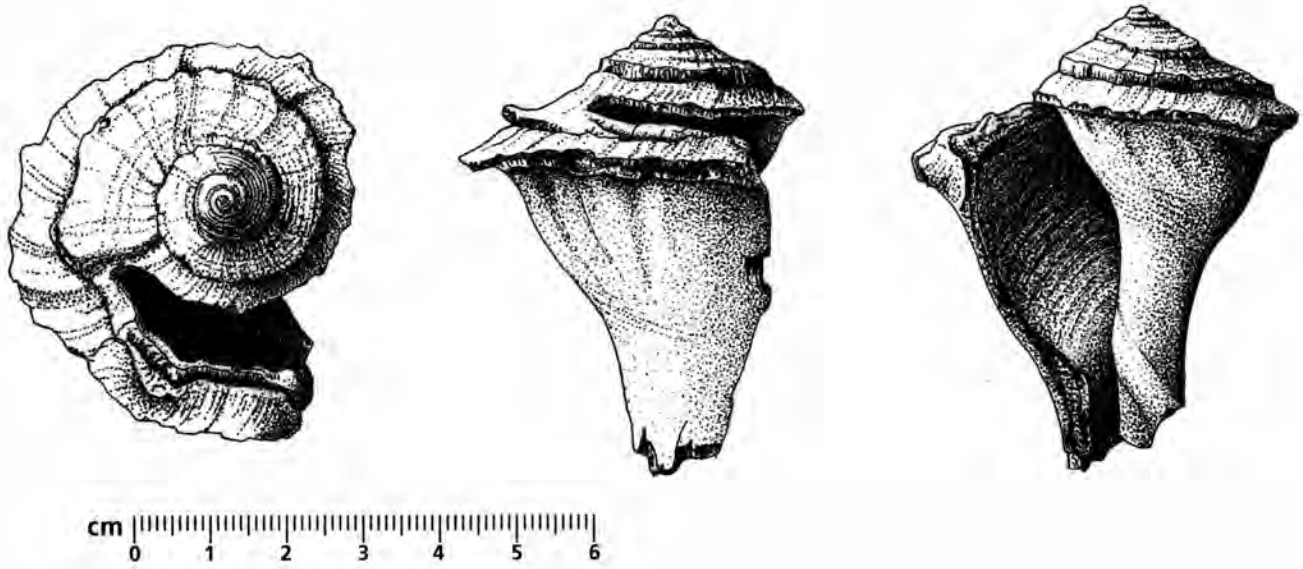
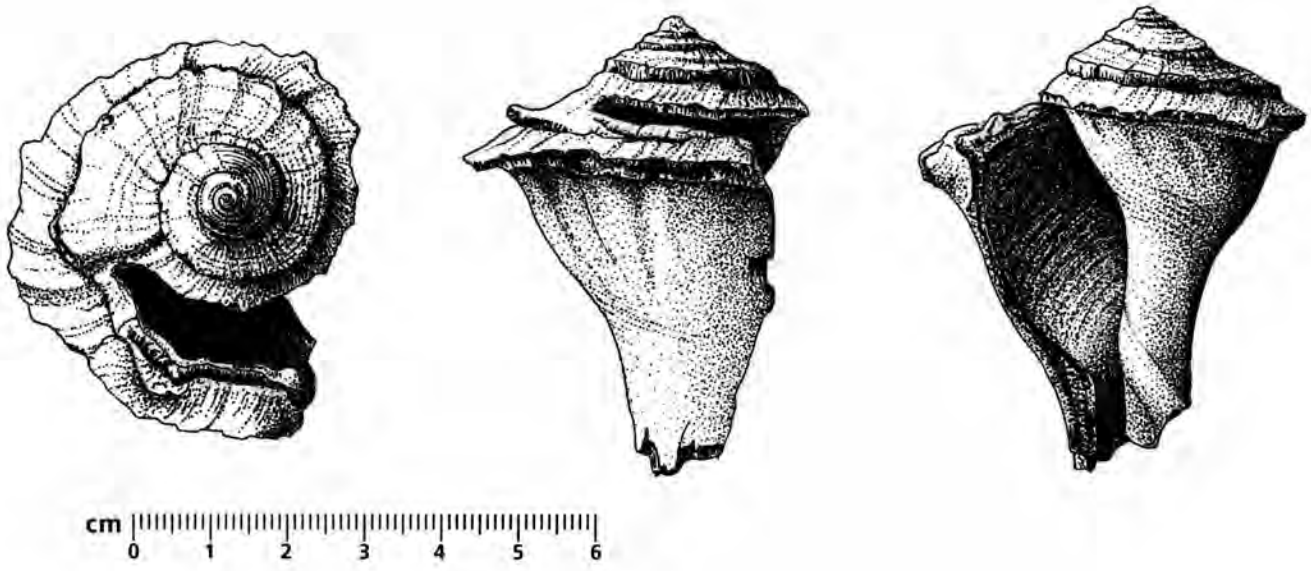
La Tierra



Volume 37
No. 1 & 2
2010

Journal of the
Southern Texas
Archaeological
Association

La Tierra



Volume 37
No. 1 & 2
2010

Journal of the
Southern Texas
Archaeological
Association

The Southern Texas Archaeological Association

The Southern Texas Archaeological Association brings together persons interested in the prehistory of south-central and southern Texas. The organization has several major objectives: To further communication among avocational and professional archaeologists working in the region; To develop a coordinated program of site survey and site documentation; To preserve the archaeological record of the region through a concerted effort to reach all persons interested in the prehistory of the region; To initiate problem-oriented research activities which will help us to better understand the prehistoric inhabitants of this area; To conduct emergency surveys or salvage archaeology where it is necessary because of imminent site destruction; To publish a journal (*La Tierra*), newsletters, and special publications to meet the needs of the membership; and to assist those desiring to learn proper archaeological field and laboratory techniques for southern Texas.

STAA Officers and Staff 2010

Chair—Jennifer Rice
Vice Chair—vacant
Treasurer—Cathy McCool
Secretary—Margaret Greco

Editor
La Tierra—Thomas R. Hester
Newsletter—Clint McKenzie
Special Publications—Thomas R. Hester
Immediate Past Chair—Clint McKenzie

Committee Chairs

Awards—Kay Hindes
Documentation—Joe Beavin
Budget—Cathy McCool
E-Mail—Cathy McCool
Field school scholarship—Karen Fulghum
Internet—James Rodriguez
Mail Out—Steve Smith
Membership—Cathy McCool
Nominations—Candy Smith
Photography—Curt Harrell
Programs—Jennifer Rice
Publicity—Wilson McKinney
Registration—Emmett Foulds
Coastal Coordinator—Tom Atkinson

Information for Contributors

The editor of *La Tierra* is Thomas R. Hester. Original manuscripts should be sent to Hester either by mail (P.O. Box 625, Utopia, TX 78884) or if possible, by email to *secocreek@swtexas.net*. Authors with questions about their manuscripts or illustrations should contact the editor. New authors are particularly urged to seek assistance in developing and submitting their papers. *La Tierra* welcomes papers on the archaeology of South Texas and surrounding areas, but we will also consider relevant manuscripts dealing with the archaeology of other parts of Texas.

Membership Information

Information on joining the STAA can be obtained by writing to the STAA at PO Box 791032, San Antonio, Texas 78279.

Back issues of *La Tierra* and Special Publications should be ordered on line at *http://www.staa.org*

About the cover: Three views of a lightning whelk (*B. perversum*), drawn by Richard McReynolds.

ISSN No. 0163-0695

Printed in 2011 in the United States of America by Ginny's Printing in Austin, Texas

Corrections for the STAA Officers and Staff 2010

STAA Officers and Staff 2010

Chair – Cathy McCool
Vice Chair – Wilson McKinney
Treasurer – Cathy McCool
Secretary – Candy Smith

Editor La Tierra – Thomas R. Hester
Newsletter – Bruce Moses
Special Publications – Thomas R. Hester
Immediate Past Chair – Jennifer Rice

Committee Chairs

Awards – Kay Hindes
Documentation – David Calame
Budget – Cathy McCool
E- Mail – Matthew Harwood
Field School Scholarship – Karen Fulghum
Website – Miosotis Moses
Mail Out – Lee Gummelt
Membership – Roy Banning
Nominations – Candy Smith
Photography – Curt Harrell
Public Outreach – Rick Pulis
Publicity – Wilson McKinney
Registration – Emmett Foulds
Coastal Coordinator – Tom Atkinson

Contents

Shell Artifacts from the Rio Grande Delta of Tamaulipas, Mexico and Texas

Don Kumpe and Mike Krzywonski

ABSTRACT

This paper examines the use of shells by Indians on the coast of the Rio Grande Delta in Tamaulipas, Mexico and Texas. Although the same types of shell artifacts were apparently manufactured on both sides of the Rio Grande during the time span of concern to this paper, approximately A.D. 1100-1700, a greater number were manufactured on the Tamaulipas side of the river. The greater productivity on the Mexican side appears to be explained by the fact that 39 out of 47 miles of the coastline of the Rio Grande Delta are in Tamaulipas. Without the barrier of the Texas or Tamaulipas Laguna Madre, Indian groups, particularly in Tamaulipas, established sites near shallow inland lagunas, or other brackish water features within a few miles of the seashore, where they had unequaled subsistence opportunities and quick access to beaches and dunes. Dunes and beaches on the coast of the Rio Grande Delta offered Indians a variety of resources, including apparently reliable sources of potable water, the majority of their shell-working tools, and seasonal opportunities to gather the immense quantities of shells required to support a shell ornament industry. Resources available to strategically located sites within a few miles of the seashore may have enabled a sizable population and semi-sedentary existence. Shell ornaments and tools from the coast of the Rio Grande Delta, including artifacts that have not been identified in previous research, are illustrated and described. Shell collecting depots are reported, experiments in shell technology are described, and subsistence opportunities on the coast of the Rio Grande Delta are examined.

INTRODUCTION

The initial report on the artifacts of the Rio Grande Delta was published by A. E. Anderson (1932), who believed there was "only one culture complex." Anderson's papers and extensive collection of artifacts are housed at TARL (the Texas Archeological Research Lab) in Austin and remain the primary sources of information on the artifacts of the region. Subsequent researchers like Sayles (1935), who defined a "Brownsville Phase" for the Rio Grande Delta, often drew upon Anderson's materials for information. MacNeish (1947; 1958) examined artifacts in 82 of Anderson's sites, including 52 sites that contained foreign trade materials (although chert was apparently excluded as a foreign material), and defined the Brownsville and Barril Complexes which persist to the present. He placed the cultures in the approximate time span of A.D. 1100-1700. Prewitt (1974:61) found little difference in the archeology on both sides of the river and viewed the greater frequency of columella projectile points in sites south of the Rio Grande to be MacNeish's (1958) basis for separating sites in Tamaulipas and Texas into two complexes (see Figure 25). The authors of this paper have also found few columella projectile points in Cameron County (2) and report an area between the Rio Grande and Arroyo Cajas Pintas in Tamaulipas where columella points are equally scarce (Kumpe n.d. a:315). Prewitt (1974:60) describes the great number of shell ornaments manufactured on the coast of the Rio Grande Delta as a shell ornament industry. He also remarks that ornaments are generally single finds within a site and occur in large groups only when associated with burials. However, caches of ornaments (columella tubular beads, *Noetia* beads, and round pendants) have been found in Cameron County (see below).

Many of the shell ornaments manufactured on the coast of the Rio Grande Delta were apparently exchanged for exotic materials and pottery from Mesoamerican cultures (Ekholm 1944; Hester 1994). Some

shell ornaments and/or unmodified marine shells appear to have been exchanged for cherts from nearby sources along the lower Rio Grande and San Fernando River. The black chert that dominates the Anderson Collection (Hughes 1947:38) may come from the Burgos-Mendez area near the San Fernando River, where Utberg's (1969: Part 1, 6-9) photo illustrations of lithic artifacts show that black cherts are dominant.

MacNeish (1958:185, 189-190) remarks that Cameron points in the Delta region are confined to the Brownsville Complex, but the authors have found that Cameron, Fresno, and Starr are the common arrow points on the coast, from Cameron County in Texas to the north end of the Tamaulipas Laguna Madre (see Figure 2). He also remarks on the diagnostic lithic tools: tiny pin-like drills and tiny circular unifaces (see Chandler and Kumpe 1993). How far inland the coastal groups may have ranged is a matter of conjecture, although John R. Boland and the senior author have found that Cameron and Fresno points are common through western Hidalgo County and 2 or 3 miles into parts of eastern Starr County, which is about 90 miles from the coast. Starr points, however, are common along the length of the lower Rio Grande, from the Gulf coast to the northern portion of Falcon Reservoir (Kumpe et al. 2000:39).

This paper includes information from the Tamaulipas side of the Rio Grande Delta and reports species of shells, like the calico clam and Von Salis' triton, that seldom range north of the southerly, more tropical area of the Delta (see Table 1). Observations made over decades indicate that shallow wells dug on the landward side of dunes were (and still are) reliable sources of potable water. Two shells, the southern quahog (*Mercenaria campechiensis)* and the giant eastern murex *(Murex fulvescens),* were apparently important shell-working tools, as was highly compacted sandstone with offshore origins. Shell collecting depots on the peripheries of sites near beach access locations in Tamaulipas are reported. The importance of easy beach access is discussed and experiments in shell technology are described. The shell tools and ornaments from the coast of the Rio Grande Delta are illustrated and described. The mollusks that may have been consumed are discussed and subsistence opportunities on the coast of the Rio Grande Delta are examined. Marine shell artifacts from inland areas along the lower Rio Grande are also illustrated and described.

The complexity and size of the Anderson Collection has apparently overwhelmed researchers for decades; analysis of the artifacts would require considerable time and preparation and no full examination of the collection exists (Wagner 2005:27). Consequently, the authors' collections from the coast of the Rio Grande Delta and information provided by others on the Anderson Collection, largely Anderson (1932), MacNeish (1958), and Salinas (1981), provide the data base for this paper. The term "whelk" refers only to the lightning whelk *(Busycon perversum)* as the authors have no artifacts that can be identified as pear whelk.

South Texas county map showing counties referred to in text. Mier is in Tamaulipas, Mexico.

THE COASTLINE OF THE RIO GRANDE DELTA: BEACH ACCESS, COLD FRONTS, FREEZE KILLS, DROUGHTS, AND HURRICANES

The Rio Grande Delta begins about 14 miles upstream from Reynosa, which is about 85 miles above the mouth of the river, and fans out to separate the Laguna Madre of southern Texas from the Laguna Madre of northern Tamaulipas (Salinas 1990:11). The climate of the Delta is described as subtropical and semiarid. Tropical storms and hurricanes occur mainly during the month of September, but yearly rainfall is such that yearly lake evaporation in Cameron County exceeds precipitation by 32-36 inches, the higher value being near the coast (Orton 1977:87-88).

