The Journal

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Foreward

The ***Journal of the Houston Archeological Society*** is a publication of the Society. Our Mission is to foster enthusiastic interest and active participation in the discovery, documentation, and preservation of cultural resources (prehistoric and historic properties) of the city of Houston, the Houston metropolitan area, and the Upper Texas Gulf Coast Region.

The Houston Archeological Society holds monthly membership meetings with invited lecturers who speak on various topics of archeology and history. All meetings are free and open to the public.

Membership is easy! As a nonprofit organization, membership in the Houston Archeological Society is open to all persons who are interested in the diverse cultural history of Houston and surrounding areas, as well as the unique cultural heritage of the Upper Texas Gulf Coast Region. To become a member, you must agree with the mission and ethics set forth by the Society, pay annual dues and sign a Code of Ethics agreement and Release and Waiver of Liability Form.

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Editor's Message

I am pleased to present Issue #136 of ***The Journal***, a special issue dedicated to the archeological research conducted by Dr. August ("Gus") Costa of Rice University and some of his students. This is precisely the reason ***The Journal*** exists – to be a vehicle for publishing new research on Texas archeology, and Gulf Coast archeology in particular. Moreover, ***The Journal*** is also the perfect platform for young archeologists to publish their first papers in a professional publication. After reading the articles presented herein, I believe you will agree with me that all of these young scholars have a strong future ahead of them in the field of archeology, whether they make archeology their profession or their avocation. The quality of their experimental research and writing dwarfs my first attempt as a student back in 1972!

The first paper by Dr. Costa reviews the significant history and contributions made by researchers at Rice University in the field of Texas archeology. This paper is then followed by a series of articles covering various aspects of experimental archeology, beginning with the experiments conducted by Dr. Costa and Amy Fox on the viability and effectiveness of gar scales as arrow points. This is followed by a paper by Rachel George in which she attempts to use several materials to duplicate the type of rock petroglyphs that have been found in the Trans-Pecos region, specifically in Lewis Canyon in Val Verde County. The next paper is by Dylan Dickens which details his efforts to both construct and then experimentally determine the function of the Guadalupe Tool. His experiments go a long way toward demonstrating how effective these tools were both as hafted and hand-held implements. This edition of ***The Journal*** then concludes with a brief but important paper by Dr. Costa wherein he analyzed some long-lost material from the Caplen Mound site in Galveston County. The material was donated to the Rice University Archeology lab many years ago but had never been opened, studied and catalogued. Dr. Costa's description of both the human remains and the attendant grave goods greatly add to the knowledge from this small but highly important site.

Please note that our new publishing policy now has an expanded the range of subjects to include any topic of archeological interest that is studied and written by a HAS member. First preference will be given to subjects along the Gulf Coast / Houston area, followed by archeological subjects within the State of Texas. Material from outside Texas and the U.S. would receive next consideration. So if you have worked on a site in Europe, Africa, Meso-America, etc., write it up and submit it to ***The Journal***.

As always, we are very open to receiving any new submission that deals with an archeological subject. Do not worry that your paper may not be "perfect"; your editor is more than willing to work with you to create a publishable result. ***The Journal*** is the ideal vehicle for young and older authors alike to either begin or expand your published resume. Please send all submissions and inquiries to Dub Crook at the following email address:

dubcrook@kingwoodcable.com

Or call me with questions at 281-360-6451 (home) or 281-900-8831 (cell).

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THE HISTORY OF ARCHEOLOGY AT RICE UNIVERSITY AND THE ARCHEOLOGY OF THE GREATER HOUSTON AREA

August G. Costa, Ph.D., R.P.A.

Introduction

The history of archeology at Rice University can be divided into three principal phases corresponding to specific faculty members. The formative phase of Rice archeology occurred during the tenure of Dr. Frank Hole from circa 1961 to 1979. A developmental phase occurred under Drs. Susan and Rod McIntosh from 1981 to 2000. Finally the contemporary phase of Rice archeology began in 2000 with the arrival of Dr. Jeffrey Fleisher. Ultimately these four professors have shaped the direction of academic archeology at Rice. In this paper, I will highlight the personalities, local research projects and collaborations of Rice faculty, staff and alumni that have shaped the modern landscape of archeology in the Greater Houston area for nearly 50 years.

The single most important contribution of the Rice program to the archeological community of the Greater Houston Area is the class ANTH 362: Archaeological Field Techniques. Unlike many other programs where field methods are taught as summer field schools, the Rice model has students conducting fieldwork over several weekends throughout the course of a semester. Although this method of field training misses out on the experience of an extended and sustained field archeology experience, it has several advantages to the traditional approach. The most prominent benefit is that Rice students gain experience in the entire process of archeology, not just the digging. Each field techniques course at Rice is organized as a complete project where the students are involved in planning, excavation, analysis and report writing. ANTH 362 has generated more than a few well dug holes in the ground; it has generated archeological knowledge from which everyone can benefit.

Anthropology at Rice University

The earliest antecedent to archeology at Rice occurred in 1960 when the university created the Department of Anthropology and Sociology. This coincided with the hiring of Edward Norbeck, an expert in Japanese cultural anthropology. In these early days, anthropology related course offerings consisted of classes on Primitive Religion, Physical and Cultural Anthropology. Expansion of the social sciences offerings throughout the 1960s resulted in the hiring of Rice's first archeologist, Dr. Frank Hole, in 1961. Shortly thereafter Rice began some of its first courses in archeology, including Old and New World prehistory. By the end of the 1960s, Anthropology had grown to become its own department with six full time faculty members.

Initially, anthropology at Rice was a relatively balanced four-field program including elements of all anthropological sub-disciplines (Cultural Anthropology, Physical Anthropology, Linguistics and Archeology). However, like many American anthropology programs, the balances between these subfield and faculty interests have competed over the years, with one subfield often winning out. Over the past fifty years, Anthropology at Rice has been inclined toward Cultural Anthropology at the expense of the other three subfields. Today full-time faculty at Rice includes six cultural anthropologists and two archeologists. No physical or biological anthropologists are employed at Rice University. Linguistics exists at Rice as a separate department within the School of Social Sciences.

Frank Hole: Formative Archeology at Rice

The early part of the formative phase of archeology at Rice was relatively uneventful for the Greater Houston Area. Frank Hole, like his renowned mentor Robert Braidwood (University of Chicago), was primarily concerned with the late prehistory and archeology of the Near East. Consequently when Hole wasn't teaching he was traveling and working in Iran and Syria. In the early 1960s, Hole carried out several field campaigns in the Khorramabad Valley of Iran, collaborating with noted Mesoamerican archeologist Kent Flannery (Table 1). Hole followed these Near East expeditions with work alongside Flannery in Mesoamerica (1966-1967).

Rice archeology was then and continues to be primarily a foreign endeavor. No long-standing archeologist at Rice has been focused on North Amer-

Table 1. Prominent Rice International Archeological Field Projects 1960-2016.

Year	Project/Site	Supervisor	Collaborators
1961-1963	Ali Kosh and Khorramabad Valley, Iran	Frank Hole	Kent Flannery
1965	Yafteh and Ghamari Caves, Iran	Frank Hole	
1966	Gheo Shih, Oaxaca Valley	Kent Flannery	Frank Hole
1967	Cueva Blanca, Oaxaca Valley	Kent Flannery	Frank Hole
1969	Chagha Sefid, Iran	Frank Hole	Colin Renfrew
1971-1972	Oaxaca Archeology Project	Richard Blanton	
2005-2007	Goree, Senegal	Ibrahima Thiaw and Susan McIntosh	
2009-2016	Songo Mnara, Tanzania	Jeffrey Fleisher	

ican archeology. Consequently, Rice archeology gained a reputation for elitism amongst other university programs in Texas, which whether fair or not is undoubtedly linked to its continued emphasis on exotic Old World and or "origins of civilization" type subjects rather than local Texan interests. Local Rice community archeology has its beginnings in 1969. This occurred when a few intrepid students and dedicated members of the Houston Archeological Society (HAS) dragged Frank Hole into the fray.

In 1969, while Frank Hole was away in Iran excavating at Chagha Sefid, an unofficial "Gulf Coast Archeology" class was organized and offered through Brown College at Rice University. This endeavor was initiated as the result HAS members engaging the Rice academic community through Ms. Mary McCutcheon, an HAS member and Rice University student. By this time, Ms. McCutcheon had already been involved with initial excavations at the Harris County Boys School (41HR80/41HR85) with Richard Gramley and HAS in the summer of 1968, prior to Lawrence Aten taking over investigations there in 1969.

By 1969, HAS member Wayne Neyland had already been working on the Clear Lake Survey/Salvage (CLS) project for some time. In the late 1960s, the Friendswood Development Company (a subsidiary of the Humble Oil Company) encouraged HAS members to conduct a survey of their properties along Armand Bayou. Many of these events were driven, at least partially, to growth related to the development of NASA's Johnson Space Center. In the course of the CLS survey, Neyland and Lou Fullen identified a large prehistoric shell midden. It was this midden, later known as the Fullen Site (41HR82) that finally brought Rice into the realm of local Houston archeology.

In 1969, field investigations of the Fullen Site (41HR82) were turned over to Mary McCutcheon, who with support from Brown College and Rice professors Robert Eisenburg (biology) and Robert Lankford (Earth Sciences), made the excavation a "Gulf Coast Archeology" class project. Unfortunately those involved with organizing this fun elective class produced little other than a large pile of *Rangia* mussel shell and associated artifacts.

At the end of the summer of 1969, Hole returned from Iran to find his lab littered with masses of Fullen Site artifacts. Hole prevailed upon undergraduate student Mike O'Brien (who had been enrolled in the class) to make something of the mess. O'Brien, who is now a prominent emeritus professor of archeology at the University of Missouri, made the Fullen site project his own and produced a summary report of the 1969 season, which finally gained Frank Hole's interest (O'Brien, 1971).

This is the chain of events that finally pulled Frank Hole into the arena of local Houston archeology. Hole had no interest in Gulf Coast archeology prior to these events and struggled as local citizens sought consultation and curation for finds being discovered in the area. Throughout the 1960s and into the 1970s, Houstonians were constantly bringing artifacts into the Rice lab. Hole's lack of interest in scholarly research in the local area seems to have reached a breaking point with the influx of materials from the Fullen Site.

Shortly after 1970, Hole agreed to be principal investigator for continued HAS surveys along Armand Bayou (Table 2). Hole also organized the first Rice archeological field techniques course which conducted excavations at the Fullen Site from 1971 to 1972, resulting in the publication of HAS Report Number 2 (Hole, 1974a). Meanwhile an eruption of local Rice fieldwork occurred as Hole and students

Table 2. Local Rice Archeology Projects – Historical Phase One as outlined in this paper.

Year	Site	Supervisor	Collaborators	Function	Sponsor	Report
1969	Fullen Site (41HR82)	Mary McCutcheon	Wayne Neyland & HAS	Academic - Field Techniques Course	Friendswood Development Company (Humble Oil subsidiary)	O'Brien, 1971
1971-1972	Fullen Site (41HR82)	Michael O'Brien / Frank Hole	Wayne Neyland & HAS	Academic - Field Techniques Course	Friendswood Development Company (Humble Oil subsidiary)	Hole et al., 1974
1971-1972	San Jacinto Battleground	Frank Hole	Robert Cartier	Compliance - Cultural Resource Management	CIWA Coastal Industrial Water Authority	Cartier and Hole, 1972: Hole, 1972
1971-1972	Shell Point (41BO2)	Frank Hole		Academic - Field Techniques Course		Hole and Wilkinson, 1973
1971-1972	Three Oaks Site (41BO41)	Frank Hole		Academic - Field Techniques Course		Unpublished
1971-1974	Acadia Shipwreck (41BO157)	Frank Hole	Wendell Pierce	Academic	Rice and the Houston Museum of Natural Science	Hole, 1974b
1974-1980	Mitchell Ridge (41GV66)	Barbara Bruce Adkins-Burger / Frank Hole	HAS and TAS	Academic - Field Techniques and PhD Thesis Project	The Woodlands Corp., The Mitchell Development Corp and others	Unpublished - see Ricklis, 1994
1978-1979	Green Lake Shell Midden (41CL62)	Frank Hole	Rice Students	Compliance - Cultural Resource Management	Standard of Ohio, Engineering Science, Inc.	Hole, 1978
1978-1980	Nottingham Lace Factory (41GV71)	Shirley Wetzel / Frank Hole	Rice Students	Academic - Field Techniques Course		Wetzel, 1980
1979	Hen House Ridge (41JP65)	Margie Lohse	Rice Students, Roger Moore	Compliance - Cultural Resource Management	Texas Parks and Wildlife	Lohse and Anderson, 1979
1977	Bryan Mound (41BO117)	Margie Lohse		Compliance - Cultural Resource Management	Strategic Petroleum Reserves	Lohse, 1977
1981	Seabrook Park / Pine Gully (41HR422)	Texas Anderson	HAS	Compliance - Cultural Resource Management	City of Seabrook, TX	Anderson, 1981
1982	Quintana Townsite (41BO135)	Frank Hole				
1985	Ashton Villa (41GV65)	Texas Anderson	Roger Moore	Academic - PhD Thesis Project		Anderson, 1985: Moore and Anderson, 1984

Table 2. Local Rice Archeology Projects – Historical Phase Two as outlined in this paper.

Year	Site	Supervisor	Collaborators	Function	Sponsor	Report
1983-1985	Kellum Noble House (41HR425)	Rod McIntosh		Academic - Field Techniques Course	Harris Co. Heritage Society	Haskell 1984: McIntosh, 1982: McIntosh and Moore, 1983: McIntosh and Salituro, 1985
1985-1990	Pecos Rockart Survey and Buck King C Rockshelter (41VV961)	Rod McIntosh, Adria La Violette, Patti Bass		Academic - Field Techniques Course	ARCHEO. K. King	Awasome et al 1989: Bass, 1989: Shier 1990: Moye and Salinas 1990
1990-1996	Tod Milby House	Adria La Violette, Rod McIntosh		Academic - Field Techniques Course	Milby Family	La Violette and Heath 1990: Thiaw, 1993: Dene, 1994, 1996
1999-2006	Storm and Uno sites (41WA218, 41WA217)	Rod McIntosh, Susan McIntosh	Walter Kingsborough	Academic - Field Techniques Course	US Forest Service	Fine and Mundy 2003: McIntosh et al 1999, McIntosh et al 2000: Foutch et al 2006: Mundy et al 2005

Table 2. Local Rice Archeology Projects – Historical Phase Three as outlined in this paper.
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Year	Site	Supervisor	Collaborators	Function	Sponsor	Report
2008-2009	Yates house (41HR980)	Susan McIntosh and Jeffrey Fleisher	Yates Museum and CARI	Academic - Field Techniques Course	Yates Museum	McIntosh and Clark 2008: Fleisher, 2009
2010-2011	J. Vance Lewis (41HR1032) and Ruthven sites (41HR1070)	Susan McIntosh	Yates Museum and CARI	Academic - Field Techniques Course	Yates Museum	McIntosh 2010, 2011
2012-2013	Ruthven (41HR1070) and Wilson-Victor site (41HR1031)	Jeffrey Fleisher	Yates Museum and CARI	Academic - Field Techniques Course	Yates Museum	Fleisher 2012, 2013
2015-2016	Camp Logan	Jeffrey Fleisher		Academic - Field Techniques Course		

contracted with the Coastal Industrial Water Authority (CIWA) to perform an archeological survey of the San Jacinto Battleground (1971-1972) whilst additional prehistoric digs occurred at Shell Point (41BO2) and the Three Oaks site (41BO41) on Chocolate Bayou (Hole and Wilkinson, 1973).

At the same time as this flurry of local Rice archeology work was occurring, Mesoamerican archeologist Richard Blanton briefly joined the Rice faculty (1971-1972). Blanton was a pupil of Hole's longtime collaborator Kent Flannery. Blanton is also the only archeologist at Rice who was focused exclusively on the Americas. During his short time at Rice, Blanton took many students to Mexico to join his Valley of Oaxaca archeology project. The addition of Blanton at Rice also allowed the course offerings to expand to include more substantial classes on New World prehistory as well as an introductory archeology course.

In 1971-1974, Hole became involved with the Acadia Shipwreck (41BO157), an 1865 Civil War blockade-runner. Local dentist and avocational diver Wendell Pierce examined the Acadia wreckage near the San Luis Pass in the 1960s. The project was a collaboration between Pierce, Rice and the Houston Museum of Natural Science. Rice's contribution was mainly through electrolytic conservation of the metal artifacts recovered from the wreck. Ultimately, Pierce passed away and Hole (1974b) undertook efforts to see that the research was published.

Throughout the 1970s, following their success at San Jacinto Battleground, Frank Hole and his students undertook several contract archeology projects required by the 1966 National Historical Preservation Act. This boom in Cultural Resource Management (CRM) projects occurred around the same time that Roger Moore joined the graduate program at Rice University in 1976. Incidentally, Moore is now the president of the oldest locally owned CRM firm in Southeast Texas (1982-present). He is also both a long-time member and Past President of the HAS. In 1978, Hole and his students surveyed Green Lake Midden (41CL62), a prehistoric site in Calhoun County. Several graduate students including Margie Lohse, Texas Anderson and Roger Moore also became active in contract archeology projects in the Greater Houston Area (see Table 2).

In the Fall of 1974 and Spring of 1975, Hole and Rice students alongside HAS volunteers began excavations at the Mitchell Ridge (41GV66) cemetery site in Galveston Island (Ricklis, 1994). Rice graduate student Barbara Bruce Adkins-Burger took charge of excavations as part of her doctoral dissertation project. Additional Rice-led excavations occurred in the Summer of 1975 and Spring of 1976. The annual Texas Archeological Society (TAS) field school was held at the site in 1978 under the direction of Barbara Bruce Adkins-Burger. Unfortunately, much of this early work at this important site was lost when staff at the Galveston Museum disposed of the Mitchell Ridge collections in the late 1970s and Barbara Bruce Adkins-Burger never completed her dissertation at Rice.

In 1978, Rice began work on the historic 1890 Nottingham Lace Factory (41GV71) on Galveston Island. This project was overseen by Hole, but carried out by Shirley Wetzel and Texas Anderson. Wetzel identified the site in 1978 and conducted preliminary archeological and historical research on the site. Her research (Wetzel 1980), along with that of Texas Anderson (1980), produced a detailed history of the short-lived factory. They also found archival evidence that the developers platted the community of Nottingham around the factory.

By the late 1970s, the Iranian Revolution had halted Frank Hole's research abroad. In 1979, Hole took a position at Yale University and remains there to this day. The loss of Frank Hole was problematic for both Rice students and the Anthropology Department. Hole had either been acting Chair or Chair of Rice anthropology for fifteen years. His departure left a major vacuum within the department. Subsequently, George Marcus and other cultural anthropology faculty took control of the department and have held it ever since. From 1979 to 1981, no senior archeology professors were present at Rice. This was problematic as many graduate and undergraduate archeology students were left without a mentor. During this stage of limbo, a number of short-term lecturers filled in for archeology including the late Dr. Robert Schacht, a former student and collaborator of both Flannery and Hole.

