. 2. NAIL COMPARISON
Doubtful Canyon nail on left; Santa Elena nail on right. The nails show great care in bending the excess length into a staple, which with the nail head, forms the equivalent of a rivet.
(Santa Elena nail courtesy South Carolina Institute of Archaeology and Anthropology, Columbia; photograph courtesy author)

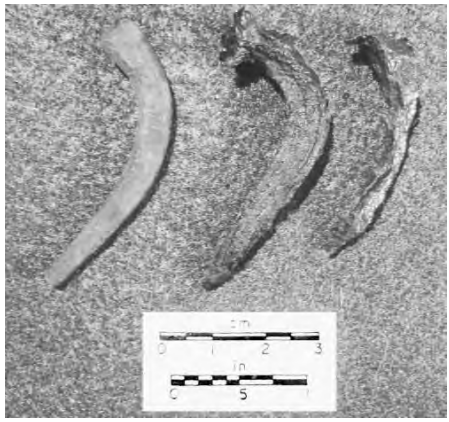


FIG. 3. NAIL COMPARISON
Doubtful Canyon nail on left; Santa Elena nails middle and right. *(Santa Elena nail courtesy South Carolina Institute of Archaeology and Anthropology, Columbia; photograph courtesy author)*

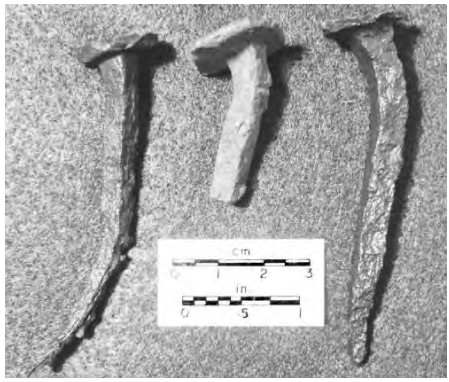


FIG. 4. NAIL COMPARISON
Doubtful Canyon nail on left; Santa Elena nails middle and right. *(Santa Elena nail courtesy South Carolina Institute of Archaeology and Anthropology, Columbia; photograph courtesy author)*

FIG. 5. NAIL COMPARISON
Doubtful Canyon nail in middle; Santa Elena nails on left and right. *(Santa Elena nail courtesy South Carolina Institute of Archaeology and Anthropology, Columbia; photograph courtesy author)*

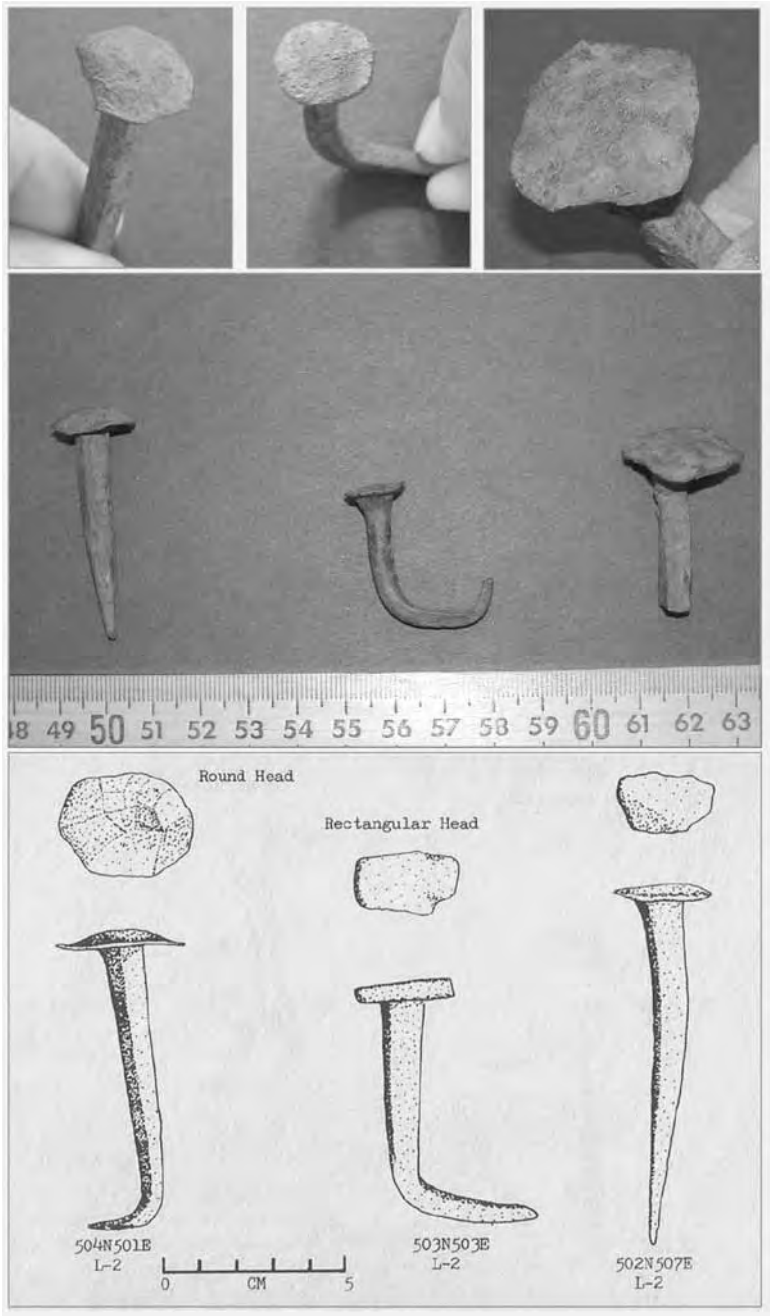


FIG. 6. NAIL COMPARISON

Doubtful Canyon nail on top; Santa Elena nail on bottom.
(Santa Elena nail courtesy South Carolina Institute of Archaeology and Anthropology, Columbia; photograph courtesy author)

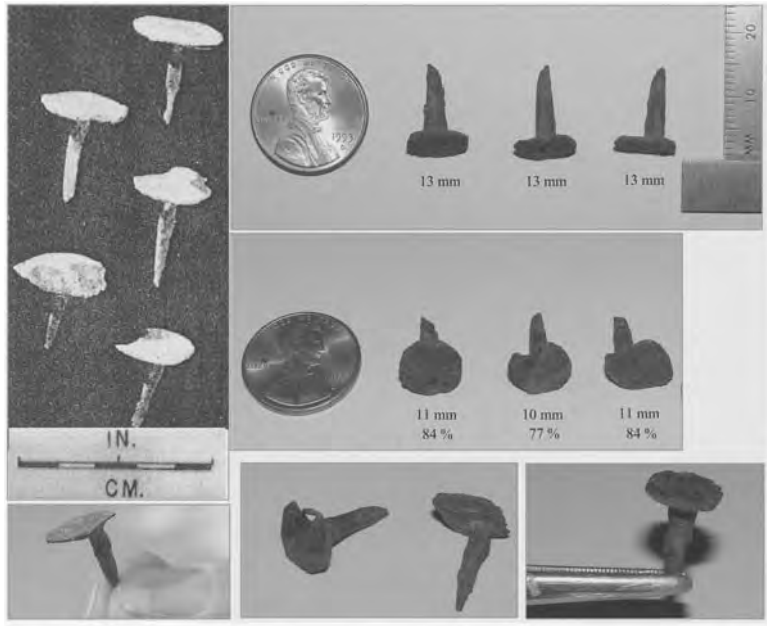


FIG. 7. COMPARISON OF DOUBTFUL CANYON NAILS AND BAYAHÁ, HAITI, NAILS
The nail heads in the top row correspond to the nails in the middle row; all are from Doubtful Canyon. The bottom drawing illustrates nail heads and their corresponding nails from Bayahá, Haiti. *(Photographs in top and middle rows courtesy author; bottom illustration courtesy Kathleen Deagan, ed., Puerto Real: The Archaeology of a Sixteenth-Century Spanish Town in Hispaniola, Ripley P. Bullen series (Gainesville: University Press of Florida, 1995), 409 fig. 12.15, drawing by William Hodges)*

the same characteristics as Spanish-South Carolina tacks dating from 1566 to 1587 that were excavated from Santa Elena. Figure 8 compares the tacks found at Doubtful Canyon to the estoperoles excavated at Santa Elena. The totality of the Doubtful Canyon nails and tacks exhibiting characteristics comparable to such pieces found at Santa Elena and Bayahá, and the five lead shot from a Spanish-source location, plus the close proximity of three Spanish balls to the iron artifacts, offers compelling, tangible evidence that the Coronado Expedition passed through Doubtful Canyon.[16]

The length of the artifact array stretching along Doubtful Canyon indicates the minimum extent of the Coronado camp. Suspected artifacts of the Coronado camp are stretched along 1.87 miles of Doubtful Arroyo's 5.5-mile total length. The Doubtful Arroyo water source is best described as a *laguna*, a term used by ranchers in modern Sonora, Mexico, to indicate intermittent

FIG. 8. ESTOPEROLES
Estoperoles are short tacks with wide round heads. The diameter of the head is about 80 percent of the length of the shank. Top left: estoperoles from Santa Elena, South Carolina. Top right: estoperoles accenting shanks from Doubtful Canyon. Middle: estoperoles accenting round heads from Doubtful Canyon. Bottom row: estoperoles in various positions.
(Illustration top left courtesy Stanley South, Russell K. Skowronek, and Richard E. Johnson, Spanish Artifacts from Santa Elena, Anthropological Studies, no. 7 (Columbia: South Carolina Institute of Archaeology and Anthropology, 1988), 45 fig. 20; photographs top right, middle, bottom row courtesy author)

pools of water in an otherwise dry arroyo. The word *charco* is often used in New Mexico for this geomorphology. A similar setting existed at Kuykendall Ruins (Chichilticale).

Doubtful Canyon would have been an obvious location for the Coronado Expedition. Level grassland east and west of Steins Peak would have nicely accommodated campsites and grazing. Trees provided fuel wood and the arroyo's vegetation was a good source of shade. In late October 1858, newspaper correspondent J. M. Farwell passed through Doubtful Canyon on the westbound Butterfield Stage and recorded the utility of the canyon as an ideal place for grazing livestock along a major trail. He reported that at the stage station, located on the east flank of Steins Peak, was "encamped a very large American train from the west." One mile east of the station were "25,000 sheep owned by a Mexican who is with them on their way to a California market." These sheep were grazing at the same location as the Coronado Expedition's animals over three hundred years earlier, in the level grassland around the Tub and Doubtful Boulder. The sheep Farwell saw would have been watering in Doubtful Arroyo.[17]

The climate Vázquez de Coronado's advance party experienced while at Doubtful Canyon also helps decipher the conditions of their presence in the area. Using the modern Gregorian calendar, we know that the advance party was in the canyon on 3 July 1540. Referencing the climate reconstruction

proposed by dendrochronologist Henri D. Grissino-Mayer, 1540 was a wet year. The Southwest's summer monsoon was likely underway when the party arrived, and it provided water to both the arroyo and Cozzens Lake, creating a fairway of favorable camps beside grassland greening from the rains.[18] The following army passed through the canyon in early October. Being a wet year, Cozzens Lake probably held water, and the arroyo and springs were likely well charged from the monsoon that would have normally lasted into September, but may have extended into October, and the grassland would have been bountiful from the largess of summer rains. The retreating army occupied the canyon on the return journey in late April 1542, after the seasonal winter rains had ended in March. The climate was cold during those years, meaning there might have been winter snow on the canyon mountains, and spring would have brought snowmelt to charge the water supply. Spring grazing would have been on dry grass grown the previous summer or from springtime green shoots. Like Kuykendall Ruins, Doubtful Canyon provided visitors good grazing along an extended linear watercourse, containing fuel wood and shade.

Given the presumed discovery of Chichilticale at Kuykendall Ruins, the location of Doubtful Canyon as a Coronado camp fits the temporal record of travel by the advance party as presented in expeditionary Juan Jaramillo's narrative. Moreover, the artifacts my team discovered at Doubtful Canyon offer tangible evidence of the captain general's presence there. The entirety of this evidence suggests that Vázquez de Coronado first entered modern-day New Mexico on the Julian calendar date of 23 June 1540, and that he did so along a prehistoric Indian trail that, some three hundred years later, became part of the Butterfield Trail.