There are 277 miles of coastline from the north end of the Texas Laguna Madre at Corpus Christi Bay to the south end of the Tamaulipas Laguna Madre at Soto la Marina; between the lagunas are 47 miles

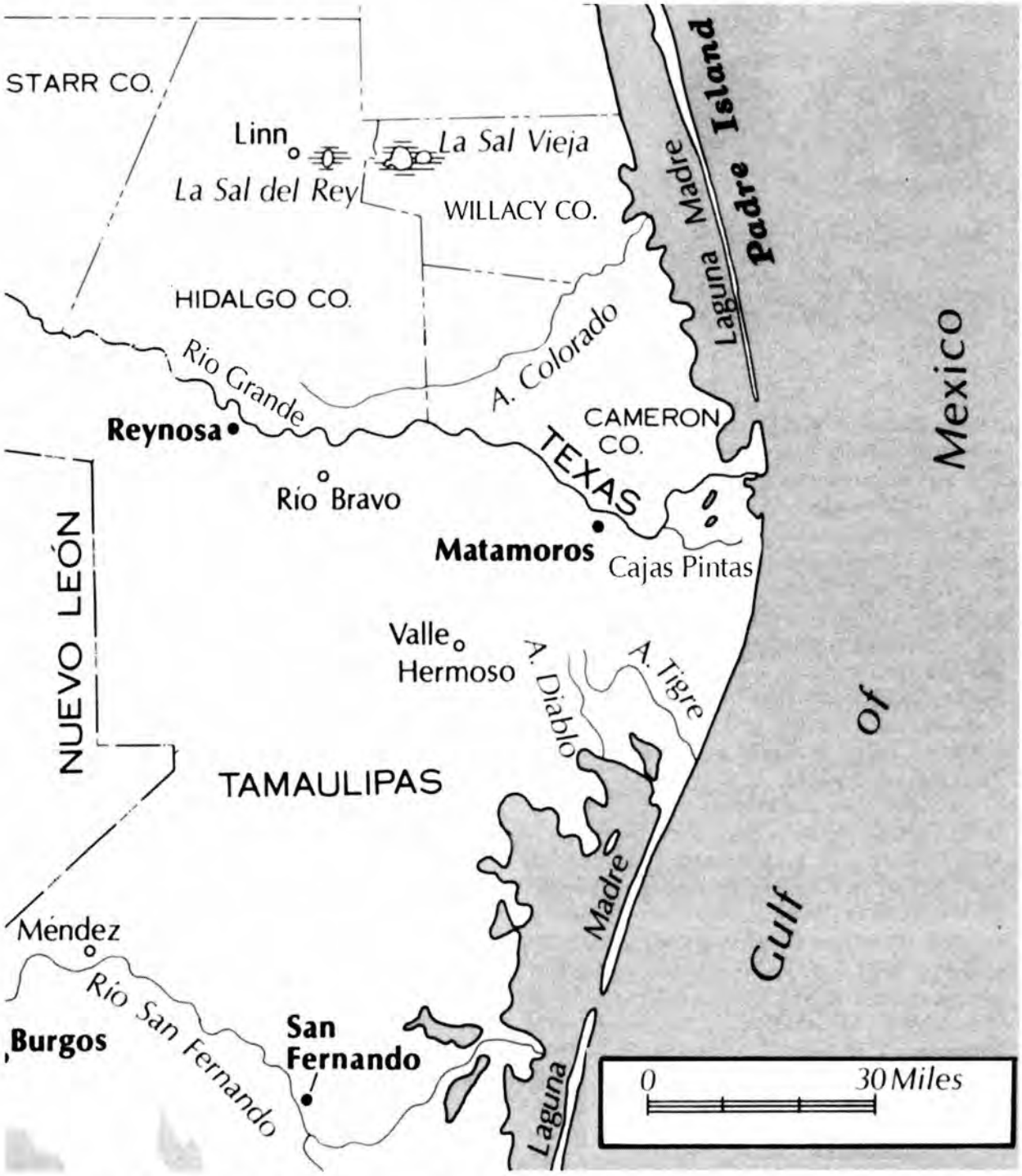


Figure 1. Map of the southern tip of Texas and coastal northeastern Tamaulipas, Mexico. The coast of the Rio Grande Delta is between the Texas and Tamaulipas Laguna Madre (adapted from Salinas 1990:10, Map 3).

of Rio Grande Delta, 7.5 miles of Delta coastline in Texas and 39 miles in Tamaulipas (Tunnell and Judd 2002:7, 15). Along the 277 miles of coastline only the coast of the Rio Grande Delta offered Indian groups the opportunity to walk to and from the beach because the barrier islands that extend 115 miles to the north and south of the Rio Grande Delta could not be reached without crossing the Texas or Tamaulipas Laguna Madre (see Figure 1). Easy access to dunes and beaches provided Indian groups with

Figure 2. The typically diminutive lithics found on the coast of the Rio Grande Delta in Cameron County and Tamaulipas: a, circular uniface scraper; b, pin drill; c, Cameron; d, Fresno; e, Starr.

reliable sources of potable water and the majority of their shell-working tools, including shells that were used as shell-working tools. Following cold fronts, storms, or hurricanes, there were opportunities to gather immense quantities of shells and other useful materials like driftwood and asphaltum. The ability to walk to the beach meant that entire groups of Indians could easily forage the shore, shell pavements, berms, dunes, and hurricane washover channels for resources, and then carry immense quantities of materials into nearby sites. The majority of sites near the seashore were also shell-working sites and shell collecting depots are located on the peripheries of some sites in Tamaulipas (see below).

In Texas there was easy beach access between South Bay and the Rio Grande. In Tamaulipas two large inland lagunas, the Mar Negro (the Black Sea) and the Barril (the Barrel), are immediately behind the dunes for approximately the first 20 miles of coastline south of the Rio Grande (see Figure 2). The Barril and Mar Negro limited beach access, but east of La Bartolina the Mar Negro narrows briefly into a connective channel affording easy beach access. Farther south, the Arroyo la Mula, a series of connective channels and meanders between the Mar Negro and the Barril, offered easy beach access. South of the Laguna Barril there was largely unfettered beach access until the north end of the Tamaulipas Laguna Madre. Because they are located immediately behind the dunes, fish populations, water levels, and salinities in the Barril and Mar Negro are driven by hurricane washover channels and the torrential rains of hurricanes. The Barril and Mar Negro and their associated meander channels are cyclically productive fisheries and, although their meanders and connective channels are often reduced to puddles, the lagunas rarely go dry (senior author's personal observations). The density of sites and types of sites on the Mar Negro and Barril indicate that the two lagunas were important parts of the shell ornament industry, and three of only four known shell collection depots are in strategically located sites on the Mar Negro and Barril (see below).

Cold fronts create mass mortality of shells and massive numbers of dosinia pairs, for example, are washed ashore in the winter (Andrews 1977:23, 242). The giant Atlantic cockle is so common on Mexican beaches east of Matamoros after cold fronts that during the 1980s a shell dealer in Texas found it profitable to dispatch a truck and sizable crew to collect the thousands of cockle shells on Mexican beaches and return them to Laguna Heights for distribution to shell shops (senior author's personal observation). Cold fronts created windfall shell harvesting opportunities for Indians and the many cold shocked shells that washed in alive were an easy source of food. Severe cold fronts may cause freeze kills of fish in Texas and Tamaulipas, sometimes catastrophic in effect. Zachary Taylor reportedly fed 5,000 men on freeze-killed fish at Corpus Christi Bay during the winter of 1845-46, and there has been an average of one freeze kill along the Texas coast every 7 years (McKee 2008:27). Indians near the mouth of the Rio Grande dried and stored fish for later use (Salinas 1990:117), but McKee (2008:30-31) remarks that millions of fish may die in a catastrophic freeze-kill and it can take 2 or 3 years for catches in the Texas Laguna Madre to return to pre-freeze levels; turtles also suffer and 25 cold-stunned green sea turtles were found in South Bay after the January 1997 freeze. Fishing is believed to have been the main source of food for Indians on the coast of the Rio Grande Delta (Salinas 1990: 116; Kumpe et al. 1998:28), but catastrophic freeze kills probably caused long term shortages of fish.

Hurricanes or tropical storms strike the Texas coast about once every two years (McGowen et al. 1977). Sixty-two hurricanes affected the Tamaulipas Laguna Madre between 1900 and 1979 (Tunnell and Judd 2002 from Hildebrand 1980). Hurricanes that affect the Rio Grande Delta may fill every laguna, pond, meander channel, arroyo, resaca, distributary channel, and intermittent waterway to overflowing, effectively reconstituting the Delta wetlands. Hurricanes cut washover channels into the Mar Negro and Barril, replenishing their populations of fish, crabs, mollusks, and shrimp. Torrential rains associated with hurricanes also inundate the coastal flats that stretch tens of miles inland and take months to drain. The Arroyo del Tigre, a distributary channel that retains a remnant sabal palm forest south of Rancho San Jose, fills during torrential rains and cuts again through old avenues to the Gulf of Mexico, a connection that may take only a few weeks to close, but not before fish, mollusks, and crustaceans repopulate its brackish lower reaches. The Rio Grande, even marginalized by dams, has been seen to run deep during torrential rains and overflow east of Brownsville, where hundreds of easily caught *longistina,* an immense freshwater prawn *(Macrobrachium acanthurus),* can be attracted to dead fish placed in the shallows (senior author's personal experience). The reconstituted wetlands attract immense numbers of waterfowl. Tunnell and Judd (2002:172, 177) remark that the Rio Grande Delta wetlands in Tamaulipas supports higher goose populations than any other area along the Tamaulipas coast, and the Laguna Madre of Texas and Tamaulipas comprise 77% of the redheads *(Aythya Americana)* wintering in coastal habitats of the Gulf of Mexico. Observations made in Tamaulipas suggest that local Indians may have taken large numbers of geese in traps (see below). As they do today on the coast of the Rio Grande Delta, catastrophic freeze-kills and droughts brought cyclical lows in fish populations. Hurricanes jump-started the ecology of the coastal delta by restocking lagunas and distributary channels and reconstituting wetlands.

SUBSISTENCE ON THE DELTA

The Rio Grande Delta, a rich biotic zone, was probably the most densely populated area of northeastern Mexico; however, woody vegetation that added to the food potential for Indian populations was largely replaced by saline grasses near the coast (Salinas 1990:11-12, 139). Never-the-less, the coast of the Rio Grande Delta apparently supported an unusually large population with the leisure time to undertake a shell ornament industry. The Rio Grande Delta extends about 85 miles above the mouth of the Rio Grande (Ibid.), but habitation sites dominated by shell artifacts and debris are rarely found farther than 35 miles from the coast (authors' personal observations). This may have been the usual or frequent range of the coastal people and appears to more or less coincide with the boundary between the woody vegetation of the inland Delta and the saline grasses and flats punctuated by vegetated lomas (clay dunes) in the coastal zone.

Some foods were apparently available throughout the Delta. Salinas (1990:115-119) remarks that fishing was probably the main source of food for Indians of the Rio Grande Delta area; peccary (javelina), deer, rabbits, rats, and mice were probably hunted by all Indian groups on the Delta. He also remarks that birds were hunted and river clams (freshwater mussels) were probably collected for food; prickly pear was the most commonly mentioned food in documentary sources (the fruit and pads were consumed) and mesquite beans and maguey root crowns were also consumed. Peyote *(Lyphophora williamsii)* is found in Hidalgo, Starr, and Zapata counties; it was eaten by Indians, but for its hallucinogenic effects and not for any food value (Weniger 1991:137-139). Peyote is also found south of Matamoros, in the hills known as Lomerio Pamoranes (Mike Krzywonski, personal communication 2010). The clustered fruit of the Rio Grande palm *(Sabal texana)* was probably used for food (Salinas 1990:118), but perhaps only during the best of years. During a visit to the National Audubon Society's Sabal Palm Grove Sanctuary east of Brownsville, Jimmy Paz (personal communication 1996) remarked that the palms had not produced dates (known locally as *micharos*) in five years due to a lack of consistent rain. Individual sabal palms can be found in Tamaulipas along the banks of Arroyo Cajas Pintas and Arroyo del Tigre, some growing in water, and a remnant sabal palm forest is on the east bank of Arroyo del Tigre south of Rancho San Jose (senior author's personal observations). The cattail *(Typha latifolia)* rings many of the brackish water ponds in the coastal zone, even within sight of dunes, and is common throughout inland areas of the Delta as well (authors' personal observations). Indians probably consumed this plant. The senior author once served the edible cattail roots like celery and they were readily consumed. The rhizomes can be pounded to remove the starch, the pollen is also

an excellent source of starch, and the female portion of the cattail can be boiled and eaten like corn on the cob (Anonymous 2009).

Twentieth century foraging activities on the Delta give insights into the foods that may have been consumed during prehistoric times. Louise Flippen (missionary, personal communication 1997) remarks that many of the rural people southwest of Matamoros near Urbano de la Rosa and Valle Hermoso supplement their food supply with "hunting and gathering" activities; the men hunt rabbits and opossums or net crawdads and fish in the many canals in the area, harvesting freshwater mussels when water in the canals is low. She also remarked that foraging appears to make up a significant part of the people's total food intake and provides recreational activities for the men. More than 20 individuals were seen filling gunny sacks with Tampico pearlymussels near Urbano de la Rosa (Bill Foerster, personal communication 1997). Yucca blossoms are commonly consumed today. Locals in Cameron County often hop fence to snap off the flowery stalks of *Yucca treculeana* (senior author's personal observations) and the stalks are sometimes offered for sale on roadsides in areas of rural Tamaulipas (Mike Krzywonski, personal communication 2010). During the late 1920s and early 1930s, Mexican laborers in Hidalgo County roasted green ebony bean pods and ate the beans; laborers near McCook trapped large numbers of quail in dense thickets of cactus and caught and consumed the wood rat *(Neotoma micropus)* (Kumpe and Krzywonski 2008:68). There is apparently no record that snakes were consumed on the Delta, but the western diamondback rattlesnake *(Crotalus atrox)* is common and was probably consumed. Driving Hwy 4 east of Brownsville after Hurricane Allen turned up a large number of rattlers above a flooded stretch of road; the snakes tended to stand their ground when approached and would have made easy meals for Indians (senior author's personal experience). Arroyo Cajas Pintas (Painted Boxes), near the coast in Tamaulipas, may have been named for the brightly colored carapace of the red eared slider *(Trachemys scripta elegans)*, which, along with other species of freshwater turtles and their eggs, were probably consumed by Indians. The list of foods that were probably consumed by all Indians living on the Delta is lengthy, although thought to be incomplete. There are at least 61 species of mammals, 36 species of snakes, and 19 lizards in the area (Blair 1950:103).

Indians with access to the Gulf coast had even greater food resources than those confined to inland areas of the Delta: salt water fishes, sea turtles, crabs, shrimp, a greater variety of mollusks, and a larger number of migrating water fowl. Migrating waterfowl were easily exploited on the coast. Buddy Ude (local bush pilot, personal communication 1995) remarked that landowners southeast of Matamoros in the vicinity of *"Embajo del Tigre"* (where the Arroyo Tigre reconnects with the Gulf of Mexico during hurricanes) use a goose trap described as a narrowing trench dug in the earth into which a quantity of bait is thrown. Feeding geese, usually lesser snow geese *(Anser caerulescens)*, work their way to the end of the trench, where it is too narrow to open their wings and fly or turn around, then are killed with a club. He also mentioned that ranchers in this area will eat and give away a lot of geese without firing a shot. This is probably an Indian method to take geese that has been usurped by landowners.

Rookery islands must have also been a rich source of food for coastal Indians; squabs and eggs would have been consumed. There are natural islands in Lower Laguna Madre that could have harbored rookeries and as many as 23 species of birds have been documented on a rookery island; there are also nearly 200 natural islands in the Laguna Madre de Tamaulipas (Tunnell and Judd 2002:186-188, 279) and there are natural islands in the Laguna Mar Negro and Laguna Barril (authors' personal observations).

Shrimp harvesting is not mentioned in early Spanish accounts, but the method for taking shrimp today in Tamaulipas could have been practiced in prehistoric times. Tunnell and Judd (2002:249-250) describe *charangas*, V-shaped shrimp traps that terminate in a mesh-enclosed rectangular *yagual* or *matadero*; they are set in channels, passes, or near shore and set to shrimp on an ebbing current, usually at night, but the many charangas contribute to closing of passes in the Laguna Madre de Tamaulipas and the small mesh sizes take even the smallest shrimp and fish. Indians on the lower Rio San Fernando are known to have made fine mesh nets that caught the smallest fish (Salinas 1990:117). Charangas in the Mar Negro and Barril include make-shift wood stands used for dip-netting shrimp at night with a lantern. The homemade long-handled dip nets are usually made from drift wood and a plant known as "*tarei*," which is used to form the large, light weight hoops; the small mesh takes even the smallest shrimp, but they are, never-the-less, salted, dried, and consumed (senior author's personal observations). The salt used is sea salt gathered from the floors of usually dry lagunas. The fishing villages on the north end of the Tamaulipas Laguna Madre, La Capilla, Las Higuerillas, and El Mezquital, are

reached by way of the "Old Salt Mine Road," where commercial salt mining continues to the present.

Relatively few mollusks were consumed on the coast of the Rio Grande Delta (see below), but in Cameron County and Tamaulipas there is evidence that oysters were occasionally on the menu (see below). Oyster harvesting in the Mar Negro is continued by an oysterman living in La Bartolina, his home marked by piles of shucked oyster shells. His harvesting method is to simply supervise 6 or 7 boys who drag rustic wooden sleds through shallows in the Mar Negro while filling gunny sacks on the sleds with oysters. The same oysterman was later seen peddling glass jars of (imported) oysters at the back doors of restaurants in Brownsville (senior author's personal observations).

The many cold-shocked sea turtles seen in South Bay were mentioned earlier, burnt crab claws are often seen in sites in Cameron County and Tamaulipas, otoliths are found in virtually every site on the coast (see Figure 6), and stingray spines were noted in a burnt lens in a site near Loma Tio Guerrero (senior author's personal observations). Coastal groups apparently had a wide variety of plentiful and easily gathered foods.

THE RESOURCES FROM BEACHES AND DUNES

Asphaltum is often found as hardened chunks in prehistoric sites along the coastline of the Rio Grande Delta, but it can be softened by heating. Indians apparently gathered asphaltum on beaches and used it for gluing, sealing, and probably for waterproofing. Weise and White (1980:49) remark that the probable natural source of asphaltic material found on the beach is offshore oil seeps. Salinas (1990:64-66, 73) remarks on Ladron de Guevara's 1738 description of the Tanaquiapemes use of tar (asphaltum) on the lower Rio San Fernando to attach stone or glass points to the foreshafts of their arrows; the Tanaquiapemes were also associated with the coastal zone of the Rio Grande Delta, where they survived into the early 1800s working as cowboys and shepherds south of modern Matamoros. Krzywonski (2004) reports the use of asphaltum to seal a shark's eye *(Polinices duplicates)* shell container that was found near La Bartolina, Tamaulipas (see Figure 10); it contained fragments of an incised bone artifact. Cut long bones "plugged" with asphaltum were in a burial at the Floyd Morris site (41CF2) in Cameron County (Collins et al. 1969:138) and asphaltum was placed in the incised designs of a rectangular bone pendant from the Ayala site (41HG1) in Hidalgo County (Hester and Ruecking 1969). Indians along the entire coast of Texas apparently used asphaltum. Sandy-paste ceramics of the Rockport Focus, for example, were often decorated and/or coated with asphaltum (Ricklis 2004b:155, 174, Figure 5.22).