Meanwhile as archeology floundered at Rice, the University of Houston (UH) was beginning to build its own program. In 1977, Kenneth Brown was hired as an assistant professor and later in the early 1980s, Randolf Widmer (1982) and Rebecca Storey (1984). It should be noted that all these UH faculty have been in place for 30-40 years and the story of their contributions to local archeology would entail a separate paper.

Rod and Susan McIntosh – Developmental Archeology at Rice

In 1981, Rice hired Roderick ("Rod") McIntosh as a tenure-track professor fill the vacancy left by Frank Hole. Like Hole, Rod and partner Susan McIntosh were both Old World archeologists with limited interest in local archeological research. Their primary academic interest was their research at Jenne-Jeno in Mali (McIntosh and McIntosh, 1982) and the early urbanization in West Africa. Following these achievements, Susan McIntosh gained a full-time position with the Rice faculty in 1984. She remains the first and only woman to teach archeology as a regular, tenure-track professor at Rice.

Despite the academic shift toward late African prehistory, Rod McIntosh continued to teach the local archeological techniques course initiated by Frank Hole. As a result of this continued instruction in archeological field techniques, Rice students continue to make new contributions to our knowledge of the local past. During the time that Rod McIntosh taught at Rice, field training was focused primarily on four sites: (1) Kellum-Noble (41HR425)/Sam Houston Park (1982-1985), (2) the Pecos Rock Art Project (1985-1990), (3) the Tod-Milby House (1990-1996), and (4) the Storm site 41WA218 in Sam Houston National Forest (1999-2007).

In the early 1980s, Rod McIntosh and students investigated several locales within the Sam Houston Park including the Kellum-Noble House (41HR425), Long Row building and the Rose Garden. Members of the Harris County Heritage Society first petitioned McIntosh to carry out these investigations. The project was an exciting opportunity to learn more about the early development of Houston and to excavate the city's oldest brick dwelling on its original foundation (Kellum-Noble House 1847).

Initial excavations in 1982 were exploratory in addition to providing artifacts to guide authentic restoration efforts. Dr. Roger Moore served as a teaching assistant in these early years of the project. Later work at the Long Row Building and Rose Garden were undertaken in advance of construction of the Museum Gallery/Tea Room complex.

The Rice field techniques course (ANTH362) at Sam Houston Park marks an important milestone for the program. In 1982, McIntosh first introduced the student co-authored annual report. This pedagogical technique appointed each student with responsibility for a different aspect of the research, culminating in a co-authored section in the final report. Consequently, we now have a detailed record of each excavation done by Rice students for the past thirty-four years. Reports from the Rice 1983-1985 Kellum-Nobel House work are available on the HAS website publications page. Efforts are underway to make all Rice reports available to the public.

In the late 1980s, Rod McIntosh began offering a course on prehistoric rock art (ANTH420/620). This course included an extended field trip to West Texas which had the dual function of providing students with first-hand experience recording rock art and gathering data for the Rice University Pecos project, headed by doctoral student Patricia Bass (Bass, 1989). From 1989 to 1990, Rice students also carried out excavations on property then owned by W. K. King. In 1989, Rice students under McIntosh carried out test excavations at the Buck King C Rockshelter site (41VV961, "Chimenea shelter"). This site included a rich assemblage of Archaic and Late Prehistoric lithics and fauna (Awasome et al., 1989). These excavations were expanded in 1990 under the supervision of visiting professor Adria LaViolette (Moye and Salinas 1990; Shrier, 1990). The site remains relatively undisturbed and appears to have had a significant ceremonial function (Howard, personal communication 2016). The site and the surrounding area is now protected and managed by Texas Parks and Wildlife within the Devils River State Natural Area.

The next main focus of the Rice field techniques course was the 1866 residence of John Grant Tod (1808-1877), a Kentuckian who served in the Texian Navy as a Commander and Commodore (1837 1845). Tod purchased a cottage near Elm and Broadway in 1866 in Harrisburg and this remained the family residence for 76 years (La Violette and Heath, 1990). Additions made by his son-in-law, C. H. Milby, resulted in a large brick house. This structure known as the "Milby House" was a historic landmark until demolished in 1959. Rice investigations at the Tod-Milby house began in 1990 under the direction of Dr. Adria La Violette (now at the University of Virginia). Dr. La Violette filled in as an adjunct professor at Rice while Rod and Susan McIntosh were on sabbatical. Field investigations at Tod-Milby were later taken up by Rod McIntosh in 1993, 1994 and continued up to 1996.

Between 1996 and 1997, fieldwork took place on the Rice Campus as ground was being broken to build several new buildings including the Baker Institute and a portion of the Gibbs Recreation Center. The report from these investigations was not available at the time of this writing, however numerous collections boxes residing in the Rice lab from these digs including glass, metal artifacts and brick testify to the magnitude of the project. The significance of these remains recovered from campus is somewhat ambiguous. Most artifacts appear to represent incinerator debris from the early 20th century (Donachie and Huebner, 1997). No intact structures were expected and none were identified in this work.

In 1999, Rod McIntosh began a seven-year project at the Storm Site (41WA218, Sam Houston National Forest) in collaboration with U.S. Forest Service archeologist Walter Kingsborough. The Storm site (41WA218) is the second of three sites (41WA217, 41WA218, and 41WA219) discovered in 1997 by Douglas Mangum (Moore Archeological, Inc.) and other U.S. Forest service archeologists. The area is located on a sandy ridge overlooking Lake

Conroe. Rice investigations (aided in 2000 by the volunteer Forest Service "Passport in Time" program), focused primarily on assessing the integrity of sandy mantle deposits in the site area. These investigations utilized Ground Penetrating Radar (GPR) to identify sub-surface targets and sedimentological analyses to assess the integrity of the deposits. Rice students also investigated the adjacent Uno site (41WA217) in 2001 and 2005. Ultimately, the Storm and Uno sites were found to preserve a well-stratified sequence of Transitional Archaic to Late Prehistoric artifacts (approximately 2300 B.C. to 1700 A.D.).

Susan McIntosh and Jeffrey Fleisher – Contemporary Archeology at Rice

Over the years, Rod and Susan McIntosh took many Rice students to Africa to undertake a variety of field projects. Although these activities are not the focus of this paper, these international contributions should not be understated. Additionally, Rod and Susan McIntosh have mentored a number of African graduate students including Tereba, Togola (Mali -1993), Ibrahima Thiaw (Senegal – 1999), Alioune Deme (Senegal - 2004), Tsholofelo Sele Dichaba (Botswana - 2010), Mamadou Cisse (Mali – 2010) and Abideme Babatunde Babalola (Nigeria – 2016). Former student Ibrahima Thiaw collaborated with Susan McIntosh to develop a Rice field school on Goree Island, Senegal in 2005 and 2007.

In 2007, Rod McIntosh departed from Rice to take up a position at Yale University. Dr. Jeffrey Fleisher was hired to replace Rod McIntosh at Rice shortly thereafter. Dr. Fleisher's research is focused on the archeology of Tanzania and the ancient Swahili of coastal eastern Africa. Since 2009, Fleisher has led Rice students on biennial excavations at the UNESCO World Heritage Site of Songo Mnara, a monumental 15th- to 16th-century Swahili town on the southern Tanzanian coast (Patel, 2014).

In 2008, Susan McIntosh shifted the Rice field techniques class to the R. B. H. Yates house site (41HR980) in Houston's Fourth Ward. The Yates Community Archeology Project (YCAP) was a collaboration between Rice archeologists, the Rutherford B. H. Yates Museum, and Community Archeology Research Institute (CARI) project archeologists Carol McDavid, David Bruner and Robert Marcom. The objective of YCAP was to investigate the lifeways of a community of formerly enslaved peoples who were primarily responsible for developing "Freedmen's Town" in the Fourth Ward (McDavid et al., 2008). Freedmen's Town is Houston's oldest African-American community. Newly emancipated slaves settled the area at the conclusion of the Civil War. From 2008 to 2013, Rice student excavations aimed at giving voice to these freed slaves and their descendants by excavating four historic properties owned by the Rutherford B. Yates Trust. This work (along with that of CARI researchers) remains the only historic archeology done in the Fourth Ward other than a few cultural resource management projects (e.g., Feit and Jones, 2007).

Excavations at the Yates house (41HR980) occurred from 2008 to 2009. Susan McIntosh and Jeffrey Fleisher alternated as principal investigator several times during this five-year project. Dr. McIntosh led the initial 2008 excavations at the Yates house (41HR980), then returned to oversee work at the J. Vance Lewis (41HR1032) and Ruthven sites (41HR1070) in 2010 and 2011. Dr. Fleisher led the 2009 season at the Yates house and later worked at the Ruthven and Wilson-Victor site (41HR1031) during the final seasons of the project from 2012 to 2013. Detailed annual reports from these investigations can be found at the following URL:

http://freedmanstownarcheology.rice.edu

In 2015, Fleisher led Rice students on a new field project at historic Camp Logan in Memorial Park. Camp Logan was an army training base during the World War I era (Aulbach et al., 2014). Ongoing investigations by Rice at Camp Logan (two field seasons now) have continued the theme of African-American archeology focusing on identifying the area of the encampment of the 370th Infantry Regiment, an all African-American unit of the Illinois National Guard that was activated along with the other regiments of the Illinois National Guard and sent to Camp Logan in Texas to train.

Conclusions

In 1961 when the first archeology class was taught at Rice, annual tuition cost less than \$200. In 2016, a student will pay more than \$40,000 per year to study at Rice. A lot has changed since the 1960s. Archeology at Rice went from being an entirely foreign endeavor to one which is relevant to the local community. Majors and non-majors alike have benefited as students of a local archeological techniques course. Archaeological Field Techniques (ANTH362) has yielded numerous student-driven reports on local archeology. At the time of this writing, Rice University Archeology has accomplished 35 field seasons in Texas. Thirty-three of these were done in the in the Greater Houston Area (Figure 1). These contributions include eleven historic and ten prehistoric sites excavated in the Houston area and at least six archeological surveys, not including the many cultural resource management (CRM) projects

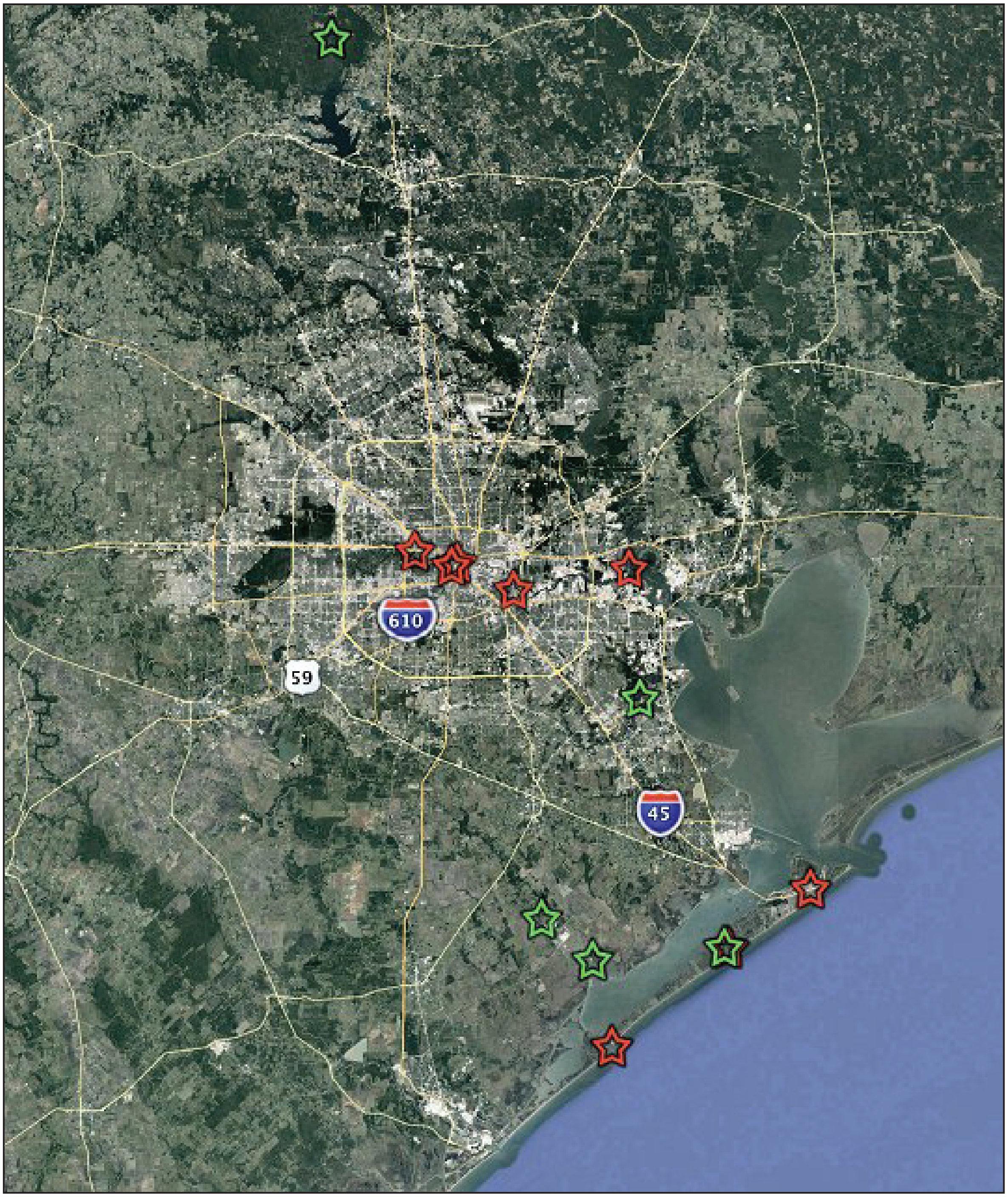

Figure 1. Map showing distribution of local Houston projects. Historic projects are shown as green stars, prehistoric projects red stars (created in Google Earth).

undertaken by advanced Rice students and alumni. No other non-profit organization other than the Houston Archeological Society can claim to have had a larger impact on the archeology of Southeast Texas as Rice archeology.

Professors Frank Hole, Rod McIntosh, Susan McIntosh and Jeffrey Fleisher have been the primary drivers of these accomplishments. Several others, including the author, have contributed over the years, but the real story of archeology at Rice and its impact on the greater Houston community is that of four core faculty members, several precocious students, and a long-standing and highly successful archeological field techniques course.

The history of archeology at Rice University falls into three phases. The formative phase of Rice archeology (1961-1979) witnessed Frank Hole's initial indifference and ultimate embrace of Southeast Texas archeology, culminating in the early Rice field schools and CRM projects. Drs. Susan and Rod McIntosh developed the program further from 1981 to 2000, and shifted focus towards African archeology combined with that of local historic and prehistoric archeology. The contemporary phase of Rice archeology began in 2000, with the arrival of Dr. Jeffrey Fleisher and has been dominated by a focus on African-American archeology in the Houston area.

This paper has examined the personalities, projects and partnerships of Rice faculty, staff and alumni that have shaped the modern landscape of archeology in the Greater Houston area for nearly 50 years. Rice archeology has always been a relatively small program. At any point in time, the program has had about two graduate students and six devoted undergrads. Despite its size the Rice program has managed to retain a reputation for being a power in African archeology as well as local archeology.

Ultimately the legacy of Rice archeology is not its prominent alumni or its headline grabbing overseas discoveries. The greatest contribution of Rice archeology is its introductory programs, where students with other career objectives get a chance to learn about and participate in the past. Non-majors have dominated nearly all the Rice archeological field techniques courses going back to the 1970s. These students have gone on to become teachers, politicians, social workers and engineers.

Rice students benefit enormously from the course offerings that archeology provides. For more than 20 years, Susan McIntosh has provided training in human osteology to Rice Pre-Med students. Jeffrey Fleisher continues to provide an innovative and interactive introduction to archeology course. In the past year I had the opportunity to design and lead a new Paleo-technology (ANTH384) course targeting Rice engineering students. Many of the Rice student papers that follow in this volume are the result of that class. These student authors include majors in kinesiology (Fox) and political science (Dickens) as well as art history and anthropology (George). The 1970 inception of local Rice archeology followed early collaborations between Rice students and the Houston Archeology Society. It is my hope that with the proper encouragement, Rice archeology majors and non-majors alike will remain engaged with the broader community through this partnership. Let's go Owls!

Acknowledgements

This paper is the result of two years organizing the local collections within the Rice Archeology lab. These collections tell the story of two peoples, those who created the archeological record and those who recovered it. It has been a pleasure working with these collections and figuring out the mini-mysteries of who did what and when. I thank Susan McIntosh and Jeffrey Fleisher for providing access to the lab. I must further thank Drs. McIntosh and Fleisher for their patience and sharing their knowledge of old research as I disturbed long forgotten collections. This paper benefitted immensely from interviews with Roger Moore, Michael O'Brien, Susan McIntosh and Jeffrey Fleisher. Frank Hole helped point me in the right directions. Margaret Howard provided info on the Pecos project. Douglas Mangum provided useful discussions on the Storm Site. I thank Louis Aulbach, Linda Gorski and Dub Crook for proofing and correcting this manuscript. I do not doubt that the story I've portrayed here is mistaken in some way. Any inaccuracies in this paper represent my mistakes alone. Finally I thank Dub Crook for the many hours of work editing and formatting the papers in this volume.

References Cited

Anderson, T.
1980 Analysis of a Late 19th Century Trash Midden: Nottingham, Texas. *Bulletin of the Houston Archeological Society* 66:10–16.

1981 *An Archeological Survey of the Seabrook Park Site on West Galveston Bay*. Report submitted to the City of Seabrook.

1985 *Cognitive Structures, Status and Cultural Affiliation: the Archeology of Ashton Villa (Texas*). Unpublished Doctoral Thesis, Department of Anthropology, Rice University.

Aulbach, L. F., L. C. Gorski, and R. Morin
2014 *Camp Logan: Houston, Texas 1917-1919.* Createspace Independent Publishing Platform.

Awasome, C. L., R. Booth and K. McDonald
1989 *An Analysis of Lithic and Faunal Remains from the 1989 Test Excavation of Buck King Cave C, Val Verde County, Texas*. Manuscript on file, Rice University, Houston.

Bass, P. M.
1989 *The Pecos Project: Semiotic Models for the Study of Rock Art*. Unpublished Ph.D. Dissertation, Rice University, Houston, Texas.

Cartier, R. R. and F. Hole
1972 History of the McCormick League and Area Adjoining the San Jacinto Battleground. Part I of San Jacinto Battleground Archeological Studies, 1971-1972. *Texas Antiquities Committee Permit Report No. 11*. Department of Anthropology, Rice University, Houston.