The history of Doubtful Canyon is essential for the purpose of dating the artifacts found there. In a previous report, I described the region including Doubtful Canyon as being seldom visited by Spaniards. After Coronado, Spanish explorers did not appear in the region until the 1690s; even then they visited an area far southwest of the canyon.[19] Beginning in the early 1780s, however, a number of excursions occurred in the Doubtful Canyon region; historian Alfred B. Thomas reported some of these forays. The diary of Capt. Don Joseph Antonio de Vildósola, detailing his campaign of 1780, reveals the reconnaissance techniques utilized by the Spanish military of that time. According to his diary, the commanding officer ordered scouting patrols to reconnoiter specific locations and then rejoin the main party, thereby examining more terrain than possible with the entire detachment. The map Thomas presents includes his interpretation of the routes traced by the Spanish military expeditions' main parties, but does not include scouting patrols.[20]

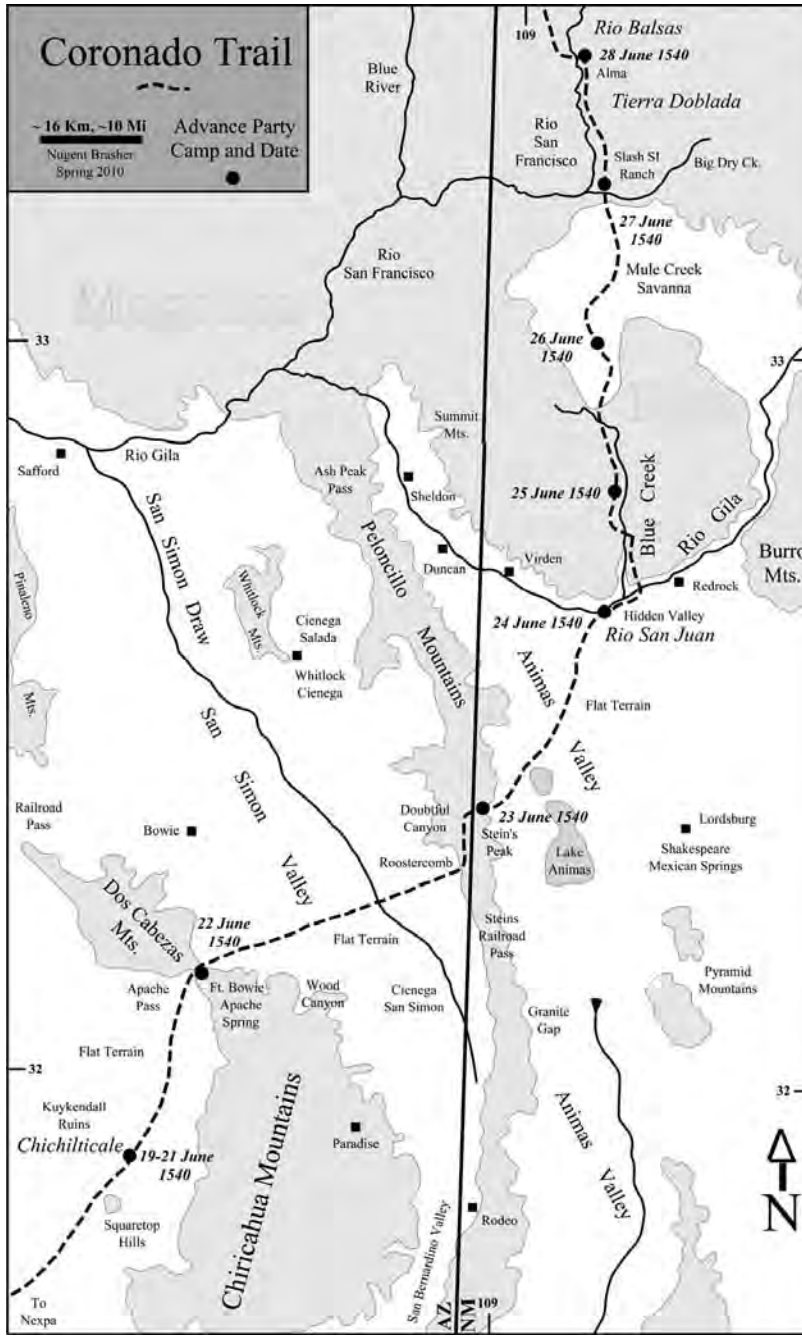
Thomas shows that, in the Doubtful Canyon region, the area east of the Chiricahua Mountains experienced the most traffic from Spaniards. This eastern area includes the San Bernardino Valley, the San Simon Valley, the Peloncillo Mountains, Animas Valley, and the south side of the Río Gila (map 2). Considering the reconnaissance techniques of the Spaniards, and recognizing that Doubtful Canyon was an important passage through the region, Spanish soldiers had probably visited the canyon by 1780, and if not, then did so shortly thereafter. Spanish military and domestic artifacts could be present in Doubtful Canyon as a consequence of two windows of Spanish presence in the region (one dating 1540–1542, the other spanning 1690–1821).

Following independence from Spain in 1821, the Mexican military occasionally visited the Doubtful Canyon region until the mid-century. In 1831 American mountain man David Jackson led a party of eleven men from Santa Fe to California. According to scholar Carl D. W. Hays:

> Each man had a riding mule; there were seven pack mules [and] five of the pack mules were loaded with Mexican silver dollars . . . Their route proceeded from water hole to water hole by way of Doubtful Canyon, Apache Pass, and Dragoon Wash to the San Pedro River just north of present St. David, Arizona . . . This direct route had been traversed in sections over its complete length by various Spanish and Mexican military parties . . . [until 1851] on account of Indian hostilities.[21]

Thus, Mexican military articles dating from 1821 to 1851 could be present in Doubtful Canyon.

After Jackson opened the Doubtful Canyon route, there is no record of any Anglo emigrants traversing the trail again. During the rush to California in 1849, potential prospectors preferred following the Gila Trail, a portion of which led southwest from the south end of the Burro Mountains, New Mexico, to San Bernardino Ranch, Arizona, and then turned west. The Frémont Association was the first recorded party to break from that traditional route. After Pres. James K. Polk confirmed the discovery of gold in California in late 1848, organizations were established to travel there and to engage in cooperative mining ventures. In 1849 the Frémont Association began its trip to California. After reading the historical record, my interpretation is that Frémont's men traveled near Soldier's Farewell Mountain; to the water pools on the northeastern side of the Pyramid Mountains near modern-day Lordsburg; to a dry camp on the western side of South Pyramid Peak; to a crossing of the Peloncillo Mountains near Granite Gap; to the Cienega San Simón (El Sauz); to a San Simón Valley dry camp in the San Simón, Wood



MAP 2. CORONADO TRAIL FROM CHICHILTICALE TO RIO BALSAS IN SOUTHEASTERN ARIZONA AND SOUTHWESTERN NEW MEXICO

Flat terrain refers to mostly level, non-mountainous topography providing easy walking.

(Map by and courtesy author)

Mountain area; to a watered camp in the Wood Canyon area; and to Apache Spring (see map 2). My reading of the record did not favor a passage through Doubtful Canyon. If I am correct in my interpretation of the route, and if emigrants following the Frémont Association traced the same route, then Doubtful Canyon hosted few wagoneer gold rush travelers, suggesting that artifacts of that emigration event should not be expected in the canyon.[22]

Following the U.S.-Mexico War, the treaty-makers at Guadalupe Hidalgo established the boundary between the United States and Mexico on 2 February 1848. The effort to effectuate this boundary brought U.S. Land Commissioner John Russell Bartlett to the Southwest, and he produced an illustrated account of his travels. Using this account, I conclude that Bartlett camped at the foot of Sugar Loaf Hill (Steins Peak) in Doubtful Canyon the morning of 1 September 1851. On 2 September, Bartlett split his party into two groups, deliberately sending the wagons through modern-day Steins railroad pass while he and the pack mules followed Doubtful Canyon to its western side at the Roostercomb.[23]

Despite their presence in the canyon, neither Bartlett nor Jackson brought a wagon through Doubtful Canyon. Possibly their wagons could not maneuver over the terrain. Only later did the first wagons penetrate the canyon, likely in 1857 when the San Antonio and San Diego Mail Company traversed the gorge. The Butterfield Overland Mail Company began operation a year later. Both these lines had stations in Doubtful Canyon. As a meal stop, the Butterfield station maintained a minimum staff, which included a cook and a station master. The station probably included a farrier-wagoner-harness cowboy as well. The presence of a station and personnel represented a sustained occupation of the canyon, and 1857 provides a benchmark for the beginning of an increased American presence in Doubtful Canyon.[24] Wagons and coaches frequented Doubtful Canyon until the Butterfield Overland Mail Company and the San Antonio and San Diego Mail Company ceased operations in the spring and the summer of 1861, respectively.[25] Stagecoaches and freight wagons returned to the region in 1867, however, when the National Mail and Transportation Company established a station at Mexican Springs, renamed Shakespeare in 1879, and operated there until 1881.[26] This Anglo history suggests that metal artifacts representing eighteen discontinuous years of stagecoach and freight wagon traffic should be expected in the canyon.

An increasing American military presence began in Doubtful Canyon in 1861. The Bascom Affair of that year initiated war with the Apaches and resulted in the construction of Fort Bowie in Apache Pass, Arizona, in 1862. Between February 1862 and December 1864, various companies of the Union California Volunteers Fifth Regiment were stationed at both Fort Bowie and

Fort Cummings, New Mexico. In 1871 Pres. Ulysses S. Grant sent a peace commission to Arizona Territory with orders to establish Indian reservations. Within a year, five reservations had been designated. Not all Apaches elected to move onto reservations, however, and openly resisted military attempts to engage them and to corral them onto reservations. By 1877 conflict had erupted between the U.S. military and the Apaches. The conflict lasted until a peace treaty in 1886, and Fort Bowie was subsequently abandoned in 1894.[27] Throughout the thirty-three years warring with Apaches, the U.S. military infrequently, but periodically, visited Doubtful Canyon. Metal military objects from this period should be expected in a representative sampling of discovered artifacts.

A Mr. Gould was the first Anglo-American resident of Doubtful Canyon, arriving before 1902. He created a dugout in the side of the canyon in the narrows at a spot of permanent surface water. As early as 1902, and before 1910, Margaret Catheryn Eshom Lyall, at that time in her fifties and known as Kate, bought the Gould dugout and moved into Doubtful Canyon. Her homestead was patented on 24 June 1924. In 1912 Elmer Archer Lyall, known as Arch, joined his mother Kate and patented his Little Doubtful homestead in May 1924. By 1914 Fred and Vera Fuqua Braidfoot had arrived in the canyon; they patented their land in 1919. Arch Lyall moved to San Simón in 1922, leaving his Little Doubtful ranch unoccupied. Kate Lyall remained in Doubtful Canyon until May 1928. No Lyall lived in the canyon after Kate left; only the Braidfoot family remained. Mary Honorhea Braidfoot, daughter of Fred and Vera, patented a homestead west of her parents in 1937, the same year her father died. Widow Vera lived until 1953. Four years later, Honorhea, the only surviving Braidfoot, died, causing both Braidfoot homesteads to be abandoned, leaving Doubtful Canyon empty of human occupation.[28] The homestead period in the canyon lasted from about 1900 to 1957 and included three home sites. Consequently, homestead-era artifacts should be expected in the canyon.

Historical artifacts expected in Doubtful Canyon lend themselves well to temporal categorization. Given that artifacts discovered in Doubtful Canyon were not transported there by secondary bearers, the following assessment seems reasonable. If Coronado were truly present with his hundreds of metal bearers, there should be an expectation of finding domestic and military artifacts from 1540 to1542. My team found seven nails and three tacks that are representative in form, function, and craftsmanship of this period. We also discovered five shot composed of Spanish lead and interpreted them to be from the sixteenth century. Few Spanish pieces dating between 1542 and 1780 should be expected because the Spanish presence in the region

was slight. Spaniards may even have been absent from the area altogether. Spanish military pieces dating between 1780 and 1821 could be present, but should not be expected because the Spanish presence was minor, considerably less than the number of metal bearers in the various Coronado parties. Likewise, Mexican military pieces dating from 1821 to 1849 could be present, but since Mexican presence was slight, such artifacts should not be anticipated. Supporting this contention, my team found no iron objects that could conclusively be identified with the post-Coronado Spanish or Mexican periods, and, most notably, isotope analysis found no conclusive Mexican lead among the thirteen shot found in the canyon, lending support to the scarcity of post-Coronado Spanish or Mexican visitors. American passenger and freight artifacts dating from 1857 to 1894 should be anticipated. American military artifacts should be expected to range in dates from 1861 to 1894. My team found American military and civilian personal items dating from 1850 to the twentieth century, as well as wagon bolts, barrel straps, horse and mule shoes, and cut and wire nails. Homesteader artifacts should date from shortly before 1902 until 1957, and, as expected, the area is littered with samples from that period.[29]

Of consequence to artifact dating, the historical calendar suggests that any domestic Spanish artifact, available in the sixteenth century, cannot be excluded as possibly being from the Coronado Expedition inventory. In favor of Spanish artifacts found in Doubtful Canyon being of a Coronado origin is that the variety and number of metal bearers with Coronado, if he passed through the canyon at all, far exceeded the total of all subsequent Spanish metal bearers, reinforcing the suggestion that any Doubtful Canyon Spanish artifact, especially if it is domestic in nature, is more likely than not a residual of the expedition. This association becomes even more probable as the number of domestic items increases.

The evidence of Spanish lead, when added to the history of the canyon and to the presence of the compelling nails and tacks, significantly strengthens the likelihood of these being vestiges of the sixteenth-century adventure and the concomitant likelihood that Doubtful Canyon was a campsite along the Coronado Trail.

The current exploration model predicts that from Doubtful Canyon, Vázquez de Coronado crossed sparse grassland to the Río Gila to camp at Hidden Valley the night of 24 June 1540. Hidden Valley hides between two major box canyons. It is an "only" spot—the only place travelers can reach or depart the river on *both* sides to proceed in a direction other than alongside the river. This forces the regional trail to be there. The northern *salida* from Hidden Valley is Blue Creek, which joins the Río Gila from the

Table 2. Doubtful Canyon Artifacts Identified by James B. Legg

ID	Legg identification	Period	Likely origin	Comment
1	Nail	Sixteenth century or later	Coronado Expedition	Essentially identical to nails in Santa Elena collection
2	Nail	Sixteenth century or later	Coronado Expedition	Essentially identical to nails in Santa Elena collection
3	Nail	Sixteenth century or later	Coronado Expedition	Essentially identical to nails in Santa Elena collection
4	Nail	Sixteenth century or later	Coronado Expedition	Essentially identical to nails in Santa Elena collection
5	Nail	Sixteenth century or later	Coronado Expedition	Essentially identical to nails in Santa Elena collection
6	Iron scissors fragment	Post-sixteenth century	Post-Coronado Spanish, Mexican, or American	Hand-cut decoration; finish too nice for common sixteenth century
7	Nail	Sixteenth century or later	Coronado Expedition	Essentially identical to nails in Santa Elena collection
8	Nail	Sixteenth century or later	Coronado Expedition	Essentially identical to nails in Santa Elena collection
9	Military button	Mid-nineteenth century	American military	1854 enlisted men's button; classic Federal button
10	Sash buckle tongue	Mid-nineteenth century or later	American military	Stamped brass; officers ornamental cloth waist belt
11	Two-piece civilian button	Nineteenth century	American civilian	Geometric designs
12	Unknown			
13	Unknown			
14	Four-hole military button	Civil War	American military	Sheet iron; Federal trouser button
15	Four-hole military button	Civil War	American military	Sheet iron; Federal trouser button
16	Unknown			Hand wrought
17	Unknown			Hand wrought
18	Chain links	Nineteenth century	American military or civilian	Cylindrical wire stock
19	Wire pin	Post-sixteenth century	Post-Coronado Spanish, Mexican, or American	Iron
20	Unknown			Embossed decoration on metal
21	Tack buckle	Eighteenth–twentieth century	Post-Coronado Spanish, Mexican, or American	Style of Civil War saddle bags
22	Spoon bowl	Eighteenth or nineteenth century	Post-Coronado Spanish, Mexican, or American	Pewter
23	Bullet	Nineteenth century	American military or civilian	Flattened, large caliber, conical

north, providing a corridor pointing toward Cíbola. After two days of travel through meager grassland, Vázquez de Coronado reached the Mule Creek savanna north of Blue Creek, extending northward to the Slash SI Ranch on Big Dry Creek. There the grass disappeared and the terrain became *doblada* (up-and-down) until the expedition reached Alma, New Mexico, on the Río San Francisco (another "only" spot, and the location of the celebrated Río Balsas crossing). From Hidden Valley to Alma, the trail lay almost exactly due north. This route was predicted in January 2005 and remains in effect after two apparent affirmations of the exploration model. Our current exploration proceeds along this trace.[30]

The Trail to Nuevo México after Coronado

Lead isotope analysis concluded that Spanish and Middle New World lead were used to make shot found at both Hawikku and at Piedras Marcadas in Tiguex, and that midwestern U.S. lead was found in a ball from Kyakima. The post-Coronado history of the land within modern-day New Mexico provides insight into who most likely carried the Spanish-lead balls. There were multiple sixteenth-century Spanish expeditions into New Mexico. Only about forty years separate the departure of Vázquez de Coronado from Río Arriba and the arrival of the Chamuscado-Rodríquez and the Espejo-Beltrán parties, and only about fifty-six years separate Vázquez de Coronado from the arrival of Juan de Oñate in New Mexico in 1598. All of these parties carried sixteenth-century objects. Differentiating these later Spanish parties from the Coronado Expedition, however, is the likelihood that they carried lead from northcentral Mexico rather than Spanish or Tarascan lead. By examining the routes and the duration of presence of post-Coronado Spanish explorations into New Mexico, I will show that Spanish shot found in New Mexico almost certainly originates with Vázquez de Coronado and his men.

