



# A Quartz Crystal Cross from Mission San Luis, Florida

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Excavations in the church complex at the 17th century Franciscan mission site of San Luis de Talimali in Tallahassee, Florida, uncovered a portion of the mission cemetery beneath the church floor. Among the remains was a cross fashioned from a single piece of quartz crystal. The raw material and shape of this artefact combine both Native American and Christian religious symbolism, while analysis of the cross using photomicrography reveals the techniques used in its manufacture. Based on the manufacturing methods and tools employed, it is suggested that the cross was fashioned by a Native American artisan.

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## Introduction

From the earliest years of Spanish exploration and settlement in the New World, religious indoctrination and conversion of native peoples was required by papal donation and mandated by Spanish law as the primary function of New World exploration and settlement (McAlister, 1984; Weber, 1992). Missionization proved to be the most efficacious means by which Spaniards could ensure a foothold in outlying territories, while promoting Christianity and “civilizing” aboriginal peoples (Bolton, 1917; Weber, 1992). Friars were frequently the first Europeans to have contact with Indian groups, and their interaction was often sustained over a considerable length of time as they attempted to modify the spiritual lives and behaviour of their charges.

Evangelization was achieved through a variety of means in different parts of the Americas and usually took advantage of cultural preconditions, including native social organization, political structure, settlement pattern, and demography. In most parts of the Western Hemisphere, Spaniards expanded into

territories in order to take advantage of natural and human resources, and essentially imposed themselves on the native inhabitants. This, however, was not the case in some areas of the New World, such as Apalachee Province in the Florida panhandle (Figure 1). Apalachee chiefs journeyed to St. Augustine in 1607 to request that the governor of *La Florida* send friars to their province (Hann, 1988: 11). Thus missions in Apalachee Province present a unique set of parameters within which to study Spanish and Indian interaction and to examine the nature of religious conversion among a native population who voluntarily embraced Christianity.

## Site Background

The first Franciscans intent on establishing formal missions, Pedro Muñoz and Francisco Martínez, did not arrive in Apalachee Province until 1633, at which time they probably established missions at the principal villages of Ivitachuco and San Luis de Jinayca where the most powerful leaders lived. In just 2 years the missionaries had baptized over 5000 Indians