Dene, A. (Editor)
1994 *Archeological Excavations at the Tod-Milby Historical Site (Third Report by members of the Rice University, Field Methods Class ANTH362b)*. Manuscript on file, Rice University, Houston, Texas.

1996 *Archeological Excavations at the Tod-Milby Historical Site (Fourth Report by members of the Rice University, Field Methods Class ANTH362b)*. Manuscript on file, Rice University, Houston, Texas.

Donachie, M. J. and A. M. Huebner
1997 *A Snap-Shot of Rice University*. Unpublished Report Submitted to Rice University by Huebner Archeological Consulting.

Feit, R. and B. M. Jones
2007 *"A Lotta People Have Histories Here..." History and Archeology in Houston's Vanishing Freedmen's Town: Results of Field Investigations at the Gregory Lincoln/HSPVA 4th Ward Property*. The Houston Independent School District and The Texas Historical Commission, Permit #3837, Archeology Report No. 184.

Fine, L. and J. Mundy (Editors)
2003 *Storm Site West 99-SH-027-1 Sam Houston National Forest, TX. Third Report by members of the Rice University, Field Methods Class ANTH362b).* Manuscript on file, Rice University, Houston, Texas.

Fleisher, J. (Editor)
2009 *Final Report on the 2009 Excavations at the R.B.ARCHEO. Yates House by the Rice University Archeological Field Techniques class (Anthropology 362/562).* Manuscript on file, Rice University, Houston, Texas.

2012 *Final Report on the 2012 Excavations at the Wilson-Victor (41HR1031) and Ruthven (41HR1070) sites by the Rice University Archeological Field Techniques class (Anthropology 362/562).* Manuscript on file, Rice University, Houston, Texas.

2013 *Final Report on the 2013 Excavations at the Wilson-Victor (41HR1031) sits by the Rice University Archeological Field Techniques class (Anthropology 362/562)*. Manuscript on file, Rice University, Houston, Texas.

Foutch, A., T. Gray, S. Hampton, Z. McLemore, A. Morgan, T. Pruitt, A. Smith (Editors)
2006 *Site 41WA218 Storm Site, Sam Houston National Forest, TX. Sixth report by members of the Rice University, Field Methods Class ANTH362b*. Manuscript on file, Rice University, Houston, Texas.

Haskell, H. W. (Editor)
1984 *Archeological Excavations at in the area of the Long Row Building. (Third Report by members of the Rice University, Field Methods Class ANTH362b, Sam Houston Park Project)*. Manuscript on file, Rice University, Houston, Texas.

Hole, F.
1972 Archeological Investigation of the North End of the San Jacinto Battleground Part II of San Jacinto Battleground Archeological Studies, 1971-1972. *Texas Antiquities Committee Permit Report No. 11*. Department of Anthropology, Rice University, Houston.

1974a Archeological Investigations Along Armand Bayou, Harris County, Texas. *Technical Report No. 2*, Department of Anthropology, Rice University. Report 2, Houston Archeological Society, Houston.

1974b The Acadia A Civil War Blockade Runner (based on artifacts recovered by the late Dr. Wendell Pierce DDS) – *Department of Anthropology Technical Report No. 1, Rice University*, Houston.

1978 *Archeological Investigations at the Vistron Petrochemical Complex in Calhoun County, Texas*. Unpublished manuscript prepared for Engineering Science, Inc., Austin.

Hole, F. and R. G. Wilkinson.
1973 Shell Point: a Coastal Complex and Burial Site in Brazoria County, Texas. *Bulletin of the Texas Archeological Society* 44:5-50.

LaViolette, A. and L. A. Heath
1990 *Site Report for the excavation of the Tod-Milby Homesite by the 1990 Rice University Archeological Field Techniques Class* (First season by members of the Rice University, Field Methods Class ANTH362b). Manuscript on file, Rice University, Houston, Texas.

Lohse, M.
1977 *Cultural Resources Survey of Bryan Mound and Adjoining Pipeline Rights-of-Way for Strategic Petroleum Reserves, Brazoria County, Texas*.

Lohse, M. and T. Anderson
1979 *The Hen House Ridge Site (41JP65) Analysis of Excavations*. Report Submitted to Texas Parks and Wildlife.

McDavid, C, D. Bruner and R. Marcom
2008 Urban Archeology and the Pressures of Gentrification: Claiming, Naming, and Negotiating "Freedom" in Freedmen's Town, Houston. *Bulletin of the Texas Archeological Society* 79:37-52.

McIntosh, R. (Editor)
1982 *Archeological Excavations at the Kellum-Nobel House Site. (First Report, by members of the Rice University, Field Methods Class ANTH362b, Sam Houston Park Project*). Manuscript on file, Rice University, Houston, Texas.

McIntosh, R. and R. Moore (Editors)
1983 *Archeological Excavations at the Kellum-Nobel House Site. (Second Report by members of the Rice University, Field Methods Class ANTH362b, Sam Houston Park Project)*. Manuscript on file, Rice University, Houston, Texas.

McIntosh, R. and E. Salituro (Editors)
1985 *Archeological Excavations at in the area of the Long Row Building. (Fourth Report by members of the Rice University, Field Methods Class ANTH362b, Sam Houston Park Project)*. Manuscript on file, Rice University, Houston, Texas.

McIntosh, R., D. E. Gallagher, S. E. Doss, S. M. Godzina and K. E. Zeigler (Editors)
1999 *Rice University Archeological Field Techniques Class, Site 41WA218, Sam Houston National Forest, Texas (First Season)*. Prepared for the USDA Forest Service. Manuscript on file, Rice University, Houston, Texas.

McIntosh, S. (Editor)
2010 *Final Report on the 2010 Excavations at the J. Vance Lewis Site by the Rice University Archeological Field Techniques class (Anthropology 362/562).* Manuscript on file, Rice University, Houston, Texas.

2011 *Final Report on the 2011 Excavations at the Ruthven 1312 Site by the Rice University Archeological Field Techniques class (Anthropology 362/562).* Manuscript on file, Rice University, Houston, Texas.

McIntosh, S. and B. Clark (Editors)
2008 *Final Report on the 2008 Excavations at the R.B.ARCHEO. Yates House by the Rice University Archeological Field Techniques class (Anthropology 362/562)*. Manuscript on file, Rice University, Houston, Texas.

McIntosh, S. and R. McIntosh
1982 Finding West Africa's Oldest City, *National Geographic*, 162(3):396-418.

McIntosh, S., S. Meyers and K. Sierk
2000 *Report on excavations at Site 41WA218 Sam Houston National Forest, Texas Second Report by members of the Rice University, Field Methods Class ANTH362b.* Manuscript on file, Rice University, Houston, Texas.

Moore, R. and T. Anderson
1984 Gilded Age Archeology: The Ashton Villa. *Archeology* 37(3):44-50.

Moye, M. and L. Salinas
1990 *Analysis of Faunal Material from Rock Shelter BKC Collected by the Rice University Field School in Spring, 1990*. Manuscript on file, Rice University, Houston, Texas.

Mundy, J. A., Foutch, S. Hampton, and J. Mendez (Editors)
2005 *Site 41WA217 Uno Site, Sam Houston National Forest, TX.* Fifth Report by members of the Rice University, Field Methods Class

ANTH362b, Manuscript on file, Rice University, Houston, Texas.

O'Brien, M.
1971 The Fullen site, 41HR82. *Bulletin of the Texas Archeological Society* 42:335–360.

Patel, S. S.
2014 Stone Towns of the Swahili Coast. *Archeology Magazine* 62:1.

Ricklis, R. A.
1994 *Aboriginal Life and Culture on the Upper Texas Coast: Archeology of the Mitchell Ridge Site, 41GV66, Galveston Island*. Coastal Archeological Research, Inc., Corpus Christi.

Shier, S.
1990 *An Analysis of Lithic Artifacts from the 1990 Excavations at Buck King Cave C, Val Verde County, Texas*. Manuscript on file, Rice University, Houston, Texas.

Thiaw, A. (Editor)
1993 *Archeological Excavations at the Tod-Milby Historical Site (Second Report by members of the Rice University, Field Methods Class ANTH362b).* Manuscript on file, Rice University, Houston, Texas.

Wetzel, S.
1980 Nottingham, Galveston Island: History of a Late 19th Century Lace Factory. *Bulletin of the Houston Archeological Society* 68:4-11.

AN EXPERIMENTAL EVALUATION OF GAR SCALE ARROW POINTS

August G. Costa and Amy Fox

Abstract

Durable scales of garfish (Family Lepisosteidae) are frequently recovered from Archaic to Late Prehistoric archeosediments in the southeastern United States. Archeological gar scales have typically been interpreted as food refuse, but some researchers have argued that they may also represent curated tools. Scales of the largest garfish species, the alligator gar (*Atractosteus spatula*), are similar in size and shape to chipped stone arrow points. Patterson (1994, 2001) recognized numerous alligator gar scale arrow points in the greater Houston Area. Many of these possible alligator gar scale arrow points ("PAGSAs") were reportedly shaped by abrasion. Yet these specimens were never adequately illustrated nor were these observations supported by experimental data. Objective criteria are needed for evaluating PAGSAs more thoroughly.

In this paper we outline the results of an experimental archeological study aimed at establishing criteria for recognizing alligator gar scale points. Anthropogenic modification of gar scales in the form of: (1) pressure flaking, (2) shaping via abrasion and (3) ballistic impact damage are explored. Our results indicate that alligator gar scales are effective projectile tips that develop impact characteristics similar to those observed in chipped stone points. Moreover, gar scales require little modification to make suitable projectile tips. Ultimately the indicators of scale modification are unlikely to survive in archeological samples. Future assessments of archeological gar scales should focus on context and statistical evaluations of selectivity in scale shape.

Introduction

Extant garfish (Family Lepisosteidae) consist of seven species, five of which are found only in North America. These include alligator gar (*Atractosteus spatula*), spotted gar (*Lepisosteus oculatus*), longnose gar (*Lepisosteus osseus*), shortnose gar (*Lepisosteus platostomus*) and Florida gar (*Lepisosteus platyrhincus*). All but Florida gar are found in Texas. Although smaller gar of the genus *Lepisosteus* are known from archeological contexts in Texas and elsewhere in the southeastern United States, this paper is concerned primarily with the larger scales of alligator gar.

Alligator gar (*Atractosteus spatula*), are notorious fish that inhabit the rivers, lakes and bays of the southeastern United States. These captivating river monsters are part of an ancient lineage of armored fish which have persisted relatively unchanged since the Cretaceous (Maisey, 2000). Alligator gar are among the largest freshwater fish in North America, and may grow up to three meters long and weigh up to 300 pounds (Peres and Deter-Wolf, 2016) (Figure 1). Alligator gar were once distributed throughout the Mississippi Valley from Ohio and Illinois down

Figure 1. Alligator Gar, Moon Lake, Mississippi. March 1910, Neg. No. 117075, Photographer D. Franklin, Courtesy Dept. of Library Services, American Museum of Natural History. Source Wikipedia.

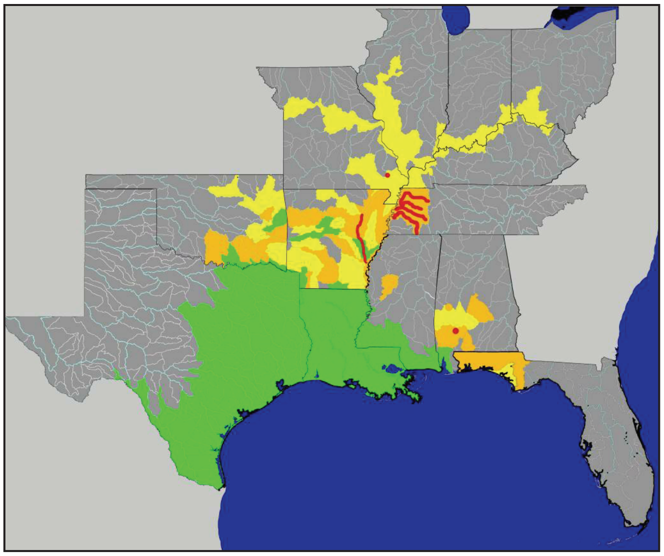

Figure 2. Watershed distribution of Alligator Gar – from U.S. Fish and Wildlife Service (http://www.fws.gov/arkansases/A_Gar/AGar_Maps.html)

to the Gulf Coast. The modern day alligator gar is restricted primarily to Gulf Coast states and parts of Mexico (Figure 2).

Alligator gar have torpedo-shaped bodies which are covered by overlapping enamel-like ganoid scales (Weed 1923; Yang et al., 2013). These scales are numerous and dense, resulting in high preservation potential within archeosediments. Garfish scales are documented at numerous archeological sites along the Gulf Coast and lower Mississippi Valley from Archaic to late Prehistoric contexts (ca. 8000 BC–1460 AD).

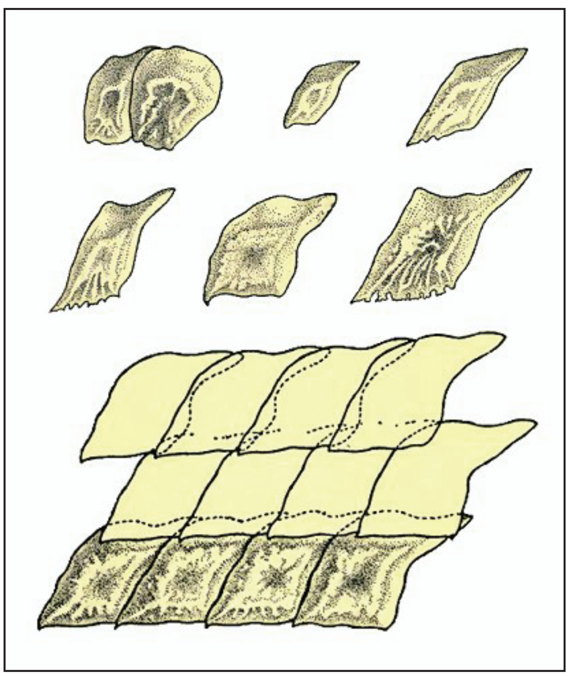

Figure 3. Variation in alligator gar scale morphology(above); Gar scales as they overlap and articulate with the fish body (below). Peg-like stems point to the head while the presumed arrow tips point to the tail. The serrated scale-margin is on the lower (belly) side (Modified from Weed, 1923).

Archeologists in the Southeast have often assumed that garfish scales (all species, including *A. spatula*) represent aboriginal food refuse. However, there is little archeological or ethnographic data to support this assumption. Research by Peres and Deter-Wolf (2016) suggests that indigenous populations of the southeastern United States did not commonly consume garfish. Although alligator gar can provide a substantial amount of edible meat, their scale armor makes processing a formidable task (Figure 3). Some early authors even suggest that gar scales are so hard and flint-like that one may see "fire fly from the edge of the axe when trying to chop through the skin of a gar" (Weed 1923: 59-60). Modern day fishermen often clean alligator gar by chopping from tail to head with a machete (without the aforementioned sparks). Even if alligator gar were on the menu in prehistoric times, it remains unclear how they would have been caught and prepared. Bartram (2001) suggests that gar may have been roasted whole in earth ovens, yet few if any thermally altered scales have been reported from archeological contexts (Peres and Deter-Wolf, 2016).

The sub-rhomboidal plan shape of most alligator gar scales is similar to some stemmed projectile points chipped from lithic materials. Academics and non-academics alike have reiterated this observation for more than a century (Spitzer, 2010). Several prehistorians have further suggested that alligator gar scales found in archeological contexts were used to tip arrow-like projectiles, particularly in lithic poor regions along the Gulf Coast (Agogino and Shelley, 1988; Patterson 1994, 2001). This long-

Table 1. Select Texas Gulf Coast sites with reported Gar remains and PAGSAs.

Site Name	Trinomial	Age	Finds	Reference
Orcoquisac Historic District	41CH57, 41CH22	Historic	>110 scales, other fish fauna	Highley et al., 1982
Buddy Rhemann Site	41FB198	Archaic	1 PAGSA (unprovenienced collection)	Patterson 2001
Parish Plant 5	41FB228	?	6 Scales	Patterson 2001
Smithers Lake	41FB245	?	2 Scales	Patterson 2001
Lake Charlotte	41CH273	Late Prehistoric	1 PAGSA	Patterson 2001
Pine Gully Site (Gibbs)	41HR422	Late Prehistoric	1 PAGSA, numerous scales	Patterson 2001
Alan Duke Collection	41HR72	Late Prehistoric	26 Scales	Patterson 2001
Spanish Moss Site	41GV53	Late Prehistoric	41 Scales	Patterson 2001
Kendrick's Hill	41JK35	Early Archaic - Late Prehistoric, Contact Period	13 scales with asphaltum	Weinstein et al., 1994
Possum Bluff	41JK24	Late Early Archaic- Late Prehistoric	1 Scale	Weinstein et al., 1995
Arenosa Shelter	41VV99	Late Archaic	170 garfish bones and scales	Jurgens, 2008

standing untested hypothesis has proliferated amongst the public. For example, the Wikipedia entry on garfish states that:

"The hard skin and scales of the gar were used by humans. Native Americans used the scales of the gar as arrowheads, native Caribbeans used the skin for breastplates, and early American pioneers covered the blades of their plows in gar skin"

The ethnohistorical record provides some support to notion that gar scales were used as arrow points. Peter Williamson, a well-known liar who lived with the Cherokee in the mid-18th century observed that scales of a particular fish were used along with several other materials to fashion arrow points (Williamson, 1768). Swanton (1946) reiterates reports from Bartram on the Florida Creeks and Du Pratz on the Natchez suggesting that both groups used gar scales to tip arrows. Nonetheless, fishermen love to tell tall tales, and alligator gar scale arrow points are a favorite and unsubstantiated scenario in the southeastern United States.

Many archeological alligator gar scales in the Houston area have been classified as prehistoric arrow points. Patterson (1994, 2001) used 10x magnification to distinguish specimens he considered modified gar arrow points. Scales were considered arrow points if they had uniform tips, smooth lateral edges and well-formed stems. However it is unclear whether the PAGSAs identified by Patterson were simply naturally occurring, pointed symmetrical gar scales. All published illustrations of PAGSA are decidedly blurry and impossible to evaluate (e.g., Nash and Rodgers 1992, Figure 9; Patterson, 1994, Figure 1). In sum there is good reason to be skeptical of the undemonstrated assumption that alligator gar scales were used in prehistoric ranged weaponry. In this paper we present the results of an experimental study aimed at providing criteria for evaluating PAGSAs. In particular this study aimed to provide answers to the following questions:

1. Can alligator gar scales be shaped through pressure flaking like knappable lithic materials? If so what are the identifying features of flaked scales?