In 1546 Spaniards discovered a bonanza of mineral wealth at Zacatecas, Mexico. Historian John Francis Bannon states that the discovery made Zacatecas the "first boom town" in North America:

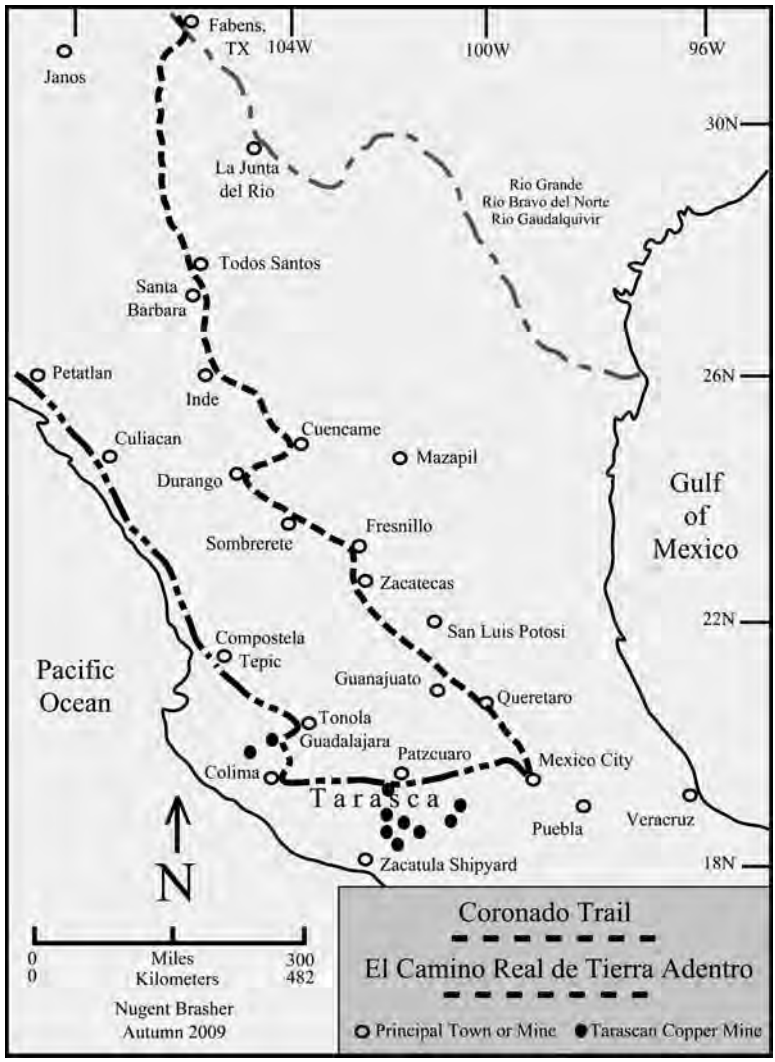
> Other [mining discoveries] followed in quick succession—some along the eastern face of the Sierra Madre, such as Guanajuato [in 1559] and Aguas Calientes [in 1575], and farther to the east on a line northward from Querétaro, such as San Luis Potosí [in 1592] and Mazapil [in 1569]. . . . A new province, Nueva Vizcaya, was established in the early 1560s [with Durango as its capital]. . . . From Durango the Spaniards pushed . . . into [modern] Chihuahua . . . to Santa Bárbara [founded

> in 1567 and located fifteen kilometers southwest of modern Hidalgo del Parral]. This last outpost, on the headwaters of one of the tributaries of the Río Conchos [and where silver had been discovered in 1567], was the center from which several expeditions to the farther north pushed out in the 1580s, expeditions which set the stage for the occupation of New Mexico.[31]

Historians George P. Hammond and Agapito Rey described Santa Bárbara as "the most renowned spot on the northern prong of Spanish advance in Mexico. It was the magnet that attracted a swarm of frontiersmen . . . [It was] the end of the line . . . and the home base for fitting out new prospecting ventures."[32] Fittingly, Santa Bárbara was the northern terminus of the *Camino Real de Tierra Adentro* (Royal Road of the Interior Land) (map 3).

Following the Coronado Expedition, Spaniards that arrived at Hawikku or Tiguex traveled after the discovery of silver at Zacatecas in 1546. These northbound Spaniards would have followed the Camino Real, the supply-line road of the central corridor of Mexico that connected the rich mines in Querétaro to Santa Bárbara, in the new northern province of Nueva Vizcaya. In 1550 construction began on the *Camino de La Plata*, the stretch of the Camino Real; running between Querétaro in the south and Zacatecas in the north. By 1552 this trade route accommodated carts and wagons. In 1582 a traveler described the road as "through the mines of Zacatecas." Lead was a valuable byproduct of mining along the Camino de La Plata.

Francisco Vázquez de Coronado did not travel the Camino Real (see map 3). The Coronado Expedition departed west from Mexico City toward Compostela. Castañeda de Nájera described the route in his report of the travel of viceroy Don Antonio de Mendoza to Compostela: "[He] departed for Compostela accompanied by many caballeros and noblemen, and he had New Year's Day of 1540 in Pasquaro (Pátzcuaro) . . . [and from there] he crossed all the land of Nueva España to Compostela." The route to Compostela passed through northern Tarasca (the modern-day states of Jalisco and Michoacán), and it is almost certain that the expeditionaries moved along a pre-conquest Tarascan trail connecting trade, administrative centers, and copper mines. From Pátzcuaro the route continued west to Colima. There the trail turned north to pass through another region of Tarascan copper mines, the farthest northwestern outposts in Tarasca, before reaching Compostela. Between Compostela and San Miguel de Culiacán, the northwestern outpost of New Spain, the trail hugged the coast, passing west of the future mines in Sinaloa. Map 3 shows that, by virtue of their route, members of the Coronado Expedition were likely exposed to many opportunities to acquire lead from Tarascan sources.[33]



MAP 3. CORONADO TRAIL AND THE CAMINO REAL DE TIERRA ADENTRO IN MEXICO

The route traveled by Vázquez de Coronado passed through Tarasca, thereby offering the Coronado Expedition access to lead from the Tarascan copper mines. The Camino Real did not enter Tarasca, so Tarascan lead was likely not carried by travelers tracing that route. *(Map by and courtesy author)*

Sixteenth-Century Spanish Explorations of New Mexico after Vázquez de Coronado

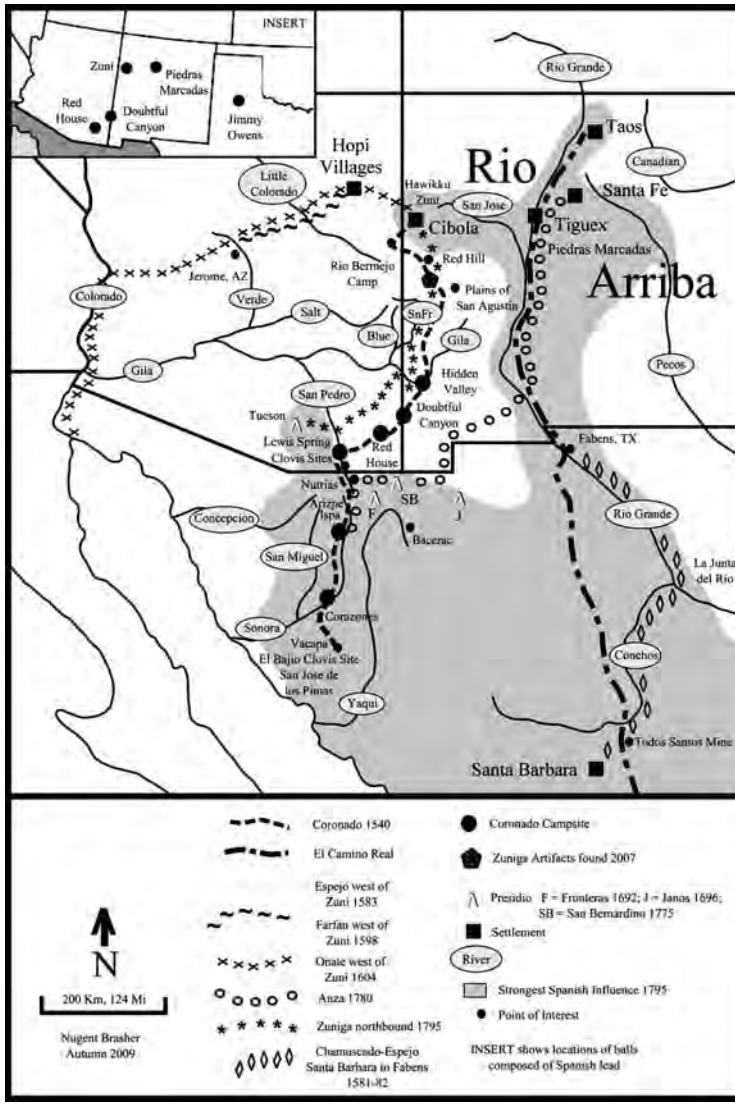
Chamuscado-Rodríquez and Espejo-Beltrán parties

On 5 June 1581, a hopeful group of thirty-one Spaniards, led by Francisco Sánchez Chamuscado and Franciscan Augustín Rodríquez, departed Santa Bárbara (see map 4). First, they followed the Río Conchos in Mexico downstream to its junction with the Río Guadalquivir (Río Grande); then they traveled up that river to the pueblos in the upper valley in the region of Río Arriba; and finally they trekked west to Hawikku. The party drove six hundred head of stock and ninety horses while transporting trade goods.

Reaching Tiguex about 1 September, Chamuscado did not linger there, and instead continued north and then east to the buffalo country of eastern New Mexico, before returning to Tiguex in Río Arriba. At the beginning of this eastward trip, around 10 September, fray Juan de Santa María attempted to return to New Spain, but was killed by Indians after only two or three days traveling south. After returning to Tiwa country, the party then explored to the west, appearing in Zuni on 15 December, where they stayed for an unknown period of time, probably measured in days rather than weeks.[34] Chamuscado again returned to Tiguex and then proceeded to the southeast to observe some reported salt deposits, after which he again returned to Tiwa country. As with his sojourn in Zuni, Chamuscado stayed for a short period of time in Tiguex, almost certainly less than two weeks.

On 31 January 1582, Chamuscado departed Río Arriba to return south without the two remaining friars who opted to remain in Tiguex. At this time, Chamuscado was ill and was being bled by his companions. He died on the trail. On Easter Sunday, 15 April 1582, the small party reached Santa Bárbara. Immediately, Hernán Gallegos, an expedition member, rushed to Mexico City with news of the adventure. Included in his report was that "the land is flat and can be traveled on foot or on horseback with pack animals, and it is suitable for wagons."[35]

Franciscan authorities in Mexico City expressed alarm upon learning that one friar had been killed and the other two friars had opted not to return with Chamuscado. In response fray Bernardino Beltrán organized a rescue party, financed by the wealthy Antonio de Espejo. On 10 November 1582, a group of about forty travelers, including some twelve to fourteen soldiers, fray Beltrán, and "captain" Espejo, departed Santa Bárbara via the Río Conchos route. One hundred fifteen horses and mules, plus arms and munitions, traveled with the party. Before reaching Tiguex in mid-February 1583, Espejo had already learned that the two friars had been killed. Espejo found that the



MAP 4. NORTHERN NEW SPAIN 1795

Trails and routes from Mexico to Rio Arriba are shown on the map. Captain José de Zúñiga reached Zuni in 1795, following the Coronado Trail between Hidden Valley and Red Hill. He was the first Spaniard to arrive there from the southwest since the Coronado Expedition 255 years earlier. The history of isolation of the stretch of the Coronado Trail between Lewis Spring and the Rio Bermejo campsite suggests that any Spanish lead found along that part of the route is more likely a product of the Coronado Expedition than from later Spaniards. The numerous Clovis artifacts found along the Coronado Trail from Vacapa to Lewis Spring suggest that the route was old and well established.
(Map by and courtesy author)

Pueblos had abandoned Tiguex, probably because they feared retaliation by the advancing Espejo party.