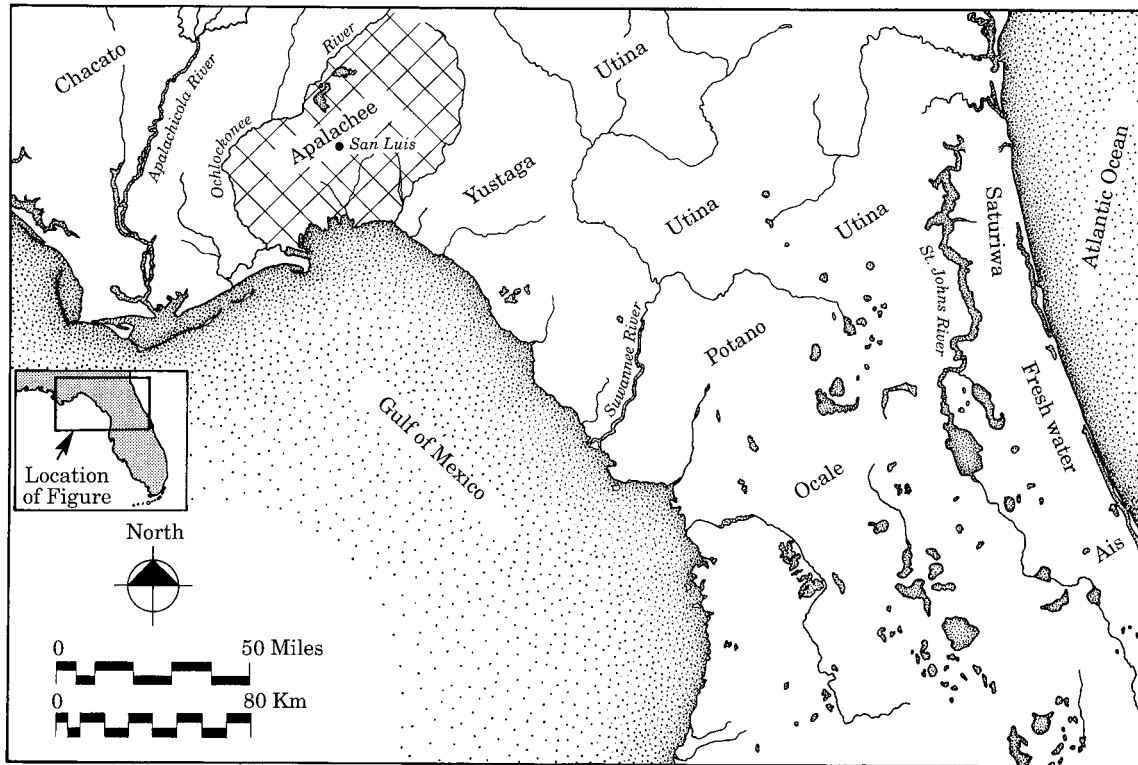


Figure 1. Location of Apalachee Province and Mission San Luis in the Florida panhandle.

(Hann, 1988: 14), and by the 1670s the Apalachee were described as being thoroughly Christianized (Hann 1994: 340). The site recognized today as San Luis was selected by the Spanish military personnel for its strategic hilltop location. The leader of the Apalachee village of San Luis moved his village to be near the Spaniards, and Mission San Luis flourished from 1656 to 1704 with more than 1400 Apalachee and Spanish residents. The town became a principal village of the Apalachee Indians and the Spaniards' westernmost religious, military, and administrative capital in Florida.

Having never been lost to local residents, San Luis continued to be mentioned in a variety of documents and publications since it was burned and abandoned by the Spaniards and Apalachee in 1704 (Boyd, Smith & Griffin, 1951). The State of Florida purchased San Luis in 1983, and since that time has supported an ongoing program of archaeological and historical research. Over the past 12 years, archaeological investigations in the mission centre have focused on the Apalachee council house (Shapiro & McEwan, 1992), the fort (McEwan & Poe, 1993), Apalachee and Spanish residential areas (McEwan, 1991, 1993; Shapiro & Vernon, 1992; Scarry & McEwan, 1995) and the religious complex (Shapiro & Vernon, 1992; McEwan & Larsen, 1995).

The locations of the church and convento were verified in 1990, and intensive archaeological investigations began in 1991. From 1994 to 1996, research in the

church complex was funded by the National Endowment for the Humanities. The overarching objectives of the project were to examine the effects of missionization on the Apalachee Indians interred in the church through religious architecture, biocultural analysis, and mortuary patterning. Of these areas of inquiry, none has been more informative about native religious conversion than mortuary patterning or burial practices.

### Burial Practices

At the end of the 1995 field season, 161 individuals out of an estimated population of 900 had been excavated (McEwan & Larsen, 1995). All of these burials, with the possible exception of one individual, were Native Americans. As is the case at other missions, all burials were interred in the sanctified ground beneath the floor of the church. They were buried in a typical Christian fashion with their heads in an easterly direction, bodies supine, extended, and with their hands folded or clasped on the chest. Slightly less than half of the burials were primary and there was a great deal of disturbance. Many burials intruded into earlier interments (often multiple times) due to the limited amount of space available for burial in the church floor. Seven of the primary burials were coffin interments, two of which were superimposed in the same pit.

Artefacts were found in association with burials throughout the cemetery, most of which were glass

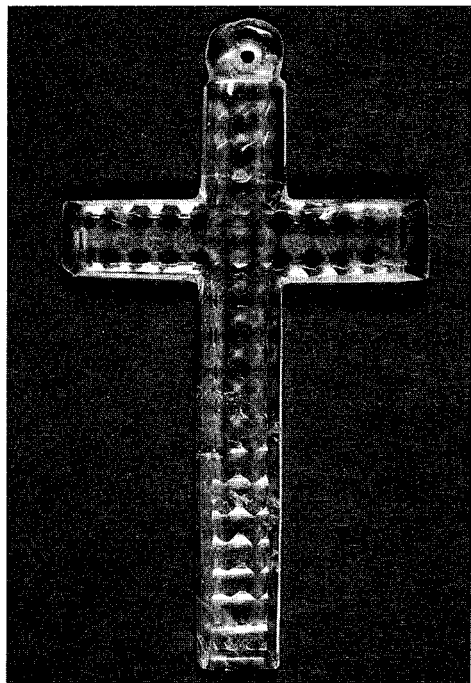


Figure 2. Photograph of entire quartz cross taken with a Nikon F2 equipped with a 50 mm macro lens at f8 for 0.125 s on Fujichrome 64T under tungsten illumination.

beads and copper tube beads. A number of unique and elaborate funerary objects were also recovered, most of which were associated with burials located at the altar end of the church cemetery. This area of the church was traditionally reserved for individuals of high social or economic status in European churches and this pattern appears to have been continued in New World communities. Grave goods recovered from the altar or west end of the San Luis church include a partial rosary, a cluster of jet amulets or *higas*, and an iron knife. However, the most unique artefact recovered to date is a quartz crystal cross (Figure 2).