2. What are the identifying features of abraded gar scales? Is shaping via abrasion worthwhile?

3. Are alligator gar scales useful as projectile tips? What are the identifying features of gar scales that have been used as projectile tips? How can archeologists tell an unused gar scale from one which has been made into an arrow point?

Methods

A large variety of alligator gar scales were purchased from a supplier, ironically named Arrowheads Direct. Garfish scale shape and size varies according to location on the body of the fish (see Figure 3). Large scales between 20-30 mm in maximum length were selected for this experiment. The scale sample included symmetrical as well as asymmetrical scales. All scales were numbered and photographed before and after all experiments.

Two scales were selected for pressure flaking experiments. These scales were held in the palm of the hand with a leather pad and pressure chipped with a deer antler tine. This procedure was essentially the same as that done to produce small chipped lithic tools such as arrow points. Two gar scales were also used as pressure flaking implements on a thin chert flake to examine the utility of scales as flintknapping tools. Another ten scales were abraded on both the margin and base regions for various durations using a medium-grained sandstone clast. Microphotographs of the abraded edges were obtained using a USB microscope (20-230x).

Calibrated Crossbow

The ballistics experiment utilized a homemade calibrated crossbow (Figure 4). A calibrated crossbow (CCB) is an apparatus which is used to standardize velocity in controlled projectile point experimentation. The CCB has been used in many other studies to test several parameters for prehistoric stone-tipped weaponry (Shea et al. 2001, Wilkins et al. 2014). Ballistic experiments were done indoors in the Rice University Archeology Lab. The CCB had a height of 80 cm and was set one meter away from the target. The CCB was aimed using an attached rifle laser sight which was calibrated within 3 cm. The draw weight of the CCB was set with a digital scale at 40-45 pounds. Projectile velocity was not measured in this study.

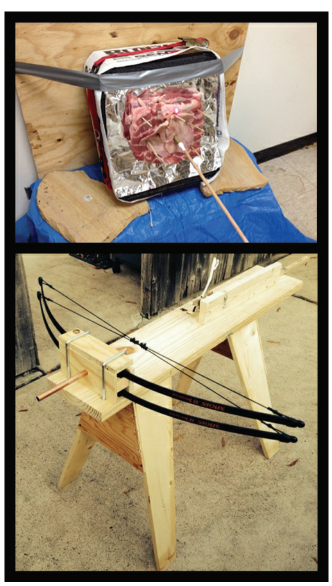

Figure 4. Calibrated crossbow and target proxy.

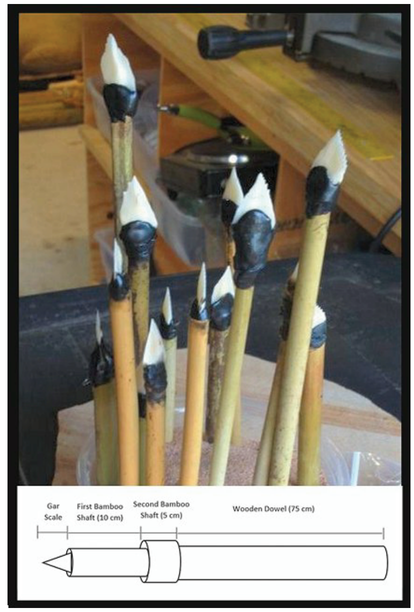

Figure 5. Gar points in foreshafts and schematic of experimental projectile set up.

Projectiles

Alligator gar scales were fitted into bamboo foreshafts of various diameters and lengths (from 5-10 cm long and 5-15 mm diameter). This experiment tested 5 unglued foreshafts, 12 hot-glued foreshafts and 12 resin-glued foreshafts (total n=29). The distal end of the foreshafts was reinforced in the majority of cases with electrical tape or duct tape. The electrical tape is a substitute for cordage wrapping on the haft joint. Join reinforcement was a necessary component of the projectile delivery system. Foreshafts that were not wrapped often failed, breaking the bamboo instead of penetrating the target. Foreshafts were mounted onto two 1/4 inch, 3 foot long dowels (Figure 5). These dowels were nocked to articulate with the wide bow strings of the CCB. The foreshafts were connected to the dowels via a short ~5-10cm bamboo joint. There was some give and impaction of the foreshafts within this joint on contact (usually between 2-6 cm).

Target

One rack of pork ribs was used to simulate a bone and tissue target medium. The ribs were halved and positioned perpendicular one on top of the other. This meat target was pinned to a youth foam archery target. The target area was 27 cm wide 24 cm high and 5 cm thick. Ribs within the rack had an average width of 2 cm. Two pork ears were skinned and draped over ribs to simulate flexible skin. The thickness of the skin was ~1 mm. Following the experiment the pork ribs were boiled for 8 hours to recover scales that had disengaged from their foreshafts and to allow the bones to be examined. Scales which exhibited significant breakage were examined and documented with a USB microscope at 20-230x power.

Results

Question 1: Knapping Gar Scales

Casual experimentation with four gar scales showed: (1) these items can be shaped by chipping and (2) that scales can be utilized as chipping tools. Small <2 mm chips were removed along the margin of two gar scales. These chips were very short (much shorter than the equivalent in knappable rock) and it proved very difficult to achieve successful flake removals from the scale cores. Gar scale surfaces are slippery and difficult to grip with an antler pressure flaking tool. Likewise the gar scales are very small and difficult to hold in a manner suitable for pressure flaking. Although alligator gar scales can be shaped in a manner broadly similar to knappable lithics, this activity is not a productive method to shape a scale-tool for cutting or piercing purposes.

Gar scales were somewhat effective as pressure flaking implements on very thin edged stone flake blanks. It was possible to retouch a thin edged stone flake using the thick base of a gar scale. The softer gar scale had the added benefit of gripping into the edge of the harder chert flake. The narrow scales worked well at knapping tasks requiring precision such as notching. Even so the small size of the scales made wielding them difficult and the scales broke apart if too much pressure was applied. The scales would not likely be very useful as pressure flakers on thick-edged objective pieces. However, larger gar scales (>3 cm) might be effective knapping tools.

Question 2: Grinding

The ten scales were abraded with a fist sized tabular piece of sandstone. Abrasive modification and shaping of gar scales was easily accomplished. Scales were ground to a more uniform shape with a stronger edge in less than 2 minutes of working. No more than 4 minutes was required to produce ground scales. Sandstone abrasion resulted in ground facets on the scale margins. This method proved useful in removing the fragile jagged serrations along the margin of some scales as well as modifying the base to facilitate hafting. Alligator gar scales can be readily shaped by grinding.

Question 3 – Are gar scales suitable projectile tips?

Several observations were made in the course of hafting gar scales for the experiment. Unlike most lithic materials gar scales surface are slippery and do not bind as well with natural or synthetic adhesives. We found that the primary advantage of adhesives was as a filler to help maintain a straight tip relative to the projectile foreshaft. Natural pine resin adhesive mostly shattered on impact. Scales hafted with pine resin did not hold up very well beyond a single use. We also found that bindings are not useful for securing gar scales. Instead bindings are more for strengthening the haft and preventing foreshaft splintering. This assumes that river cane was preferentially used in Gulf Coast projectile systems.

Twenty-nine alligator gar scale tipped arrows were fired (Table 2). Of these, five scales fractured on impact (HG8-10, R2 and R14). The stem of one scale (HG2) broke transversely as it was being extracted from the target. The vast majority of the ballistic sample (79%) did not show any sign of breakage. Four points were shot a second time and these shots also failed to produce impact damage. The results of these ballistic experiments suggest that alligator gar scales are in fact suitable as tips for some ranged weapon systems. The scale tipped projectiles passed easily all the way through the target media (both skin and rib tissue). Even hits on bone had good penetration (Figure 6). These projectiles left wounds 20-50 mm in maximum dimension.

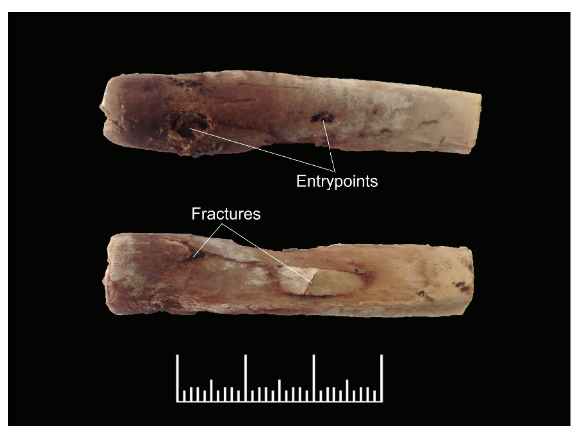

Figure 6. Pork rib impact damage from gar scale tipped arrows. Front of bone above and backside below (Scale is 3 cm).

Table 2. Results of Gar Scale Arrow Experiments.

Specimen No.	Times Shot	Embedded	Scale Description	Scale Breakage
NG1	1	N	Thick, no serrations	N
NG2	1	N	Thick, no serrations	N
NG3	1	Y	Not recovered	
NG4	1	Y	Thin serrated edge	N
NG5	1	N	Serrated	N
HG1	1	N	Pointy thick, serrated edge intact	N
HG2	2	Y	Thick serrated edge	Extraction Damage
HG3	2	N	Smooth edges, thick, no serrations	N
HG4	1	N	Thin serrated edge	N
HG5	2	N	Thin serrated edge	N
HG6	1	N	Thin serrated, transparent thin	N
HG7	1	N	Thick, no serrations	N
HG8	1	N	Small, thin	Recurrent lateral, and transverse
HG9	1	Y	Thick serrated edge	Lateral and transverse
HG10	1	N	Thin serrated edge	Transverse
HG11	1	N	Thick	N
HG12	2	N	Irregular serrated	N
R1	1	N	Thick serrated edge	N
R2	1	N	Thick serrated edge	Recurrent Lateral
R4	1	Y	Thick, no serrations	N
R6	1	Y	Thick, no serrations	N
R7	1	N	Thin serrated edge	N
R8	1	N	Thick, no serrations	N
R9	1	Y	Thick serrated edge	N
R10	1	N	Thick, no serrations	N
R11	1	N	Thin serrated edge	N
R13	1	N	Thick, no serrations	N
R14	1	N	Thick, no serrations	Transverse
R15	1	N	Thin serrated edge	N

*NG: no glue *HG: hot glue *R: resin

The five scales that broke exhibited transverse (n=2) and lateral recurrent or stepping breakage patterns (n=3). The transverse breaks are bending fractures perpendicular to the tip (i.e. the tip snapped off). The lateral recurrent breaks commonly occurred along the narrow serrated edge of the scales (Figure 7). Aside from the magnitude and location of these breakage patterns it would be difficult to distinguish these from those acquired intentionally through pressure flaking or accidentally via trampling.

Discussion

The results of these experiments support the hypothesis that alligator gar scales can be easily modified and utilized as tips for projectile weaponry. Gar

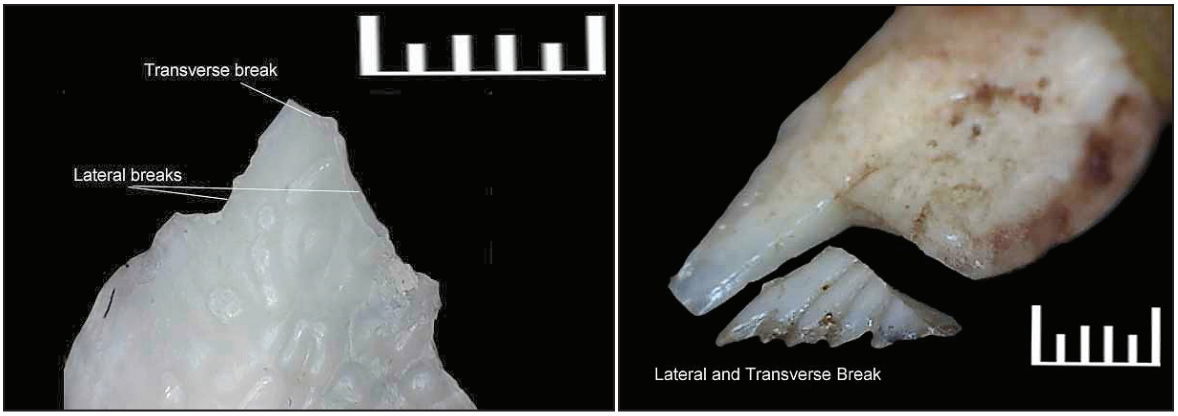

Figure 7a. Specimen HG8 showing recurring lateral damage and transversal damage; Figure 7b. Specimen HG9 showing lateral and transverse break from impact which resulted in the point being embedded in the bone target (Scale is 5 mm).

scales are hard brittle materials which can be shaped and fractured somewhat like siliceous rocks. However, pressure flaking was inefficient for shaping scales compared to the abrasion method. Gar scales ground on sandstone could be honed sharp and strengthened in a few minutes. Our grinding results largely support the casual gar scale experimentation as outlined by Patterson (1994).

The gar scale tips used in the projectile experiment would have been lethal missiles. Gar scales are effective tips which allow significant penetration even when they hit bone. The penetration achieved during our experimentation suggests that gar tipped arrows might pass all the way through a medium sized ungulate. Additional long range ballistic experimentation with authentic arrows is needed to assess the flight characteristics of gar scale tipped projectiles. Gar scales are much lighter tips than stone points and would likely require some fine tuning to fly correctly.

One weakness in unmodified gar scales as projectiles tips is the tendency for the serrated edge to catch and fracture on impact. The fracture patterns observed are superficially similar to those seen among lithic points (e.g., transverse and lateral fractures). This shortcoming could be addressed by abrasive grinding of the serrated scale margin in just a few minutes. Although no ground scales were utilized in the ballistic experiment, this minor modification would likely extend the lifespan of a gar scale point. Grinding in general made the scale points more symmetrical and durable. The expediency of gar scale tool production in lithic poor regions of the southeastern United States (like the greater Houston area), would have made it an attractive technological strategy.

These experiments have provided empirical proof-of-concept to the notion that gar scale tipped ranged weaponry could have been utilized by prehistoric people. Scales modified by grinding show clear evidence of abrasion and faceting of edges. Scales that have failed on impact also have specific breakage features that might be identifiable in a well preserved archeological sample. Even so, additional experimental work with gar scales is needed to address the problem of equifinality and distinguish other potential edge modifying processes such as trampling or thermal shock (e.g., roasting or cooking garfish). Ultimately more researchers need to be aware of gar scales in archeological contexts and their potential importance.

Gar scales with adhering asphaltum have been reported in coastal Texas from the Seabrook Park/Pine Gully site 41HR422 (unconfirmed, Patterson, 1994) and several from the Kendrick site (41JK35) along the Lower Lavaca River (Weinstein et al. 1994). Although one would expect natural adhesive to be a clear indicator of gar scale arrow point use, the evidence is not clear cut. Only three of

Figure 8. Gar scales from the Lower Lavaca river (41JK35) with asphaltum on the base (Modified from Weinstein et al., 1994).

thirteen gar scales with residue from the Lower Lavaca River had asphaltum exclusively on the base (Figure 8). Other scales exhibited asphaltum on the tip, edges and dorsal surfaces (Zimmerman, in Weinstein et al. 1994).

Despite the remarkable examples above, very little attention has been paid to gar scales in archeofaunal assemblages. Consequently diagnostic evidence of gar scale tool use has also likely gone undetected. Most archeological faunal reports list the number of identifiable garfish elements - typically a simple scale count. Faunal analysts do not commonly distinguish alligator gar (*Atractosteus*) remains from other garfish (*Lepisosteus*) despite the large size difference. No research is yet available on garfish scale growth or differences between species – past or present.

Garfish scale shape variation across the body of the animal also needs to be studied. Adult alligator gar have thousands of scales - many of which are not suitable for use as projectile tips. Future work aimed at distinguishing between a natural death assemblage distribution of gar scale forms versus an artificial curated assemblage will likely be fruitful in resolving the question of garfish food versus garfish tool use. If a sufficient geometric morphometric dataset is available it would be possible to statistically test for intentional shape selection in an archeological sample of gar scales.

Finally one should consider whether gar scales if curated by prehistoric people, served some other technological or non-utilitarian purpose. Pere and Deter-Wolf (2016) suggest that gar remains including scales may have been used as tools for tattooing or scarification. Gar scales may have been essential ritual tools for some groups of aboriginals in the Southeast. The gar is the historic tribal emblem of the Koasati (Coushatta) tribe of Louisiana and embodies courage, wisdom, strength and discipline (Healy and Orenski, 2003). Gar scales are found in a variety of archeological contexts including burials, where they might be interpreted as the remnants of ritual containers or sacred bundles of talisman-like objects (Pere and Deter-Wolf, 2016). There is a great deal of complexity in human-garfish relationships in the prehistoric Southeast that awaits further research. We hope that this study will stimulate further inquiry into this fascinating dynamic.

References Cited

Agonino, George A. and P. Shelley

1988 Could Gar Scales Have Been Used as Projectile Points in the Southern United States and Northern Mexico? *The Artifact* 26(1):29-31, Journal of the El Paso Archeological Society, El Paso.

Bartram, W.

2001 Travels through North and South Carolina, Georgia, East and West Florida. University of North Carolina, Chapel Hill NC. URL http://docsouth.unc.edu/nc/bartram/menu.html (accessed 7.2.16)

Healy, D. T. and Orenski, P. J.

2003. *Native American Flags*. University of Oklahoma Press, Norman, Oklahoma.

Highley, Lynn, Anne Fox, and Will Day

1982 Mission Nuestra Señora de la Luz and Presidio San Augustín de Ahumada: The Orcoquisac Historic District in Chambers County, Texas. *La Tierra* 9(2):2-17.

Jurgens, Christopher J.

2008 The Fish Fauna from Arenosa Shelter (41VV99), Lower Pecos region, Texas. *Quaternary International* 185.1 (2008): 26-33.

Maisey, John G.

2000 Continental Break Up and the Distribution of Fishes of Western Gondwana During the Early Cretaceous, *Cretaceous Research*, 21, (2): 281-314.

Nash, M. A., and R. M. Rogers

1992 Data Recovery on Four Archaeological Sites for the Channel to Liberty Project, Chambers County, Texas. Espy, Huston and Associates, Inc., for Galveston District Corps of Engineers.

Patterson, Leland

1994 Gar Scale Arrow Points. *The Journal* 109:13-15. Houston Archeological Society, Houston.

2001 Current Data on Gar Scale Arrow Point in Southeast Texas. *The Journal* 127:7-8. Houston Archeological Society, Houston.

Peres, Tanya M. and A. Deter-Wolf

2016 Reinterpreting the use of Garfish (Lepisosteidae) in the Archeological Record of the American Southeast. In *People with Animals: Perspectives and Studies in Ethnozooarcheology*, edited by L. Broderick, Oxbow Books.

Shea, John, Zachary Davis and Kyle Brown

2001 Experimental Tests of Middle Paleolithic Spear Points Using a Calibrated Crossbow.

Journal of Archeological Science 28(8):807-816.