Despite objections by Beltrán, Espejo used his time in the northern periphery for financial gain by prospecting for minerals as far west as the central region of modern-day Arizona. At the end of February, the explorers left the Río Grande north of Tiguex, near modern-day San Felipe, and turned west. They passed through Zia and Acoma Pueblos before reaching Hawikku on 15 March 1583. About three weeks later, Espejo and nine soldiers departed Hawikku and continued west, while Beltrán remained in Hawikku with most of the expedition. Espejo passed through the Hopi pueblos in his search for mines. On 30 April 1583 at Aguato (Awátovi), the Espejo group partitioned into two parties of five men. One party continued west towards modern-day Jerome, Arizona, where the Indians showed Espejo mines. The other party, including "friendly Indians," returned to Zuni. Espejo was back at Zuni on 17 May 1583. He returned using a different route because he wanted to observe and appraise the land. Traveling on this alternate path, Espejo found a more level route from Zuni to the mines. In modern Zuni (then called Halona), he learned that the five soldiers who returned from Aguato "had not yet met the father or the other five companions." Nevertheless, Beltrán was there with some three to five soldiers plus another two dozen people. They had spent two months in the Hawikku-Zuni area, making their visit the longest of any Spaniards since Vázquez de Coronado withdrew from the area in 1542 with 1,550–2,350 people and approximately 6,220 livestock.

Nine days after Espejo returned to Zuni, Beltrán resolved to return south to the "land of peace." Despite the objections of Espejo, the friar and about thirty followers headed toward Santa Bárbara shortly after 26 May 1583. A few days later, on 31 May, Espejo, with eight fighting men and some servants, also began the return trek to Santa Bárbara. Espejo likely retraced his route to Acoma, and near there his party skirmished with local Querecho Indians. Continuing on the party reached Tiguex on 19 June 1583. The trail between Acoma and the Río Grande near Puala Pueblo (Puaray) was new to Espejo because he had not followed that route on his journey toward Zuni. As for Beltrán, Hammond and Rey report that he and his followers "reached Santa Bárbara, safe and sound, before Espejo's group, but we have no record of their journey." Espejo remained in Tiguex only a few days, during which time he burned Puala Pueblo before he headed east to Pecos. On 5 July 1583, Espejo departed Pecos and turned south, forging a new trail to the Río Conchos, via the Río Pecos, reaching Santa Bárbara on 10 September 1583.[36] The sum total of Espejo's time in Tiwa country was about two weeks.

Gaspar Castaño de Sosa

On 27 July 1590, the expedition of Gaspar Castaño de Sosa departed Almadén (modern-day Monclova, Coahuila, Mexico). He was accompanied by more than 160 men, women, and children and their livestock, which included more than 250 oxen. The party's convoy contained at least ten carts bound for Río Arriba, an area the travelers fully intended to colonize. Castaño had sought permission from the viceroy for his expedition, but he had been denied; nevertheless, he proceeded defiantly with his plan. About 10 March 1591, by way of west Texas, eastern New Mexico and Pecos Pueblo, the party reached modern Santo Domingo, New Mexico, where they established a center of operations. Castaño's people were the first Spaniards to venture north employing wheeled carts. With twenty men, possibly on 12 March, Castaño rode south in search of mineral deposits. He reached the Río Grande near modern-day Bernalillo on about 13 or 14 March. He crossed the river for a brief visit before returning to the east side and turning south. On 14 or 15 March, Castaño ordered thirteen of his men to return to Santo Domingo. During the next two days, the eight remaining Spaniards visited Pueblos on both sides of the river near modern-day Alameda and Corrales. They passed one night on the west side of the river, possibly at or near Piedras Marcadas. On 15 or 16 March, Castaño began his return along the east side of the Río Grande to Santo Domingo. Upon return his unauthorized adventure crumbled when Capt. Juan Morlete arrived with fifty men to arrest Castaño and his people. As per the viceroy's orders, Morlete impounded all the expedition's goods and brought them back to Mexico City. The total elapsed time of Castaño's presence in Tiguex was less than a week. Castaño, of course, never reached Zuni.[37]

Gutiérrez de Humaña and Francisco Leyva de Bonilla

Following Castaño de Sosa by three years, the unauthorized party of Antonio Gutiérrez de Humaña and Francisco Leyva de Bonilla and an unknown number of followers settled in Río Arriba at San Ildefonso Pueblo. The Spaniards traveled among the pueblos for a year. While it can be presumed that they likely visited Tiguex, there is no record of them visiting Zuni. Since the party was looking for mines, however, it is reasonable to consider that they may have traveled to Zuni.[38]

Juan de Oñate

On 26 January 1598, when colonist Juan de Oñate departed the Río San Gerónimo near the Todos Santos mines, he rejected the traditional route and followed another trail to Río Arriba. Historian Marc Simmons suspects

Oñate chose an alternate route because Spanish "slaving expeditions raiding [Indian] villages" along the Río Conchos had provoked hostility among the Native inhabitants of the river valley. Riley described the route: "[Oñate] struck out from a base in northern Chihuahua in a northwesterly direction, roughly following the line of modern Mexican Highway 15, but intercepting the Río Grande somewhat to the south and east of modern El Paso." Geographer Hal Jackson offers three places where Oñate could have crossed the Río Grande—all near modern-day Fabens, Texas. Oñate then followed the Río Grande to Río Arriba.[39]

Anthropologist David H. Snow reports that Oñate was joined by between 560 and 700 persons, mostly men, on his journey. Using Hammond and Rey's translations of the Spanish documents covering the expedition, I counted 8,149 animals traveling with the group. Oñate's advance party reached Tiguex by 24 June 1598, and, finding the country mostly deserted, the colonists arrived at Santo Domingo on 30 June, where they established their first settlement. The carts and wagons arrived on 18 August, and that date marks the greatest concentration of Europeans and their provisions in Río Arriba since the Coronado Expedition. The date also marks the beginning of the flood of European articles into the region.[40]

On All Saints Day 1598, on his expedition to discover the South Sea, Oñate first arrived in Zuni. He and his military party reached Hawikku on 3 November, remaining until 8 November. During that time, Capt. Marcos Farfán de los Godos traveled to Zuni Salt Lake. Afterward, the party continued west to the Hopi villages where Oñate was told of people to the south who painted their bodies with colors of the earth. Oñate sent Captain Farfán to investigate while Oñate returned to Hawikku about 23 November 1598. On 11 December, Farfán reported to Oñate that he had found silver mines. The following day, due to the coming winter and concern for his party, Oñate abandoned his quest for the South Sea and departed Zuni for Río Arriba. The Oñate party had frequented Zuni for a period of about three-and-a-half weeks. Six years later, in October 1604, Oñate returned to Zuni on his second attempt to reach the South Sea. Accompanying Oñate were two friars, a military captain, and thirty soldiers. The party found four of the six Zuni Pueblos in ruin, but inhabited, with Hawikku being the principal Pueblo. Oñate successfully reached the mouth of the Río Colorado where it enters the Sea of Cortés, which he believed to be the South Sea. In April 1605 the party passed through Zuni on its return to Río Arriba. Oñate likely spent less than five total weeks in Hawikku during his respective journeys in 1598, 1604, and 1605.[41]

Don Juan Bautista de Anza, Don Manuel de Echeagaray, and José de Zúñiga

Colonization of New Mexico and conversion of local Indians began when Oñate arrived at Río Arriba in 1598, even though missionaries were not sent to Zuni until 1629. That year fray Francisco de Porras and fray Roque Figueredo founded a church at Hawikku. Four years later, the Zunis killed two missionaries and some soldiers, forcing the Spaniards to abandon the mission. By 1643 the Spaniards had returned to Hawikku and the Zunis helped rebuild the mission. Only in 1670, when Apaches killed the missionary, did the Spaniards abandon Hawikku forever. The mission at Zuni lasted a further decade, until the Pueblo Revolt of 1680, when the missionary was killed. In 1699 the Spaniards built a new church, but the Hawikku mission was not recreated because the Zunis adopted a more compact settlement. After 1700 military and religious traffic increased between Río Arriba and Zuni, although the Pueblo remained far removed from Spanish, then Mexican, and finally Anglo influence.[42]

In 1780 Gov. Don Juan Bautista de Anza was credited with blazing a trail from Santa Fe to Arizpe, in modern-day Sonora, Mexico. The route followed the Río Grande southward to near modern-day Hatch, New Mexico, then southwest to the New Mexico Bootheel, then west to Las Nutrias, and, finally, south to Arizpe. The Anza route stayed south and east of the Coronado trail that passed through modern-day southeastern Arizona and western New Mexico.[43] Seven years after the Anza adventure, Don Manuel de Echeagaray attempted to "open a route which would facilitate the exchange of goods [between Sonora and Santa Fe]." Using Hammond and Rey's summary of Echeagaray's excursion, I have attempted to reconstruct his route. I estimate that the party reached the plains of San Agustín, near Horse Springs, New Mexico, before backtracking to Apache Creek and turning north to reach Hardcastle Gap in New Mexico, before returning to the southwest.[44]

In 1795 Capt. José de Zúñiga arrived at Zuni from the southwest, the same direction as had Vázquez de Coronado, rather than from the central corridor. Zúñiga's party was exploring for a road connecting the Spanish colony at Tucson, Arizona, with Río Arriba (see map 4).[45] At Zuni Zúñiga reported a missionary in the "Pueblo de Nuestra Señora de Guadalupe de Zuni." Zúñiga also mentioned departing Zuni to the southwest and camping at "an abandoned pueblo known as el agua caliente del Pueblo antiguo de Zuñi," likely Hawikku. Zúñiga did not proceed east of Zuni.[46]

Firearms and Lead in Río Arriba and Zuni, Post-Coronado

Motive, means, and opportunity should be addressed when considering lead shot found in Río Arriba and Zuni. Written history reveals that balls of Middle

New World or Spanish lead could have appeared at Hawikku and Tiguex as soon as forty years after Coronado. Evidence supports the likelihood that one or all of the Chamuscado-Rodríquez, Espejo-Beltrán, and Oñate parties carried firearms and lead and discharged their weapons at Zuni. Some Hawikku visits were lengthy and offered greater opportunity to leave shot there. Beltrán and some two dozen people, including several soldiers, remained at Hawikku-Zuni for two months, while Espejo roamed to the west in 1583. Shot from that visit are possible at Hawikku. The Oñate visit to Hawikku in 1598 lasted over three weeks, followed by other visits of unknown duration in 1604 and 1605, and shot could have come from those occasions. Other lead balls could have appeared at any time after Oñate arrived in 1598.

After Coronado departed and before Oñate arrived, opportunities for lead carried by Spaniards to appear at Tiguex occurred during brief visits by a few people. The thirty-one members of the Chamuscado-Rodríquez party were there less than two weeks; Espejo-Beltrán and his group of forty were there about two weeks; and Castaño, with twenty or fewer men, was there less than a week. Humaña was likely at Tiguex, but with an unknown number of people for an unknown length of time. Although lead found at Tiguex could have originated with any of these travelers, the Oñate colonization of New Mexico provided an even greater opportunity for lead to appear in Tiwa country. Given the presumed wide range of the colonists, lead from those settlers could be the source for shot found at Tiguex.

The written record of these expeditions is rife with references to arquebuses. Testimony by Chamuscado-Rodríquez expedition members Pedro de Bustamante and Hernando Gallegos, for example, states that each person carried arquebuses and that such firearms had been used to kill buffalo. Gallegos wrote, "We fired quite a few arquebus shots, at which the natives were much frightened," and "the arquebuses roared a great deal and spat fire like lightening," and "[Pedro de Bustamante] picked up a bit of hay, started a fire by means of an arquebus, and prepared to burn the pueblo." Historian John Kessell reports that on occasion, the Spaniards of the Chamuscado-Rodríquez party "inspired both respect and friendship by firing their arquebuses." Gallegos reported that when the Chamuscado-Rodríquez expedition arrived back in Santa Bárbara, "we were well received . . . and given a warm welcome. We fired a salute to the town with our arquebuses." The Espejo party also employed arquebuses on their expedition. Kessell writes, "The Spaniards camped two arquebus shots away [from Pecos] . . . When they asked for food, the natives . . . pulled up their ladders and refused to come down . . . Espejo and five soldiers, threatening to burn the place, entered and began firing their arquebuses in the plaza and streets." Castaño reported that the

raising of the cross at pueblos in Río Arriba was accompanied by "the sound of trumpets and arquebus shots." Simmons writes that during a festival for the dedication of Oñate's church at San Juan Bautista in September 1598: "At week's end, the festival concluded with a thunderous volley of artillery." These examples illustrate that Spaniards frequently discharged arquebuses—and thus distributed lead shot—at many sites in Río Arriba and Zuni, and for a variety of reasons.[47]

The inventory of materials carried by the Oñate party reveals the importance of lead and firearms to the expedition, as well as information on where at least some of the lead was obtained: "[On 9 February 1597], at the mines of Todos Santos, the governor [Oñate] presented [to the inspector] 100 quintals of lead. It had been bought from Diego de Zubía, alcalde mayor." On 3 January 1598, an inventory found that only seventy-eight quintals and eight pounds of lead remained. About three weeks later, after the final inspection, the Oñate Expedition departed Arroyo San Gerónimo, north of Santa Bárbara. On the second day of the march the expedition passed by El Torrente de la Cruz and reached "the mouth of the Todos Santos mine," where the party spent the night. Jackson provided a verbal location for these mines, and I understand them to be about forty kilometers north of modern Parral, Chihuahua. Although there are no records confirming these facts, it is not inconceivable that Oñate bought still more lead at Todos Santos. If he did not, then the last recorded amount of lead carried by Oñate was 17,168 pounds, all from Todos Santos mine.[48]

In addition to the lead for the unified expedition, individual members carried personal lead and powder. Expedition members made references to the equipment they took on the Oñate Expedition, including "two molds and a gunner's iron ladle for making balls"; "eight pounds of ammunition"; "twenty-five pounds of powder"; "two pounds of powder and four of shot"; "half an arroba (~12.5 lbs.) of powder"; "one barrel of powder containing about half a quintal (50 kg, 110 lbs.)"; "twenty-five pounds of lead"; "one mold for making shot"; "twenty-five pounds of lead made into bullets and buckshot"; and "one arroba (25 lbs.) of powder and half an arroba (~12.5 lbs.) of ball." The records include numerous instances of expedition members carrying tools for gunsmithing.[49]

This evidence provides the means for lead shot and firearms to arrive from Mexico, as well as a motive for the discharge of them, as early as 1581, and the consequential opportunity for lead shot to appear at Hawikku and Tiguex. The reports show that Oñate purchased Todos Santos lead near Santa Bárbara. Consequently, Santa Bárbara, then, provided a potential source of lead to any northbound traveler.