### Symbolic Significance of the Quartz Cross

This artefact has generated a tremendous amount of popular and scientific interest not only because of its inherent beauty, but because of its potential value for enhancing our understanding of religious conversion and symbolism among the mission population. The shape of the artefact is that of a Latin or Roman cross, with an elongated bottom "arm". This basic shape, along with that of the Greek cross with four arms of equal length, was also a common symbol and decorative motif among prehistoric Native Americans who used a cross to signify the four directions, four seasons, and other natural phenomena. It has been suggested that the universality of the cross as a spiritual symbol made it possible for Indian groups who were subjected to forced conversion to use "Christian symbols" as a means of reinforcing their precontact belief systems (Gettig, 1989: 12).

Although it has been documented that the Apalachee living at San Luis accepted the Catholic faith voluntarily, it is equally well documented that they did not give up their reliance on traditional spiritual leaders and healers. In fact, official Spanish policy advised respect for native customs which did not conflict with Christian beliefs and morals. While there is no evidence of the cross being used in any manner (specifically in relation to material culture) by the prehistoric peoples of north Florida, it does begin to appear as a decorative motif on native pottery in Florida at mission sites (Milanich, 1995: 204–205). This suggests that the cross and its associated religious symbolism within Christian doctrine may have been introduced by Spaniards and adopted by native Floridians *in toto*.

The quartz cross recovered at San Luis may have had further symbolic significance, both to Apalachee people and to Spaniards. Quartz crystal was a natural material thought to possess special powers by many aboriginal groups in southeastern North America. As such, it was often used for amulets and other objects of religious or ritual significance (Jones, 1873: 521; Williams, 1986: 179). The ethnohistorical and archaeological records also reveal that ritual uses of quartz crystals were common in the eastern U.S.A. over an extensive period of time (Hamell, 1983: 13–16).

Among the Cherokee, one of the most sacred religious objects was the *ulunsâta* or *ulûnsû'ti*, a quartz crystal used to portend the future (Fenton, 1961: 265; Fogelson, 1961: 222; Mooney, 1900: 298–300, 458–461; Olbrechts, 1930: 549). It was also employed at ceremonies aimed at preventing epidemic disease (Butrick, n.d.). Creek and Seminole groups used quartz crystals to bring luck in hunting, attract members of the opposite sex, make rain, and to ward off bullets in battle (Howard, 1968: 79–80; Hudson, 1976: 168–169, 1984: 19). The recovery of quartz crystals from many precontact and protohistoric Mississippian sites in the Southeast (Byrd, 1989: 28–29; Hudson, 1976: 168; Milanich, 1994: 411–412; Mitchem, 1989: 399–402; Moore, 1894a: 22, 25, 1894b: 203), and at contemporaneous Caddoan sites in Texas and Louisiana (Webb, 1948: 134), demonstrates that late prehistoric southeastern groups also prized these objects.

Spanish uses of and beliefs associated with rock crystal are equally diverse. As early as the 1300s, Paternoster beads in European rosaries were often made of crystal (Evans, 1970: 50). In the 16th century, the art of carving rock crystal reached greater perfection in Europe and crystal became one of the preferred materials for making rosary beads (Johnson, 1944: 76; Evans, 1970: 77; Muller, 1972: 62). At the same time, crystal jewellery became very popular among elite Spaniards, including royalty (Johnson, 1944: 76–77; Muller, 1972: 59).