Spitzer, Mark
2010 *Season of the gar: adventures in pursuit of America's most misunderstood fish*. University of Arkansas Press, Fayetteville.

Swanton, J. R.
1946 The Indians of the Southeastern United States. *Smithsonian Institution, Bureau of American Ethnology, Bulletin* 137.

Weed, A. C.
1923 The Alligator Gar, *Fieldiana.* Popular series, *Zoology* (5), 57-72.

Weinstein, R,
1994 *Archeological Investigations Along the Lower Lavaca River, Jackson County, Texas: The Channel to Red Bluff Project*. Report prepared for the U.S. Army Corps of Engineers, Galveston District. Coastal Environments, Inc.

Wilkins, Jayne, Benjamin J. Schoville and Kyle S. Brown
2014 An Experimental Investigation of the Functional Hypothesis and Evolutionary Advantage of Stone-Tipped Spears. *PloS One* 9(8): e104514.

Williamson, Peter
1768 *The Travels of Peter Williamson, among the different nations and tribes of savage Indians in America*. Edinburgh.

Yang, W., B. Gludovatz, E. A. Zimmerman, H. A. Bale, r. O. Richie and M. A. Meyers
2013 Structure and Fracture Resistance of Alligator Gar (Atractosteus spatula) Armoured Fish Scales. *Acta Biomaterialia* 9(4):5876-5889.

EXAMINING USE-WEAR ON CHERT PETROGLYPH PECKING TOOLS USED ON EDWARDS PLATEAU LIMESTONE, WEST TEXAS

Rachel E. George

Objective

This experimental archaeology project seeks to simulate Trans-Pecos region (West Texas) petroglyph creation in order to shed light on the materials and methods it involves, as well as the remains petroglyph manufacture may leave behind in the archaeological record.

Background

The International Federation of Rock Art Organizations (IFRAO) has been requesting more experimental archaeology research on rock art since 1998 when the Australian rock art researcher, Robert G. Bednarik, called for additional research worldwide on petroglyph manufacture. One area of inquiry, of particular interest to Bednarik, was how pecking tools develop use-wear patterns on their surfaces as a result of petroglyph creation (Bednarik 1998). Having a firm grasp of these use-wear patterns and the methods that cause them could allow for petroglyph pecking tools to be identified in archeological lithic artifact assemblages. This would open the door to more firmly dating petroglyphs by correlating them with lithics found *in situ*. The research project laid out in this paper takes on Bednarik's challenge to uncover common patterns of use-wear on petroglyph pecking tools with a specific focus on petroglyph manufacture the Trans-Pecos region of West Texas.

Fidelity to the geology of West Texas in the design of the experiment is imperative because the raw materials used in petroglyph manufacture are highly determinant of the resulting use-wear. An experiment similar to the one contained in this paper was carried out by archaeologists, Neemias Santos Da Rosa, Sara Curas/Garcês, and Pedro Cura, which examined the petroglyph manufacture of the Cachão Do Algarve petroglyphs in Portugal. In their paper, *Between Tools and Engravings: Technology and Experimental Archaeology to the Study of Cachão Do Algarve Rock Art*, the author's comment that their results greatly with the type of raw material (Santos Da Rosa et al. 2014). Differences in raw material correlated with differences in efficiency of production, preciseness of marks, and use-wear on the tool. Remaining as faithful as possible to the raw materials available in the Trans-Pecos region allows this experiment to produce the most authentic results.

West Texas is home to one of the most extensive collections of rock art anywhere in the world, boasting nearly a thousand pristine preserved pictograph sites. However, in spite of the enormous corpus of pictographs in this region, only one significant petroglyph site exists in West Texas, Lewis Canyon. Lewis Canyon is a massive complex of hundreds of petroglyphs that span an area over 160 square meters (Figure 1) (Willis 2015). The site is significant due to its massive size and because petroglyphs are comparatively rare the Trans-Pecos region in which, the dominant variety of rock art is polychromatic pictograph compositions (Turpin 1994, 2005; Boyd 2003).

The limestone in this region of West Texas is part of the Edwards Plateau, a karstic region of Texas composed primarily of fine grain limestones from the Cretaceous (Blum et al. 1994). The Edward Plateau region contains many rock shelters, which have been carved into the limestone by rivers such as the Pecos River and the Rio Grande. These rock shelters are the site of the majority of the region's pictographs. Lewis Canyon was formed as a result of the same process of limestone deformation by water.

Figure 1. A series of petroglyph motifs in Lewis Canyon (Willis 2015). Reproduced with permission from the author.

Figure 2. Lewis Canyon Petroglyph depicting an anthropomorph stylistically similar to the anthropomorphs of Red Monochrome Style, a Pecos pictograph style associated with the Late Prehistoric period (post ~1000 A.D.) (Willis 2015). Reproduced with permission from the author.

Before the site was cleared in the early 2000s, many of the Lewis Canyon petroglyphs were under a layer of lacustrine sediment deposited by regular flooding. Solveig Turpin, a leading rock art scholar, has speculated that the placement of the Lewis Canyon petroglyphs near this water source may be a clue to the art's significance (Figure 2) (Turpin 2005).

The petroglyphs of Lewis Canyon are all pecked into the Cretaceous limestone bedrock that makes up the canyon floor. Using limestone as an art medium restricts the tools and methods one can use to make petroglyphs. For example, the artist has to use a pecking tool harder than the limestone, such as a local chert. It is currently unknown precisely what tools were used to create the Lewis Canyon petroglyphs, but it was likely they were expedient tools made from locally available rock. Experiments performed by experimental archaeologist John C. Whittaker and his team, indicate that pointed stone cobbles are the most probably variety of tool used in the creation of the "pecked" style petroglyphs common to Lewis Canyon (Whittaker et al. 2000). This is supported by local Trans-Pecos rock shelter excavations, which are characterized by abundant chert cobbles and flakes in their occupation deposits.

The lack of organic material associated with petroglyphs makes it difficult to determine their age. Most previous researchers have made age estimates based on a typological classification of the petroglyph's stylistic qualities. Typological dating of some of these petroglyphs is thought to be possible because there are few motifs which resemble "Red Monochrome Style," a Late Prehistoric pictograph style that dominated Pecos rock art after circa 1000 A.D. (Figure 3). Moreover, the presence of a petroglyph bison-hunting scene in Lewis Canyon may hint that the petroglyphs date within a range of ca. 3100- 2500 BP, when a more mesic climate interlude enabled bison from the Southern Great Plains to expand their territory in the region (Turpin 1994, 2005; Boyd 2003). These date ranges, based on the typological analysis of rock art motifs, allows us to place the Lewis Canyon petroglyphs in a rough temporal context.

Interpretation of the Lewis Canyon petroglyphs would benefit from further excavation of nearby

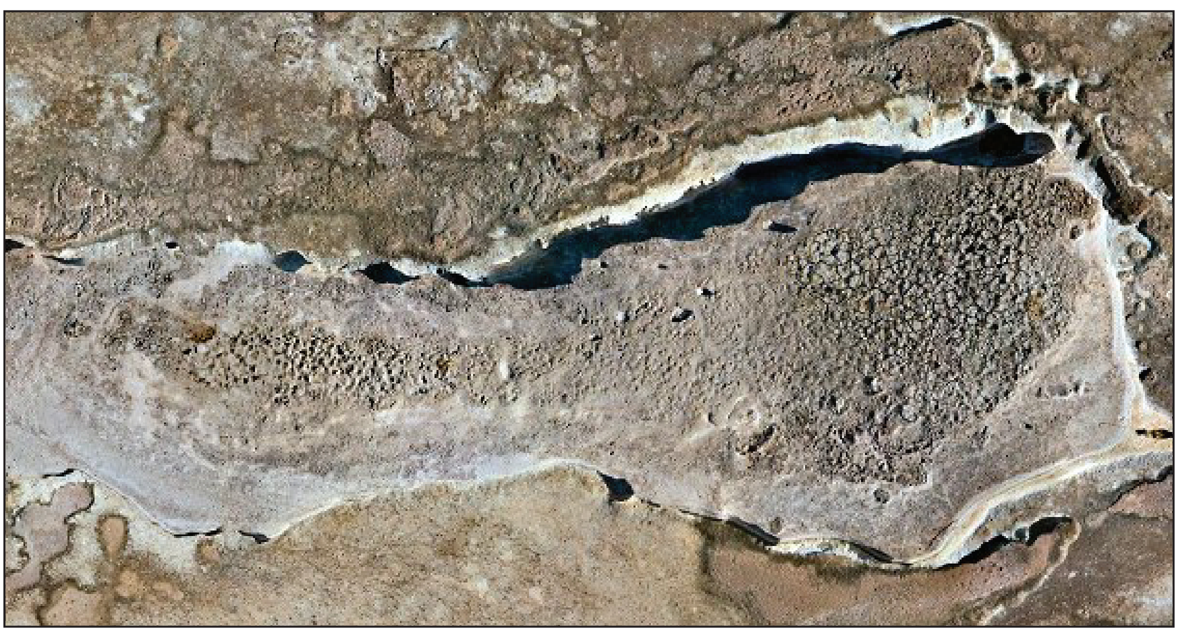

Figure 3. The tinaja excavated by Solveig Turpin in the 1980s (Willis 2015). Reproduced with permission from the author.

archaeological deposits, which could potentially help shed light on when they were created. Lewis Canyon has been reported to contain a "small campsite" archaeological deposit littered with broken chert and a large burnt-rock midden, located between the petroglyphs and a nearby stream. However, neither of these sites seem to have been excavated systematically (Turpin 2005). Finding petroglyph-pecking tools in future excavations in Lewis Canyon may allow us to link the petroglyphs to dateable material in the archaeological record. Toward this aim, the following experimental archeology project endeavors to construct a set of criteria that will help archaeologists identify petroglyph-pecking tools.

The design for this experiment draws on research related to Lewis Canyon, petroglyph manufacture, and Texas geology in order to create a simulation of prehistoric West Texas petroglyph manufacture.

Experiment Design

Materials

- A variety of lithic tool types made out of Chert and given identifying letters (Figure 4)
  - A – biface; fine grained Edwards Chert
  - B - biface with cortical butt; river-tumbled Colorado Chert
  - C, D - flaked cobbles; river-tumbled Colorado Chert
  - E, F - blade-like hard hammer flakes; high quality Georgetown Chert
  - G - blade-like hard hammer flake; fine-grained Edwards Chert
- Soft chalky Texas limestone bricks (Figure 5)
- Camera

Figure 4. The lithic tool types used in the experiment labeled with identifying letters.

Figure 5. The limestone bricks used in the experiment.

- Safety Equipment (gloves, goggles)

Procedure

This experiment consisted of subjecting lithic tools to the stress of petroglyph manufacture in timed intervals and then examining their transformation between each use. The first step involved labeling all of the tools for easy identification. Each tool was then subjected to a series of five trials that took place over intervals of five minutes. Five sets of five minutes were chosen based on information gathered from a few trial runs with extra flakes before the experiment began. These preliminary trials demonstrated that after five intervals the tools were often too dulled to make clean peck marks. Additionally, these trials showed that five minutes was the shortest interval of time in which the tools consistently showed noticeable use-wear. During these preliminary trials and the trials that composed the experiment, the tools were struck against the limestone at a rate of 200-500 beats per minute. Although efforts were made to be consistent, the amount of force applied in each peck varied just like it would have in Prehistoric times.

After each trial, photographs were taken of the sides of the tool that had been used to strike the limestone. These photographs included a shot of the dorsal side, the ventral side, and the pointed edge of the tool in order to showcase the full range of deformation that the tool underwent during the trial. Other observation about the tool's appearance as well observations about the tools performance and debitage production were noted as well. The results are presented and discussed below.

Results and Interpretation

Table 1 below details the observations made throughout the experiment.

Although there was some variation according to tool type, the deformation of the tools from petroglyph manufacture seemed to consistently occur along a predictable trajectory. The repeated striking caused the point of the tools to dull as pieces of chert debitage were worn off the tools surfaces (Figure 7). Also, the tools all immediately began picking up powder produced by striking the chalky limestone. This powder became caked in the fissures on the surface of the tool that connected with the limestone upon being struck (Figure 6). The caked limestone powder as well as the dulling effect on the tools quickly made the lithics poor petroglyph pecking

Figure 6. Powdered limestone caked in the fissures of lithics (top to bottom, left to right); Tool D after 3rd Trial, Tool E after 3rd Trial, Tool B after 4th Trial, Tool A after 4th Trial.

Table 1. Results of Experimental Rock Pecking Tool Use

Tool Type	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
A, Biface	Little change	Collected limestone powder in grooves	Nearly no chert debitage removed	Caked with limestone powder	Caked with Limestone powder
B, Biface with Cortical Butt	Collecting Limestone powder	Caked with Limestone powder	Some debitage 2-4 pieces removed	Noticeably dull	Produces imprecise peck marks
C, Flaked Cobble	Collecting Limestone powder	Noticeable chert debitage	Caked with limestone powder	Very dull	Dents the limestone instead of creating defined peck marks
D, Flaked Cobble	Collecting some limestone powder	Some debitage	Caked with limestone powder	4 Pieces of noticeable debitage	Noticeably dull
E, Flake	Collecting limestone powder in the fissures on its point	Some debitage	Caked limestone powder	5-9 visible pieces of chert debitage	Too dull to make precise peck marks
F, Flake	Comparatively little limestone powder collected	Limestone powder accumulating in fissures on point	Considerable chert debitage 7 pieces	Caked limestone powder	Far too dull to make precise peck marks
G, Flake	Collected limestone powder in grooves	Fissures caked with powdered limestone	Noticeably duller	5-8 visible pieces of chert debitage	Too dull to make a defined peck mark

Figure 7. Debitage shed from Tool E (flake) after 4th Trial.

Figure 8. Tool C after 5th Trial; note that the point of the tool has been worn to a flattened plateau which has been highlighted white by caked limestone powder.

tools, rendering their marks indistinct, usually by the fifth trial (Figure 8).

The variation in deformation among tool types seemed to have the most to do with the relative thickness of the tool. The long flakes (Tools E, F, and G) tended to splinter apart quickly creating more debitage due to their thinness. While the tools with thicker bodies such as the flaked cobbles and bifaces tended to become poor pecking tools much quicker because their edges had a wider surface area to begin with.

Discussion and Conclusions

Although the experiments did not produce use-wear that was distinctive enough to be identified by the untrained eye in the field, it did promise the possibility that petroglyph pecking tools may be able to be better identified in the lab using diagnostic criteria based on observations obtained from this experiment. In general, the tools underwent two types of deformation: (1) the collection of limestone powder in the tool's fissures and (2) the dulling of the pointed edged that connected with the limestone when the tool struck the surface. Although, more experimentation is necessary in order to come up with a definitive set of pecking tool use-wear criteria, it can be suggested that lithics from the archaeological record which demonstrate both of these types of deformation are likely to be related to petroglyph manufacture.

For example, if lithic artifacts were recovered during future excavations in Lewis Canyon which had one edged dulled in a manner consistent with percussion and evidenced limestone particles trapped within the fissures of that same dulled edge, it could be argued that they should be associated with petroglyph manufacture. This would then allow any dates associated with those lithic tools to potentially further expand our understanding of the temporal context of the Lewis Canyon petroglyphs. Furthermore, due to the ubiquity of limestone and chert throughout North America and beyond, this experiment has potential relevance to studies of petroglyph sites the world over.

Additional items to consider in future replication experiments include the differences between the materials used in this simulation and those that make up the floor of Lewis Canyon and other petroglyph sites. For example, limestone has highly variable qualities and is very susceptible to weathering. The limestone bricks used in this experiment have a somewhat different overall chemical make-up than the limestone floors of Lewis Canyon and other sites. Furthermore, a wet area in direct sunlight such as Lewis Canyon means its limestone will be subject to elemental weathering. It is likely that the limestone of Lewis Canyon has a harder patinated outer crust made of weathered limestone, which the limestone bricks used in the experiment lacked.

Nevertheless, the consistent trajectory of wear demonstrated in this experiment indicates that there is the potential to distinguish specific petroglyph pecking tools from lithics used for other purposes. In order to further define a diagnostic criteria for identifying petroglyph pecking tools, additional experiments will need to be conducted that examine whether the limestone powder is preserved within the fissures of stone tools contained in archaeological deposits and whether the dullness resulting from the percussion of petroglyph manufacture can be distinguished from other kinds of tool use-wear. Further experimental archaeology on the technology of petroglyph manufacture is imperative so that archaeologists can gain greater access to the beliefs, thoughts, and practices of prehistoric peoples who produced petroglyphs.

References Cited

Bednarik, Robert G.
1998 The Technology of Petroglyphs. *Rock Art Research 15.1. www.IFRAO.com*. International Federation of Rock Art Organizations (IFRAO), accessed September 14, 2015.

Blum, Michael D., Rickard S. Toomey, and Salvatore Valastro
1994 Fluvial Response to Late Quaternary Climatic and Environmental Change, Edwards Plateau, Texas. *Palaeogeography, Palaeoclimatology, Palaeoecology* 108(1-2):1-21.

Boyd, Carolyn E.
2003 *Rock Art of the Lower Pecos*. Texas A&M University Press, College Station.

Santos Da Rosa, Neemias., Sara Cura/Garcês, and Pedro Cura.
2014 Between Tools and Engravings: Technology and Experimental Archaeology to the Study of Cachão Do Algarve Rock Art. In *Technology and Experimentation in Archaeology Proceedings of the XVI World Congress (Flrianoplis, 4-10 September 2011),* edited by Sara Cura, Jedson Cerezer, Maria Gurova, Boris Santander, Luiz Oosterbeek, and Jorge Cristóvão. Archaeopress: Publishers of British Archaeological Reports, Oxford. 10(27 & 42):87-96

Turpin, Solveig
1994 Lower Pecos Prehistory: The View from the Caves. In *The Caves and Karsts of Texas*, edited by William R. Elliot and George Veni, pp. 69-84.

2005 Location, Location, Location: The Lewis Canyon Petroglyphs. *Plains Anthropologist* 50(195):307-324.

Willis, Mark
2015 Lewis Canyon Petroglyph Site. *Lewis Canyon Petroglyph Site Giga-Pan*. SHUMLA Rock Art School, 2013.

Whittaker, John C., Sarah Koeman, and Racheal Taylor.
2000 Some Experiments in Petroglyph Technology. *1999 International Rock Art Congress Proceedings 1*. ARARA Research. American Rock Art Research Association.