Chert does not occur naturally on the coast of the Rio Grande Delta or on South Padre Island, but an occasional source of chert for Indians may have been the stone artifacts from earlier Archaic and Paleo periods that are found today and presumably during Late Prehistoric times on the beaches of South Padre Island in Cameron and Willacy counties (see Figure 3). These often heavily beach-rolled artifacts may wash in from drowned prehistoric sites and were once found on any stretch of beach south of the Mansfield Pass. Now, following efforts to replenish the beach, they are usually found north of the town of South Padre Island. Artifacts occur so randomly on the beach that many are found inadvertently by beach-combing tourists during the winter months, but many of their finds have been recorded, including waste flakes, an Archaic drill, Morhiss, Matamoros, Scottsbluff, and Golondrina (see Turner and Hester 1999). Although Paleo Indian and Archaic Period artifacts are common finds on South Padre Island, none have been reported from beaches between the Rio Grande and the north end of the Tamaulipas Laguna Madre.

Coquina, naturally cemented shells also known as beach rock, outcrops at Baffin Bay, indicating a Pleistocene Gulf beach environment similar to Little Shell and Big Shell today on Padre Island (Tunnell and Judd 2002:34, 80). Coquina pieces are on many spoil mounds in the Texas Laguna Madre (Weise and White 1980:64) and there is loosely cemented coquina on spoil mounds beside the Brownsville Ship Channel (senior author's personal observations). Mike Krzywonski (personal communication 2009) has recovered fist-size pieces of strongly cemented coquina from three sites of the Brownsville and Barril Complexes; his experiments with a mesquite limb and strongly cemented coquina indicate that this material could have served as effective rasps to remove bark and shape wood. He suggests that storms may bring in strongly cemented coquina from offshore outcrops and notes that some pieces of Gulf sandstone (see below) have coquina-like shell inclusions. Frank W. Judd (personal communication 2009) remarks that strongly cemented coquina is only rarely seen on the Rio Grande Delta, but he describes it as "formidable material." Coquina reamers used to manufacture c-shaped

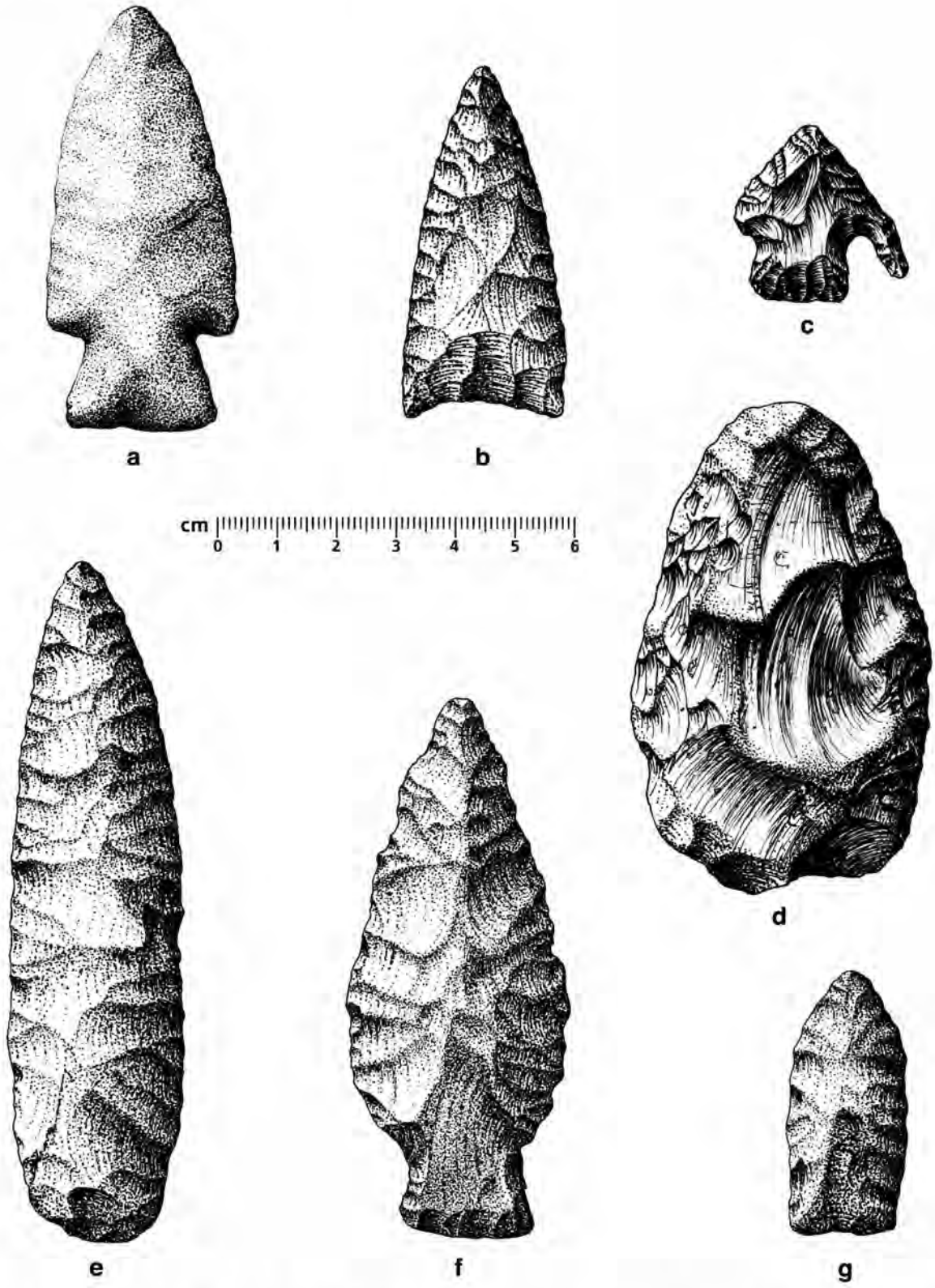


Figure 3. Artifacts found on the beach on South Padre Island, Cameron and Willacy counties (only b and f are from Willacy County): a-c and e-g were found below the high tide line; d, found while digging a fire pit in sand above the high tide line. Drawings by Richard McReynolds.

shell fishhooks on the southern coast of Ecuador are reported by Meggers et al. (1965:29, Figure 14; Plate 20). They describe the coquina as coarse, compacted water-worn shell particles cemented together.

Coral appears to have been a resource for Indians. Anderson (1932:30) mentions pieces of "rubbed" coral in sites on the Rio Grande Delta and Salinas (1981:29) remarks that coral is one of the grinding tools in the Anderson Collection. Neither author describes the coral, but it appears to have been used as a shell-working tool. Only two corals are familiar to the authors. Stony coral *(Astrangia astreiformis)*, which Andrews (1977:303) calls a "strange animal," is usually branched and pieces are found on South Padre Island, on Boca Chica, and on the beaches in Tamaulipas (senior author's personal experience). There is also a coral found in "chunks" on South Padre Island, but a coral chunk exhibited by the University of Texas-Pan American Coastal Studies Laboratory at Isla Blanca Park is identified only as a "coral head." Twenty fragments or chunks of similar coral heads from 15 prehistoric sites of the Brownsville and Barril Complexes are in the Krzywonski Collection; although none display grinding or rubbed marks, experiments indicate that they could have served as effective wood rasps (Mike Krzywonski, personal communication 2010). Coral heads apparently defy identification. From photos of a coral head found in a prehistoric site by Mike Krzywonski, John W. Tunnell, Jr. of TAMU-CC (personal correspondence to David W. Hicks at UT-Pan American, 2010) made the following remarks:

> "...it appears to be *Solenastrea*. There are two species that occur in the tropical West Atlantic, *S. bournoni* and *S. hyades*. The first is smaller in size and usually with bumps all over the surface, so I think yours is the latter. However, since it appears to be quite eroded (as a fossil), exact ID may be impossible. The closest present day live distribution is on the Campeche Bank reefs, and they both extend from there, south Florida, the Bahamas, Caribbean and West Indies. Since we have found large chunks of coral on the beaches of south Texas and northern Mexico for years, we assume that they drifted up here from coral reefs to the south off Veracruz. However, they could be real fossils from the South Texas banks from the late Pleistocene."

Driftwood was useful firewood and may have been used in many other ways. Immense trees from tropical areas far to the south and native trees carried to sea by the Rio Grande are flung ashore on local beaches during tropical storms and hurricanes (authors' personal observations). Some, including the native Montezuma bald cypress *(Taxodium mucronatum)* (Donohu 1980:23), could have been used to make dugouts. Salinas (1990:128) remarks that dugouts were numerous among Indians of the Rio Grande Delta during the early 1500s, when the Garay expeditions were there.

European materials were apparently collected from beaches or salvaged from shipwrecks by coastal Indians during the Early Historic Period. Salinas (1990:129-130) remarks on three citizens of Reynosa who were acquiring wax and iron from coastal Indians in 1772. Materials recovered in 1973 from the *San Esteban* (41KN10), one of 3 Spanish ships wrecked on Padre Island in 1554, included wrought iron anchors, cannon, tools, and even aboriginal artifacts, a polished iron pyrite mirror and obsidian blades (Arnold 1978:27). Anderson (1932:31) reports green bottle glass projectile points found in sites on the Rio Grande Delta. They were probably made from bottles found on nearby beaches. McReynolds (2008) illustrates 18 glass arrow points and tools from Indian sites on the Rio Grande Delta in Tamaulipas and Texas, nine from the Garcia Pasture site (41CF8) in Cameron County. Knapping traditions, particularly glass knapping, apparently survived into the 20th century among remnants of some Indian groups. Mallory (1994:46-47) remarks on chipped glass tools from the 1930s found at Caddo Adais homesites in Los Adais, Louisiana. He also mentions Pat Wray, of Kilgore, Texas, a Caddo Adais who recalls her grand-parents chipping glass.

Potable water from "sand wells" that were dug on the landward side of dunes was an important resource for coastal Indians and continues to be important for fishing villages at the north end of the Tamaulipas Laguna Madre. Andrews (1977:6) mentions "foul tasting" yet potable water that could be found by digging a shallow hole in the sand. She is referring to a layer or lens of freshwater from rainwater that filters through the sand and floats above a denser, heavier layer of saltwater seepage from the Gulf of Mexico. Weddle (1968:287-288) mentions that members of Parrilla's 1766 expedition to Isla de San Carlos de los Malaguitas (Padre Island) dug shallow wells in the sands, as the coastal Indians did, to obtain drinking water, but apparently it was not always common knowledge that freshwater could be found by digging a shallow hole in the sand. Early Anglo settlers were perplexed by the

fact that Karankawas always seemed to have ample water while they could find little (Newcomb 1961:60). A rock-lined sand well or *noria* known as Las Calabazas (The Gourds) supplies drinking water for three small fishing villages at the north end of the Tamaulipas Laguna Madre. Eutemio Chavez (elder citizen of La Capilla, personal communication 1989) remarked that Las Calabazas had long been in use before it was rock-lined in 1964. Apparently the water is continually replaced by rainfall and seepage. Las Calabazas, like all sand wells, is on the landward side of dunes and serves the villages of La Capilla, Las Higuerillas, and El Mezquital, which, from Mexican census figures supplied by Tunnell and Judd (2002:13), had a combined population of 1,121 in 1990. Supplemental wells closer to El Mezquital have reportedly been dug. Sand wells were also noted in use at Soledad del Mar and San Roman, which are coastal ranches between the Laguna Barril and the north end of the Tamaulipas Laguna Madre. Jesus Garcia, an elder of La Bartolina, constructed a wood-lined sand well for his cattle east of Loma Tio Guerrero during a drought in May, 1978. It was approximately 12 yards square to accommodate a number of animals. Daily hauling 55 gallon drums of water to his cattle during another drought in March, 1982, Jesus again despaired of rain and reconstructed his sand well (Kumpe n.d. a:77-78, 193, 202, 431). Garcia's well supplied large amounts of water during successive droughts and the sand well near La Capilla, Las Calabazas, has supplied hundreds with drinking water for decades. On the coast of the Rio Grande Delta, it appears that sand wells provided reliable, accessible, and probably permanent sources of potable water for Indians. Weddle (1968:288) remarks that there was no reliable drinking water on Padre Island, but the sand wells known to have been used by Indians on Padre Island may have been as reliable as the present day sand wells on the coast of the Rio Grande Delta in Tamaulipas, although perhaps not always as accessible. There are sizable prehistoric sites on the laguna side of North Padre Island (Ed Mokrey, personal communication 2010) that probably owe their existence to the reliability of sand wells. Campbell (1964:6) remarks that the sands of Padre Island constitute an excellent aquifer. He also points out that it is relatively easy to find fresh water on Padre Island by making shallow excavations in old swales or in recent deflation basins.

Pumice, a volcanic rock, floats in from Tuxla in southern Mexico and other sources around the world (Andrews 1977:308). Indians of the Rio Grande Delta used it for "rubbing" and to make pipes (Anderson 1932:29-30; Jackson 1940; MacNeish 1958:189). Experiments show that wet pumice can also be used to put a polish on shell ornaments (Salinas 1981:29) and some of the highly polished shell artifacts in the Anderson Collection are illustrated by Mercado-Allinger and Ricklis (1996:69, Figure 2.1.14). A pumice stone tool from the coast of the Rio Grande Delta in Tamaulipas is illustrated (see Figure 4) and Tom Hester (personal communication 2010) remarks that there are many of these in the Anderson Collection.

Sand was useful as an abrasive for drilling deep holes in tubular shell beads with a soft drill such as bone (Janota 1980:36; Salinas 1981:27-28). Shells and shell fragments are important components of the silicone dioxide (quartz) sand of South Padre Island, which also contains the dark-colored heavy mineral magnetite (iron oxide) (Weise and White 1980:16, 21; Andrews 1977:12). Don Hockaday (Director of the UT-PanAm Marine Lab on South Padre Island, personal communication 1996) found that the sand of South Padre Island also contains the dark-colored heavy mineral ilminite (iron titanium oxide). He remarks that it is magnetite and ilminite that streak beaches and dunes with blackish lines.

Sandstone that apparently washes in from offshore deposits during storms and hurricanes is referred to as "Gulf sandstone" in this paper. Anderson (1932:30), apparently referring to Gulf sandstone, mentions "sandstone abrading and rubbing stones." Salinas (1981:25-26, 29-29) remarks that materials in the Anderson Collection indicate that (Gulf) sandstone was used to cut whelk shell, perforate *Oliva* tinklers, and grind (smooth and shape) the edges of shell tools and ornaments. Experiments found that gritty Gulf sandstone fragments are also effective tools for controlled pressure flaking of dosinia valves (see below). On South Padre Island and along the coastline of the Rio Grande Delta, Gulf sandstone can be found in berms, where shells and materials are accumulated on the backbeach by larger than normal waves, and in shell pavements, where older shells and materials are exposed by deflation (Weise and White 1980:22-23, 40-41).

Gulf sandstone fragments are small, strongly cemented, rounded from beach-rolling, and unusually gritty. It is the most durable sandstone known to the authors. Ed Mokry (personal communication 2010) remarks that Gulf sandstone is not found on beaches or in prehistoric sites in the Corpus area, where the sandstones that are found are from inland sources. The location/s of offshore deposits of Gulf sandstone apparently conspire with currents in the Gulf of Mexico to bring this unique material ashore on beaches in

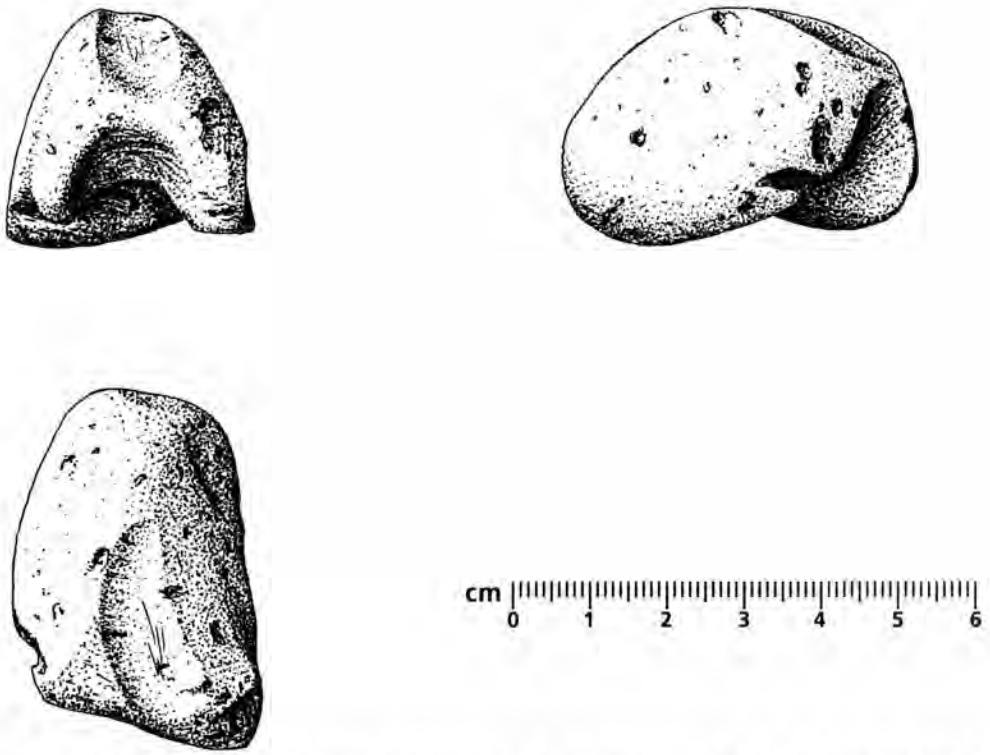


Figure 4. Three views of a deeply grooved pumice stone tool from a site on the coast of the Rio Grande Delta in Tamaulipas. Salinas (1981:29) found pumice unsuitable for grinding, but remarks that shell can be polished by rubbing with wet pumice stone.