By the 16th century, artisans in Spain were producing amulets and charms of jet, crystal, or coral that were believed to protect against spells or the "evil eye". The most popular style was the *higa*, a clenched-fist

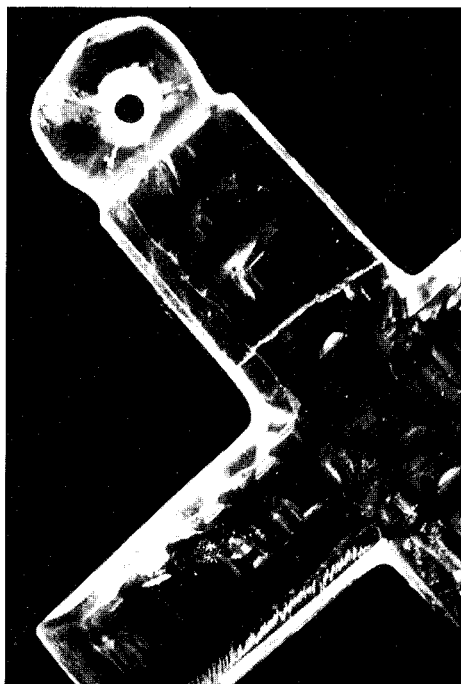


Figure 3. Upper section of cross viewed under dark-field illumination which underscores natural and manufacturing flaws in the suspension loop, as well as the natural fracture plane across the upper vertical arm.

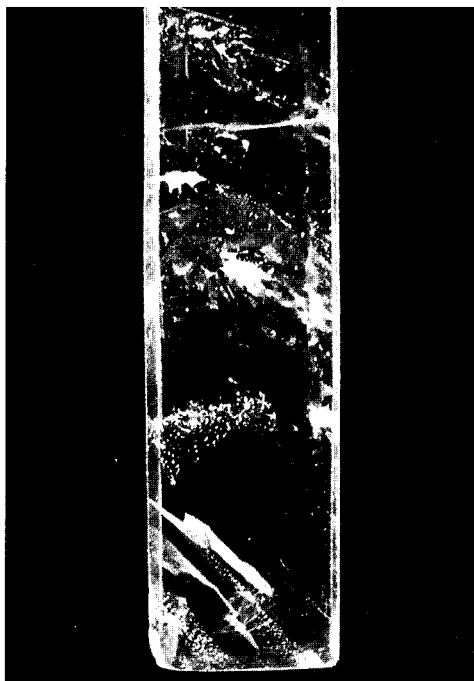


Figure 4. Dark-field transmitted photomicrograph of the long vertical section illustrating the numerous flaws, cracks, and fracture planes in the quartz.

amulet that remains in widespread use among Latin peoples today (Muller, 1972: 24, 69, 146, figure 94). Although *higas* were not a Christian symbol (the origins are apparently Islamic), they were commonly worn in Spain. At the same time, the use of rock crystal in Christian reliquary pendants also became popular (Muller, 1972: 70). Even members of the nobility such as Juana, the daughter of Charles V, had a quartz crystal reliquary pendant in the shape of a cross (Muller, 1972: 59).

Faceted crystal beads are often classified as Florida Cut Crystal beads when found at historic period sites in the Southeast. Those recovered from 17th century mission sites in *La Florida* may have functioned as rosary beads, but they have not been recovered in association with burials or in other unequivocal contexts.

Because quartz crystal was a desirable raw material for religious objects among both southeastern Native Americans and Spaniards, it is unclear whether the selection of quartz as the raw material from which to manufacture the San Luis cross had only Christian significance or a broader syncretic mixture of Christian and traditional Apalachee symbolic meaning.

One of the most intriguing aspects of this artefact was determining how it was manufactured and whether the artisan was Spanish or Native American. Initially, it was even unclear whether the cross was made of quartz or glass. The lack of surface patina and internal fracture planes, however, suggested quartz. Ann S. Cordell (Ceramic Technology Laboratory, Florida Museum of Natural History) tested the cross using a Mohs Hardness Kit and examined minute fragments of the cross under a petrographic microscope. The hardness of the raw material and the interference colours under crossed polars were consistent with quartz (pers. comm. to McEwan, 1994). Charles S. Tumosa (Conservation Analytical Laboratory, Smithsonian Institution) also examined the cross and suggested that it was probably made by a native based on the crude and biconically drilled suspension loop (pers. comm. to McEwan, 1995). Although parallel striations were visible to the naked eye on most worked surfaces, and some flake scars were evident on the edges of the suspension loop, it was not until the cross was photomicrographed by one of the authors (Davidson) that it could be studied in depth using technology previously unavailable to most archaeologists.