Respecting the written history, the availability and use of firearms, and the convenience of lead mines along the road, I reasoned that although the early Río Arriba explorers, or those even later, could not be excluded as the bearers of the Spanish lead balls from Hawikku and Piedras Marcadas, that it was most likely these late sixteenth-century adventurers carried Middle New World lead, particularly Mexican, rather than Spanish shot. The shortage of lead that existed in Spain at that same time, coupled with irregular maritime transportation, suggests that Spanish lead was probably not exported to Mexico. As for the source of the late sixteenth-century explorers' Middle New World lead, it seems reasonable that lead arriving in Río Arriba after Coronado was more likely from northcentral Mexico than from Tarasca or Central America because of the different travel route. Moreover, lead from northcentral Mexico was probably unavailable to the Coronado Expedition. He did, however, travel through the Tarascan mining region and could have obtained lead along that route. Given these parameters, just being able to confidently identify Tarascan lead (Coronado route) and northcentral Mexico lead (post-Coronado route) provides compelling evidence for assigning a relative date to balls of Mexican lead.

Unfortunately, lead isotope analysis was inconclusive as to whether the two Middle New World lead shot found at Hawikku and the single Middle New World ball found at Piedras Marcadas were specifically Tarascan, northcentral Mexican, or Central American because the shot appears among all three imprecisely bounded isotope populations. Consequently, I cannot assign the Middle New World lead found at Hawikku or Piedras Marcadas to a particular expedition or event—it may or may not be from the Coronado Expedition. On the other hand, because of historical reasons, I am confident in assigning the Spanish lead found at Hawikku and Piedras Marcadas to the Coronado Expedition.

Temporal Interpretation of Artifacts

The written history of post-Coronado Spaniards arriving in Río Arriba impacts any temporal interpretation of metal artifacts found in that region. Given that only about forty years separate the departure of Coronado from Río Arriba and the arrival of the Chamuscado-Rodríquez and the Espejo-Beltrán parties, and that only about fifty-six years separate Coronado from the Oñate's arrival, it follows that sixteenth-century objects were carried by all these parties. This timeline complicates any effort to assign a Coronado presence based purely upon the presence of sixteenth-century artifacts.

When interpreting the age of metal artifacts specifically from Hawikku, it is important to consider the number of people, the dates, and the duration of

their presence in the region. The Flints estimate that 2,000 to 2,800 people began the Coronado Expedition. Europeans, not Indios Amigos, were almost certainly the dominant metal-bearers of the excursion. When the expedition conquered Hawikku, however, its members were divided. Beginning on 7 July 1540, the advance party, consisting of 80 to 110 European metal-bearers and more than 700 Indios Amigos, began the occupation of Hawikku. Some three months later, on about 8 October 1540, the following army joined the advance party, and increased the population of metal-bearers to 400 European men-at-arms plus European women and children. The following army stayed for twenty days before departing toward the east. In total this first large occupation lasted nearly four months and is likely the biggest occupation ever of Hawikku.[50]

The next and final Coronado occupation of Hawikku occurred when the retreating army, composed of 1,550 to 2,350 people, arrived in early spring of 1542 on its return to Mexico. The expedition was undivided at that time, thereby providing a second large gathering of European metal-bearers. Because of normal usage and attrition, these men and women likely bore less metal than those expeditionaries of 1540. On 5 April 1542, the retreating army departed Hawikku for New Spain, having occupied the pueblo for a number of days, a time span that provided another opportunity for European articles to have been lost and to become future artifacts.[51] In total Coronado and at least one hundred metal-bearers occupied Hawikku for about four months. During one month in particular, more than four hundred metal-bearers occupied Hawikku.

In contrast to the Coronado occupations, the first measurable European presence at Zuni after Coronado occurred when about thirty members of the Espejo-Beltrán party sojourned for two months at Hawikku-Zuni in 1583. There is no record of a larger expeditionary party arriving after Espejo-Beltrán. These numbers show that the Coronado Expedition stayed longer and contained more European metal-bearers than any other non-Native American presence ever at Hawikku. The cargo of the Coronado Expedition included many domestic items, and such a concentration of European domestic items did not occur again at Hawikku. This temporal reality significantly elevates the likelihood of domestic artifacts found at Hawikku belonging to the Coronado Expedition, rather than to later travelers.

Interpretation of the age of metal artifacts found in Tiwa country, just as at Hawikku, must consider the number of people, the dates, and their duration, as well as conditions at Tiguex itself. Of all the groups of metal-bearers arriving prior to Oñate in 1598, the Coronado assemblage was by far the most numerous and of the longest duration. In comparison the smaller

Chamuscado-Rodríquez, Espejo-Beltrán, Castaño, and Humaña parties were in Tiwa country only briefly. Consequently there was less opportunity for expeditionaries to lose or discard objects. Respecting this history, it is most likely that sixteenth-century Spanish artifacts found in Tiguex are from Vazquez de Coronado, although one cannot exclude such artifacts being from a later Spanish presence, such as those carried by a settler arriving with Oñate.[52]

Spanish and Mexican Lead Shot at Jimmy Owens

Lead isotope ratio analysis identified one shot found at the Jimmy Owens site as Spanish lead and three balls as being Middle New World lead. In my attempt to determine the event(s) that caused this lead to be at the location, I could find no written evidence that the Jimmy Owens site was ever occupied or visited by Spaniards after Vázquez de Coronado departed there in 1541. Archaeologist Jonathan E. Damp reported, "The Owens site is a Coronado campsite in Texas that has no later component so all artifacts found at the site should pertain to the Coronado Expedition." Despite Damp's claim, however, I reported previously that a Spanish military copper button, dated between 1710 and 1750, was discovered at the site.[53] How the button arrived at the site remains unknown, but it offers evidence of Spanish metal at Jimmy Owens that is unrelated to the Coronado Expedition.

While no written record exists of Spanish explorations of the Jimmy Owens site itself, historical evidence suggests that Spaniards visited the larger geographical region. Spanish military excursions to the east commenced as soon as Oñate arrived in Río Arriba and continued until Mexican independence in 1821. As early as September 1598, Oñate sent scouts from Río Arriba to the headwaters of the Canadian River near modern-day Amarillo, Texas, and Oñate led an expedition that reached central Kansas in 1601.[54] These excursions at the turn of the seventeenth century are consistent with the age of the button found at the Jimmy Owens site.[55]

Lead isotope analysis was inconclusive as to whether the three Middle New World lead shot found at Jimmy Owens were Tarascan, northcentral Mexican, or Central American because, similar to the Hawikku and one Piedras Marcadas balls, the shot appears among all three imprecisely bounded isotope populations. Given the post-Coronado Spanish presence in the Jimmy Owens region, the likelihood that these Spaniards carried lead from Mexico, and acknowledging that the Jimmy Owens site was a water source that attracted long-distance travelers, one cannot exclude post-Coronado Spaniards as possible bearers of the three balls under consideration. Given the association of the three Jimmy Owens shot with accepted Coronado artifacts, however,

and the isotopic possibility that the lead could be Tarascan, it is much more likely that the balls of Middle New World lead found at Jimmy Owens are indeed from Tarasca and the Coronado Expedition rather than from a later, unreported Spanish excursion. With respect to the shot of Spanish lead found amongst dozens of accepted Coronado artifacts, I concluded that it almost certainly belonged to one of Coronado's expeditionaries.

Conclusion of Lead Isotope Discussion

Lead isotope analysis concluded that balls of Spanish lead were present at all five confirmed or suspected Coronado Expedition sites that my team analyzed—Kuykendall Ruins, Doubtful Canyon, Hawikku, Piedras Marcadas, and Jimmy Owens. As a consequence of the lead analysis, I modified my ever-evolving exploration model to include the likelihood of Spanish lead at Coronado sites.

The historical record best interprets the bearers of Spanish lead. This record shows that firearms, therefore lead, traveled with the Coronado Expedition. I have pointed out that the expedition had access to Tarascan, not north-central Mexican lead, thereby increasing the likelihood that Mexican lead of that expedition was from western Mexico. Lead and lead shot were also among the inventory of the post-Coronado expeditions to Río Arriba. I have demonstrated that this lead was most likely from north-central Mexico, readily available as a by-product of the extensive post-Coronado silver mining in that region, thereby essentially eliminating it from being a Coronado residual. I have reasoned that it is unlikely that post-Coronado expeditions carried Spanish lead to Río Arriba because of the lead shortage in Spain and the availability of Mexican lead along the travel route.

Exactly where a particular lead shot was found strengthens or weakens its relationship to Vázquez de Coronado. I previously proposed that "Spanish lead found within specific geographical corridors is diagnostic of the Coronado Expedition."[56] My team currently considers Spanish lead shot, found along the route of the Coronado Expedition from the Río San Pedro to the Río Bermejo campsite (Río Zuni southwest of Hawikku), to be artifacts that are temporally restricted to the sixteenth century. The presence of these shot as well as crossbow boltheads, and certain bells and beads, are decisive evidence of Vázquez de Coronado along that trace. The team's current hypothesis for lead shot found at Hawikku and beyond is that shot made of north-central Mexican lead are almost certainly of post-Coronado age, and that lead shot of Tarascan or Spanish sources are more likely than not a product of the Coronado Expedition. Consequently, when Spanish lead is discovered with

generic artifacts that *could* be sixteenth century, especially if found on land between Hawikku and the U.S.-Mexico border, the lead serves to elevate the likelihood of these non-temporal artifacts being residuals of the Coronado Expedition.[57]

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James B. Legg, collections specialist at the South Carolina Institute of Archaeology and Anthropology, continues to provide confidence-inspiring identification of our artifacts, a major contribution deserving of deference and for which we are forever grateful. A special thanks to archaeologist Pearce Paul Creasman, who has generously contributed x-ray and conservation technology for our program since its inception. Stanley South, Chester DePratter, and Kathleen Deagan have supported and encouraged us, and have made available the resources of their respective institutions, and to them we send our respectful appreciation. John Kessell contributed respected and appreciated suggestions for the manuscript. The images and maps presented here were graphically enhanced by the considerable skills of Steven I. Rothman, and to him I direct a nod of warm appreciation. Economic geologist Spencer R. Titley kindly identified rock types for the project.

Without exception the private landowners in Doubtful Canyon and points north wish to remain unnamed and have requested that I not disclose the exact locations of artifacts we discovered. Permission by these landowners, of course, allowed this exploration to proceed, and I will graciously respect their wishes.

Gentleman Ed Barnes, a pioneer, guide, and keen observer of the Peloncillo Mountains, now deceased, merits special recognition for his contribution to exploration at Doubtful Canyon.

Most personal to me, I express my appreciation, gratitude, and admiration to Karen Whiteside Brasher—explorer, imagineer, companion, wonderful.

Notes

1. For a vivid account from the Zunis' perspective of the events surrounding the battle at Hawikku, see Edmund J. Ladd, "Zuni on the Day the Men in Metal Arrived," in *The Coronado Expedition to Tierra Nueva: The 1540–1542 Route Across the Southwest*, ed. Richard Flint and Shirley Cushing Flint (Niwot: University Press of Colorado, 1997), 225–33. According to the anonymous author of "Traslado de las Nuevas, 1540," the rocks hurled at Capt. Gen. Francisco Vázquez de Coronado by the warriors were *piedra perdidas*. This phrase suggests "wild pitch." Perhaps the rock fight appeared as misguided missiles to the Spaniards, but the warriors probably were expert rock slingers and often hit their targets, including the golden, feather-adorned captain general. Sources for the Spanish side of the story, some of them contradictory, include: "Traslado de las Nuevas (Anonymous Narrative), 1540," "[Francisco] Vázquez de Coronado's Letter to the Viceroy, August 3, 1540," "The Relación de la Jornada de Cíbola, Pedro de Castañeda de Nájera's Narrative, 1560s (Copy, 1596)," "The Relación del Suceso (Anonymous Narrative), 1540s," in *Documents of the Coronado Expedition, 1539–1542: "They Were Not Familiar with His Majesty, nor Did They Wish to be His Subjects,"* ed., trans., and annot. Richard Flint and Shirley Cushing Flint (Dallas, Tex.: Southern Methodist University Press, 2005), 295, 256–58, 445–46, 503, 691 n. 40, respectively; and Domingo Martín, Fourth de oficio Witness, "A Transcript of the Testimony," Juan de Contreras, Fifth de oficio Witness, "A Transcript of the Testimony," Rodrigo Ximón, Sixth de oficio Witness, "A Transcript of the Testimony," Cristóbal de Escobar, Seventh de oficio Witness, "A Transcript of the Testimony," Juan Troyano, Eighth de oficio Witness, "A Transcript of the Testimony," Rodrigo de Frías, Ninth de oficio Witness, "A Transcript of the Testimony," Melchior Pérez, Tenth de oficio Witness, "A Transcript of the Testimony," Pedro de Ledesma, Eleventh de oficio Witness, "A Transcript of the Testimony," Francisco Vázquez de Coronado, Sworn Statement of the Governor, "A Transcript of the Testimony," in *Great Cruelties Have Been Reported: The 1544 Investigation of the Coronado Expedition*, Richard Flint (Dallas, Tex.: Southern Methodist University Press, 2002), 101–2, 117, 119, 135, 153–54, 179–80, 200–1, 220–21, 243–45, 297–98, respectively.
2. Nugent Brasher, "The Chichilticale Camp of Francisco Vázquez de Coronado: The Search for the Red House," *New Mexico Historical Review* 82 (fall 2007): 433–68; Nugent Brasher, "The Red House Camp and the Captain General: The 2009 Report on the Coronado Expedition Campsite of Chichilticale," *New Mexico Historical Review* 84 (winter 2009): 1–64; and Nugent Brasher "Spanish Lead Shot of the Coronado Expedition: A Progress Report on Isotope Analysis of Lead from Five Sites," *New Mexico Historical Review* 85 (winter 2010): 79–81.
3. Brasher, "The Red House Camp and the Captain General," 54.
4. Professor Franco Marcantonio is a director of the Radiogenic Isotope Geochemistry Laboratory in the Department of Geology and Geophysics at Texas A&M University, College Station.