Tamaulipas and the southern tip of Texas, but not farther north. A few weeks of heavy rainfall in early 1997 exposed a large fragment of beach-rolled Gulf sandstone (75.5 x 54.5 x 16 mm) among the bones of a burial in Cameron County (Kumpe n.d. a:723). Valued as a tool for working shell, the Gulf sandstone fragment was apparently included as burial goods.

Sea beans, seeds of tropical plants carried to sea by rivers, can be found in lines of beach drift and farther inland after the passage of hurricanes. They could apparently be traded to inland groups of Indians. Cabeza de Vaca traded "fruit like a bean" to inland groups who used it as a medicine and in dances (Newcomb 1961:70). Present day *curanderos*, curing specialists who apparently function in many ways as did Indian shamans, prescribe the *ojo de venado* or deer eye *(Mucuna sloanei)* as a preventive for the common (imagined) ailment known as *mal ojo*, the evil eye (Torres 2006:13-14). The deer eye, a commonly found sea bean on Gulf shores (senior author's personal experience), is sold in *hierberias (*or *yerberias)*, shops found in every town along the lower Rio Grande that sell medicinal herbs, mystical products, "religious" articles, and books to explain the use of such items. The senior author has friends who believe in and have used the "protective powers" of the deer eye, which may have been the most likely sea bean traded to inland groups of Indians. It may have been the most highly valued if more than one type of sea bean was being traded.

Shale stones or beach stones are described as "fire-marked" by Anderson (1932:29), who found them in sites on the coast of the Rio Grande Delta. The authors also find shale stones in sites, although rarely fire-marked. Like Gulf sandstone fragments (above), shale stones can be gathered in berms or shell pavements and are apparently from offshore deposits. Those found in sites have irregular shapes, are small (about the length and width of an open hand or smaller), usually flat and thin, have rounded edges and smooth surfaces from beach-rolling, and may be naturally perforated. Fragments of shale stones exhibit grey interiors and often resemble pot sherds. They are never numerous in sites and their use is uncertain, but Anderson's comment that he found them fire-marked suggests an association with hearths.

Shells were a vital resource for Indians on the coast of the Rio Grande Delta. They gathered most of their shells from the Gulf side (Prewitt 1974:60), used

Table 1. Species of Marine Shells Recovered in Sites on the Gulf Coast of the Rio Grande Delta in Texas and Tamaulipas, Mexico.

Architectonica nobilis (Common sundial)	*Murex fulvescens* (Giant eastern murex)
Busycon perversum (Lightning whelk)	*Neretina virginea* (Virgin nerite)
Busycon spiratum plagosum (Pear whelk)	*Noetia ponderosa* (Ponderous ark)
Callista maculata (Calico clam)	*Oliva sayana* (Lettered olive)
Callista nimbosa (Sunray venus)	*Phalium granulatum* (Scotch bonnet)
Cerethida pliculosa (Plicate horn shell)	*Pleuroploca gigantea* (Florida horse conch)
Codakia orbicularis (Tiger lucina)	*Polinices duplicates* (Shark's eye)
Crassostrea virginica (Eastern oyster)	*Polymesoda caroliniana* (Carolina marsh clam)
Cymatium pathenopeum (Von Salis' triton)	*Prunum apicina* (Common Atlantic marginella)
Cypraea cervus (Atlantic deer cowrie)	*Rangia cuneata* (Common rangia)
Dosinia discus (Disk dosinia)	*Spisula solidissima* (Atlantic surf clam)
Dosinia elegans (Elegant dosinia)	*Strombus alatus* (Fighting conch)
Fasciolaria lilum (Banded tulip)	*Tellina* sp.*
Laevicardium robustum (Giant Atlantic cockle)	*Terebra taurina* (Flame auger)
Mercenaria campechiensis (Southern quahog)	*Thai haemastoma floridana* (Florida rock shell)
Mercenaria campechiensis texana (Texas quahog)	

Based on Andrews 1977 (and Andrews 1971 for Von Salis' triton)

*An artifact on *Tellina* sp. was recovered by A. E. Anderson (Zavaleta 1991:Figure 21).

some unmodified shells for ornaments and tools, even for shell-working tools, and used other shells to manufacture ornaments and tools (see below). They probably consumed those that were found alive. At least 31 species of marine shells have been found in coastal sites on the Rio Grande Delta (see Table 1), but not all are typically found on Gulf beaches. The plicate horn shell *(Cerethida pliculosa)* lives on mud flats in bays, the common Atlantic marginella *(Prunum apicina)* is found in shallow inlet areas, the common rangia *(Rangia cuneata)* is a brackish water species, and the Texas quahog *(Mercenaria campechiensis texana)* lives in open bays and inlet influenced areas (Andrews 1977). The eastern oyster *(Crassostrea* virginica*)* is found in South Bay in Texas and in the Laguna Mar Negro in Tamaulipas (see below). The eastern oyster is also found in the Laguna Madre de Tamaulipas (Tunnell and Judd 2002:83-84).

Silicified bones of Pleistocene fauna wash ashore on the beaches of South Padre Island and Boca Chica, providing Indians with a rare source of stone. Bob Mallouf (personal communication 1979) identified a silicified, beach-rolled rectangular fragment of Pleistocene bison rib bone that was found in a prehistoric site on the edge of South Bay. A test flake had been removed from one end. The opposite end was crudely chipped and apparently used as a tool until it split lengthwise; both halves were found and restored. A silicified bone pendant (55 x 22.9 x 14 mm) found in a burial on the Cameron-Hidalgo Counties border by Jerry Hubbard (personal communication 1997) was examined by the senior author. It had a single biconical perforation at one end and appeared to be a fully beach-rolled fragment. Six *Oliva* beads and a triangular whelk shell pendant (111 x 91 x 3 mm) were also in the burial and these closely resemble Brownsville Complex artifacts from the Ayala site in Hidalgo County (see Hester and Ruecking 1969:Figures 2 and 4 or Hester 1980:74, Figure 4.10, A-C, G).

HURRICANE WASHOVER CHANNELS AND THE BEACH AS NATURAL PATHWAYS

Between the Rio Grande and the north end of the Tamaulipas Laguna Madre, prehistoric sites containing artifacts that are typical of the Brownsville-Barril Complexes are sometimes found in sand dunes beside hurricane washover channels. Prehistoric sites actually

follow in the path of a washover channel east of Loma Tio Guerrero (authors' personal observations). Indians apparently used some hurricane washover channels as convenient lanes through the dunes and sometimes spent time near these natural pathways.

The 39 mile length of beach from the Rio Grande to the north end of the Tamaulipas Laguna Madre is used today as a natural pathway by the often impoverished yet independent people who work in the fishing industry (see Figure 1). From the late 1970s to the early 1990s, the senior author collected shells in Tamaulipas and often saw people walking south on the beach after dark. These were usually individuals or small groups of 2 or 3 men, but families with children were also noted. Avoiding dangerous highways and transportation costs, pedestrian traffic on the beach was on firm sand below the high tide line, where rattlesnakes that hunt in the dunes after dark are not a concern and the cooling Gulf breeze keeps mosquitoes at bay. Moonlight lit the way. A rare day pedestrian who was questioned remarked that he dip-netted shrimp in the Laguna Madre de Tamaulipas and was walking to El Mezquital, a distance of about 19 miles, where he could catch a ride to the *chalan* (ferry) at Las Higuerillas and cross the pass (Kumpe n.d.a:201). Traveling by day indicated that he hoped to catch a ride at least part of his way, but south of the Laguna Barril the beach is often hazardous and wheeled traffic spotty at best. Salinas (1990:128) remarks that Indian groups of the Rio Grande Delta kept narrow paths cleared through forested areas and dense thickets, but the natural beach pathway along the 39 mile long Delta coastline in Tamaulipas may have seen more traffic than the cleared paths through chaparral. The Rio Grande Delta region between the Tamaulipas and Texas Laguna Madre forms a complex system of coastal plain uplands and wetlands, lomas, clay dunes, old Rio Grande distributary channels, resacas, playa lakes, wind-tidal flats, and small lagoons (Tunnell and Judd (2002:15). The natural beach pathway on the coast of the Rio Grande Delta in Tamaulipas offered Indians access into many of these environments and potable water could be found along the entire 39 mile long beach by digging a shallow hole in the sand on the landward side of dunes.

SHELL COLLECTING DEPOTS

Because two large inland lagunas, the Mar Negro and the Barril, are immediately behind the dunes for approximately the first 20 miles of coastline south of the Rio Grande, Indian activities on the northern part of the Delta coastline in Tamaulipas centered around narrow connective channels offering easy beach access. Indians apparently used beach access locations to gather resources, including immense quantities of useful shells, which were carried inland to sites within a few miles of the seashore and dumped on the peripheries of sites at locations the authors refer to as shell collecting depots. The majority of the immense quantities of shells that appear to have been in the depots are believed to have been collected after cold fronts, but large numbers of useful shells could have also been collected after storms or hurricanes. Empty shells of gastropods acquire sand and bits of pulverized shells as they pass through the surf zone and shell collecting depots are recognized by intrusive deposits of small shell debris and sand, apparently spilled from the shells of countless gastropods as they and other useful shells were repeatedly dumped at these favored locations. Three substantial shell collecting depots are strategically located west of easy beach access points, where the Mar Negro or Barril narrow into channels that are easily and quickly crossed. One sizable shell depot, approximately 30 by 35 yards in area, is east of La Bartolina at El Ebanito. It is within reach of hurricane storm surge, but far enough behind dunes and meanders to eliminate the introduction of shells during storm surge. Never-the-less, the senior author has seen the small shell debris and sand at El Ebanito spread by rainfall and storm surge so that it now includes a greater amount of shell reduction debris from adjacent shell-working areas. Mike Krzywonski (personal communication 2009) remarks on a still discrete shell collecting depot farther inland from El Ebanito, apparently beyond the reach of storm surge. A third shell depot was noted on Arroyo la Mula, a series of connective channels and meanders between the Barril and Mar Negro. A fourth shell depot was recorded northeast of La Capilla.

Usually a few small gastropods are the only intact shells remaining in the depots, but a large horse conch found to the side of the shell depot at El Ebanito was thoroughly riddled by marine organisms and did not appear to be useful. Comparing the types of shells used by coastal Indians with the frequency of species on Delta beaches after cold fronts, it appears that bivalves, the disk dosinia *(Dosinia discus)* and the giant Atlantic cockle *(Laevicardium robustum)*, may have been the most common shells in the depots. The lettered olive *(Oliva sayana)* was probably the most common gastropod. Shell collecting depots are found on the edges of sites within a few miles

of the seashore, where Anderson (1932:29) remarks that archeological material is most often found. Sites associated with shell collecting depots contain shell reduction debris, shell tools, finished shell ornaments, ornaments in various stages-of-production, and shell working tools like pin drills, Gulf sandstone, and quahog shell hammers. They are habitation sites, but also appear to be important shell-working sites. Immense quantities of shells were apparently dumped in the shell collecting depots, indicating that shell gathering after cold fronts, storms, or hurricanes may have been a group activity. If so, Indians may have considered the stored shells to be communal property.

THE LIGHTNING WHELK

The sinistrally spiraled lightning whelk (*Busycon perversum)* (see Dreiss 1995:541-542) was the most commonly used shell for ornaments and tools on the coast of the Rio Grande Delta, where it appears that thousands of pounds of whelk shell would have been required to sustain the shell ornament industry of the Brownsville-Barril Complexes. Andrews (1977:147) remarks that the lightning whelk has wavy brown streaks (see Figure 5), but large adults usually lose color. She also remarks that it opens bivalves by chipping the valve edges with its own shell. Luer (1986:131, Figure 5) illustrates chips made by a whelk in the margin of a quahog and damage that a whelk may inflict on its own shell by its chipping behavior. Indians apparently favored the more or less ivory-colored shells of large adults for ornaments.

The Texas Laguna Madre is historically hypersaline (Allison 1987), an inimical environment for the whelk which prefers a normal salinity environment and would only be expected to commonly occur in bays north of Laguna Madre (Hall 1981:215-217). Consequently, the Gulf side is the apparent source of raw material used in the manufacture of (whelk) shell ornaments (Prewitt 1974:60). The Lower Laguna Madre of today, however, has significantly reduced salinities because of the opening and deepening of Brazos Santiago Pass in 1938 and construction of Port Mansfield Channel in 1957 (Allison 1987). The greater volume of Gulf of Mexico water circulating between these passes probably accounts for the whelks that presently live in Lower Laguna Madre and these appear to be generally smaller than those that live offshore. Mike Krzywonski (personal communication 2009) has collected shells for decades, but his largest live-gathered lightning whelk from Lower Laguna Madre is only 10 inches in length. Andrews (1977:147) gives the size range of the lightning whelk as from 100 to 200 mm (a maximum length of about 8 inches), but larger shells, from 11 inches to at least 14 ¼" inches in length, are found on the coast of the Rio Grande Delta and on South Padre Island (senior author's personal experience). Large whelks wash in from the Gulf during storms or hurricanes and a few come ashore after cold fronts. The largest whelk found

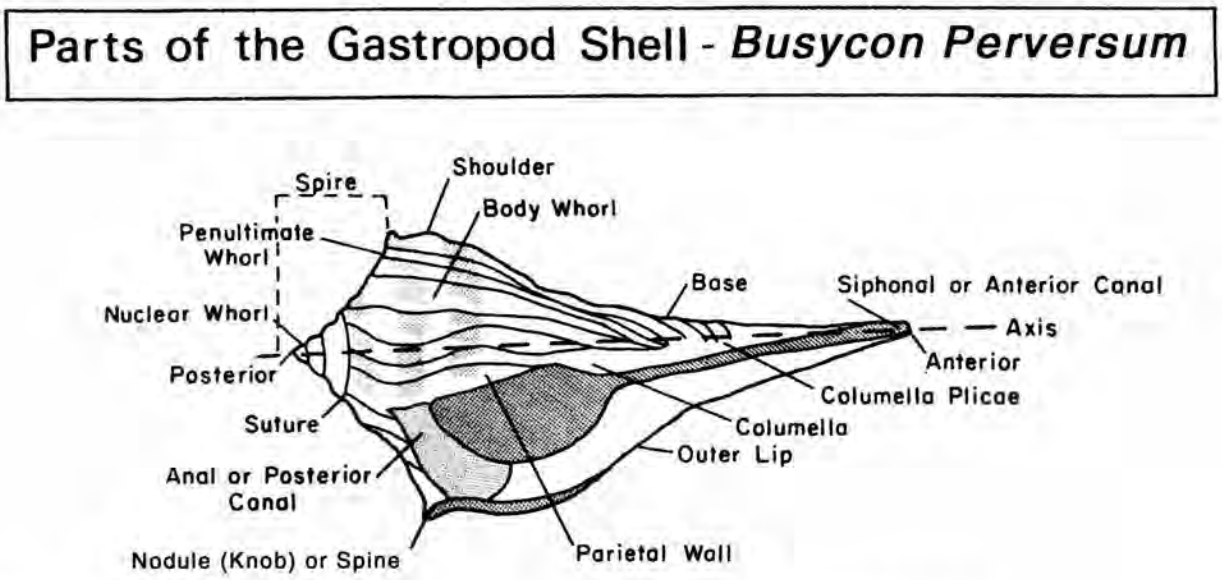


Figure 5. Parts of the lightning whelk (*Busycon perversum*). Adapted from Hall (1981: Fig. 44).

by the senior author (14 ¼") was collected during a storm in Tamaulipas at a well known shell bar east of the southern Mar Negro. Collectors on South Padre Island often find large specimens of *B. perversum* (11 inches and larger) by watching for buried shells while walking old hurricane washover channels from the dunes to the edge of the Laguna Madre (Kumpe n.d.a:503). Large intact whelk shells must have been prized by Indians, but the number of these found today on Delta and barrier island beaches seems too few to have supported their shell ornament industry. Although large intact whelks were undoubtedly more common during prehistoric times, the senior author often finds beach-rolled fragments of whelk shell in prehistoric sites, indicating that Indians resorted to collecting fragments of whelk shell to support their shell ornament industry. Storms push shells onto the backbeach and so whelk shell fragments can be found in berms and shell pavements. The senior author easily collected more than 100 pounds of sizable (useful) fragments of whelk shell from shell pavements in Tamaulipas and gave a quantity of it to Elton Prewitt, who was making replica shell jewelry. It appeared that many hundreds of pounds of useful whelk shell could have been gathered from the shell pavements in Tamaulipas. Indians appear to have acquired some of their whelk shell by collecting fragments of whelks from berms and shell pavements. They probably retrieved large intact whelks and fragments of whelks from hurricane washover channels.