### Photomicrography

All reflected, bright-field, and dark-field photomicrographs were taken with a Nikon SMZ-U zoom trinocular stereo microscope using a  $0.5\times$  plan achromat objective and  $10\times$  high eyepoint, wide-field oculars. For reflected light microscopy, samples were illuminated with incident tungsten-halide (150 W) light generated by a Fostec coaxial fibre optics unit attached directly to the objective. Oblique illumination was

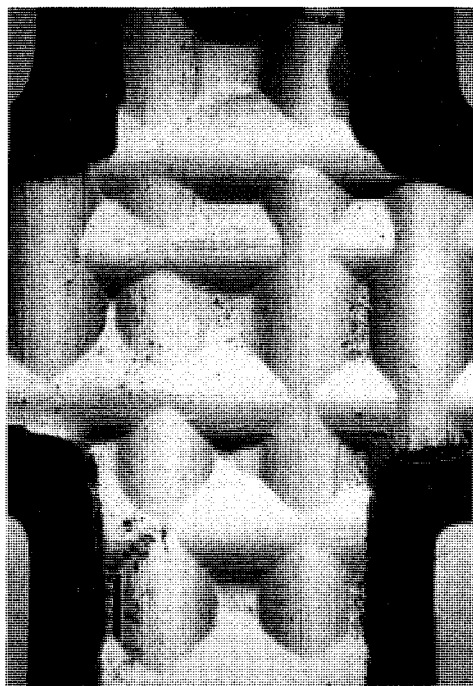


Figure 5. Transmitted polarized optical micrograph of the central portion of the cross illuminates the parallel striae produced by a metal file.

provided by several Dolan-Jenner dual-pipe fibre optics units with variable-intensity tungsten-halide light sources. Bright-field and dark-field transmitted stereo microscopy was accomplished with the SMZ-U using a 6 V-30 W (tungsten-halide) diasopic illumination source located in the base of the microscope that provides a convenient lever for quick changeover between the two illumination modes. Transmitted polarized microscopy was done with a Nikon Optiphot-pol equipped with a  $1\times$  strain-free objective (Van Winkle *et al.*, 1990). The colour temperature of all light sources was  $3200^{\circ}\text{K}$ .

Images were captured on Fujichrome 64-T transparency film adjusted for a colour temperature balance matching the illumination sources. Exposure times were monitored by a Nikon UFX-III exposure monitor equipped with a photomultiplier tube, and are accurate to 0.01 s. In all cases, a  $2.5\times$  projection lens was used to focus the image onto the film plane. E-6 film processing was done in-house using a JOBO CPP-2 operated at  $38.3 \pm 0.1^{\circ}\text{C}$ . Contrast was enhanced by the addition of 3.0 g phenidone per litre of first developer (Davidson & Lofgren, 1991). The colour developer was optimized by adjustment of the pH to 11.5 units using 1.0 N NaCl. The pH of the colour developer was monitored during processing to ensure consistency in colour saturation and depth. In most instances, the film was under-exposed by 2-3 f-steps and the process time in the first developer increased by 45% (push-processing).

## Manufacturing Techniques

Using the images produced through photomicrography, many natural features and manufacturing details of the cross readily became apparent. It was fashioned from a single piece of quartz crystal. The finished product measures 7 cm long (measured from the top of the suspension loop to the end of the lower arm) and 4 cm wide (measured from the ends of the horizontal arms). It averages 0.5 cm thick (obverse to reverse) over most of the body, slightly thinner at the suspension loop. The obverse side is decorated with a series of convex pyramidal projections, while the reverse face is flat. The obverse and reverse edges of all of the arms are bevelled and a suspension loop is incorporated in the quartz of the top arm.

The photomicrographs reveal that the quartz from which the cross was fashioned had several natural flaws, including faults and fractures (Figures 3 & 4). The presence of these imperfections prohibited the extensive use of pressure flaking in manufacture.

Figure 5 was taken using transmitted polarized light, and clearly shows that the pyramidal projections on the obverse side were produced by abrading the surface with a cylindrical metal tool such as a rat-tail file. Perpendicular grooves were engraved, leaving the projections and giving the obverse face a faceted appearance.

Photomicrographs reveal file marks on all the edges (Figures 6 & 7). The cross appears to have been manufactured by initially decorating a large piece of quartz through delicate pressure flaking and filing. The body was then carefully fashioned by additional flaking and filing sufficient to achieve the basic form, and finished by bevelling and smoothing the edges with a file into the final desired shape.