5. Brasher, "Spanish Lead Shot of the Coronado Expedition," 79–80.
6. Table 1 provides isotope ratios for ten lead shot my team determined were from Spanish source locations. Because my findings are best presented in three-dimensional, color graphics, interested readers should view the methodology and supportive evidence by visiting the permanent website. See the analysis at www.chichilticale.com. Brasher, "The Red House Camp and the Captain General," 54; Brasher, "Spanish Lead Shot of the Coronado Expedition," 80; Charles M. Haecker, "Tracing Coronado's Route through Trace Element Analysis," (paper, Society for Historical Archaeology, Albuquerque, N.Mex., 12 January 2008); "Muster Roll of the Expedition, Compostela, February 22, 1540," in *Documents of the Coronado Expedition*, Flint and Flint, 152–62; and Castañeda de Nájera, "Relación," 449, 457. The analysis was influenced by a lively verbal joust between 1992 and 1993 among more than a dozen of the most respected researchers in the field of lead-isotope-ratio analysis for archaeological purposes. See *Archaeometry* 34, no. 1 (1992): 73–105; *Archaeometry* 34, no. 2 (1992): 311–17, 327–29; and *Archaeometry* 35, no. 2 (1993): 241–63. The discussion centered on methods of interpretation of isotope data, with an emphasis on the problems of overlapping populations, outliers, and selection of appropriate graphics. The team's internal analysis carefully considered the comments and techniques of these researchers. Of particular interest were the comments of nuclear physicist E. V. Sayre of the Conservation Analytical Laboratory of the Smithsonian Institution in 1993. He then wrote, "The suggestion that one should use a computer program to rotate continuously the three-dimensional data through all arbitrary angles until one can visually observe, in a projection on a computer screen, the best separation between the specimens in question is an excellent one. The only reason we have not done so for our recent publications was that we did not have the required computer software readily at hand." *Archaeometry* 35, no. 2 (1993): 250. Sayre's comments caught my attention because rotating data points in three-dimensional space was common practice by early 1988. My Macintosh platform, personal petroleum exploration workstation, utilized the statistical software *MacSpin* and *DataDesk* in 1991. *MacSpin* displayed data in three-dimensional form and allowed the user to "spin" data, that is, to rotate it in three dimensions and to animate data points. *MacSpin* was first developed on a VAX computer at the Stanford Linear Accelerator, but was re-coded in the mid-1980s to operate in the Macintosh environment. *DataDesk* likewise offered the capability to "spin" the data. The team's lead-isotope analysis in 2009 employed such rotation techniques, which significantly influenced sample identification conclusions. In addition to the internally generated analysis, Dr. Michael J. Rothman of Michael J. Rothman and Associates, LLC, an independent data analysis and visualization consulting company in Hopewell, New York, conducted a comparative data analysis. The editors of the *New Mexico Historical Review* kindly granted my request to post the detailed lead analysis. The regional extent of the database was warranted by recognition that the Coronado Expedition included members from all parts of Spain, as well as Crete, Sicily, and Italy. For example expeditionary Diego de Candia from Crete carried an arquebus. "Appendix 3: Known Members of the Coronado Expedition," in *Documents of the Coronado Expedition*, Flint and Flint, 605–15. The lead-isotope-ratio database was assembled from the following published sources, listed in chronological order, from oldest to youngest by publication date: G. L.

Cumming and S. E. Kesler, "Source of Lead in Central American and Caribbean Mineralization," *Earth and Planetary Science Letters* 31 (July 1976): 262–68; T. E. Ewing, "Lead Isotope Data from Mineral Deposits of Southern New Mexico: A Reinterpretation," *Economic Geology* 74 (May 1979): 678–84; George L. Cumming, Stephen E. Kesler, and Dragan Krstic, "Isotopic Composition of Lead in Mexican Mineral Deposits," *Economic Geology* 74 (October 1979): 1395–407; George L. Cumming, Stephen E. Kesler, and Dragan Krstic, "Source of Lead in Central American and Caribbean Mineralization, II: Lead Isotope Provinces," *Earth and Planetary Science Letters* 56 (December 1981): 199–209; J. E. Dayton and A. Dayton, "Uses and Limitations of Lead Isotopes in Archaeology," in *Proceedings of the 24th International Archaeometry Symposium*, ed. J. S. Olin and M. J. Blackman (Washington, D.C.: Smithsonian Institution Press, 1986), 13–41; G. L. Cumming and S. E. Kesler, "Lead Isotopic Composition of the Oldest Volcanic Rocks of the Eastern Greater Antilles Island Arc," *Chemical Geology* 65 (March 1987): 15–23; Antonio Arribas Jr. and Richard M. Tosdal, "Isotopic Composition of Pb in Ore Deposits of the Betic Cordillera, Spain: Origin and Relationship to Other European Deposits," *Economic Geology* 89 (August 1994): 1074–93; Z. Stos-Gale, N. H. Gale, J. Houghton, and R. Speakman, "Lead Isotope Data from the Isotrace Laboratory, Oxford: *Archaeometry* Data Base I; Ores from the Western Mediterranean," *Archaeometry* 37, no. 2 (1995): 407–15; Dorothy Hosler and Andrew Macfarlane, "Copper Sources, Metal Production, and Metals Trade in Late Postclassic Mesoamerica," *Science* 272 (1996): 1819–24; F. Velasco, A. Pesquera, and J. M. Herrero, "Lead Isotope Study of Zn-Pb Ore Deposits Associated with the Basque-Cantabrian Basin and Paleozoic Basement, Northern Spain," *Mineralium Deposita* 31 (1996): 84–92; B. M. Rohl, "Lead Isotope Data from the Isotrace Laboratory, Oxford: *Archaeometry* Data Base 2; Galena from Britain and Ireland," *Archaeometry* 38, no. 1 (1996): 165–80; Z. A. Stos-Gale, N. H. Gale, and N. Annetts, "Lead Isotope Data from the Isotrace Laboratory, Oxford: *Archaeometry* Data Base 3; Ores from the Aegean, Part I," *Archaeometry* 38, no. 2 (1996): 381–90; A. Canals and E. Cardellach, "Ore Lead and Sulphur Isotope Pattern from the Low-temperature Veins of the Catalonian Coastal Ranges (NE Spain)," *Mineralium Deposita* 32, no. 3 (1997): 243–49; N. H. Gale, Z. A. Stos-Gale, G. Maliotis, and N. Annetts, "Lead Isotope Data from the Isotrace Laboratory, Oxford: *Archaeometry* Data Base 4; Ores from Cyprus," *Archaeometry* 39, no. 1 (1997): 237–46; E. Marcoux, "Lead Isotope Systematics of the Giant Massive Sulphide Deposits in the Iberian Pyrite Belt," *Mineralium Deposita* 33 (1998): 45–58; Judith A. Habicht-Mauche, "Stable Lead Isotope Analysis of Río Grande Glaze Paints and Ores Using ICP-MS: A Comparison of Acid Dissolution and Laser Ablation Techniques," *Journal of Archaeological Science* 29 (September 2002): 1043–53; Casilada Ruiz, Antonio Arribas, and Antonio Arribas Jr., "Mineralogy and Geochemistry of the Masa Valverde Blind Massive Sulphide Deposit, Iberian Pyrite Belt (Spain)," *Ore Geology Reviews* 19 (January 2002): 1–22; J. F. Santos Zalduegui, S. Garcia De Madinabeitia, and J. I. Gil Ibarguchi, "A Lead Isotope Database: The Los Pedroches–Alcudia Area (Spain); Implications for Archaeometallurgical Connections Across Southwestern and Southeastern Iberia," *Archaeometry* 46, no. 4 (2004): 625–34; Fernando Tornos and Massimo Chiaradia, "Plumbotectonic Evolution of the Ossa Morena Zone, Iberian Peninsula: Tracing the Influence of Mantle-Crust Interaction in the Ore-Forming

Processes," *Economic Geology* 99 (August 2004): 965–85; Michael B. Rabinowitz, "Lead Isotopes in Soils Near Five Historic American Lead Smelters and Refineries," *Science of the Total Environment* 346 (June 2005): 138–48; A. M. Thibodeau, S. J. Killick, J. Ruiz, J. T. Chesley, K. Deagan, J. M. Cruxent, and W. Lyman, "The Strange Case of the Earliest Silver Extraction by European Colonists in the New World," *Proceedings of the National Academy of Sciences* 104, no. 9 (2007): 3663–66; Sanghamitra Ghosh, "Heavy Stable Isotope Investigations in Environmental Science and Archaeology," (PhD diss., Florida State University, 2008); and James K. Mortensen, Brian V. Hall, Thomas Bissig, Richard M. Friedman, Thomas Danielson, James Oliver, David A. Rhys, Kika V. Ross, and Janet E. Gabites, "Age and Paleotectonic Setting of Volcanogenic Massive Sulfide Deposits in the Guerrero Terrane of Central Mexico: Constraints from U-Pb Age and Pb Isotope Studies," *Economic Geology* 103, no. 1 (2008): 117–40.

7. Richard Flint, e-mail message to author, 10 November 2009. British historian John H. Elliott is a world-renowned writer on Spain and its economy. Readers wanting a more detailed description of the Spanish economy during the sixteenth century should consult J. H. Elliott, *Imperial Spain 1469–1716* (New York: St. Martin's Press, 1964), 172–91, 279–315.
8. Clarence Henry Haring, *Trade and Navigation Between Spain and the Indies in the Time of the Hapsburgs* (Gloucester, Mass.: Peter Smith, 1964), 208, 215, 272, 274, 280, especially 16, 71, 201–15, 272, 274, 280; Francisco Gutiérrez Guzmán, *Minería en Sierra Morena* (Linares, Spain: Colegio Oficial de Ingenieros Técnicos de Minas de Linares, Granada, Jaén, y Málaga, 2007), 171–201, especially 171, 181, 183–84, 186, 189–92, 195, 200–1; Ramón Fernández Soler, *El distrito minero Linares: La Carolina* (Madrid: 1954), quoted in *Minería en Sierra Morena*, Guzmán, 195; and Archivo General de Indias [hereafter AGI], Correos, 457B, R. 2, N. 6. Both Clarence Henry Haring and Francisco Gutiérrez Guzmán note that the Spanish started to line ships' hulls with lead beginning in 1514. For a measure of the amount of lead required, see Haring, *Trade and Navigation*, 277–78.
9. Brasher, "The Red House Camp and the Captain General," 40–48.
10. "Several Wildfires Burn In Region: One Near Sunsites Brings Evacuations," *Sierra Vista (Ariz.) Herald*, 26 March 2009; Gordon Fraser, e-mail message to author, 25 March 2009; and Clay Riggs, e-mail message to author, 27 March 2009.
11. Brasher, "The Red House Camp and the Captain General," 12, map 2 (number 23); 24, fig. 12.
12. Ibid., 54. Dr. Jean-Luc Schwenninger at the Research Laboratory for Archaeology and the History of Art, University of Oxford, performed these tests.
13. Brasher, "The Red House Camp and the Captain General," 4, 12.
14. Mary H[onorhea]. Braidfoot, U.S. Patent 1094636, 20 December 1937; Brasher, "The Chichilticale Camp of Francisco Vázquez de Coronado," 461; and Brasher, "The Red House Camp and the Captain General," 10, 44.
15. Fred Braidfoot, U.S. Patent 67013570, 15 March 1919. "The papers of Gerenville Goodwin, written in the mid-1930s, contain the place name Tsisl-Inoni-bi-yi-tu, which is the Apache name for 'Stein's Pass,' or Doubtful Canyon." Edwin R. Sweeney, personal communication with author, 21 August 2009.
16. James B. Legg writes, "Your nails are very nice—they are easily 16th century, although they could be later as well. In any case they are very much like our Santa Elena nails,

except in much better condition than most of ours. We only see them this nice when they have been heavily burned." James B. Legg, e-mail message to author, 26 January 2009. Jennifer M. Hamilton and William H. Hodges, "The Aftermath of Puerto Real: Archaeology at Bayahá," in *Puerto Real: The Archaeology of a Sixteenth-Century Spanish Town in Hispaniola*, ed. Kathleen Deagan (Gainesville: University Press of Florida, 1995), 409, fig. 12.15; and Eugene Lyon, e-mail message to author, 17 October 2009. For a discussion and photographs of *estoperoles* see Stanley South, Russell K. Skowronek, and Richard E. Johnson, *Spanish Artifacts from Santa Elena*, Anthropological Studies series, no. 7 (Columbia: South Carolina Institute of Archaeology and Anthropology, 1988), 34, 39–40, 44–45, especially 57–58.

17. Walter B. Lang, *The First Overland Mail: Butterfield Trail; St. Louis to San Francisco 1858–1861* (privately printed, 1940), 1:119.
18. Data used for my climate reconstruction is from Henri D. Grissino-Mayer, "El Malpais Precipitation Reconstruction," www.ncdc.noaa.gov/paleo/drought/drght_grissno.html and ftp://ftp.ncdc.noaa.gov/pob/data/paleo/treering/reconstructions/newmexico/malpais_recon.txt. Cozzens Lake is my name for the spot in Doubtful Canyon referred to by Samuel Woodworth Cozzens as "Stein's Peak Lake, about three miles from the [Steins Butterfield] station . . . a little lake scarcely a hundred and fifty feet in breadth." In his exaggerated portrait of the location, Cozzens claimed that fifty-foot tall saguaro cacti were located around the lake and a "snow-clad" Steins Peak reflected in the water. With the help of Edwin R. Sweeney, I confirmed that Cozzens was at the spot in mid-August 1859, casting doubt upon snow being atop the 5,867-foot mountain. My field reconnaissance found no evidence of saguaro cacti, alive or dead. Verified, however, is Cozzen's claim that the lake drains in two directions. The lake, hidden from the view of Butterfield Trail travelers by a low hill, is formed by a shallow depression at the western head of Doubtful Arroyo that captures rainwater. The lake normally drains eastward down Doubtful Arroyo, but when it is full, water also spills over the edge to the west and escapes out of West Doubtful Arroyo. Cozzens happened to see the lake full of water because he was there during the peak of the summer monsoon. Samuel Woodworth Cozzens, *The Marvelous Country or, Three Years in Arizona and New Mexico, the Apache's Home* (Minneapolis: Ross and Haines, 1967), 225–34; and Edwin R. Sweeney, letter to author, 5 February 2006.
19. Brasher, "The Red House Camp and the Captain General," 40–48.
20. Alfred B. Thomas, *Forgotten Frontiers: A Study of the Spanish Indian Policy of Don Juan Bautista de Anza, Governor of New Mexico, 1777–1787* (Norman: University of Oklahoma Press, 1932), 207–15, map in sleeve. Notable as temporal benchmarks, Capt. Manuel de Echeagaray and Capt. José de Zúñiga passed through the region in 1788 and 1795, respectively.
21. Carl D. W. Hays, "David E. Jackson," in *The Mountain Men and the Fur Trade of the Far West: Biographical Sketches of the Participants by Scholars of the Subject and with Introductions by the Editor*, 10 vols., ed. LeRoy R. Hafen (Glendale, Calif.: Arthur H. Clark, 1972), 9:232–33.
22. *Overland to California on the Southwestern Trail, 1849: Diary of Robert Eccleston*, ed. George P. Hammond and Edward H. Howes, Bancroft Library Publications, no. 2 (Berkeley: University of California Press, 1950), 174–86.