THE CONSUMPTION OF MOLLUSKS

It appears that relatively few mollusks were consumed by Indians on the coast of the Rio Grande Delta and only two small shell middens are known to the authors. Kumpe et al. (1998:25-28, 32) report a rangia midden (41CF159) in Cameron County that was found and photographed by Mike Krzywonski. They also report common rangia shells in sites some 20 miles or more inland in Tamaulipas, where it appears that these brackish water mollusks were consistently consumed when available, but in small numbers. A second rangia midden, smaller in area than 41CF159 but more densely packed with shells, was recorded northwest of La Capilla, Tamaulipas (Kumpe n.d. a:426). Common rangia were also consumed during the Historic Period in areas southeast of Matamoros (Kumpe et al.1998:32-33).

The eastern oyster *(Crassostrea virginica)*, which prefers a salinity range between 10 and 30 ppt (Andrews 1977: Appendix E, 318), was apparently able to live in the hypersaline Lower Laguna Madre during prehistoric times because the Brownsville population of oysters is genetically distinct from other Texas, Gulf, and Atlantic coast oyster populations (Buroker 1983), able to spawn and grow quickly in salinities greater than 40 ppt (Breuer 1962). The oysters of South Bay in Lower Laguna Madre are harvested commercially and a new population that was discovered about a half mile south of Three Islands is harvested during the summer months (Kumpe et al.1998:25). Oysters are also harvested commercially in Laguna Madre de Tamaulipas and they may also be genetically distinct, but no research has been conducted on these populations (Tunnell and Judd 2002:83-84). Few seem to know of the smaller population of oysters near the mouth of the Rio Grande in the Laguna Mar Negro; they are also harvested, but on a small scale (see above). Prewitt (1974:60) reports a prehistoric site in Cameron County (41CF8) with an appreciable quantity of oyster. Mike Krzywonski (personal communication 2010) remarks on another site in Cameron County with an appreciable quantity of oyster, this site overlooking Lower Laguna Madre. There are three sites known to contain appreciable quantities of oyster in Tamaulipas, all three near the Laguna Mar Negro (authors' personal observations).

The most common bivalves in sites on the coast of the Rio Grande Delta, *Laevicardium robustum* and *Dosinia discus*, were used as tools, but are most commonly found on beaches after cold fronts, when cold shocked live shells wash ashore in Texas and Tamaulipas (senior author's personal observations). Live shells collected during winter may have been consumed at or near gathering locations or carried alive into sites and consumed before they were put to use, which would leave no evidence that they were consumed. Unmodified southern quahog valves found in sites are usually beach-rolled and were apparently used as hammers (see below). Fragments of the Texas quahog *(Mercenaria campechiensis texana)* were noted in a prehistoric site on Resaca los Pajaros at La Bartolina, Tamaulipas (Kumpe n.d.a:562), but this shell is rarely found in sites. The sunray and calico clam are rarely found unless edge-flaked or broken from use as tools. The Atlantic surf clam and tiger lucina were also edge-flaked for use as tools and are scarce. A few valves of the Carolina marsh clam have been noted in prehistoric sites south of La Bartolina, where it may have rarely been consumed (Mike Krzywonski, personal communication 1999).

Fifteen to 20 miles or more inland, shells of the Tampico pearlymussel *(Crytonaias tampicoensis)* are scattered through prehistoric sites along portions of Arroyo del Tigre in Tamaulipas, where it appears to have been consistently consumed in small quantities. At El Caracol, which is also on the Tigre, there are indications that freshwater mussels were consumed during the Historic Period, but that is a common occurrence. Freshwater mussels continue to be harvested and consumed in large numbers near Matamoros (see above).

Steele (1987:229) remarks that the Atlantic bay scallop *(Argopecten irradians amplicostatus)* was undoubtedly used (for food) along the entire (Texas) coastline; however, it is not found in sites in Cameron County or Tamaulipas (authors' personal observations). At least one bivalve appears to have been consumed in Tamaulipas during the Historic Period, but not earlier. Refuse piles of the cross-barred venus *(Chione cancellata)* were found on an occupied island at the north end of the Tamaulipas Laguna Madre. The *Chione* shells were among bottles and trash dating from the mid 20th Century and it was noted that valves from one of the refuse piles were eroding into an adjacent prehistoric site (Kumpe n.d.a:493). Comparatively few bivalves were used for food on the Delta and it appears that even fewer gastropods were consumed.

Large intact lightning whelks are rarely found in sites and there are none with kill holes in the authors' collections. MacNeish (1958:189) mentions "pierced whole conch shells" in the Anderson Collection, but are the piercings kill holes? Juvenile lightning whelks are more common, but no more than two or three are usually found in sites. The shark's eye *(Polinices duplicates)* is rarely modified and was noted in small concentrations, from 8 or 10 up to 25 medium to large shells, in two sites near the north end of the Tamaulipas Laguna Madre, each concentration interpreted as the remains of a single meal (Kumpe n.d. a:413, 428). The shark's eye often occurs as single finds in sites in Tamaulipas and these may have also been consumed. Andrews (1977:33, Figure 14F) illustrates the fully extended sizable white mantle of *P. duplicates*, which may have made it an attractive food item.

A few usually intact specimens of the following gastropods are consistently noted in coastal sites in Cameron County and/or Tamaulipas: pear whelk (*Busycon spiratum*), common sundial *(Architectonica nobilis)*, fighting conch *(Strombus alatus)*, banded tulip *(Fasciolaria lilium)*, Florida rock shell *(Thai haemastoma)*, lettered olive *(Oliva sayana)*, juvenile specimens of the Florida horse conch *(Pleuroploca gigantea)*, and Von Salis' triton *(Cymatium pathenopeum)*, the latter seen only in Tamaulipas. Sixty-one giant eastern murex *(Murex fulvescens)* were found in a singular site in Tamaulipas, but their spines were crushed and apparently used as punches (see below); there was no evidence that the murex had been consumed. The few large murex shells found in other sites in Tamaulipas also have crushed spines. The Atlantic deer cowrie *(Cypraea cervus)* inhabits offshore reefs (Andrews 1977:122). It is represented in sites in Tamaulipas by aperture edge fragments with riblets, but lives at such a distance offshore it is unlikely to have been found alive.

The lettered olive *(Oliva sayana)* is the most common of the gastropods found in sites, but nearly all of the shells have been naturally perforated by marine organisms and/or have damaged, beach-rolled apertures consistent with dead-gathered shells. Some seemingly pristine *Oliva* shells have small shell debris from the surf zone wedged into their apertures, which is also an indication that they were dead-gathered. None of the 28 *Oliva* beads from the burial at the Bruns site in Hidalgo County had been live-gathered (see Figure 33) and it appears that the lettered olive was usually dead-gathered and rarely if ever consumed. The other gastropods listed above may have been consumed when found alive, but in insignificant numbers.

To summarize, appreciable quantities of eastern oyster have been noted in two sites in Cameron County and three sites in Tamaulipas, two small rangia middens have been recorded, and there is some evidence that the shark's eye was consumed in small numbers. Farther inland, freshwater mussels and common rangia have been recorded in numerous sites, but usually in insignificant numbers. Indians on the coast of the Rio Grande Delta were apparently not in the habit of carrying useless shells into habitation sites, but shell collection depots (described above) indicate that they collected large numbers of useful shells, probably after cold fronts or storms when live shells wash ashore. Useful or not, those shells found alive may have been consumed at or near gathering locations. Some useful shells may have been carried alive into sites and consumed before the shells were put to use, which would leave no evidence that they were consumed. More mollusks may have been consumed than the surviving evidence indicates and coastal Indians may have more readily and consistently consumed small numbers of mollusks, common rangia, freshwater mussels, and probably *Rabdotus*, when foraging 15 to 20 or 30 miles inland, where they

were removed from the coast with its ready supply of fish. Fishing was probably the main source of food for Indians of the Rio Grande Delta (Salinas 1990:116) and relatively few mollusks were consumed. No major, dense shell middens have been reported for discrete Rockport phase components and it is possible that shellfish gathering was also a very minor subsistence activity on the central coast of Texas during the Rockport phase, ca. 1250/1300-1700 A.D. (Ricklis 2004a:174), which was contemporaneous with the Brownsville-Barril Complexes.

BASIC SHELL TECHNOLOGY OF THE BROWNSVILLE-BARRIL COMPLEXES

Salinas (1981:16-30) examined shell working tools, shell artifacts, and manufacturing debris in the Anderson Collection, used beach-gathered shells from Boca Chica with (Gulf) sandstone and pumice from the Delta for experiments, and employed microscopic examination to determine the basic shell technology of the Rio Grande Delta. He found that whelk whorl held on a small stone anvil was easily shaped by percussion. The edges of flake and biface tools used to cut shell acquired recognizable characteristics and left V-shaped cuts when used in a sawing motion to cut shell. A U-shaped groove formed when an abrasive (sand) was used with these tools. Water was helpful as a lubricant and to remove the powdered shell created while sawing. Microscopic examination found multi-directional "rolling" marks (from the rolling of sand grains under pressure) accompanied by deeper length-wise marks in the sides of cuts in shells that were made by flake or biface tools used with an abrasive. Salinas (Ibid.) remarks that sandstone used to cut shell left U-shaped grooves and water was useful while cutting, to remove the powdered shell that impregnates the sandstone. He found that local (Gulf) sandstone was used more often to cut shell than flake or biface tools that were made from imported cherts.

THE NATURAL PERCUSSION NOTCHES ON QUAHOGS

Without collecting shells, as did the Indians, it can be difficult to interpret natural features on shell artifacts. After examining edge-flaked shell tools in the Anderson Collection, Salinas (1981:19) remarked that edge-flaked southern quahog *(Mercenaria campechiensis)* valves with percussion notches near the umbo on their posterior and anterior margins had been hafted as adzes. Luer (1986:134-135, Figure 7) also believed that quahog valves with notched margins were modified, an idea perpetuated by Marquardt (1992) and Apple (2004: Table 2). However, Chandler and Kumpe (1998:20-21) found that percussion notches on the posterior and anterior margins of some edge-flaked quahog tools are a natural phenomenon, as are similar notches on the margins of many beach-gathered quahog valves. They found that a large number of quahog valves collected on South Padre Island have natural percussion notches on their anterior and posterior margins. There are in fact thousands of quahogs with natural notches on their anterior and posterior margins on South Padre Island, Boca Chica, and beaches in Tamaulipas. The notches are always in the same locations on the margins and often fit snugly over the exterior contours of other quahog valves. It appears then that waves are the likely percussion instruments and proximate quahog valves in the surf zone are the likely anvils producing natural percussion notches on the margins of many quahogs.

THE UNMODIFIED SHELLS USED AS TOOLS AND ORNAMENTS

Cockle Shell Tools. Fragments and occasionally intact valves of the giant Atlantic cockle *(Laevicardium robustum)* are in nearly every coastal site of the Rio Grande Delta (authors' personal experience). It is the largest cockle on the Texas coast, reaching 101 mm (Andrews 1977:219). A recovered cache (or perhaps a forgotten stack) of 4 nested cockle shell valves found in a Cameron County site south of Port Isabel (Kumpe n.d. a:891) appears to highlight how well suited cockle shells were to the needs of mobile hunter-gatherers, who when carrying four or five light-weight nested cockle shells had a complement of cups, bowls, ladles, scoops and containers. There is usually no evidence of use on the relatively few intact cockle shells found in sites on the Delta, but John R. Boland recovered an intact valve with a nearly two inch length of margin that was apparently flattened from use wear (Kumpe n.d.a:363). The coastal Indians made a great use of unmodified cockle shells, but appear to have had a surplus for trade (see below).

Dosinia Valves As Fish-Scaling Tools. The disk dosinia *(Dosinia discus)* lives near shore, reaches a size of 76mm, and valves found on beaches are often neatly punctured with a hole drilled by a predatory

gastropod (Andrews 1977:242). Modified and unmodified dosinia valves are common in prehistoric sites on the coast of the Rio Grande Delta in Tamaulipas. The modified valves were pressure flaked for scraping or cutting tools (see below and see Figure 27). The senior author had long presumed that the many unmodified valves in sites were still waiting to be pressure flaked, but it appears that they were used to scale fish. More than 30 unmodified dosinia valves were noted in each of two tiny prehistoric sites along an isolated meander of the Arroyo la Mula in Tamaulipas. The sites were apparently used exclusively for fishing and the only materials found in the sites were the dosinia valves and a variety of otoliths (see Figure 6). It appeared that the many unmodified dosinia might be explained if the fish had been scaled where they were caught, rather than in habitation sites. Consequently, an unmodified dosinia valve was taken to Fisherman's Wharf on South Padre Island for scaling experiments. After a returning fisherman flopped three huge redfish on a cleaning table and gave dubious permission for a scaling experiment, the dosina valve was used to scale the three large fish in less than 2 minutes. The margin of the shell was found to be unaltered by the task (Kumpe n. d. a:514). Modern saw-toothed metal scaling tools rasp and rip away fish scales, while the curved margin of a dosinia valve slides beneath scales and lifts them away cleanly. The valves of other bivalves might adequately scale fish, but are unlikely to outperform the thin valves of *Dosinia discus*, which is the only unmodified bivalve commonly found in coastal sites on the Delta that is suitable for the task. Large numbers of unmodified dosinia valves were found in two sites used exclusively for fishing and have been noted in many other sites on the coast of the Rio Grande Delta in Tamaulipas. They were apparently used to scale fish, including the heavily scaled red drum (*Scianops occelatus*). Lynn Highley (personal communication to Ed Mokry 1985) remarked that she experimentally used a *Callista nimbosa* valve to successfully scale speckled trout at Snoopy's Pier on North Padre Island.

Murex Spines As Punches. The giant eastern murex *(Murex fulvescens)* reaches 150 mm in size (Andrews 1977:150). Its shell is stout, formidably arrayed with a complement of sturdy spines, and as many as 22 of the spines may be sizable (see Figure 7d). A few large murex shells with crushed spines had been noted in sites in Tamaulipas, but they attracted little attention until a minimum of 61 large murex were found in an area of about 30 x 25 yards at a singular site north of La Capilla. More than 1,000 sizable spines of the 61 murex shells had been reduced to crushed knobs and many of the shells were missing sections of body whorl (see Figure 7a-c). The ground in the site was littered with fragments of murex and it appeared that the crushed spines had been used as tools. Experiments appeared to be in order. During a survey of common rangia on the Rio Grande Delta (Kumpe et al. 1998), Richard McReynolds recovered a whelk shell in a stage-of-reduction that might have been accomplished with hammer and punch (see Figure 8). An attempt was made to replicate McReynolds' artifact using a murex shell spine as a punch and indirect percussion seemed likely. While kneeling, the siphonal end of a whelk shell was placed on a wood anvil on the ground and the point of a murex spine was positioned on the aperture edge of the

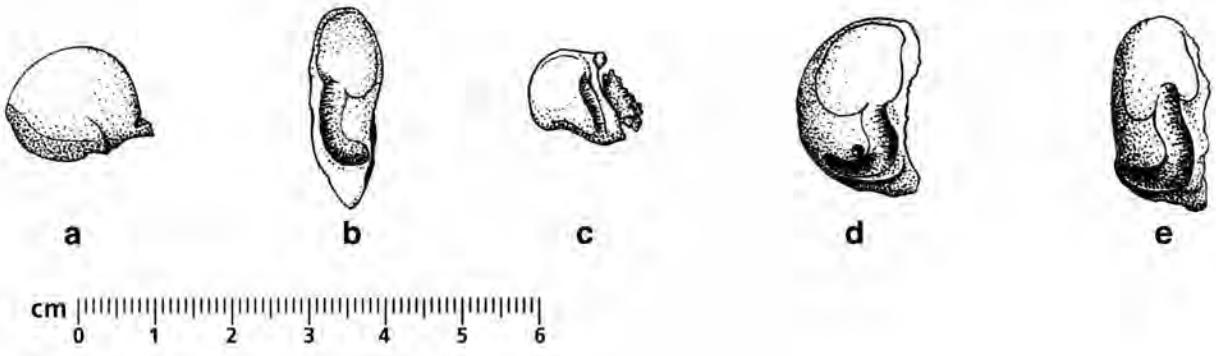


Figure 6. Otoliths, the calcareous ear bones of fishes: a, gafftop (*Bagre marinus*); b, spotted seatrout (*Cynoscion nebulosus*); c, Atlantic croaker (*Micropogonias undulates*); d, black drum (*Pogonias cromis*); e, red drum (*Scianops ocellatus*) (Zimmerman et al. 1988). Excepting those of the catfishes, older otoliths in prehistoric sites have gradually turned from white to dull gold. Otoliths were a shade of light yellow at the site of an early 20th century fishing lodge on El Realito Peninsula in Cameron County.