The only part of the cross that exhibits other manufacturing processes is the suspension loop. Photomicrographs indicate that it was formed through pressure flaking, filing, and drilling, and was probably the most difficult part of the pendant to produce (Figure 8). Unlike the arms of the cross which are intricately executed, the suspension loop is highly irregular and crude, and was drilled biconically after being thinned by filing.

The quartz cross shows very little evidence of use. The photomicrographs reveal few indications of chipping or abrasion resulting from wear on the body of the cross, and this interpretation is underscored by the very fragile nature of the artefact which inevitably would have broken along one of several large fracture planes had it been subjected to much handling or use.

## Discussion

Techniques used in the manufacture of the quartz cross as evidenced by photomicrography are informative in determining the ethnic affiliation of the artisan. Indians living at the mission would have had access to a limited number of European tools and materials, while Spaniards had a full range of iron implements at their

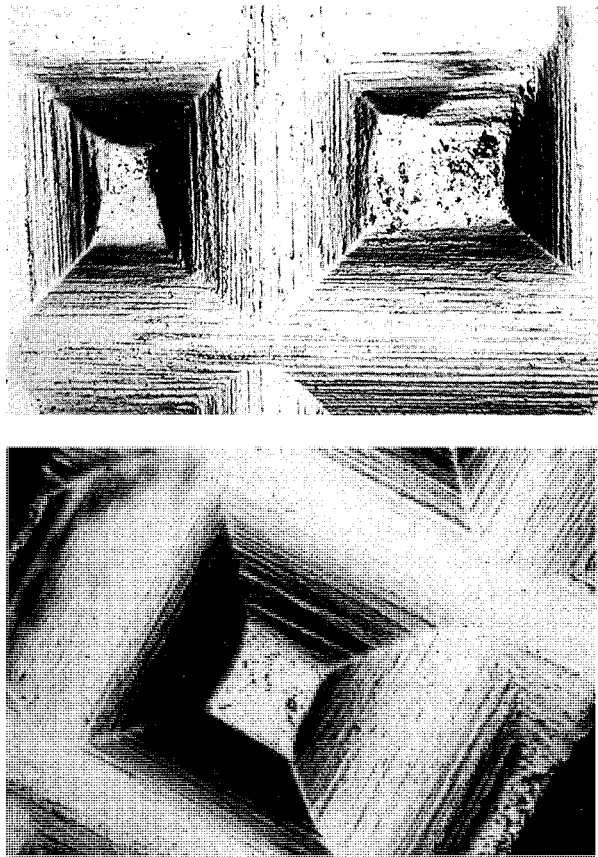


Figure 6. Quartz cross birefringence. Using transmitted polarized light, photomicrographs make a detailed examination of the tool marks possible. The upper photomicrograph shows the central portion of the cross while the lower one is a detail of an arm.

disposal. The body of the cross was formed and decorated using some pressure flaking and a considerable amount of filing. While it is impossible to determine what was used to flake the edges, the parallel and regular striae indicate that a metal file was used to smooth them. However, the crude manner in which the suspension loop was drilled suggests that the manufacturer used some type of non-metal tool. While a Spanish craftsman would have used a metal drill, an Indian artisan might not have had access to the tool of choice for such an endeavour. Further evidence suggesting that the manufacturer was Indian is the fact that the suspension loop was biconically drilled; a common technique among Native Americans. The absence of post-manufacture wear indicates that the cross was made specifically as a grave good or offering, the use of which was not generally condoned by the church or practised by Europeans.

### Summary and Conclusions

When the quartz cross was first recovered at San Luis, it appeared perfectly symmetrical and was initially thought to be a moulded glass cross manufactured in



Figure 7. Detail of striae created while abrading and smoothing the edge of the cross.

Europe. Subsequent study and consultations with material scientists illuminated various aspects of the artefact, but photomicrography proved to be the most useful technology for understanding the natural properties and manufacturing techniques associated with the cross. This, in turn, has provided compelling evidence that the artisan who made this magnificent object was a Native American who manufactured the cross to accompany the Christian-style burial of an Apalachee Indian in a Franciscan church.