23. John Russell Bartlett, *Personal Narrative of Explorations and Incidents in Texas, New Mexico, California, Sonora, and Chihuahua, Connected with the United States and Mexican Boundary Commission during the Years 1850, '51, '52, and '53*, Rio Grande Classic series (1854; repr., Chicago: Rio Grande Press, 1965), 367–70. Of interest is John Russell Bartlett's reference to Steins Peak: "Our guide here pointed out to us *El Peloncillo*, or Sugar Loaf, a mountain of this form in the high range alluded to, with an opening near it." Bartlett, *Personal Narrative*, 364. *Peloncillo* means "little bald ones," or "little baldies," from the word *pelón*, meaning bald, as in bald head. Bartlett wrote peloncillo as "sugar loaf." The correct word for sugar loaf is spelled *piloncillo*. The Spanish letter *i* is pronounced like the English letter *e* as in "seed." I suspect that Bartlett heard the Spanish word piloncillo, with an *i*, but apparently spelled what he heard, meaning he spelled the word with an English-sounding *e*, which resulted in peloncillo. Mexican sugar-loaf candy called piloncillo is brown, granular, and cone-shaped. The mountains called the Peloncillo are brown and barren of vegetation; they are bald. The word peloncillo fits them perfectly. Steins Peak is brown, granular, and cone-shaped; the word piloncillo fits it nicely. By chance, therefore, both words are appropriate for either the range or the individual peak. Spanish-speaking readers who see the actual mountains would readily accept the moniker Peloncillo Mountains. Nugent Brasher, "The Search for Chichilticale" (unpublished manuscript, in author's possession, 2006), 122–23. In 1583 on the night before the Espejo Expedition entered Zuni, diarist and soldier Diego Pérez de Luxán described camping at a "very high rock in the shape of a sugar loaf we named El Real del Pilón." George P. Hammond and Agapito Rey, *The Rediscovery of New Mexico, 1580–1594* (Albuquerque: University of New Mexico Press, 1966), 183. For a similar description of the Peloncillo Mountain range, see Robert Julyan, *Place Names of New Mexico* (Albuquerque: University of New Mexico Press, 1996), 261–62.
24. George Hackler, *The Butterfield Trail in New Mexico* (Las Cruces, N.Mex.: Yucca Enterprises, 2005), 13–15; and George Hackler, personal communication with author, 2 February 2009. North of Margaret Catheryn Eshom "Kate" Lyall's house, the canyon narrows forcing post-Bartlett wagoneers to trim away part of the canyon side to allow passage of their rigs.
25. Hackler, *The Butterfield Trail*, 190, 196.
26. Nugent Brasher, "The Bootheel: A Critique of Southwestern Archaeological Exploration" (unpublished manuscript, in author's possession, 2004), 191–92.
27. Ibid., 194–97.
28. Nugent Brasher, "Pioneers of Doubtful Canyon" (unpublished manuscript, in Special Collection of Lordsburg-Hidalgo Library, Lordsburg, New Mexico, 2006), 1–18; Kate Lyall, U.S. Patent 940394, 20 June 1924; and Elmer A[rch]. Lyall, U.S. Patent 938296, 15 May 1924.
29. Table 2 was generated from the report provided by Legg in 2009. The table shows a positive correlation between artifacts and historical periods as predicted by interpreting the written history. Additional evidence of nineteenth-century American military or civilian artifacts are seven lead shot ranging from 0.31 caliber to 0.51 caliber identified by isotope ratios as composed of midwestern U.S. lead.
30. A detailed discussion of the exploration model and the predicted campsites is included in Nugent Brasher, "The Coronado Exploration Program: A Narrative of

the Search for the Captain General," in *The Latest Word from 1540: People, Places, and Portrayals of the Coronado Expedition*, ed. Richard Flint and Shirley Cushing Flint (Albuquerque: University of New Mexico Press, forthcoming October 2011), 229–61. Three hundred and five years after Coronado departed Hidden Valley on his return to Mexico, Lt. William H. Emory conducted a military reconnaissance of the Río Gila. My interpretation of his map shows him to be at Hidden Valley on 21 October 1847. Emory, who was following the Río Gila, crossed from the north side to the south side of the river at that spot because it was the only passage between box canyons. William H. Emory, "Military Reconnaissance of the Arkansas Rio del Norte and Rio Gila," (Washington, D.C.: Wendell and Van Benthuysen, 1848). As this report goes to press, I can announce that the team has discovered at the Slash SI Ranch on Big Dry Creek, New Mexico, a ball of Spanish lead and several metal artifacts consistent in form, function, and craftsmanship with the sixteenth century. We consider these findings a discovery of a third Coronado Expedition campsite. Details of this discovery will be presented in an article published in a future issue of the *New Mexico Historical Review*.

31. John Francis Bannon, *The Spanish Borderlands Frontier, 1513–1821*, Histories of the American Frontier series (Albuquerque: University of New Mexico Press, 1974), 28–29. Additional silver strikes near Zacatecas, Mexico, included Sombrerete in 1558, Fresnillo in 1566, and Indé in 1567. Ramon Eduardo Ruiz, *Triumphs and Tragedy: A History of the Mexican People* (New York: W. W. Norton, 1992), 74; and Carroll L. Riley, *Río del Norte: People of The Upper Rio Grande from Earliest Times to the Pueblo Revolt* (Salt Lake City: University of Utah Press, 1995), 226.
32. Hal Jackson, *Following the Royal Road: A Guide to the Historic Camino Real de Tierra Adentro* (Albuquerque: University of New Mexico Press, 2006), 158; and Hammond and Rey, *The Rediscovery of New Mexico*, 140.
33. Castañeda de Nájera, "Relación," 442; Antonio de Mendoza, "The Viceroy's Letter to the King, Jacona, April 17, 1540," in *Documents of the Coronado Expedition*, Flint and Flint, 234, 239; Elinore M. Barrett, *The Mexican Colonial Copper Industry* (Albuquerque: University of New Mexico Press, 1987), 5, 7; and J. Benedict Warren, *The Conquest of Michoacán: The Spanish Domination of the Tarascan Kingdom in Western Mexico, 1521–1530* (Norman: University of Oklahoma Press, 1985), 2. Post-Coronado mines in Sinaloa are shown by George L. Cumming, Stephen E. Kesler, and D. Krstic, "Isotopic Composition of Lead in Mexican Mineral Deposits," 1396, fig. 1.
34. Carroll L. Riley, *The Frontier People: The Greater Southwest in the Protohistoric Period*, rev. ed. (Albuquerque: University of New Mexico Press, 1987), 23; Riley, *Río del Norte*, 227–33; Carroll L. Riley, "Puaray and Coronado's Tiguex," in *Collected Papers in Honor of Erik Kellerman Reed*, Papers of the Archaeological Society of New Mexico, no. 6 (Albuquerque, N. Mex.: Albuquerque Archaeological Society Press, 1981), 197; Albert H. Schroeder and Dan S. Matson, *A Colony on the Move: Gaspar Castaño de Sosa's Journal, 1590–1591* (Santa Fe, N.Mex.: School of American Research, 1965), 168–75; John L. Kessell, *Kiva, Cross and Crown: The Pecos Indians and New Mexico, 1540–1840* (Albuquerque: University of New Mexico Press, 1987), 37–39; Bannon, *The Spanish Borderlands*, 29, 30, 32; and Hammond and Rey, *The Rediscovery of New Mexico*, 8–9, 12–13, 88–92, 104, 131, 137. Interestingly, when the

party reached Tiguex, they were not confronted by the Tiwas despite Coronado's ravaging of the pueblos forty years earlier.

35. Hammond and Rey, *The Rediscovery of New Mexico*, 13–14, 106–7, 109, 111–12, 131–32, 137–38.

36. Riley, *The Frontier People*, 167; Riley, *Río del Norte*, 233–39; Riley, "Puaray and Coronado's Tiguex," 199–200; Kessell, *Kiva, Cross and Crown*, 41, 43; Bannon, *The Spanish Borderlands*, 32–33; Hammond and Rey, *The Rediscovery of New Mexico*, 25, 153–55, 174–86, 194, 198–99, 203–7, 215, 225–28; Schroeder and Matson, *A Colony on the Move*, 167–68; and Edward H. Spicer, *Cycles of Conquest: The Impact of Spain, Mexico, and the United States on the Indians of the Southwest, 1533–1960* (Tucson: University of Arizona Press, 1962), 156. Dates and corresponding days reported by Pérez de Luxán are from the Julian calendar. With respect to numbers of people and livestock on the Coronado Expedition, I have previously estimated that the undivided membership was composed of 400 to 500 Europeans, 1,300 indios amigos, and 6,500 livestock. Brasher, "The Chichilticale Camp of Francisco Vázquez de Coronado," 435; and Brasher, "The Red House Camp and the Captain General," 55. Per my request, Richard Flint kindly provided a revised count: "For several years now we have been estimating the size of the expedition when it began as most likely between 2,000 and 2,800 (400 European men-at-arms, 400 slaves and servants, unknown number of European women and children, 1,200–2,000 Mexican Indian allies). Attrition during the expedition is known even less well. As an educated guess we suggest that the loss through death and desertion was about 100 European men-at-arms (this includes those who were killed and those who fled from San Gerónimo, as well as 1 person who went with fray Juan de Padilla to Quivira), at least 100 servants and slaves (their exposure to danger may well have been greater than that of their masters), unknown number of European women and children, at least 250 Indian allies. Thus, minimum losses, we think, would total 450. That yields a returning expedition size of perhaps 1,550–2,350. The number of livestock [present with the Retreating Army in 1542] would truly be a wild guess. They would have wanted to conserve some of the livestock for meat while on the return trail, if they could. In addition, some investors purchased livestock to bring on the expedition. They also would have wanted to return with as many as they could, if they couldn't cash out by selling them. There was certainly some loss of horses (perhaps 100). Mules probably died at a similar rate (100/558 or 18 percent). Since the expedition began with perhaps 1,000 mules, that means a loss of something like 180." Richard Flint, e-mail message to author, 21 August 2009. Castañeda de Nájera counted the number of livestock present with the expedition on the Great Plains at "one thousand horses and five hundred of our cows and more than five thousand rams and ewes." Castañeda de Nájera, "Relación," 490. Richard Flint's suggested loss of animals diminishes this count to 6,220 head of livestock with the retreating army.

37. Schroeder and Matson, *A Colony on the Move*, 11, 13, 38, 54, 65, 108, 111, 130, 141, 143, 146, 149–51, 159–76; Riley, *The Frontier People*, 167; Riley, *Río del Norte*, 242–44; Kessell, *Kiva, Cross and Crown*, 47; Hammond and Rey, *The Rediscovery of New Mexico*, 245, 289, 291–95, 301, 305, 308, 312; and Samuel Temkin, "Gaspar Castaño de Sosa's 'Illegal' Entrada," *New Mexico Historical Review* 85 (summer 2010): 269, 280 n. 29. On 4 May 1598, at modern-day El Paso, Texas, Oñate reported that his northbound

party found "the ruts made by the ten carts that Castaño and Morlete took out from New Mexico." George P. Hammond and Agapito Rey, ed. and trans., *Don Juan de Oñate: Colonizer of New Mexico, 1595–1628*, 2 vols. (Albuquerque: University of New Mexico Press, 1953), 1:316. Hammond and Rey report "Monday of Holy Week, March 29" as the date of Morlete's arrival in New Mexico, matching the date provided in the testimony of Juan Calderón on 18 March 1592. Hammond and Rey, *The Rediscovery of New Mexico*, 44. If New Mexico is considered to be Santo Domingo, and if the date is accepted without question, then Castaño took two weeks to travel only some thirty miles from Alameda to Santo Domingo, thereby increasing his time in the region by that duration. My check of the Julian calendar for that period confirms the claim of 29 March 1591 being the Monday before Easter Sunday on 4 April. However, my reading of the tone of Castaño's *Memoria*, the paucity of information offered for his journey between Alameda and Santo Domingo, and the out-of-character slow travel of the usually rapidly moving Castaño, cause me to distrust the date of 29 March.