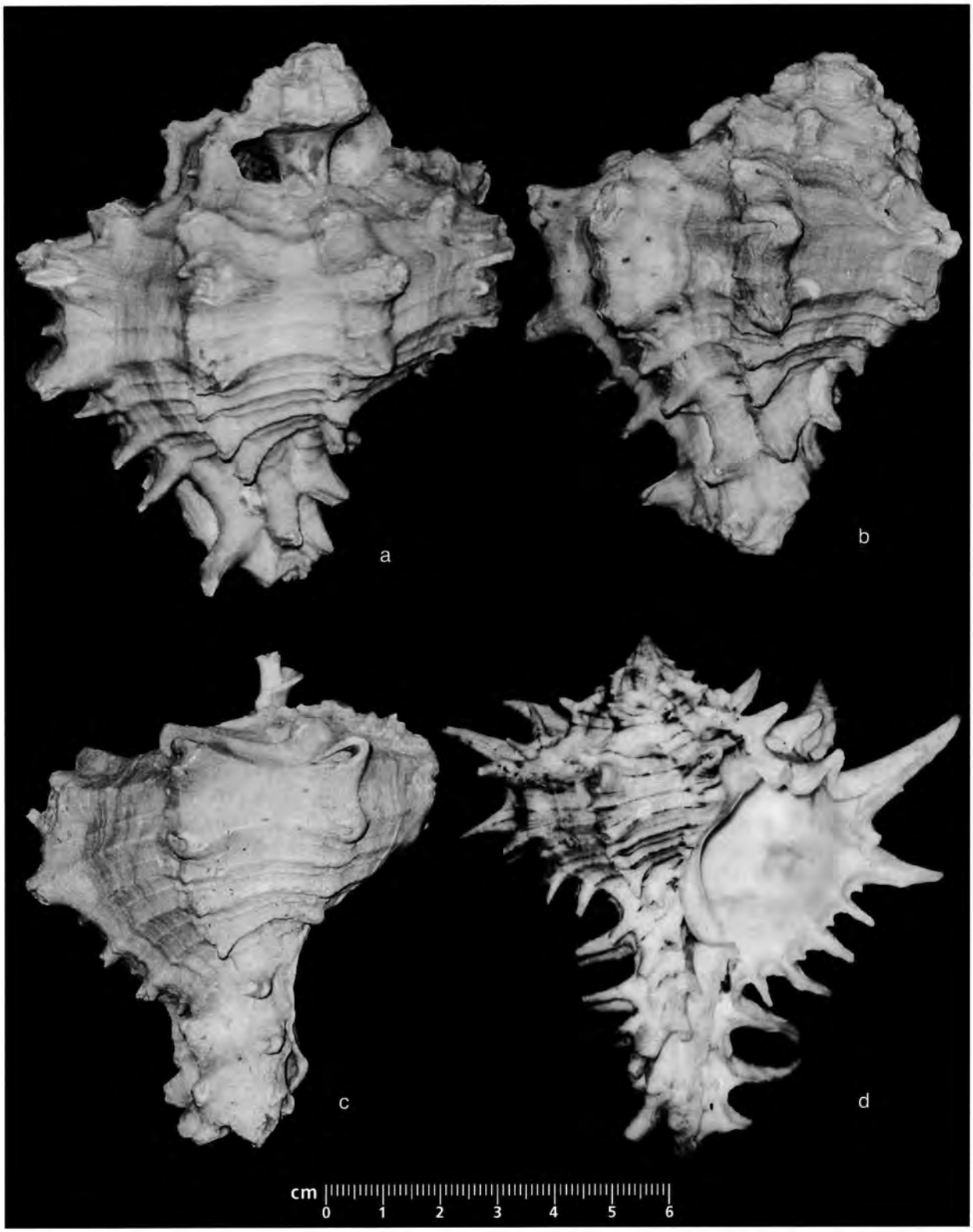


Figure 7. The giant eastern murex (*Murex fulvescens*): a-c, three of 61 murex shells with crushed spines in a singular site on the coast of the Rio Grande Delta, each crushed spine apparently used as a punch for shell reduction; d, a pristine murex shell for comparison. Experimental use of a murex spine punch produced a replica of the artifact in Figure 8. Photo by Mike Krzywonski.

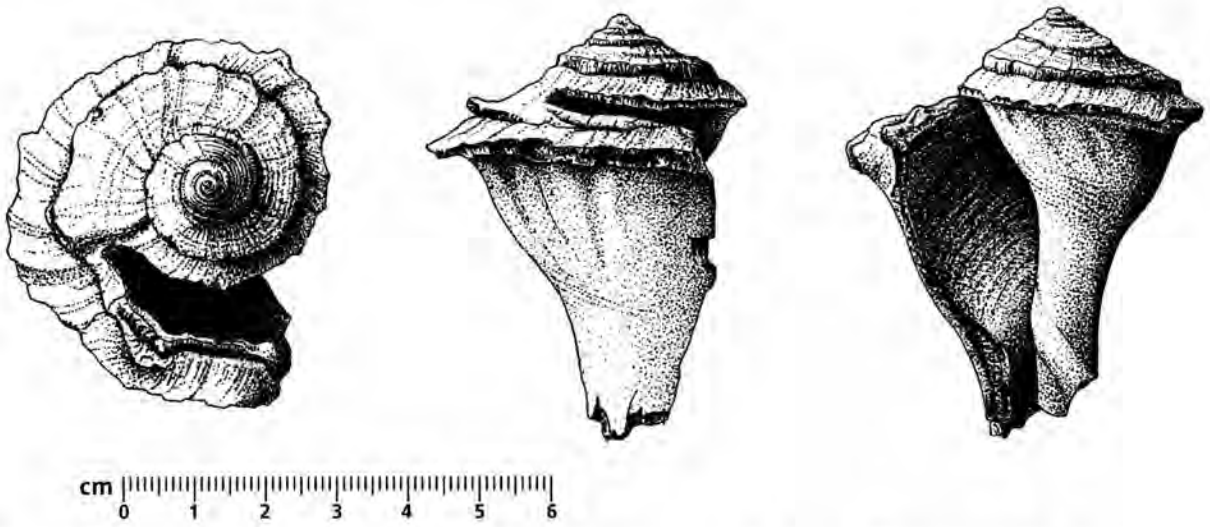


Figure 8. Three views of a lightning whelk (*B. perversum*) in a late stage-of-reduction. The body whorl has been removed and the craftsman is in the process of separating the inner whorl from the columella by chipping between sutures. Using indirect percussion, a replica of this artifact was quickly made using a murex shell spine as a punch (see Figure 7). Drawings by Richard McReynolds.

whelk's penultimate whorl. Using a quahog shell as a hammer, the murex shell was then forcefully struck as nearly opposite the positioned spine as possible. This chipped away a bit of the penultimate whorl and the process was repeated for nearly four minutes, when a replica of the artifact in Figure 8 had been produced. The spine used as a punch was reduced, but still appeared useful (Kumpe n.d.a:591). During the experiment, it was impossible to strike the murex shell opposite the positioned spine without striking spines, but the spines distributed impact. None of the murex whorl was broken by hammer blows, although a heavy, cudgel-like wood hammer may have been more forgiving in the long run and more effective than the quahog shell. The whelk shell was held upright by the same hand that positioned the murex shell and the spine that had been selected for use. This balancing act was tumbled by hammer blows and it would have been helpful for a second person to hold the whelk shell upright. Murex shells with crushed spines have been noted in other coastal sites, usually from one to three or four shells, and the sites also contain the diminutive lithics of the Late Prehistoric Period (see Figure 2). Murex shells with crushed spines are particularly common in sites on the coast of the Rio Grande Delta in Tamaulipas.

Noetia Ornaments. The ponderous ark *(Noetia ponderosa)* is a heavy bivalve that reaches 63.5 mm in size (Andrews 1977:192). It is a common beach shell on South Padre Island, on Boca Chica, and on the coast of the Rio Grande Delta in Tamaulipas. Beach-gathered *Noetia* are often perforated at the umbo by predatory gastropods and hundreds of naturally perforated juvenile *Noetia* can be gathered on South Padre Island in a matter of hours (senior author's personal experience). Opportunistic Indians used the naturally perforated juvenile and adult *Noetia* as ornaments, as beads or pendants, and naturally perforated *Noetia* are often found in sites on the Delta, sometimes in large numbers (authors' personal experience). A cache of juvenile *Noetia* was found in a Cameron County site south of Port Isabel (Kumpe n.d. a:581). Collins et al. (1969:133, 142) remark on *Noetia* ornaments in the Anderson Collection at TARL and report a large number of *Noetia* beads in burials at the Floyd Morris site in Cameron County, a few with remnants of a reddish pigment. Armando Vela (personal communication 2010) commonly recovers juvenile *Noetia* from sites near the salt lake, La Sal del Rey, in Hidalgo County. Newton (1963:10) and Mokry (1979) report *Noetia* ornaments from sites on Arroyo los Olmos in Starr County, Hester (1969a) notes *Noetia* beads from 41KL13 in Kenedy County, two *Noetia* beads were found at 41NU164 in Nueces County (Ed Mokry, personal communication 2010), and Ekholm (1944: Figure 52X) reports *Noetia* ornaments in use among the Huasteca.

Quahog Hammers. The southern quahog (*Mercenaria campechiensis)* is a very heavy shell reaching

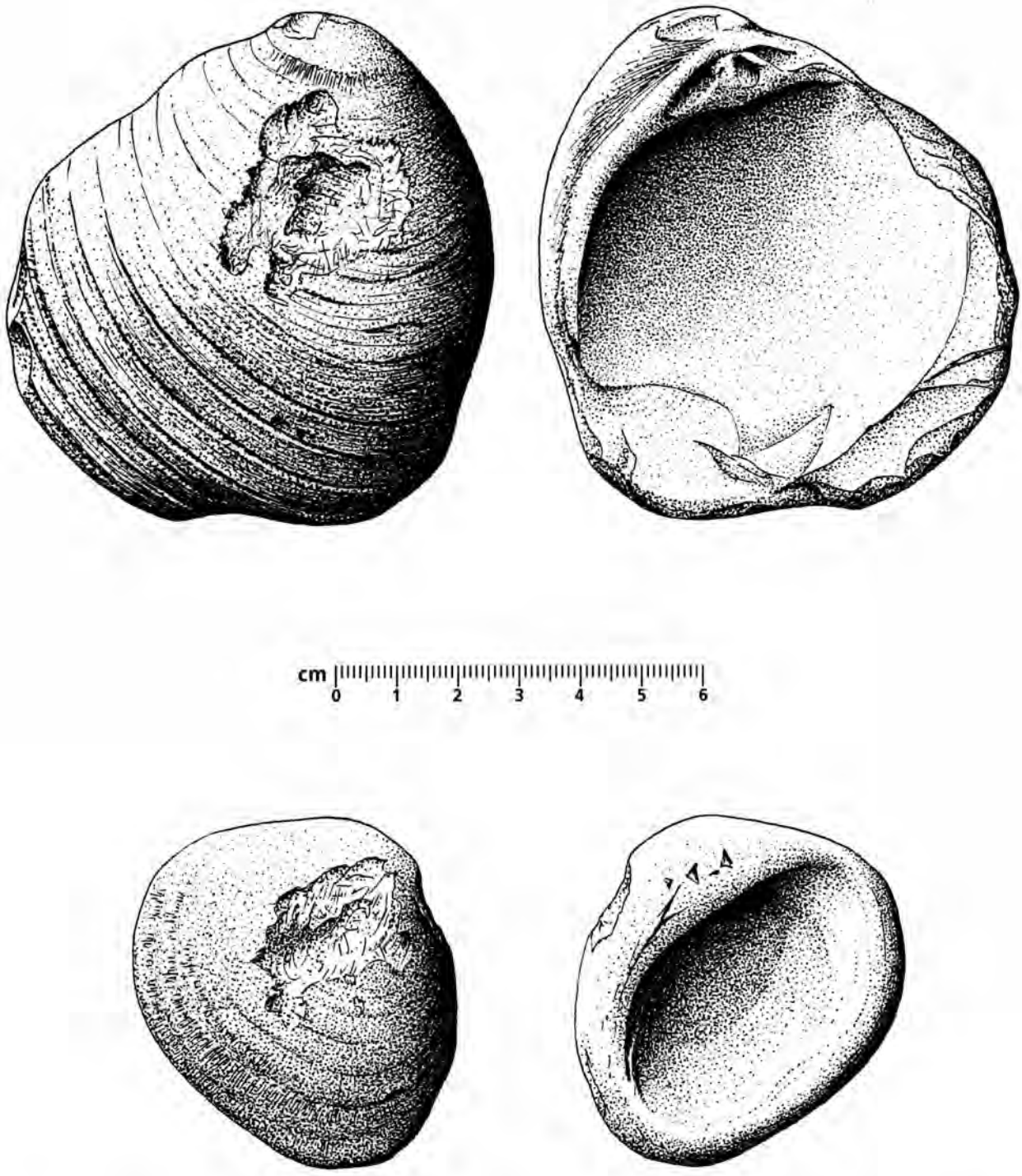


Figure 9. Quahog hammers with pitted exteriors from the Anderson Collection (from Chandler and Kumpe 1998:19, Fig. 3): Top, two views of a typically large quahog hammer; Bottom, two views of an unusually small quahog hammer with a second pitted area on the anterior side of the umbo. Indians used unmodified valves as hammers; altered (pitted) exteriors came from hammering (flattening) the sturdy spines of large whelks. Continued hammering punched flattened knobs through the whelk shells and the resulting thick shell discs were used to make thick beads (see Figure 42d-f).

152 mm in size (Andrews 1977:246). Reports of quahog hammers are rarely found in the literature, but at Big Mound Key, a shell mound complex comprising an artificial island in Florida, it was suggested that quahog "anvils" with a "pounded" area on an otherwise unworn dorsal surface might have been grasped with the whole hand and doubled as hand-held hammers (Luer 1986:143). Although only fragments of quahogs are found on the Gulf side of North Padre Island (Ed Mokry, personal communication 2010), there are thousands of intact quahog valves on South Padre Island and on beaches in Tamaulipas, where Indians used unmodified valves for hammers (see Figure 9). Quahog valves used to hammer and so flatten the spines (or knobs) of large whelks are altered by this heavy duty task and can be recognized as hammers by the distinctive pitted areas on their exteriors, the pitting found usually behind the umbos (Chandler and Kumpe 1998). Continued hammering punched flattened knobs through the whelk shell and the thick shell discs were used to make thick beads. Sides of thick discs extracted by hammering may have a distinctive raggedy look (see Figure 42d-e) and nearly all of the knobs of an otherwise intact large whelk can be punched through the whelk shell by hammering (senior author's personal experience).

Knobs included on the ends of some long rectangular ornaments may have also been initially flattened by hammering to save time (see Figure 43b). Quahog valves used for the heavy duty task of flattening knobs and manufacturing plain discs from knobs can be recognized as hammers, but the apparently larger number of quahog valves used for light hammering tasks cannot be identified because their exteriors are often impervious to use wear. A beach-gathered quahog valve was used as a hammer to remove the spires of 45 *Oliva* shells and the contact area of the quahog was without evidence of use wear under microscopic examination (180X) (Chandler and Kumpe 1998:20). The quahog hammers in the authors' collections have pitted exteriors and were found in sites in Tamaulipas within a few miles of the seashore. The same sites contain larger numbers of unaltered quahog valves that are believed to have been used for light hammering tasks. There are a few small hammerstones in the Anderson Collection (Salinas 1981:24) and only three whelk shell hammers in the Krzywonski Collection, but there are a large number of quahog hammers in the authors' collections and there are others in the Anderson Collection at TARL (see Figure 9). Although their use was largely restricted to sites within a few miles of the seashore, the use of quahog hammers freed hard to obtain stone for the manufacture of vital tools like pin drills and arrow points. Only altered (pitted) quahog valves have been collected, but they are, nevertheless, the most common hammers in the authors' collections from the coast of the Rio Grande Delta, where they were apparently used primarily as shell working tools. Quahog hammers appear to have been in use during the Late Prehistoric Period and they are particularly common in sites within a few miles of the seashore in Tamaulipas.