If this interpretation is correct, it provides a fascinating example of religious conversion and acculturation among at least some of the Apalachee population. While it can be argued that the symbolic significance of quartz was a continuation of traditional native beliefs or an example of syncretism, the shape of the cross has no known precontact precedent in the Apalachee Province. Also while some aspects of mortuary patterning may have been an admixture of cultural traditions, most of the observed characteristics appear to be predominantly European in origin and speak to the profound impact of missionization on Apalachee life.

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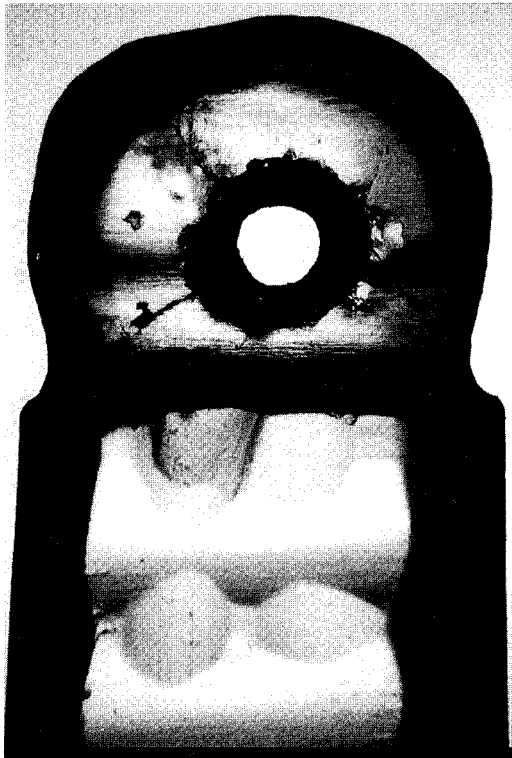


Figure 8. Views of suspension loop using dark-field transmitted light microscopy (top) and bright-field microscopy (bottom). These illuminate the pressure flaking by which the cross was initially shaped and the crude nature of the biconically drilled suspension loop.

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## References

- Bolton, H. E. (1917). The mission as a frontier institution in the Spanish American colonies. *American Historical Review* 23, 42-61.
- Boyd, M. F., Smith, H. G. & Griffin, J. W. (1951). *Here They Once Stood: The Tragic End of the Apalachee Missions*. Gainesville: University of Florida Press.
- Butrick, D. S. (n.d.). An account of the customs and traditions of the Cherokees. *Papers concerning the Cherokee Indians, vol. 4*. Manuscript on file, E. E. Ayer Collection. Chicago: Newberry Library.
- Byrd, K. (1989). Tchefuncte subsistence practices at the Morton Shell Mound, Iberia Parish, Louisiana. *Louisiana Archaeology* 16, 1-128.
- Davidson, M. W. & Lofgren, G. E. (1991). Photomicrography in the geological sciences. *Journal of Geological Education* 39, 403-418.
- Evans, J. (1970). *A History of Jewellery, 1100-1870*. Boston: Boston Book and Art.
- Fenton, W. N. (1961). Iroquoian culture history: a general evaluation. In (W. N. Fenton & J. Gulick, Eds) *Symposium on Cherokee and Iroquois Culture. BAE Bulletin 180*. Washington, DC: Bureau of American Ethnology, Smithsonian Institution, pp. 257-277.
- Fogelson, R. D. (1961). Change, persistence, and accommodation in Cherokee medico-magical beliefs. In (W. N. Fenton & J. Gulick, Eds) *Symposium on Cherokee and Iroquois Culture. BAE Bulletin 180*. Washington, DC: Bureau of American Ethnology, Smithsonian Institution, pp. 215-225.
- Gettig, L. J. (1989). *The History of the Cross in Religious and Social Symbolism*. Wickenburg, AZ: Rainbow Hogan Museum of the Cross.
- Hamell, G. R. (1983). Trading in metaphors: the magic of beads. In (C. F. Hayes III, Ed.) *Proceedings of the 1982 Glass Trade Bead Conference. Research Records 16*. Rochester, NY: Research Division, Rochester Museum & Science Center, Rochester, pp. 5-28.
- Hann, J. H. (1988). *Apalachee: The Land Between the Rivers*. Gainesville: University Presses of Florida.
- Hann, J. H. (1994). The Apalachee of the historic era. In (C. Hudson & C. Chaves Tessar, Eds) *The Forgotten Centuries*. Athens: University of Georgia Press, pp. 327-354.
- Howard, J. H. (1968). The Southeastern Ceremonial Complex and its interpretation. *Missouri Archaeological Society Memoir* 6, Columbia.
- Hudson, C. M. (1976). *The Southeastern Indians*. Knoxville: University of Tennessee Press.