"KNAPPING AWAY AT MYSTERY": AN EXPERIMENTAL ARCHEOLOGICAL INVESTIGATION ON GUADALUPE TOOLS

Dylan T. Dickens

Introduction

Approximately 5,500 years ago, the South Texas coastal plain hosted a variety of Early Archaic peoples who manufactured and left behind a material culture that archaeologists continue to analyze to this day. While many of these lithic technologies, such as Clear Fork tools, Gower and Laguna projectile points, and painted pebbles have been extensively studied, some, such as the Guadalupe tool, remain a partial mystery (Turner et al. 2011). While these tools have been found and recorded in sites across the South Texas coastal plain, a definitive answer on their function, usage, and construction continue to remain largely a mystery. Through an analysis of the existing literature on Guadalupe tools, the sites in which they are found, and modern ethnographic parallels, a large portion of the puzzle can be filled in. These sources of research provide a strong foundation for an experimental replication, hafting, and utilization of these tools, to further test potential production sequences, hafting aspects, and best practices in usage. This paper thus serves to provide additional insights on the subject of Guadalupe tools and their function.

Guadalupe Tools

In reviewing the literature on Guadalupe tools, it is important to start with their original description and occurrence at the Panther Springs Creek site (41BX228). Guadalupe tools were defined as, "... a thick percussion-flaked artifact with a very abruptly truncated distal [working] end...roughly ranging from 55º-85º," (Black and McGraw 1985). Sixteen artifacts identified as Guadalupe Tools were found at the Panther Springs site and the archaeological evidence suggested that they were hafted and used for woodworking by a non-specialized hunter-gatherer society. The tool's function was further supported by a comprehensive analysis of three separate caches of Guadalupe tools, consisting of nineteen individual artifacts (Brown, 1985). This analysis showed evidence of hafting, woodworking, and specialized production, all in line with the initial theory introduced by Black and McGraw (1985).

Black and McGraw further report on two potential manufacturing sequences, Model No. 1., (Figure 1), and Model No. 2. (Figure 2.). Model No. 1., also suggested by Brown (1985), involves quartering a rounded cobble so that the remaining portion possess a 55º-85º slope, suitable to eventually become the truncated distal working end of the tool. A flake is then taken off of the quartered cobble, creating the general overall shape of a Guadalupe tool. Model No. 2., suggested by Black and McGraw (1985), involves knapping a roughly trifacial tool preform, before removing a flake on the distal end to create the 55º-85º truncated distal working edge. While other excavations have led to the discovery of additional Guadalupe tools, such as sites in Uvalde County (Baker 2003) and Webb County (Brown

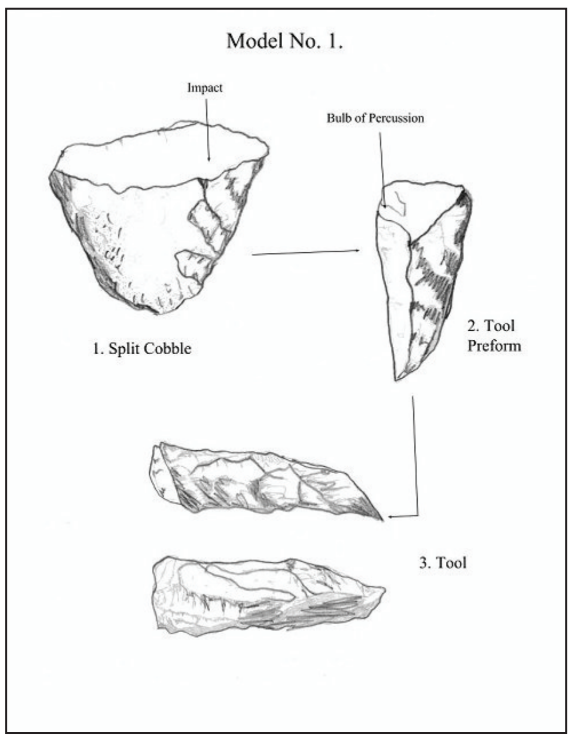

Figure 1. Guadalupe Tool Production Model No. 1 (redrafted from Black and McGraw 1985).

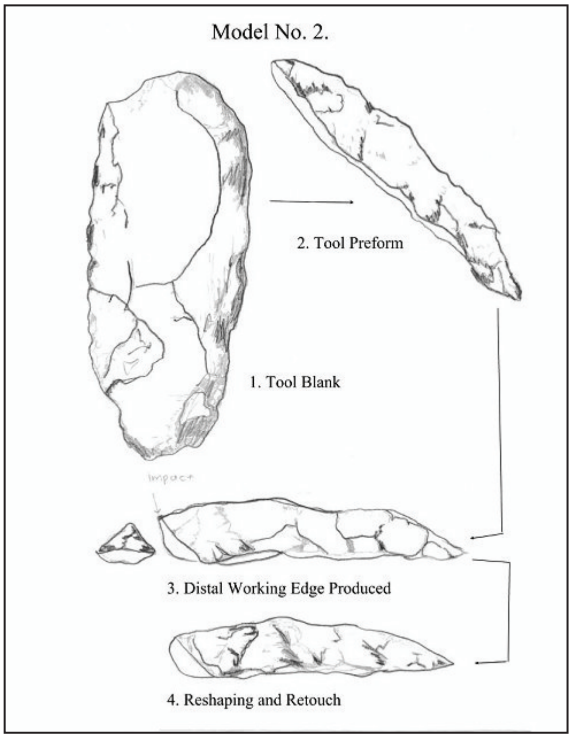

Figure 2. Guadalupe Tool Production Model No. 2 (redrafted from Black and McGraw 1985).

1989), no new conclusions or useful information on Guadalupe Tools were proposed.

Two major contemporary ethnographic studies have been conducted which bear relevance to the function of Guadalupe tools. In a study on the production of flint-knapped stone adzes in the village of Langda in Indonesia, Stout (2002) helps to provide a powerful contemporary comparison. Not only do the stone adze heads look remarkably similar to the Guadalupe tools, but the cultural significance, hafting techniques and usage also fall in line with the earlier presented theories on the function of Guadalupe tools. Further evidence for specialized lithic production, strategic caching and the cultural importance of lithic tools was provided by a combined archeological and ethnographic study on hunter gatherer societies (Andrefsky 1994). The theory that Guadalupe tools acted as hafted woodworking elements is further supported by archaeobotanical evidence which indicates a far more temperate climate with plentiful wood resources in the South Texas coastal plain 5,500 years ago (Hester 1995).

Experimental Analysis

Reviewing the existing literature on Guadalupe tools is only a first step in attempting to understand the function of these Archaic artifacts. Three large

Figure 3. Hafted Striking Motion.

factors still find themselves in question: (1) the production sequence, (2) the aspects of hafting the tool, and (3) determining the most effective use of the tool; all three of which can be further investigated through experimental means. After identifying these three testable factors, I strived to replicate as many varieties of Guadalupe tools as possible. Crafted by three separate archaeologists, and with a variety of working edge angles, these tools would undergo comprehensive testing, both hafted at a variety of angles, and non-hafted, against a piece of indigenous, green oak wood. Each tool would strike the wood 300 times at controlled strength in a swinging adze motion (Figures 3 and 4) at a spot unique for each tool. The resulting damage to the wood would then be analyzed by measuring the relative depth of the cut between the bark and the deepest point, the length of major axis of the cut, and the texture of the exposed wood within the cut.

The first step in the experiment was to create a set of Guadalupe tools to be used for the wood working experiment. Dr. August Costa, an Adjunct Lecturer at Rice University, was the first archaeologist to produce a set of stone tool heads to be used in the

Figure 4. Unhafted Hand-Held Striking Motion.

project. These three heads, labeled TG-1, TG-2, and TG-3, respectively (Figure 5), were all knapped from chert using a percussive hard hammerstone technique following a preform-flake production sequence as proposed in Black and McGraw's Model No. 2 (see Figure 2). Tool TG-1 weighed in excess of 100 grams and was 10.5cm in length with a working edge of 75^{o}. Tool TG-2 weighed 24 grams, was 5.5cm in length, and had a working edge of 73^{o}. Tool TG-3 weighed 76 grams, and was 8.5cm in length, and had a working edge of 82^{o}.

When comparing tools TG1-3 with the description and images of Black and McGraw's recovered Guadalupe tools, a few major differences stand out (Figure 6). While the same general shape is maintained across both groups, TG-1 is somewhat larger than those reported from archeological contexts, and TG-2 is significantly smaller. In addition, the working edge of TG-2 is very narrow, measuring half a centimeter across, and the working edge of TG-3 is slanted to the left in a manner irregular amongst recovered tools (see Figure 5). Dr. Costa reported much difficulty in attempting to manufacture the tools, and was unable to produce any tools following the cobble-quartering Model No. 1 method of production. The largest reported concern was one of resource cost, as the attempts to craft the tools via a Model No.1 method of production led to many wasted chert cobbles and unusable materials.

Texas Department of Transportation (TxDot) archaeologist, Christopher Ringstaff, graciously agreed to be the second archaeologist to attempt and produce a set of stone tools for this experiment. The four tools he crafted were labeled TC-1, TC-2, TC-3, and TC-4 (Figure 7). Each of these tools was knapped from chert utilizing both hard hammerstone

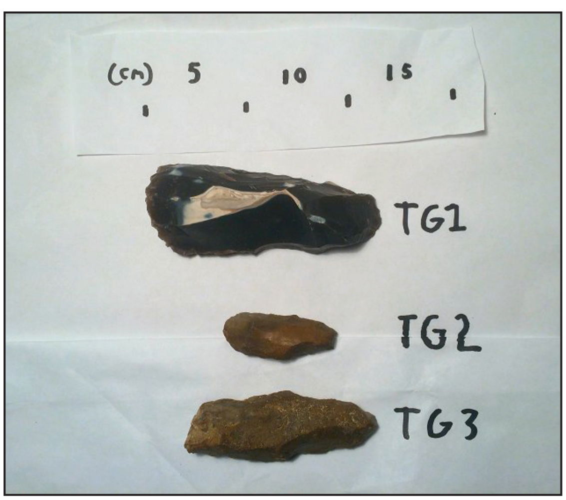

Figure 5. Experimental Guadalupe Tools TG-1, TG-2 and TG-3.

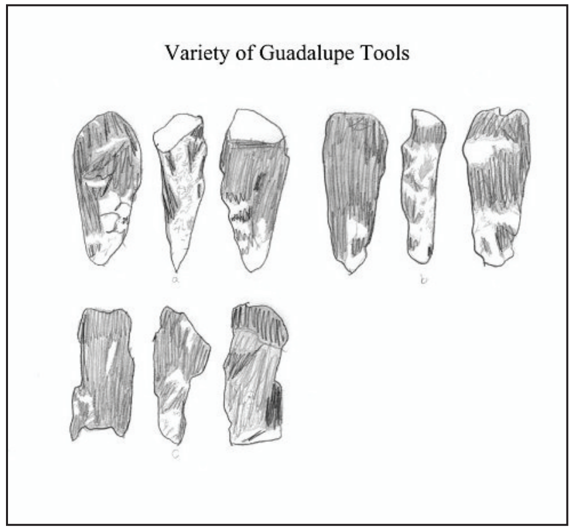

Figure 6. Guadalupe Tools from Archeological Contexts (redrafted from Black and McGraw 1985).

and soft hammer percussion flaking. Mr. Ringstaff also used the Model No. 2 method of preform-flake production. Tool TC-1 weighed 48 grams, was 7.5 cm in length, and had a working edge of 63^{o}. Tool TC-2 weighed 80 grams, was 9 cm in length, and had a working edge of 62^{o}. Tool TC-3 weighed 63 grams, was 8.5 cm in length, and had a working edge of 65^{o}. Lastly, tool TC-4 weighed 73 grams, was 8 cm in length, and had a working edge of 63^{o}. These replications compare more favorably to Guadalupe tools recovered from archeological contexts as all four are within the recorded ranges for both length and work-

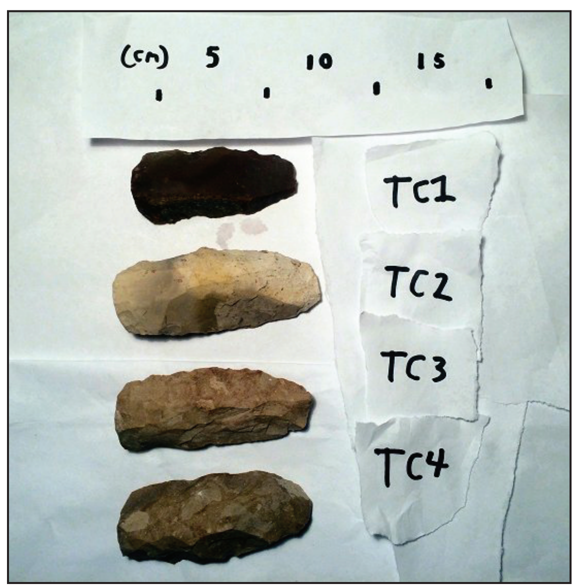

Figure 7. Experimental Guadalupe Tools TC-1. TC-2. TC-3 and TC-4.

Figure 8. Hard Hammerstones KH-1 through KH-3.

ing edge angle, and visually appear highly similar to the discovered artifacts.

The final set of replication tools was crafted by the author. The knapping kit consisted of three hard percussive hammerstones, labeled KH-1, KH-2, and KH-3 (Figure 8), and three chert cobbles, KC-1, KC-2, and KC-3 (Figure 9). Rather than utilize the previously used preform-flake Model No. 2 production sequence, the author chose to attempt and produce the tools via the cobble-quartering, Model No. 1 method of production. This was accomplished by firmly striking the cobble along a "natural fault line" or visible change in the cobble's cortex with a hard, rounded, percussive hammerstone (KH-1). Surprisingly, all three cobbles quartered along their "natural fault line," the most illustrative example being KC-2 (Figures 10 and 11). The tools constructed by the author, TD-1, TD-2, and TD-3 (Figure 12), were knapped from chert via percussive hard hammerstone technique, and following a cobble-quartering Model No. 1 production sequence. The hardest aspect was not the physical quartering of the cobble as reported above, but rather the actual shaping of the quartered flint, a task that would likely be simpler for a more experienced flint knapper.

Tool TD-1 weighed in excess of 100 grams, was 10 cm in length, and had a working edge of 37°. Tool

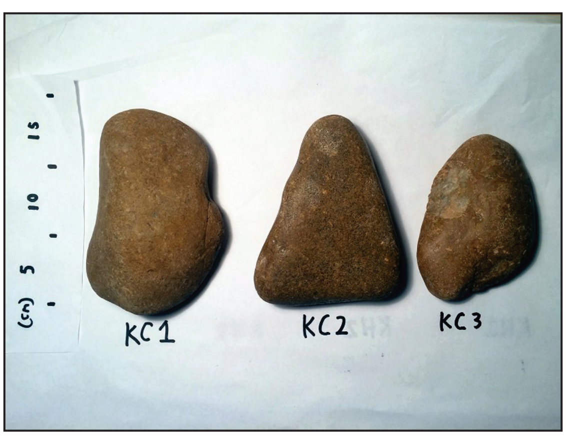

Figure 9. Chert Cobbles KC-1 through KC-3.

Figure 10. Impact Point on Chert Cobble KC-2.

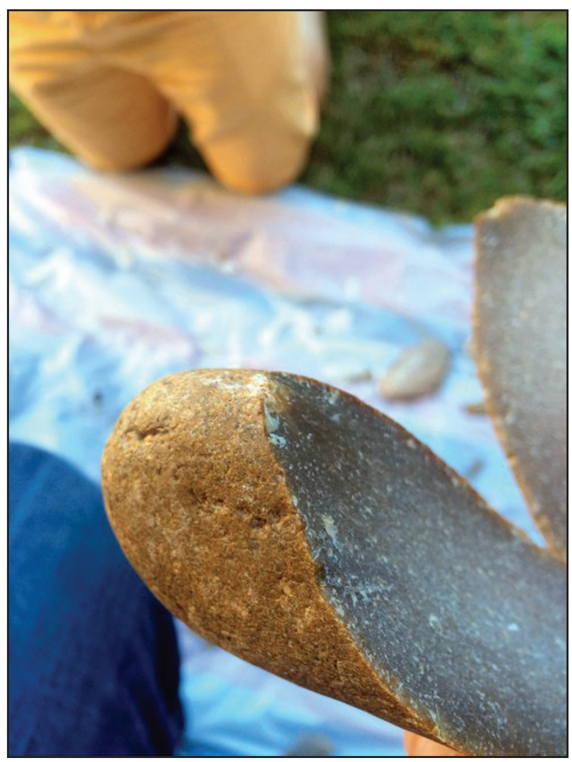

Figure 11. Post Impact Quartered Chert Cobble KC-2.

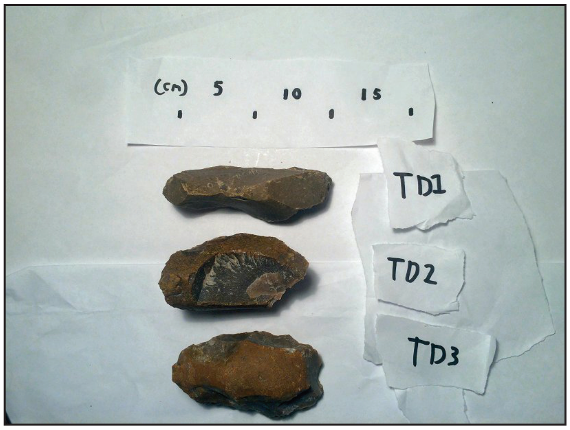

Figure 12. Experimental Guadalupe Tools TD-1, TD-2 and TD-3.

TD-2 also weighed greater than 100 grams, was 8 cm in length, and had a working edge of 50^{o}. Tool TD-3 weighed greater than 100 grams, was 8 cm in length, and had a working edge of 63^{o}. Tools TD1-3 least resembled true Guadalupe tools as reported by Black and McGraw (1985). Tool TD-1 is longer and wider than recovered Guadalupe tools, has a steeper cutting edge, and an overall irregular shape. Tool TD-2 can hardly be considered a Guadalupe tool as its proximal half fell off during the latter stages of construction. Lastly, tool TD-3, while maintaining the most regular characteristics, has an oddly textured working edge.

After producing these ten lithic tools, the next step of the experiment was to find hafting elements. Six wooden hafting elements were produced and labeled KE-1, KE-2, KE-3, KE-4, KE-5, and KE-6 (Figure 13). As can be seen in Figure 13, each of these wooden elements has both a vertical shaft as well as angled joint to hold the lithic tool. KE-1 was 32.5 cm in length and had an angle of 58^{o}; KE-2 was 33 cm in length with an angle of 60^{o}; KE-3 was 28 cm in length and had an angle of 80^{o}; KE-4 was 22 cm in length with an angle of 119^{o}; KE-5 was 28.5 cm in length and had an angle of 78^{o}; lastly KE-6 was 45 cm in length with an angle of 75^{o}. All wooden hafts were sourced locally using native Texas wood. The variety of replication tools coupled with different lengths and shapes of wood handles allowed for many variables to be tested in this analysis. The lithic tools varied in weights from as low as 24 grams to over 100 grams, with working edges between 37^{o} and 82^{o}. The wooden hafting elements range in lengths from 22 cm to 45 cm, with angles from 58^{o} to 119^{o}. Two separate construction sequences for the lithic tools (Model No. 1 and Model No. 2) were also tested.