Shark's Eye Containers. Andrews (1971:99-100) remarks that the shark's eye *(Polinices duplicates)* is a predatory snail that drills a neat, round hole in the shells of its prey. She gives the diameter of the shark's eye to about 63 mm, but larger specimens are commonly found on beaches and in prehistoric sites on the coast of the Rio Grande Delta. Krzywonski (2004) reports a large unmodified shark's eye (72 mm in diameter) that was used as a container and sealed with an asphaltum plug that extended approximately 33 mm into the interior of the shell (see Figure 10).

Figure 10. A shark's eye (*Polinices duplicates*) container photographed on a mirror with its asphaltum plug in place. A fragment of curated bone protrudes from the asphaltum (from Krzywonski 2004:73, Fig. 1).

After the asphaltum plug was removed, the shell was found to contain fragments of 2 bone artifacts, one fragment decorated by 10 edge notches and 2 parallel rows of punctuates.

THE TRADE IN UNMODIFIED SHELLS

Dreiss (1995:543) remarks that there is scant evidence to suggest that shell tools or ornaments were manufactured away from the coast at inland sites in Texas. At inland sites (west of Hidalgo County) along the lower Rio Grande, there appears to be evidence for the manufacture of shell ornaments (see below), but no evidence for the manufacture of shell tools.

Giant Atlantic Cockle. Cockle shell fragments are often found in inland sites (west of Hidalgo County) along the lower Rio Grande (Newton 1963; Kumpe n.d. a). They are believed to represent intact cockle shell valves acquired by trade and used as cups, bowls, ladles, scoops, and containers by inland groups of Indians. Once the cockle shell valves were broken, the fragments were sometimes shaped and perforated for use as ornaments (see Figure 54a-b).

Lightning Whelk. Boyd (1998:44) mentions a complete, unaltered conch/whelk shell found at 41ZP8 in Zapata County at Falcon Reservoir. He remarks on other whelk shell fragments found in sites on the reservoir, from which sections were apparently removed for bead manufacture. This paper reports the remnant of a small *B. perversum* that was found at Falcon Reservoir in Zapata County. Its body whorl is missing and there are three cuts in the shell that appear to be abandoned efforts to remove the last small sections of inner whorl (see Figure 54f). Some unmodified whelk shells apparently reached Indian groups living well inland on the lower Rio Grande and some were used to make ornaments.

Noetia ponderosa. Naturally perforated *Noetia* from inland sites on the lower Rio Grande in Starr County have been reported by Newton (1963:10) and by Mokry (1979).

Oliva sayana. There is reason to believe that some *Oliva* tinklers were manufactured by inland groups. On the coast of the Delta, the overwhelming majority of perforations in tinklers are transverse, made by cutting with flake and biface tools or by grinding with Gulf sandstone. Transverse partial perforations were sometimes made with the same tools and completed by drilling, but conical perforations made by drilling straight through are exceedingly rare on the coast. However, perforations in tinklers from inland sites along the lower Rio Grande are more often conical, perforated by drilling straight through. This suggests that some *Oliva* tinklers were made by inland groups, perhaps from unmodified *Oliva* shells or from *Oliva* beads acquired in trade (see Boyd et al. 1997:39 and Figure 53c in this paper).

Quahog Fragments. Beach-rolled fragments of the southern quahog *(Mercenaria campechiensis)* are consistently found in prehistoric sites on the coast of the Rio Grande Delta (Kumpe 1996). More than 200 specimens from sites in Cameron County and Tamaulipas are in the authors' collections. They have been broken and shaped by natural processes in the surf zone and a few have been naturally perforated by marine organisms (see Figure 11). Indians could have gathered these from the surf zone, from berms, or from shell pavements, but the fragments were apparently selected for aesthetics, for symmetrical shapes and fully rounded edges. Modified beach-rolled fragments of quahogs have not been found in coastal sites, but two that were modified for use as pendants were found in sites as far as 130 miles inland from South Padre Island (see Figure 53f-g) and three unmodified fragments (like those in Figure 11) were noted in sites near the Rio Alamo in Tamaulipas (Kumpe n.d. a:102). Making maximum use of available resources, opportunistic Indians on the coast of the Rio Grande Delta apparently gathered beach-rolled quahog fragments and traded them to inland groups as blanks for pendants. There is no evidence that coastal Indians used the shell fragments in any other way.

THE MODIFIED SHELL TOOLS

Adzes

Rectangular to Roughly Square Adzes. Adzes made from the body whorl of the lightning whelk *(B. perversum)* are found in sites on the Delta. Mokry (1980) identified 2 types of adzes from sites along Oso Creek in Nueces County. His Type I is rectangular to roughly square in shape and ground at an angle on the inner side of the shell to produce a steeply beveled bit or cutting edge on the harder exterior side of the shell. Grinding is at a right angle to the long axis and toward the anterior end of the original shell. Lateral edges may be well ground or virtually unmodified, and the posterior end retains knobs. These tools have a concave (c-shaped) cross section. A rectangular adze from Nueces County is illustrated (Figure 12a) for comparison with a rectangular adze from the Rio Grande Delta (Figure 13a). Apparently scarce in Tamaulipas, most of the rectangular adzes

Figure 11. Beach-rolled southern quahog fragments from sites on the coast of the Rio Grande Delta. They were apparently gathered by coastal Indians and traded to inland groups as blanks for pendants (see Figure 53f-g); perforations in the shell fragments (above) are natural, made by marine organisms. Photo by Mike Krzywonski.

found on the Rio Grande Delta are from Cameron County. At Morhiss (41VT1) in Victoria County there were 3 Type I adzes with traces of asphaltum on their proximal ends and wear traces suggesting that they were hafted at an oblique angle to the long axis of the handle (Dockall and Dockall 1996:217).

Triangular Adzes. Mokry's (1980) Type II adze is triangular in shape and, like the rectangular adze, it is ground at an angle on the inner side of the shell to produce a steeply beveled bit or cutting edge on the harder exterior side of the shell. Grinding is at a right angle to the long axis of the original shell, but toward the posterior or spiral end of the shell. Lateral edges may be well ground or unmodified. Triangular adzes include a portion of the siphonal end of the whorl and so have a sinuous (s-shaped) cross section. Two triangular adzes from Nueces County are illustrated (Figure 12b-c) for comparison with a triangular adze from the Rio Grande Delta (Figure 13b). Most of the triangular adzes found on the Rio Grande Delta are from Cameron County. They appear to be scarce in Tamaulipas. Type I and Type II adzes in the authors' collections from the Rio Grande Delta are often severely weathered and chalky. On other parts of the Texas coast they are known to be Late Archaic, although continuing into the Late Prehistoric (Ricklis 1996:103).

Large Adzes. Salinas (1981:18, Figure 1) illustrates a "large" adze in the Anderson Collection (see Figure 14), remarking that it was made by removing a large section of the body whorl and the siphonal end of a large whelk by cutting or grinding below the knobs and by percussion. A "c-shaped" bit or cutting edge was ground at a right angle to the long axis of the shell and then one of the sides was ground in a similar way. This adze was apparently made on a shell comparable in size to the shell drawn in Figure 15, but the small drawings and brief description leave questions. It includes the siphonal end and has two c-shaped bits. Another large adze from Cameron County is in the senior author's collection; it is 231 mm in length

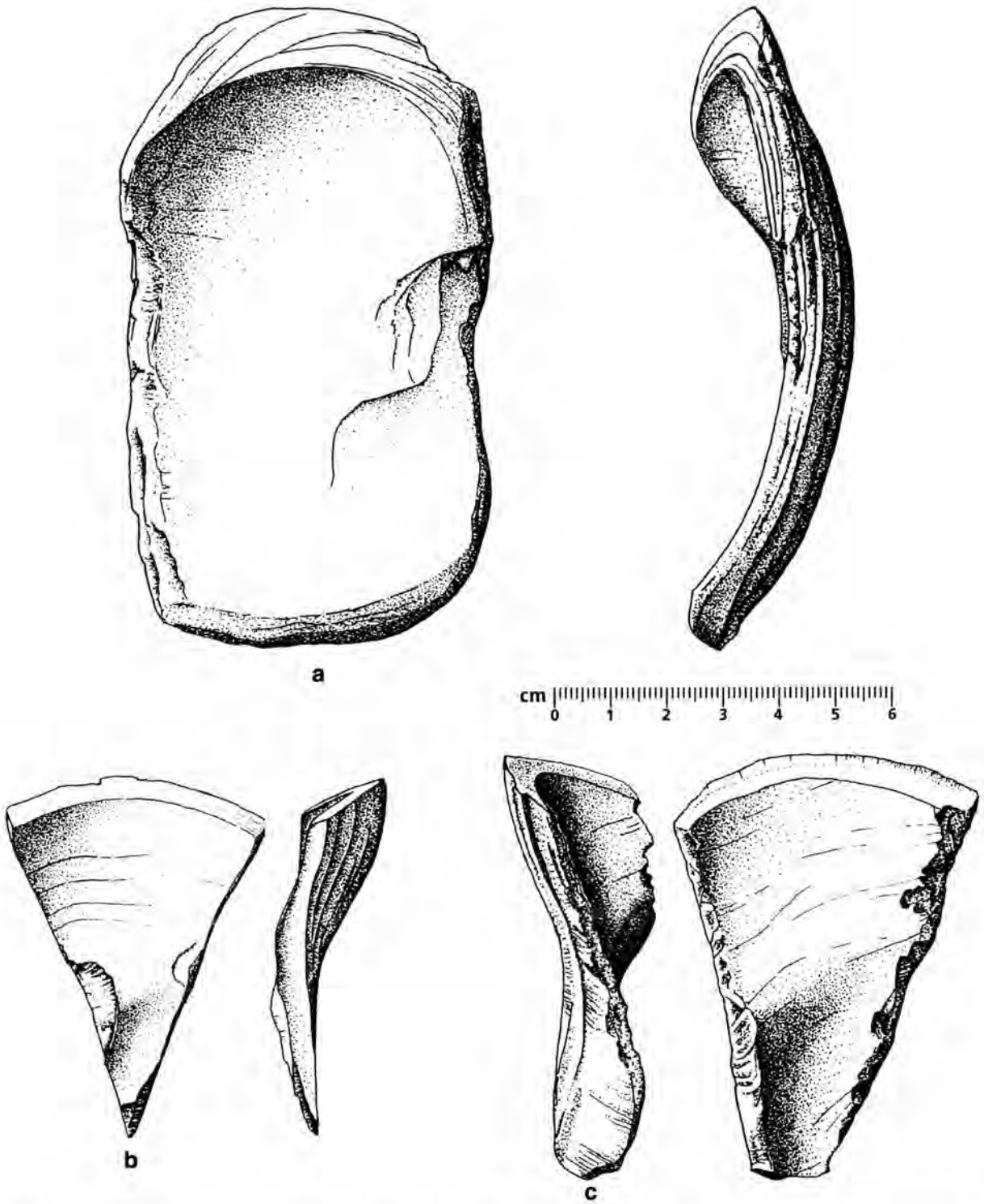


Figure 12. Whelk whorl adzes from Nueces County (Courtesy of Ed Mokry): a, large rectangular adze from 41NU104; b, triangular adze from 41NU164; c, triangular adze from 41NU167. Compare to adzes from Cameron County in Figure 13. Drawings by Richard McReynolds.

Figure 13. Whelk whorl adzes from Cameron County: a, large rectangular adze; b, a triangular adze. Both are weathered and chalky. Rectangular and triangular adzes are comparatively scarce in Tamaulipas.

and includes the siphonal end, but apparently had only one bit and only a portion (74 mm) of the bit survives. The maximum width of this tool is 123mm and it was removed from the shell by percussion. Large adzes in this paper retain their siphonal ends and appear to be specialty tools designed for heavy duty tasks.

Curved Adzes, named for their strongly curved bits, are probably among the "specialized tools" mentioned by Anderson (1932:30). They are large, heavy duty tools that have not been identified in previous research, although it seems likely that they are in the Anderson Collection.

Figures 15-16 illustrate a curved adze that is typical of 8 in the authors' collections. It is made from the body whorl of a large whelk with offshore origins. The outer lip of the shell, naturally flattened and smoothed during the empty shell's journey to shore, is the side opposite the bit. Grinding at an angle on the inner side of the shell produced a steeply beveled, strongly curved bit or cutting edge on the harder exterior side of the shell. The long length of the curved bit is in line with the long axis of the shell and the posterior end retains knobs; the short length of the bit is at a right angle to the long axis of the shell. Although strongly curved, the entire length of the bit rests flush on a flat surface when, with the inner side of the shell facing the user, the outer lip is gripped with both hands and held at a steep angle to the work surface (see Figure 17), but that is not to say that the work surface was necessarily flat. Holding the adze in this way provides the most comfortable grip, gives maximum control, and keeps knuckles from harm's way. The adze may have been used in pulling motions. A portion of the siphonal end of the whorl is included and appears to have been snapped (see the break edge on left in Figure 15). It is possible that, like Anderson's adze in

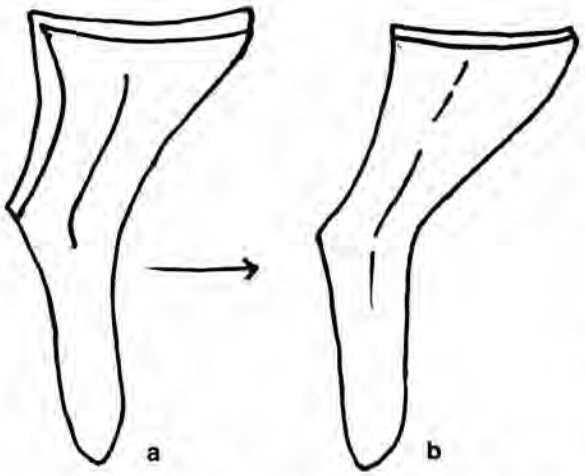


Figure 14. A "large" adze in the Anderson Collection (from Salinas 1981:18, Fig. 1): a, the section removed from a large *B. perversum*; b, the finished adze with a c-shaped bit ground at a right angle to the long axis of the shell and a second c-shaped bit ground in line with the long axis. The shell this adze was made from is apparently comparable in size to the shell in Figure 15.

Figure 14, the entire siphonal end was once a part of this tool. If so, it would have provided a wider grip and greater force could have been applied, but none of the 8 curved adzes in the authors' collections retain the siphonal end. The thickness of the curved bit is from 4 to 4.5 mm and the adze weighs 137.2 grams.

Figure 17 illustrates a curved adze (158 x 107 x 18 mm) held by the unmodified outer lip of the shell with both hands. This is the most comfortable grip and the tool may have been held in this manner and used in pulling motions. Like the curved adze in Figures 15 and 16, this adze is typical of 8 in the authors' collections. The nearly square break at the curve of the bit appears to have occurred at the same time as the bit edge in line with the long axis of the shell was sheared off, but use wear indicates that the tool continued in use. The surviving length of the original bit is concave from use wear and the posterior end retains knobs. The naturally flattened outer lip of the shell has a maximum thickness of 8 mm and the bit is from 4.8 to 6mm thick. The adze weighs 225.2 grams. There may be a large number of curved adzes in the Anderson Collection.

Curved adzes in the authors' collections have one strongly curved bit and are not known to include the siphonal ends of the shell, but they do include the knobs. It is difficult to determine a temporal range for surface collected artifacts, but triangular and rectangular adzes found in Cameron County are often weathered and chalky. On other parts of the Texas coast they are known to be late Archaic, although continuing into the Late Prehistoric (Ricklis 1996:103). Curved adzes, however, have not been found in severely weathered or chalky condition. They are found in sites containing the diminutive lithic artifacts of the Late Prehistoric Period (see Figure 2) and are apparently found only on the coast of the Rio Grande Delta. Presumed to be wood working tools, speculation on the use of the curved adze runs the gamut, from shaping bows to shaping dugouts.

Sunray Adzes. A sunray venus *(Callista nimbosa)* with a ground bit was found in a site on the coast of the Rio Grande Delta by Mike Krzywonski (see Figure 18). Grinding is at an angle on the inner side of the shell so that the beveled bit edge (45 mm in length) is on the harder exterior side of the shell. This adze may be one-of-a-kind, unless there are similar tools in the Anderson Collection.

Choppers

Shell Choppers. Anderson (1932:30) mentions shell "hand axes" (choppers), apparently believing that one of the shell tools found on the coast of the Rio Grande Delta was suitable for chopping activities. The most likely candidate would appear to be quahog valves with chipped margins, which are usually in the literature as scrapers (Hester 1980; Chandler and Kumpe 1998), but Luer (1986:143) reports three quahog valves that functioned as hand-held chopping implements; they were found at Big Mound Key, a shell mound complex in Florida. He also remarks on quahog valve choppers recovered from two other sites in Florida. Quahog valves are heavy and some edge-flaked specimens show heavy use wear (see Figure 28a-c). While the majority of edge-flaked quahog valves may have been scraping tools, experiments with a replica edge-flaked quahog and a driftwood log cutting board indicated that some edge-flaked quahogs could have been useful for light chopping tasks related to food processing, beheading fish for example.