- Hudson, C. M. (1984). *Elements of Southeastern Indian Religion*. Iconography of Religions. Section X: North America. Fascicle 1. Institute of Religious Iconography, State University Groningen. Leiden, The Netherlands: E. J. Brill.
- Johnson, A. M. (1944). *Hispanic Silverwork*. New York: Hispanic Society of America.
- Jones, C. C., Jr. (1873). *Antiquities of the Southern Indians, Particularly of the Georgia Tribes*. New York: Appleton.
- McAlister, L. N. (1984). *Spain and Portugal in the New World, 1492–1700*. Minneapolis: University of Minnesota Press.
- McEwan, B. G. (1991). San Luis de Talimali: the archaeology of Spanish-Indian relations at a Florida mission. *Historical Archaeology* 25(3), 36–60.
- McEwan, B. G. (1993). Hispanic life on the seventeenth-century Florida frontier. In (B. G. McEwan, Ed.) *The Spanish Missions of La Florida*. Gainesville: University Press of Florida, pp. 295–321.
- McEwan, B. G. & Larsen, C. S. (1995). *Archaeological and Biocultural Investigations in the Church Complex at San Luis*. Report to the National Endowment for the Humanities. Tallahassee: Florida Bureau of Archaeological Research.
- McEwan, B. G. & Poe, C. B. (1994). Excavations at Fort San Luis. *The Florida Anthropologist* 47, 90–106.
- Milanich, J. T. (1994). *Archaeology of Precolumbian Florida*. Gainesville: University Press of Florida.
- Milanich, J. T. (1995). *Florida Indians and the Invasion from Europe*. Gainesville: University Press of Florida.
- Mitchem, J. M. (1989). *Redefining Safety Harbor: Late Prehistoric Protohistoric Archaeology In West Peninsular Florida*. Ph.D. thesis, University of Florida.
- Mooney, J. (1900). Myths of the Cherokee. *Nineteenth Annual Report of the Bureau of American Ethnology, 1897–1898*. Washington, DC: Smithsonian Institution, pp. 3–548.
- Moore, C. B. (1894a). Certain sand mounds of the St. John's River, Florida. Part I. *Journal of the Academy of Natural Sciences of Philadelphia* X, 5–103.
- Moore, C. B. (1894b). Certain sand mounds of the St. John's River, Florida. Part II. *Journal of the Academy of Natural Sciences of Philadelphia* X, 129–246.
- Muller, P. E. (1972). *Jewels in Spain, 1500–1800*. New York: Hispanic Society of America.
- Olbrechts, F. M. (1930). Some Cherokee Methods of Divination. *Proceedings of the 23rd International Congress of Americanists*, 547–552.
- Scarry, J. F. & McEwan, B. G. (1995). Domestic architecture in Apalachee Province: Apalachee and Spanish residential styles in the late prehistoric and early historic period Southeast. *American Antiquity* 60, 482–495.
- Shapiro, G. & McEwan, B. G. (1992). *Archaeology at San Luis: The Apalachee Council House. Florida Archaeology 6, Part 1*. Tallahassee: Florida Bureau of Archaeological Research.
- Shapiro, G. & Vernon, R. (1992). *Archaeology at San Luis: The Church Complex. Florida Archaeology 6, Part 2*. Tallahassee: Florida Bureau of Archaeological Research.
- Van Winkle, D. H., Davidson, M. W., Chen, W. X. & Rill, R. L. (1990). Cholesteric helical pitch of near persistence length DNA. *Macromolecules* 23, 4140–4148.
- Webb, C. H. (1948). Caddoan prehistory: the Bossier Focus. *Bulletin of the Texas Archeological and Paleontological Society* 19, 100–147.
- Weber, D. J. (1992). *The Spanish Frontier in North America*. New Haven, CT: Yale University Press.
- Williams, S. C. (Ed.) (1986). *Adair's History of the American Indians*. Reprinted. New York: Promontory Press. Originally published 1930, Johnson City, TN: National Society of Colonial Dames, Watauga Press.