38. Riley, *Río del Norte*, 245–46; Hammond and Rey, *The Rediscovery of New Mexico*, 323.
39. Marc Simmons, *The Last Conquistador: Juan de Oñate and the Settling of the Far Southwest*, Oklahoma Western Biographies series (Norman: University of Oklahoma Press, 1991), 49, 91; Riley, *The Frontier People*, 23–25; Riley, *Río del Norte*, 226–28, 247; Bannon, *The Spanish Borderlands*, 32–33; Kessell, *Kiva, Cross and Crown*, 77; and Jackson, *Following the Royal Road*, 93–94.
40. David H. Snow, e-mail message to author, 17 November 2009; Hammond and Rey, *Don Juan de Oñate*, 215–16, 220, 224, 228–89; and Riley, "Puaray and Coronado's Tiguex," 200. Livestock consisted of horses, mules, oxen, sheep, goats, swine, and cattle. Provisions were carried by pack animals as well as carts and wagons. While I tallied sixty-seven carts and wagons, the "Record of the Marches by the Army, New Spain to New Mexico, 1596–98" reports, "Of the eighty-three carts and wagons which began the expedition, sixty-one arrived." This apparent inventory discrepancy, as well as an incomplete count of people, should not be unexpected. The count of Monterrey reported to the king about Juan de Frías Salazar's inspection, writing, "there were some men in the neighborhood who had absented themselves . . . and [the inspector] was sure that they would join the expedition." "Record of the Marches by the Army, New Spain to New Mexico, 1596–98," in *Don Juan de Oñate*, Hammond and Rey, 320, 390. The Coronado Expedition did not utilize carts; almost certainly the quantity of provisions arriving with Oñate far exceeded that of Coronado. After Oñate's arrival, pack trains supplying the missions ensured there was a regular flow of provisions into the region. Carroll L. Riley, personal communication with author, 20 November 2009.
41. Simmons, *The Last Conquistador*, 127–32, 173–75; Hammond and Rey, *Don Juan de Oñate*, 327–28, 393–97, 1013; Bannon, *The Spanish Borderlands*, 39; and Riley, *The Frontier People*, 317, 325.
42. Spicer, *Cycles of Conquest*, 187–88, 197–98; Riley, *The Frontier People*, 167–68; and Carroll L. Riley and Joni L. Manson, "The Cibola-Tiguex Route: Continuity and Change in the Southwest," *New Mexico Historical Review* 58 (October 1983): 357–59.
43. Thomas, *Forgotten Frontiers*, 171–207, map in sleeve.
44. George P. Hammond, ed., "The Zúñiga Journal, Tucson to Santa Fé: The Opening of a Spanish Trade Route, 1788–1795," *New Mexico Historical Review* 6 (January

1931): 40, 42–47. Anthropologist Bernard L. "Bunny" Fontana states, "The likelihood is very strong that the mortal remains of Echeagaray are under glass and on display for all to see beneath the floor of the church in Arizpe. Two University of California archaeologists (Bob Heizer and Ted McCown) and a U[niversity of] C[alifornia] geologist (Howel Williams) were present when locals ripped out the old wooden floor of the church in Arizpe and were satisfied that Juan Bautistia de Anza the younger had been found when they came on a guy whose 18th-century officer's uniform was still somewhat intact. I had made the arrangements to get the Berkeley guys flown down there. A few years after the remains were exposed, someone discovered the actual burial record of Anza and found out that he was buried in a different place in the church (in a side chapel rather than in the nave). The officer—as identified by his clothing—actually exposed was very probably Echeagaray. I think the remains are still labeled as those of Anza in the church and by the townspeople." Bernard L. Fontana, e-mail message to author, 13 February 2010. Carroll L. Riley adds, "Quite a number of years ago, [my wife] Brent and I were on one of the Gran Quivira tours. We stopped at Arizpe and my old friend and Jesuit Father Charlie Polzer was giving a lecture about Anza. He suggested that the remains in the church floor were really those of Echeagaray. A local young woman in the audience, I think she was head of the local historical society, vigorously disagreed with Charlie and there was a shouting match that went on for several minutes." Carroll L. Riley, e-mail message to author, 30 May 2010.

45. José de Zúñiga, "Una expedición militar de Tucson (Arizona) a Zuñi (Nuevo México)," in La España ilustrada en el Lejano Oeste: viajes y exploraciónes por las provincias y territorios hispánicos de Norteamérica en el siglo XVIII, ed. Amando Represa, Estudios de historia (Valladolid, Spain: Junta de Castilla y León, Consejería de Cultura y Bienstar Social, 1990), 89–100. Editor Amando Represa incorrectly reports the year of the expedition as 1791; the actual year was 1795.

46. Zúñiga, "Una expedición militar," 95. For a map of the Zuni area, see Madeline Turrell Rodack, "Cibola, From Fray Marcos to Coronado," in *The Coronado Expedition to Tierra Nueva* Flint and Flint, 105, Map 2. On 22 August 2009, I asked Riley and Richard Flint whether they thought that the abandoned pueblo known as "el agua caliente del Pueblo antiguo de Zuñi" was Hawikku. Riley responded, "sounds like Hawikuh [*sic*]or Kechipawan though the latter is unlikely, being tucked away on the mesa-top. Kwakina is out in that area, but I don't recall that there are obvious ruins. But Hawikuh [*sic*] certainly [is likely]." Carroll L. Riley, e-mail message to author, 23 August 2009. Richard Flint countered, "[Riley] referred to Kechiba:wa (or Kechibawan or Kechipawan) which would have been long abandoned at Zúñiga's time. But it was near the spot most commonly called Ojo Caliente on the Zuni Reservation. Near there, in the eighteenth century a 'refugee village' was established. I imagine that's what Zúñiga was referring to. See Ferguson and Hart, *A Zuni Atlas*, numerous pages." Richard Flint, e-mail message to author, 24 August 2009. A couple of days later, Riley wrote, "Well, yes, as Ferguson and Hart among others point out, Ojo Caliente (Kyana-a) was a farming village in historic times. But, even if Ojo Caliente was deserted at the time he came through, Zúñiga would probably think of the nearby impressive RUINS of Hawikuh [*sic*]when mentioning the site." Carroll L. Riley, e-mail message to author, 26 August 2009. The question is relevant in determining

which direction Coronado entered Hawikku. I believe that Coronado and Zúñiga traveled much of the same trail, with an important exception being that northbound Zúñiga departed Coronado's trail at the Red Hill cinder cone and lava flow near modern-day Red Hill, New Mexico. Zúñiga wrote that after crossing a "*sexa [ceja] de malpais*" (eyebrow-shaped flow of lava rock), and bearing to the north-northeast, he reached Zuni Salt Lake, which he described as "very beautiful salt flats with footprints and trails headed in various directions." From there Zúñiga continued to Zuni (Halona), arriving from the southeast. Zúñiga, "Una expedición militar," 94–95. By departing Halona to the southwest and reaching Hawikku, Zúñiga would have rejoined Coronado's presumed route. Richard Flint interprets the Spanish word *sexa*: "Probably the word is '*ceja*,' which is used frequently in geographical/topographical contexts to refer to a surface stratum of rock visible in an escarpment that is usually significantly different in color from the underlying rock strata. More generically, it can refer to a cliff or steep bedrock face of any sort." Richard Flint, e-mail message to author, 23 August 2007. I responded to Flint, noting, "The lava flow at Red Hill forms an escarpment of BLACK rock sitting on BUFF-COLORED Colorado Plateau bedrock. The contrast is striking—this is the only place such occurs along the route most likely followed by Zúñiga." Nugent Brasher, e-mail message to Richard Flint, 23 August 2007. The word *ceja* most commonly means eyebrow; the Red Hill lava flow is so shaped. The route taken by Zúñiga in 1795 may have been known long before. In 1760 Bp. Pedro Tamarón y Romeral of Durango made an expedition of inspection to the upper Southwest. He wrote, "When I was in Bassaraca (Baserac), the general of the Opatas, Don Jerónimo, offered, if I liked, to take me from there to New Mexico in a few days, for he knew a much shorter route than the one I had planned to take to El Paso." Eleanor B. Adams, ed., "Bishop Tamaron's Visitation of New Mexico, 1760," *New Mexico Historical Review* 28 (April 1953): 198; and Riley and Manson, "The Cibola-Tiguex Route," 350.

47. Hammond and Rey, *The Rediscovery of New Mexico*, 71, 94, 98, 112, 127–38, 280, 285, 288; Kessell, *Kiva, Cross and Crown*, 38, 42; and Simmons, *The Last Conquistador*, 118. Whether or not lead was fired during the discharge of arquebuses for ceremonial or awe-inspiring purposes remains a question. Spanish art historian Pablo Martín Gómez describes the process of loading an arquebus as including "some firm strokes with the ramrod to compact the mass of powder, wad and ball" before priming the exterior firing mechanism to make the weapon ready to discharge. Martín Gómez suggests that arquebuses were prepared as such for immediate use, but that if the shooter elected to delay his discharge, he would cover the firing mechanism "so that the devil could not ignite the gunpowder" [so that the arquebus could not fire by mistake]. This procedure shows that lead was routinely tapped into the powder and wadding, but offers no evidence that this procedure was followed during ceremony or exhibition. Pablo Martín Gómez, *Hombres y Armas en la Conquista de México, 1518–1521* (Madrid, Spain: Almena Ediciones, 2001), 93, 171, lámina (plate) 8.
48. Hammond and Rey, *Don Juan de Oñate*, 144, 225, 311; and Jackson, *Following the Royal Road*, 126, 133.
49. Hammond and Rey, *Don Juan de Oñate*, 238–39, 242, 252, 259, 271, 276–77, 282, 566.
50. Richard Flint, e-mail message to author, 21 August 2009; Brasher, "The Chichilticale Camp of Francisco Vázquez de Coronado," 435; and Anonymous Narrative, "Traslado

de las Nuevas, 1540," in *Documents of the Coronado Expedition*, Flint and Flint, 294. I have interpreted Julian calendar dates for campsites of the following army. I based the 8 October 1540 date on Pedro de Castañeda de Nájera's claim of the army's departure from Sonora in "middle September." Brasher, "The Red House Camp and the Captain General," 62 n. 74. For the following army's length of stay in Cíbola, see Castañeda de Nájera, "Relación," 455.

51. Richard Flint, e-mail message to the author, 21 August 2009. I based the departure date from Hawikku on the presence of the expedition at the Río Frío on 9 April 1542. Brasher, "The Red House Camp and the Captain General," 62 n. 74.
52. Riley, *Puaray and Coronado's Tiguex*, 199–200; and Carroll L. Riley, e-mail message to author, 26 November 2009. The brevity of these later visits was likely due to abandonment of Tiguex, a factor that must be considered when interpreting the source of metal artifacts found there. Riley describes the invasion of Tiguex by Vázques de Coronado as the effective beginning of the end of Tiguex: "A significant development in the winter of 1540–41 was the destruction of all the Tiguex pueblos. . . . Thirteen of the towns deserted by the Indians were looted and dismantled by the Spaniards. . . . By the spring of 1541 Tiguex was largely destroyed. *All* the towns were occupied or burned." Forty years later, when Chamuscado arrived, "Tiguex was making a recovery but the scars of the Coronado occupation were still very real. . . . Except for Chamuscado, no Spanish party after Coronado really had much interest in Tiguex, probably because there was little left but poverty. Espejo concerned himself with the western pueblos and the Keres, and Castaño with Pecos, the Tewa, and Keres. Oñate, though he occupied the whole pueblo area, centered his activities on the Tewa and the Keres." Riley points out, "By Oñate's time, the first missionaries did not seem to consider the area very important—only two missions were established there, both around or after 1610 with two others made visitas. Missions were at Sandia and Isleta and visitas at Puaray and Alameda. These four towns were the Tiguex of the 17th century."
53. Jonathan E. Damp, The Battle of Hawikku: Archaeological Investigations of the Zuni-Coronado Encounter at Hawikku, the Ensuing Battle, and the Aftermath during the Summer of 1540, Zuni Cultural Resource Enterprise, no. 884 (Zuni, N.Mex.: Zuni Cultural Resource Enterprise, 2005), 52; and Brasher, "The Red House Camp and the Captain General," 37–39.
54. Hammond and Rey, Don Juan de Oñate, 398–405, 746–60.
55. Oklahoma historian Alfred B. Thomas summarized Spanish explorations east of Santa Fe from 1599 to 1792. He provided two maps that trace the range of Spanish excursions and the Jimmy Owens site falls well within the reach of Spanish exploration, both reported and unreported. Alfred B. Thomas, "Spanish Exploration of Oklahoma, 1599–1792," Chronicles of Oklahoma 6 (June 1928): maps.
56. Brasher, "Spanish Lead Shot of the Coronado Expedition," 80.
57. The Coronado Expedition carried crossbows. I have previously reported that archaeologist Frank Gagné claimed that the "Chamuscado-Rodríquez-López and the Espejo-Luxán expeditions" also used crossbows. If Gagné is correct, then post-Coronado crossbow boltheads could have reached Zuni or Rio Arriba with those expeditions in the 1580s. Richard Flint and Shirley Cushing Flint, however, strenuously dispute Gagné's contention. In the early 1990s the Flints studied the published documents

dealing with both of those expeditions, as well as those of twenty-four other sixteenth-century expeditions, specifically picking out all references to items of material culture, including arms and armaments. They found no references to crossbows in the documents relating to either of those expeditions, concluding "Gagné was simply wrong; there is absolutely no mention of crossbows in the documentation of either of those expeditions." My own research found no mention of crossbows in the accounts of Castaño or Morlete, or in the muster of the Oñate Expedition. Given this history, crossbow boltheads in the Southwest are almost certainly from the Coronado Expedition. See Brasher, "The Chichilticale Camp of Francisco Vázquez de Coronado," 453; Francis Roland Gagné, Jr., "Spanish Crossbow Bolt Heads of Sixteenth Century North America: A Comparative Analysis" (master's thesis, Wichita State University, 1997): 3–4; Richard Flint, e-mail messages to author, 5–6 March 2010; and Richard Flint, "The Pattern of Coronado Expedition Material Culture," (master's thesis, New Mexico Highlands University, 1992. There is an unfortunate insinuation that crossbows in the New World were not obsolete in 1596. Pedro Ponce de León, a rival of Oñate for "exploration, pacification and settlement of New Mexico," in his attempt to gain the royal contract, claimed he offered more than Oñate. Included in this greater offering were "fifty crossbows," these being items specifically mentioned as absent in the Oñate inventory. Military arms historian Harold L. Peterson describes the Ponce de León offering as the "last known reference to crossbows for use in America." Oñate, not Ponce de León, however, won the contract, and Hammond and Rey present evidence that these fifty crossbows never reached New Spain. Providing still more evidence of the disappearance of crossbows, Peterson writes, "By the middle of the 16th century, however, the crossbow had been largely superseded as a military weapon in Europe . . . A few crossbowmen were listed in the Spanish forts of St. Augustine and Santa Elena in 1570, 1573, but they were distinctly of secondary importance." The Flints allow that "after the 1560s, there may have been an occasional stray [crossbow], but they were definitely no longer a weapon of choice and were definitely not present in numbers sufficient to account for the many crossbow bolt heads that have been recovered in recent years in the Southwest." Haring reported that while crossbows were mandatory on vessels in 1552, by 1573 they were "superseded by the more effective arquebus." Charles Wilson Hackett, Historical Documents Relating to New Mexico, Nueva Vizcaya, and Approaches Thereto, to 1773 (Washington, D.C.: Carnegie Institution of Washington, 1923), 1:280, 282; Harold L. Peterson, Arms and Armor in Colonial America 1526–1783 (New York: Bramhall House, 1956), 7; Hammond and Rey, Don Juan de Oñate, 11–12; and Haring, Trade and Navigation, 274–75.