Figure 13. Wooden Hafting Elements KE-1 through KE-6.

With this myriad of elements and testable variables assembled, the next step in the experiment was to create a set of complete, hafted Guadalupe tools. Three tools from each knapper were used, two were hafted and one was used unhafted. The lithic tools and wooden hafts were randomly matched to one another, with the leftover three lithic heads remaining unhafted. Nine complete Guadalupe tools were thus created, TC-2 and KE-6 were hafted to form GT-1; TG-1 and KE-4 were hafted to form GT-2; TG-2 and KE-2 were hafted to form GT-3; TC-4 and KE-5 were hafted to form GT-4; TD-3 and KE-1 were hafted to form GT-5; TD-1 and KE-3 were hafted to form GT-6; TG-3 became unhafted tool GT-7; TC-1 became unhafted tool GT-8; and TD-2 became unhafted tool GT-9. Each tool hafted tool was completed using contemporary duct tape as the hafting material. The resulting nine Guadalupe tools (Figure 14) were then used to strike a piece of indigenous, green, oak wood. Each tool would be used to strike a unique spot 300 times at controlled strength.

Experimental tool GT-1 consisted of a normatively-shaped lithic head with a working edge of 62^{o}, and a long, naturally curved hafting element measuring at 75^{o}. The cutmark created by GT-1 was a large sized fissure, 1.2 cm deep and 6 cm along the major axis (Figure 15). The cutmark was smooth with a significantly roughened worked end. Tool GT-2 consisted of a irregularly-shaped lithic head with a

Figure 14. Completed Guadalupe Tools GT-1 through GT-9.

Figure 15. Cutmark Produced by Hafted Experimental Tool GT-1.

Figure 16. Cutmark Produced by Hafted Experimental Tool GT-2.

Figure 17. Cutmark Produced by Hafted Experimental Tool GT-3.

working edge of 75° and a short, obtuse angled hafting element measuring at 119°. The cutmark created by GT-2 was a large-sized fissure, 2.1cm deep and 10 cm along the major axis (Figure 16). The cut was rough with a significantly more roughened worked end. Tool GT-3 consisted of a irregularly-shaped, roughly crafted lithic head with a working edge of 73°, and an average-sized hafting element measuring at 60°. The cutmark created by GT-3 was a medium-sized fissure, 0.5 cm deep and 5 cm along the major axis (Figure 17). The cut was smooth with no roughened buildup from carving.

Experimental tool GT-4 consisted of a normatively-shaped lithic head with a working edge of 63° and an average-sized right-angled hafting element measuring at 78°. The cutmark created by GT-4 was an average sized fissure, 1 cm deep and 7 cm along the major axis (Figure 18). The cut is smooth with a significantly roughened worked end. Tool GT-5 consisted of a irregularly-shaped lithic head with a working edge of 63° and a large, heavy hafting element measuring at 58°. The cutmark created by GT-5 was an average sized fissure, 1.2 cm deep and 6 cm along the major axis (Figure 19). The cut was smooth with an extremely roughened worked end. Tool GT-6 consisted of a irregularly-shaped lithic head with a working edge of 37° and a short right-angled hafting element measuring at 80°. The cutmark created by GT-6 was large sized fissure, 2.5 cm deep and 8.5 cm along the major axis (Figure 20). The cut was smooth with a roughened worked end.

Figure 18. Cutmark Produced by Hafted Experimental Tool GT-4.

Figure 19. Cutmark Produced by Hafted Experimental Tool GT-5.

Figure 20. Cutmark Produced by Hafted Experimental Tool GT-6.

Tool GT-7 consisted of an unhafted, irregularly-shaped lithic head with a working edge of 82º. The cutmark created by GT-7 was relatively small, 0.3 cm deep and 3 cm along the major axis (Figure 21). The cut was very smooth with no rough worked end. Tool GT-8 consisted of an unhafted, normatively-shaped lithic head with a working edge of 63º. The cutmark created by GT-8 is a small-sized fissure 0.5 cm deep and 3.5 cm along the major axis (Figure 22). The cut was very smooth with no rough worked end. Lastly, tool GT-9 consisted of an unhafted, irregularly-shaped and poorly crafted lithic head with a working edge of 50º. The cutmark created by GT-9 is a small sized fissure, 1 cm deep and 2.5 cm along the major axis (Figure 23). The cut was smooth with a little rough worked end. After the completion of all nine cuts, a comparative analysis was then conducted to provide insights into the construction, hafting and usage of Guadalupe tools.

Returning to the three testable factors of construction sequence, aspects of hafting, and effective use of the tool, new evidence from this experiment may be applied to potentially bring about new end-use interpretations. When concerning the production sequence, conflicting evidence emerges. Two professional archaeologists attempted to create Guadalupe tools utilizing the Model No. 2 production sequence, and an avocational archaeologist attempted to create the same tools utilizing construction sequence Model No. 1. All three were successful in one way or another. The three largest cutmarks were created by tools GT-1, GT-2, and GT6, each of which originated from a separate craftsman. In terms of tool utility and work potential, there appears to be no obvious difference originating in the production sequence. The cutmarks created by the normatively-shaped heads of tools TC-1, TC-2, and TC-4 generated the largest cuts of the small and medium-sized tool, and have the smoothest worked areas in comparison to irregular tool heads. This suggests that the normatively-shaped tools crafted by Christopher Ringstaff led to a smoother and more efficient cutting of wood. Whether this is entirely due to the shape of the lithic tool heads or simply the superior craftsmanship of experimental tools TC-1, TC-2, and TC-4 is open to debate; but there is certainly evidence to support the effective usage of a normatively-shaped Guadalupe tool as an effective woodworking artifact.

The largest cutmark, created by tool GT-2, was made with an irregularly-shaped head. This lithic tool (TG-1) however, while classified as irregularly-shaped, is the closest in form to a normatively shaped Guadalupe tool. Moreover, TG-1 was formed in the same style as TC-1, TC-2, and TC-4, in a preform flake Model No. 2 production sequence. This implies that when analyzing the tools from a production sequence standpoint, Model No. 2 is not only more viable in terms of producing normatively-shaped tools, but also in terms of producing more efficient tools. While the quartering aspects of production sequence Model No. 1 are certainly feasible, as demonstrated by the author of this paper (see Figures 10 and 11), a more experienced flint knapper needs to produce better quartered cobbles in order to test the efficacy of the Model No. 1 production sequence. The results of this portion of the experiment suggest that the Archaic inhabitants of South Texas likely used a combination of both Model No. 1 and Model No. 2 production sequences, dependent upon the individual craftsman and the customs of the

Figure 21. Cutmark Produced by Hand-Held Experimental Tool GT-7.

Figure 22. Cutmark Produced by Hand-Held Experimental Tool GT-8.

Figure 23. Cutmark Produced by Hand-Held Experimental Tool GT-9.

people utilizing the tool. This is supported by apparently the use of a variety of knapping techniques as seen in recovered Guadalupe tools from archeological contexts (Stout 2002; Black and McGraw, 1985).

The aspects of hafting are the next tested factor in this experiment, specifically the angle, length, and weight of the wooden hafting elements. The most obvious observation is that Guadalupe tools were clearly hafted for effective use. The cutmarks created by the non-hafted tools, GT-7, GT-8, and GT-9, are significantly smaller than any of the cuts created by hafted tools. However, the size of the cuts created by experimental tools GT-1, GT-2 and GT-6, apparently have little relationship when analyzing hafting elements. The weight of the wooden handle does not appear to be a major factor as the tool with the heaviest hafting element, GT-5, only created a moderately-sized cut. There is a general trend towards length, as GT-1 and GT-3, which created two of the largest cutmarks, also have the longest two longest hafting elements. This evidence is countered however, as the largest fcutmark from the entire experiment, created by tool GT-2, was the tool with the shortest hafting element.

Another potential factor in determining the effectiveness of the tools is the difference in working angle between the lithic tool and the wooden handle. In the three largest cuts, the difference in angles were 13^{o} in tool GT-1, 44^{o} in tool GT-2, and 43^{o} in tool GT-3. Compared to the three tools which created only moderate-sized cuts, the average angle difference is significantly higher. This factor is further supported by the fact that the largest cuts were consistently created the tool with the largest difference in tool-to-haft angle.

The final testable factor was in terms of efficacy and tool utility. After only 300 strikes, the most efficient tools, GT-1, GT-2, and GT-6, were able to create significant cutmarks into the wood. The smallest cuts, produced by the unhafted lithic heads, were the smoothest, suggesting that while unhafted Guadalupe Tools were inappropriate for large scale cutting and carving, they may have found hand-held usage for detail work. Regardless of tool size, the normative-shaped tools crafted by Christopher Ringstaff produced smoother cuts, more suitable for specialized manufacture. There is no question that these tools were used as hafted woodcarving tools for large-scale woodworking, and potentially additionally used as hand-held tools for more detailed work as well.

Conclusions

This replication experiment on Guadalupe tools was not designed to extensively test any one single factor, but rather through experimental means test a variety of potential factors which may impact artifact construction, especially of non-projectile point utilitarian tools. In this regard, this experiment has demonstrated a variety of insights on the construction, hafting and end-use of Guadalupe tools. This experiment has showed that both production sequence Model No. 1 and Model No. 2 are viable construction techniques in crafting an effective Guadalupe tool. Since there is variability in Guadalupe tool shape and size in the archaeological record, it is likely that the Archaic peoples of South Texas used both production sequences.

The results of this experiment also provides strong support that Guadalupe tools were hafted, as hafting of the tool exponentially increases its efficacy in terms of cutting. Hafting elements of various lengths and weights however, tend to have little effect on the overall efficacy of the tool. While there is a potential trend in terms of longer hafts leading to more effective cutting, a more significant trend has been found in the difference between the angle of the lithic tool's working edge and the hafting element angle. The larger this difference, the more effective the tool, suggesting that more angled hafting elements were more efficient. There is additionally the potential that some Guadalupe tools may have been used in an unhafted, hand-held mode for more detailed work. Lastly, Guadalupe tools of a more normative shape universally created smoother cutmarks, suggesting that the tool's ideal shape arose from a desire not for brute efficiency but rather specialized crafting. While still further experimental research into these tools needs to be conducted for a more complete functional analysis, the evidence produced in this experiment can has shed some light on Guadalupe tools and their usage.

References Cited

Andrefsky, William Jr.
1994 The Geological Occurrence of Lithic Material and Stone Tool Production Strategies. *Geoarchaeology: An International Journal* 9(5):375-391.

Baker, Ed
2003. The University of Texas and 1990: Texas Archaeological Society Excavations at 41UV132, the Smith Site, Ulvade County, Texas. *Bulletin of the Texas Archeological Society* 74:1-30.

Black, S.L., and A. J. McGraw
1985 The Panther Springs Creek Site: Cultural Change and Continuity Within the Upper Salado Creek Watershed, South-Central Texas. *Archaeological Survey Report 100*. Center for Archaeological Research, University of Texas, San Antonio.

Brown, Kenneth M.
1985 Three Caches of Guadalupe Tools from South Texas. *Bulletin of the Texas Archeological Society* 56:75-125.

1989 The Bingaman Cache of Stone Tools from Webb County. *La Tierra* 16(3):8-28.

Hester, Thomas R.
1995 The Prehistory of South Texas. *Bulletin of the Texas Archeological Society* 66:427-459.

Stout, Dietrich
2002 Skill and Cognition in Stone Tool Production: An Ethnographic Case Study from Irian Jaya. *Current Anthropology* 43(5):693-722.

Turner, Ellen Sue, Thomas R. Hester, and Richard L. McReynolds
2011 *Stone Artifacts of Texas Indians, 3rd edition*. Taylor Trade Publications, Lanham, Maryland.

NEW HUMAN REMAINS AND A GLASS TRADE BEAD FROM CAPLEN MOUND (41GV1)

August G. Costa, Ph.D., R.P.A.

Abstract

During an inventory of the collections in the Rice University Archeology lab in the fall of 2015, the author discovered a small bag of human remains labeled from the "Caplen site." Although the source and chain of custody for this collection is uncertain, the remains were likely turned over to the university from a looter or a looter's descendant prior to the 1980s. A blue glass bead and a red ochre nodule were found commingled with the human remains. These finds are consistent with the type of artifacts reported from Caplen Mound (41GV1) (Woolsey, 1932; Campbell, 1957). Caplen Mound (41GV1) is a Late Prehistoric to Protohistoric (A.D. 900–1600) cemetery located on the Bolivar peninsula in Galveston County, Texas. The site is among the earliest academic excavations carried out in Southeast Texas (Woolsey, 1932). It is also one of the earliest and thoroughly looted aboriginal cemeteries in Texas. This paper describes the new remains and associated grave goods and places them within the context of previous research on the site.

Introduction

A small collection was found in the Rice University Archaeology lab in a paper bag labeled "Caplen site" with no other accompanying information. The contents of the bag were found to contain a small amount of fragmentary human remains and two artifacts including a blue glass bead and a small lump of red ochre. Although the provenance of this collection is not irrefutable, it appears consistent with previously described collections from Caplen Mound (41GV1) (Woolsey, 1932; Campbell, 1957). It remains unclear how this collection came to be in the Rice University Archaeology lab as Rice University never conducted investigations at Caplen Mound. The most plausible explanation for the presence of the collection is that these items were looted from the site and donated to the lab from a private individual. This most likely occurred in the early days of archeology at Rice and certainly prior to the Native American Graves Protection and Repatriation Act (NAGPRA) of 1990. Although lacking precise contextual information, the collection is significant as it includes a rare example of a European glass trade bead and Caplen Mound is a major source of mortuary data on Late Prehistoric aboriginals in coastal Southeast Texas.

The Caplen site is named for Caplen Station situated on the nearby Santa Fe Railway line on the Bolivar Peninsula (Campbell, 1957). In the early decades of the 20th century this location, known only as the "Indian Cemetery," was thoroughly plundered by looters. Nearly 70% of Caplen cemetery was destroyed before methodical archeological work occurred there (Campbell, 1957).

Caplen cemetery is situated on a small knoll. The site is not a mound in the strict archeological sense as it does not appear to have been built purposefully as a monument. The brush covered "mound" is about 15 meters in diameter and one meter above sea level (Taylor and Dial, 2016). Although the knoll was reportedly accentuated by aboriginal shellfish discard activities, no accessory occupation sites are known in the immediate area.

The first and only field investigations of the cemetery occurred in 1932 under the direction A.M. Woolsey, a pupil of Professor J. E. Pearce at the University of Texas at Austin. These investigations sampled the core area (approximately 30%) of the mound and recovered 66 burials, 23 of which were disturbed. Unfortunately this fieldwork was not very systematic and no grid or clear stratigraphy was reported for the site. The results of the University of Texas (UT) investigations were never published, however subsequent researchers have made attempts to analyze the assemblage and place them into context from unpublished field notes (Campbell, 1957; Powell, 1994; Taylor and Dial, 2016). Radiocarbon dates on human bone from Caplen Mound along with diagnostic artifacts (two European glass beads) suggest that the cemetery was used from A.D. 900 to the Protohistoric period, approximately A.D. 1520 to 1700 (Powell, 1994: Taylor and Dial, 2016). The burials recovered by UT from Caplen Mound are dominated by adults, but also included two infants and six sub-adults. The majority of the burials appear

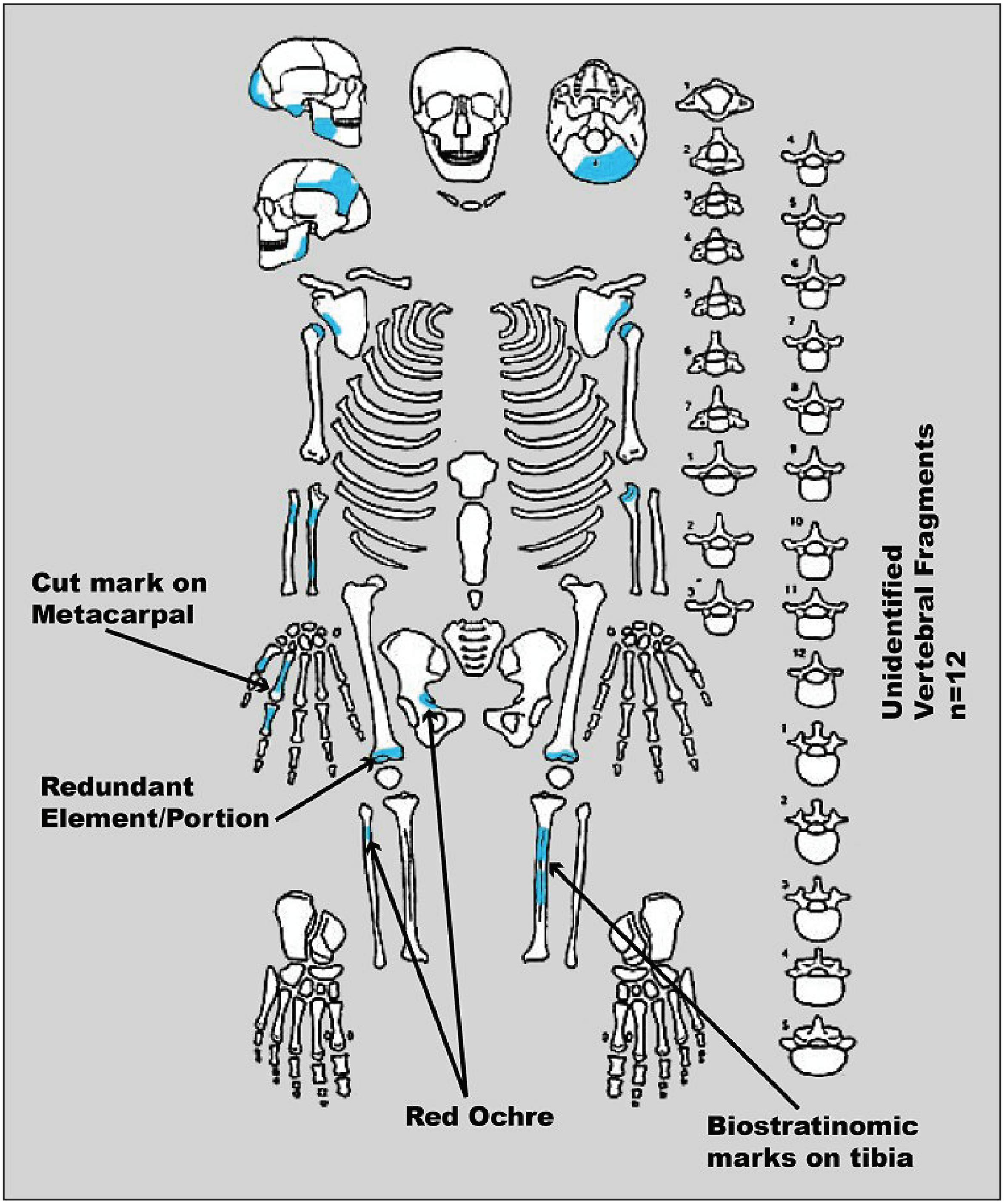

Figure 1. Skeletal elements identified (solid blue) in this analysis. Modified from Buikstra and Ubelaker (1994).

to have been placed within small pits, in flexed or semi-flexed positions with the head facing east (Campbell, 1957; Taylor and Dial, 2016). Only three adults males were found interred with a north-south orientation (Taylor and Dial, 2016).

Many burials at Caplen Mound included associated grave goods such as shell gorgets, bone and shell beads, a carved bone pendant, a tortoise shell rattle, chipped stone dart points (e.g. Gary and Kent points), drills, and pottery (n=110). Powdered and nodular red ochre was found on and around many of the burials. The majority of the Caplen Mound pottery is consistent with local Goose Creek wares, however Campbell (1957) identified 17 Rockport

Table 1. Inventory of human remains observed from new Caplen Mound collection.
IND# notes individual A or B (accessory individual) represented in sample.

Spec#	Description/Element	Count	NISP	IND#	Notes
1	Fragmentary Right Upper Maxilla (M2, M1, P4, P3, C1)	7	5	A	Large Tartar Deposit on C1, enamel pearls on M1 and M2, Wear is moderate to heavy, Likely sub-adult. M2 has fused roots. C1 is blunted and incisorform. M3 eruption indicates individual >15 years.
2	Rib fragments	8	?	A	1 conjoin. Most are medial-ventral shaft fragments. Large Adult sized.
3	Right Mandible	1	1	A	Gonial angle/ascending ramus portion
4	Left Mandible	1	1	B	Gonial angle/ascending ramus portion. Appears smaller and non-antimeric to spec#3
5	Left Scapula	2	1	A	Axillary border and glenoid fossa
6	Left Proximal Tibia	1	1	A	Anterior Crest portion. Biostratinomic markings on posterior surface (n=3).
7	Left Humerus (1 of 2)	1	0.5	A	Diaphysis
8	Right Scapula	1	1	A	Axillary border
9	Left Humerus (2 of 2)	3	0.5	A	Distal epiphysis
10	Right Radius (mid proximal), Portions of Right Ulna and left ulna olecranon process	3	3	A	
11	Right Fibula	1	1	A	Proximal shaft. Covered in Red Ochre
12	Left and Right lateral and medial distal epicondyles of the Femur (portions of)	8	2	A & B?	Likely comes from >1 Individual
13	Right and Left Humeral heads	2	2	A & B?	Right element is very large
14	Right Os Coxa (Ishium, Blade, Body and Pubis)	3	1	A	Red ochre on ishium fragment
15	Vertebral Fragments	12	?	A	
16	Unidentified Long fragments	15	?	A	
17	Unidentified Short fragments	10	?	A	
18	Occipital (Right Lateral includes lambdoidal suture)	5	1	A	Open sutures - Many of skull vault pieces can be taped together for partial reconstruction.
19	Left Parietal	5	1	A	Open sutures (some portions already glued together.
20	Right Temporal	1	1	A	Mastoid process area-inner ear preserved. Some possible ochre - reddening
21	Right Parietal	2	1	A	
22	Misc. Skull Vault Fragments	6	?	A	
23	1st Metacarpal and Proximal Intermediate Phalange	5	2	A	MC1 has possible cut mark
	Total	**103**	**26**		
	*Note: all elements are incomplete.				

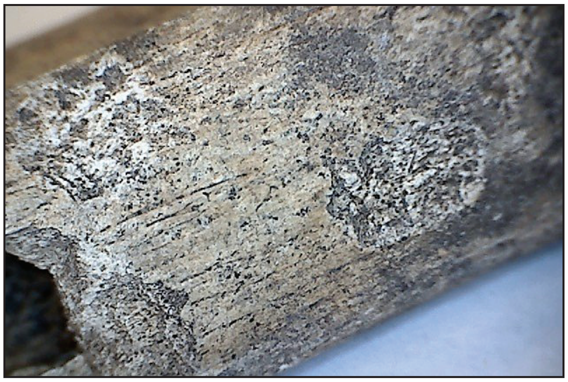

Figure 2. Biostratinomic markings on the posterior face of a left tibia diaphysis.

ware sherds and one sherd consistent with East Texas Caddoan pottery. Finally two turquoise-colored European glass beads were associated with an infant burial (Burial 12) suggesting that the latest use of the cemetery post-dates A.D. 1519. One of the glass beads is doughnut-like (diameter 7 mm, length 4.5 mm); the other is cylindrical (diameter 6.5 mm, length 7 mm) (Campbell, 1957).

The discovery of new material attributable to Caplen Mound is important. Given the significance of this site and the occurrence of a previously unreported glass trade bead, a systematic analysis and inventory of the collection was undertaken. Ultimately the goal of this work was to assess what is present in the collection prior to a transfer of custody to the Texas Archeological Research Laboratory (TARL) where the 1932 UT collection is curated.

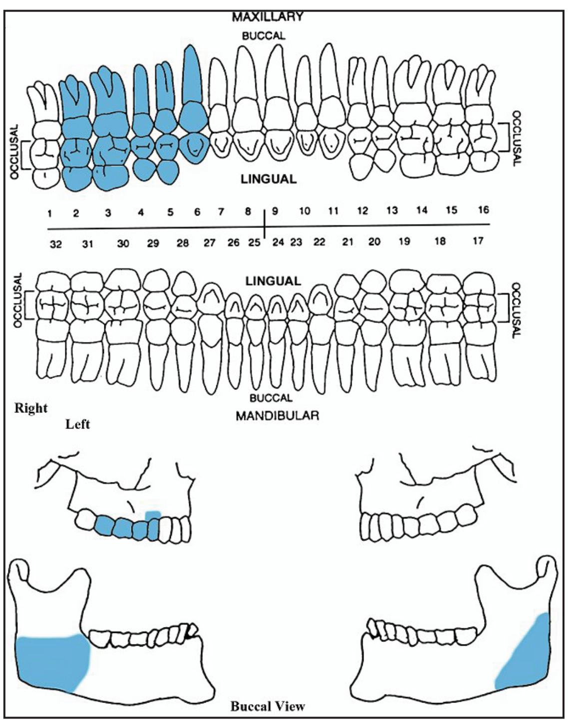

Figure 3. Dental elements identified (solid blue) in this analysis. Modified from Buikstra and Ubelaker (1994).

Methods

All remains from the Rice University Caplen Mound collection were laid out on a large table. The human remains were sorted by element and given catalog numbers. Identification of elements preserving diagnostic morphology was undertaken utilizing the Rice osteology reference collection and reference texts (e.g., White et al. 2011; White and Folkens, 2005). Features of interest were examined more closely and documented using a digital USB microscope (20x-230x). The human remains were documented using forms from Buikstra and Ubelaker (1994).

Results

Human Remains

One hundred and three bone fragments were examined from the collection (Table 1). Overall the condition of the remains was poor with most identifiable bone represented by the epiphyses of long bones (Figure 1). The vast majority of bones were too fragmentary to attribute to a specific skeletal element. A total of 26 individual skeletal elements were identified representing a minimum of at least two individuals. Twenty-five long bone fragments could not be identified. Twelve vertebral fragments are present in the assemblage, however these remains were too fragmentary to identify their positions within the vertebral column. Likewise eight rib fragments were observed that preserved too little diagnostic morphology for more specific identification.

The appendicular skeleton is represented by distal right and left femora. Lateral and medial condyles are present. Those identified from the right side are numerous and appear to represent more than one individual. The left tibia is represented by two fragments. One tibia specimen has unidentified biostratinomic markings on the posterior surface. These markings appear post-mortem and are pit-like in morphology. The marks appear to be consistent with percussion pitting (Figure 2). The upper arms are represented by left and right scapula fragments and humeral heads. The humeral heads are drastically different in size, again suggesting the presence of at least two individuals in the skeletal sample. Finally, a few finger bones were observed including a proximal and intermediate phalange as well as a first

Figure 4. Broken surface of red ochre fragment associated with skeletal remains.

metacarpal. The side and ray of these finger bone elements was not determined. The first metacarpal exhibits an apparent cut mark.

The best-preserved remains are those of the skull. These are represented by a partial occipital; partial left parietal and partial right temporal bone. Portions of the left parietal had already been partially reconstructed (i.e., fragments were found that had been glued together). Several of the other skull vault bones conjoined to form larger fragments. Mandibular fragments are present in the form of the gonial angle formed by the ascending and transverse rami. Both left and right mandibular fragments of the same portion are present. The size and morphology of these mandibular fragments are incongruous which suggests they do not belong to the same individual.

A partial right maxilla (Figure 3) is present which includes the first and second molars, both premolars and the canine (M^2, M^1, P^4, P^3, C^1). Enamel pearls were present on the buccal aspect of M^1 and portions of M^2. Enamel pearls are common developmental defects in enamel formation. The canine is peg-like and has a large amount of dental calculus (tartar) on the apical area. Observed dental wear is moderate to

Figure 5. Glass bead found associated with the skeletal material.

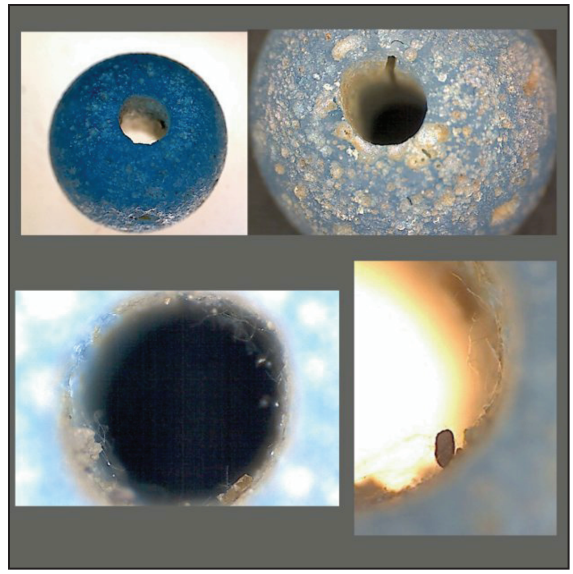

Figure 6. Various views of glass bead. Photomicrograph at lower right shows the unknown fibers present in drill hole.

heavy. No incisors were recovered. No lower dentition was observed.

Red ochre was observed on several skeletal elements including portions of an ischium (innominate) fragment, a right proximal fibula and the temporal (see Figure 1).

Minimum Number of Individuals MNI =>1

The vast majority or remains observed in the sample appear to come from a single sub-adult individual. Nonetheless, the redundancy of the distal right femur and two non-antimeric elements observed (humerus, mandible) suggest that the remains of at least two individuals are present in the sample.

Age and Sex

The principal individual represented in the sample (via skull and teeth remains) appears to be a sub-adult individual. The teeth consist of adult dentition with moderate to heavy wear. The absence of a third upper molar may indicate an age of approximately 15 years. All cranial sutures observed in the skull vault are open, further indicating a sub-adult. Finally the nature of postcranial skeletal preservation is suggestive of an individual in which epiphyseal ossification has not yet occurred. In sum, the remains observed in this study appear to represent a young teenager. The remains are too incomplete to attempt a sex determination.

Artifacts

Two artifacts were found commingled with the human remains. One is a small piece of red ochre, the other a glass bead. The ochre specimen is an irregularly shaped nodular piece (Figure 4). The exterior is black with patches of white matter, possibly some form of mineral precipitate. The specimen has no wear facets indicating that it had not been worked or processed in any way. One straight broken face suggests that the piece was once part a part of a larger mass. The ochre specimen is 20 mm in length, 11.9 mm in width, 10.4 mm in thickness and weights 2.2 g.

The bead specimen has a short barrel form and is made in a blue-green (turquoise) colored glass (Figure 5). The surfaces are pitted as if ground (Figure 6). The bead is slightly asymmetrical from top to bottom. The glass is opaque and the bead hole does not appear to have been drilled. The bead hole has an elongate furrow in central portion. Under a binocular microscope at 20-200x, fibers of some sort can be observed in the drill hole (Figure 6). It is unclear, whether the fibers might represent a cordage element on which the bead was strung or some unassociated material that was later introduced to the bead hole. The bead measures 6.1 mm parallel to the hole, diameter is 7.4 mm, drill hole inner diameter is 1.45 mm, and weight is 0.4 g.

Discussion

The previously unreported remains described here are extremely fragmentary and prohibit a detailed assessment of the health, stature and sex of the individuals. Even so, the remains can be said to represent more than one person. This is unsurprising given the large number of graves reported in the cemetery at Caplen Mound. In spite of the destruction caused by looters, the graves were apparently packed so close together that subsequent burials disturbed earlier ones (Campbell, 1957). The remains documented here were found partially covered with ochre alongside a nodular piece of red ochre. Ochre is a common grave offering and many of the remains excavated by UT at Caplen Mound were found with evidence of red ochre mortuary treatment.

Two bones in the collection were found to bear biostratinomic markings which should be investigated further. One mark is an apparent cut mark on a hand bone. The other consists of two pit-like markings on the shaft of a shinbone. Both of these markings appear to be post-mortem in nature and unrelated to modern looter or curator activities. Although these marking are interesting, they appear to be isolated examples in the overall sample. In some cases, percussion and cut marks on the remains of the deceased may indicate special treatment of the dead prior to interment. However the author knows of no other examples of such a mortuary practice in the Late Prehistoric record of the area. At present it is unclear if similar markings are present in the collections from Caplen Mound recovered by UT.

It is important to note that these markings cannot be taken to indicate evidence of cannibalism. Much more compelling evidence would be required to support such a hypothesis. The majority of the remains deposited at Caplen Mound cemetery can be attributed to the Atakapa-speaking Akokisa. Although the Choctaw exonym “Atakapa” means “man-eater” and other European accounts (e.g. de Bellisle) imply the possibility of ritual cannibalism among the coastal aboriginals of Southeast Texas, no robust archeological evidence yet supports this scenario. At present one cannot rule out the possibility that the pit marks (see Figure 2) observed here were caused by some animal. Further research might help provide better answers on these markings.

The discovery of a glass bead specimen is an exciting find as such items indicate early contact between Europeans and the aboriginal inhabitants of Southeast Texas. Glass beads are rare in mortuary contexts of Southeast Texas. Only two beads of similar description were recovered from the UT investigations at Caplen Mound. These beads were associated with a single sub-adult individual (Burial 12). This raises the possibility that the newly discovered collection from Caplen Mound was derived from or nearby Burial 12. Unpublished notes by A.M. Woolsey indicate that the mound was littered with looter pits at the time of initial investigations in 1932 and Burial 12 was recovered from a shallow grave (<30 cmbs). Additional work comparing the collection described here to the skeletal elements recovered from Burial 12 is warranted to ensure that the current sample is not part of the same sub-adult individual.

Glass beads similar to that found here were recovered from burials at Mitchell Ridge cemetery (41GV55) in Galveston County (Ricklis, 1994). Although a total of 3,243 glass beads were recovered overall from Mitchell Ridge Area 4, only 25 of these came from Protohistoric contexts; the remainder derived from Early Historic graves that post-dated A.D. 1700 (Ricklis, 1994). The new glass bead specimen from Caplen Mound (and perhaps the previous finds) appears consistent with bead type IIA7 found at Mitchell Ridge. These are simple donut-shaped drawn beads that are turquoise in color and range in size from small to very small (Ricklis, 1994). These beads are known as Itchuknee Plain blue-green glass beads and are commonly found in late 16th-17th century contexts throughout the Southeast (Ricklis, 1994). In fact, it is the most common glass bead type on early 17th century Spanish mission sites in Florida (Deagan, 1987; Ricklis, 1994). This bead variety is also the most common glass bead recovered at Mitchell Ridge comprising 75 percent of the bead assemblage (n=2,433).

The occurrence of an Itchuknee Plain glass trade bead suggests that the latest use of Caplen Mound cemetery must post-date circa 1575 A.D., when this type first appears in the Southeast (Ricklis, 1994). Given the comparative lack of other European trade goods at Caplen Mound, these beads and perhaps some Rockport pottery were traded up the coast to the Bolivar Peninsula. There is little to suggest that the people represented at Caplen Mound had sustained contact with Europeans.

The Caplen Mound cemetery (41GV1) is the first site form entry for Galveston County in the Texas Historical Commission's records. It is a critical site for understanding aboriginal lifeways and potential impacts of early European contact in coastal Southeast Texas. Unfortunately this valuable resource was largely destroyed in the early 20th century. Even so, new and valuable information can be gleaned from careful study of the materials that have survived. The new finds reported here will be reunited with those curated at TARL. There is still much to be learned about the people who lived and died on the Bolivar peninsula. It is hoped that these discoveries will encourage additional research on this forgotten group of people.

References Cited

Buikstra, Jane E., and Douglas H. Ubelaker.
1994 Standards for data collection from human skeletal remains. *Arkansas Archeological Survey Research* Series No. 44.

Campbell, Thomas N.
1957 Archeological Investigations at the Caplen Site, Galveston County, Texas. *Texas Journal of Science* 9:448-471.

Deagan, K. A.
1987 *Artifacts of the Spanish Colonies of Florida and the Caribbean, 1500-1800, Volume 1, Ceramics, Glassware and Beads.* Smithsonian Institution Press, Washington D. C.

Powell, Joseph
1994 Bioarchaeological Analysis of Human Skeletal Remains from the Mitchell Ridge Site. In *Aboriginal Life and Culture on the Upper Texas Coast: Archaeology of the Mitchell Ridge Site, 41GV66, Galveston Island*, by Robert A. Ricklis, pp. 287-405. Coastal Archaeological Research, Inc., Corpus Christi.

Ricklis, Robert A.
1994 *Aboriginal Life and Culture on the Upper Texas Coast: Archaeology of the Mitchell Ridge Site, 41GV66, Galveston Island.* Coastal Archaeological Research, Inc., Corpus Christi

Taylor, Matthew S. and Susan Dial,
2016 *Caplen Mound.* Texas Beyond History, Texas Archeological Research Laboratory, University of Texas at Austin
URL.
http://www.texasbeyondhistory.net/coast/images/ap4.html (Accessed 7.6.16.)

White, Tim D., Michael T. Black, and Pieter A. Folkens.
2011 *Human Osteology*. Academic press.

White, Tim D., and Pieter A. Folkens. T
2005 *The Human Bone Manual*. Academic Press.

Woolsey, A. M.
1932 Excavation of a Burial Site, Caplen Mound, 1 ½ miles N.E. of Caplen, Galveston, County, Texas. The University of Texas Anthropology Department. *Unpublished MS.* On file, Texas Archeological Research Laboratory, Austin.