Fishhooks

Fishhooks Made of Whelk Whorl. Curved single-piece fishhooks made of shell were manufactured on the Rio Grande Delta in Cameron County and in Tamaulipas (see Figure 19a-c). They all appear to be J-shaped. Anderson (1932:30), perhaps not thoroughly convinced that they could function effectively

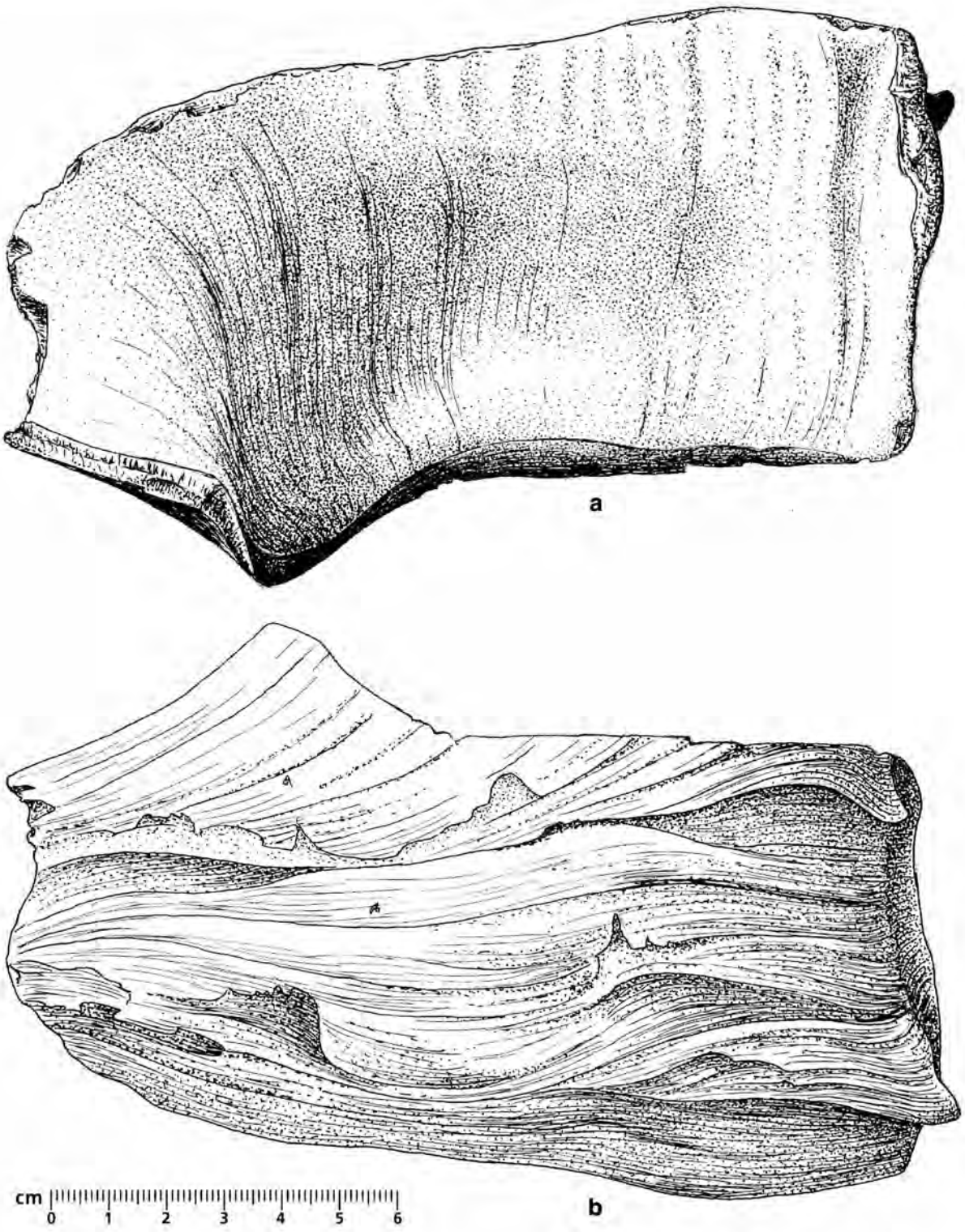


Figure 15. A curved adze: a, the interior side of the shell with its long curved bit; b, the exterior side of the shell. The curve of the bit is better seen in Figure 16. Drawings by Richard McReynolds.

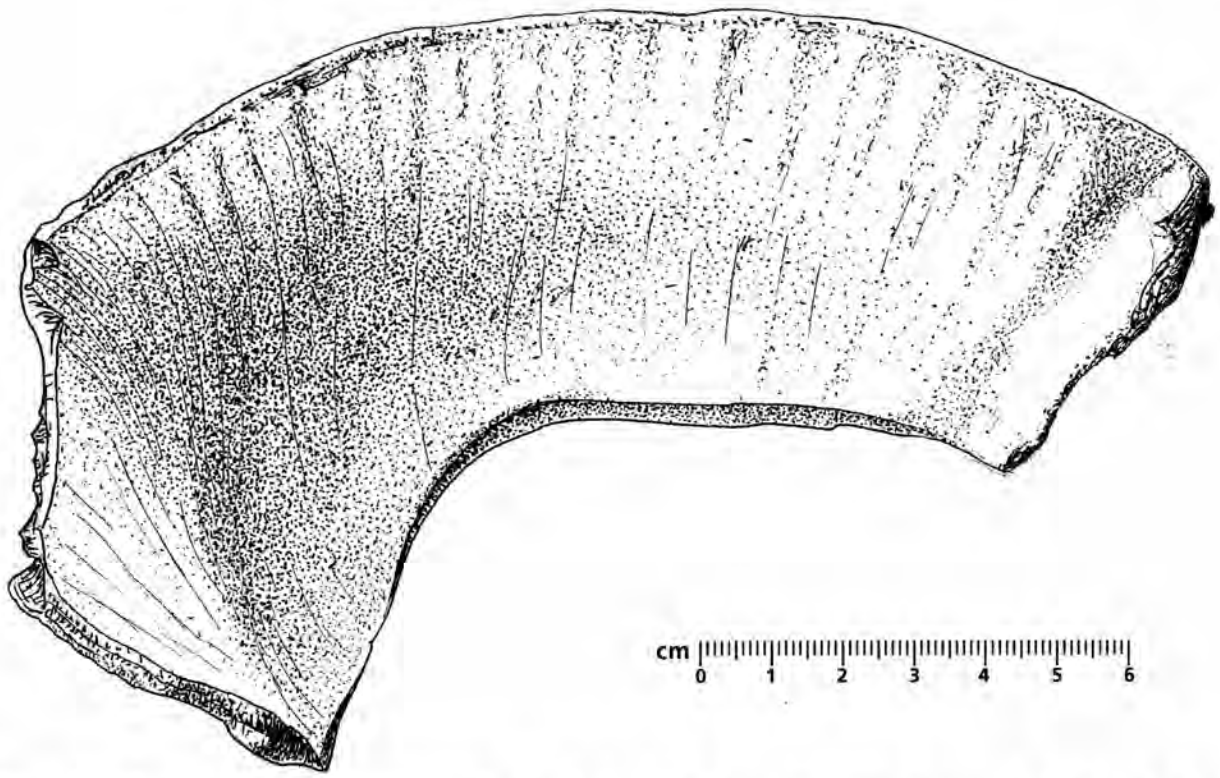


Figure 16. A third view of the curved adze in Figure 15. Here the adze is drawn in a raised position with the bit edge flush on a flat surface; curved adzes may have been used in this position, gripped on the corners with both hands and pulled repeatedly toward the user (see Figure 17).

as fish-hooks, calls them "hook-shaped objects" and remarks that they were made of conch/whelk shell and freshwater mussel shell (see below), but successful testing of curved single-piece hooks for securing fish has been carried out (Heizer 1949:90). MacNeish (1958:190) describes shell fishhooks from Cameron County and Tamaulipas in the Anderson Collection, remarking from Sayles (1935) that shell fishhooks are also in the Rockport Focus, but apparently in error as Sayles (Ibid.) makes no mention of shell fishhooks in the Rockport. Tom Hester and Ed Mokry (personal communications 2010) remark that they have not seen shell fishhooks from the Rockport. The authors have found nine one-piece shell fishhooks made of whelk whorl on the coast of the Rio Grande Delta, but only three comparatively complete specimens are illustrated (see Figure 19). One of the nine hooks is slightly incurved, but all nine appear to closely resemble a complete shell fishhook illustrated by Anderson (1932: Plate 7, No. 15). Ekholm (1944:480, Figure 52e'-f') illustrates 2 large "shell hooks" from the Huasteca that were found in Las Flores burial 21; their shanks are broken and he remarks that it is impossible to determine whether or not they were of practical use as fishhooks. He also remarks on another "very incomplete" shell hook from Las Flores that is coated with asphalt in one portion. The nine shell fishhooks found by the authors did not come from burials as did those from Las Flores, but, with one exception, are from the shorelines of various lagunas and connective channels within a few miles of the Gulf of Mexico shoreline. The exception was found farther inland in Cameron County, on Resaca de los Fresnos about 10 miles west of Lower Laguna Madre. Heizer (1949) discusses curved single-piece shell and/or bone fishhooks found in 3 areas of California (south central coast, Central Valley, and northwestern coast); as on the coast of the Rio Grande Delta, fishing was an important subsistence pursuit in each of the three areas of California where curved single-piece fishhooks are found. The hooks from the Rio Grande Delta, which are apparently only made of shell, most closely resemble bone hooks from the coast of Humboldt County, California (site No. Hum-67). Curved

Figure 17. A curved adze, its strongly curved bit flush on a flat surface, is held by the unmodified outer lip of the shell. Curved adzes may have been held in this position and used in pulling motions. The break at the curve of the bit probably occured at the same time as the bit edge in line with the long axis of the shell was sheared off, but the tool continued in use. Photo by Mike Krzywonski.

Figure 18. A sunray adze, possibly one-of-a-kind; this reduced *Callista nimbosa* was ground at an angle on the inner side of the shell to produce a bit on the harder exterior side.

single-piece fishhooks that were manufactured on the coast of the Rio Grande Delta are large, J-shaped, have simple pointed shanks and simple points, and were always made of shell. Only rarely are they slightly incurved. They are usually made of whelk whorl, but occasionally they are made of freshwater mussel shell (see below). Shell fishhooks in the Anderson Collection are about 60 mm in length (MacNeish 1958: 190). Miles (1968: Figures 1.224 and 3.82) illustrates a method of manufacturing one-piece shell fishhooks. Heizer (1949:89) lists several authors who describe the manufacture of curved shell fishhooks from the Santa Barbara region of California. Meggers et al. (1965:39, Figure 19; Plate 24) illustrate stages in the manufacture of single-piece shell fishhooks on the southern coast of Ecuador.

Fishhooks Made of Freshwater Mussel Shell. Anderson (1932:30) remarks that "hook-shaped objects" (curved single-piece fishhooks) found on the Rio Grande Delta are occasionally made of freshwater mussel shell, but there are none in the authors' collections and they appear to be rare. Mussel shell

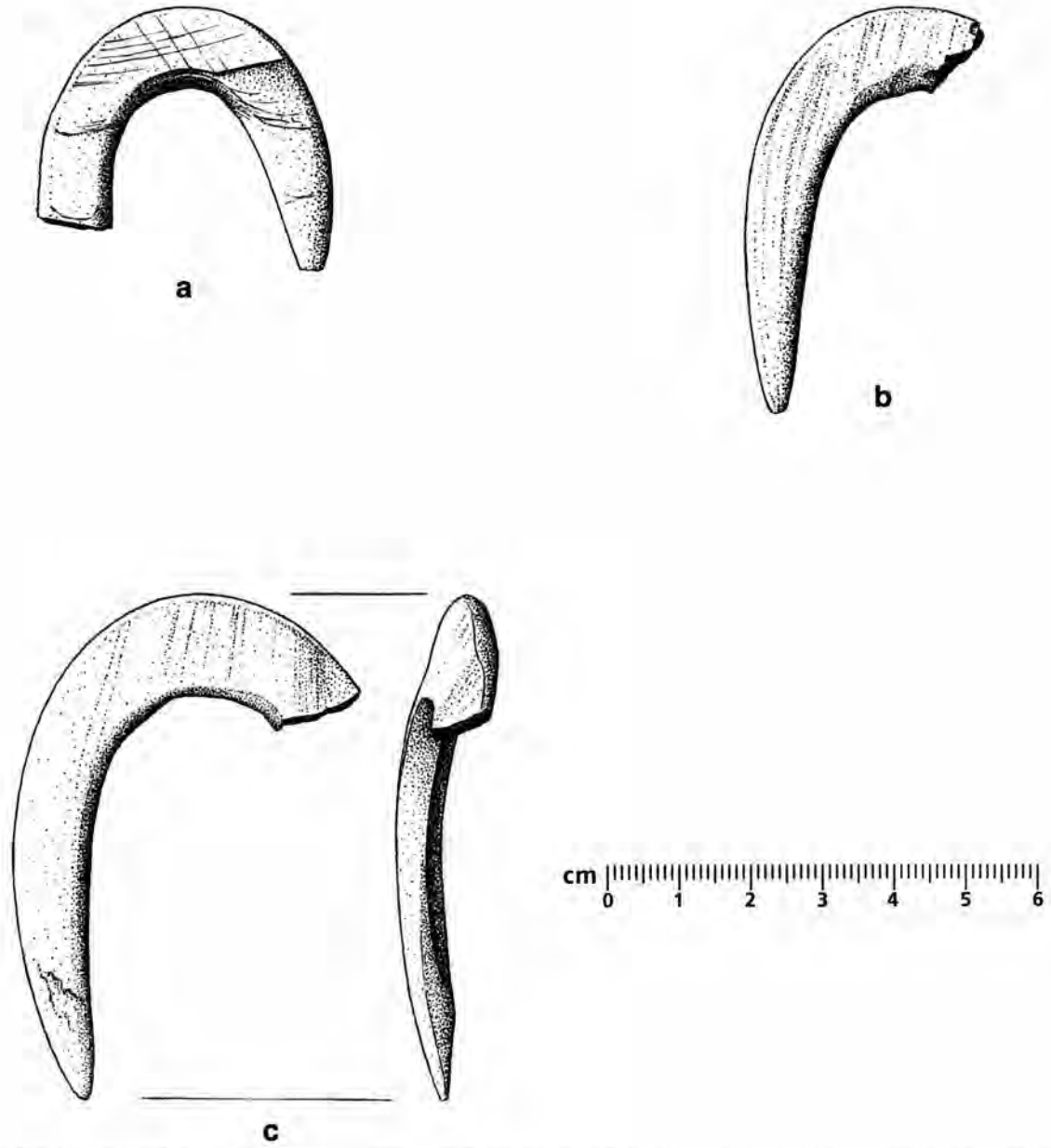


Figure 19. Curved single-piece fishhooks made from whelk whorl: a, the bend and point of a fishhook missing its shank; b, a shank that broke at the bend; c, a shank and partial bend. All from sites on the coast of the Rio Grande Delta. Fishhooks were also made from freshwater mussel shell. Drawings by Richard McReynolds.

fishhooks may have been iridescent or lustrous. Heizer (1949:89) remarks that all shells used for making hooks in California are iridescent, the luster believed to act as a lure for the fish. Bone, employed more rarely for making hooks in California, is believed to have been certainly used with bait or a lure attached because of its dull luster. The majority of fishhooks found on the Rio Grande Delta were made of dull colored whelk whorl and so they must have also been used with bait or a lure attached. However, those hooks made of freshwater mussel shell may have been lustrous and probably colorful on one side, purple, pink, salmon, or orange, if made from the locally common Tampico pearlymussel (*Crytonaias tampicoensis)* (see Howells et al. 1996:49). There may be several reasons why few iridescent mussel shell fishhooks were made on the Delta. The highly iridescent abalone shell, which is the most commonly used shell to make hooks in California

(Heizer 1949:89), is not found in Texas and the generally murky water in local resacas, lagunas, and meander channels would render iridescence of little value. However, lustrous and possibly colorful freshwater mussel shell fishhooks could have been useful to lure fish in the often clear waters of the Lower Laguna Madre.

Gaming Discs

Anderson (1932:30) lists gaming discs (tools for gambling) among the shell artifacts found on the Rio Grande Delta, but there are no shell discs in the authors' collections that can be construed as gaming discs. It is hoped that an examination of the Anderson Collection will one day bring these artifacts to light.

Gouges

Columella Gouges. Gouges are the second type of beveled shell tool found on the coast of the Rio Grande Delta (see Figure 20). They are mentioned by Anderson (1932:30) and MacNeish (1958:190), who remarks that shell gouges in the Anderson Collection are mainly from Cameron County. The overwhelming majority of columella gouges in the authors' collections are also from Cameron County.

Figure 20. Columella gouges from the Rio Grande Delta: a, Cameron County; b, Tamaulipas. They were usually made from columellae of *Pleuroploca* (see Figure 21), but occasionally from columellae of *B. perversum*.

Figure 21. A sizable Florida horse conch (*Pleuroploca gigantea*) that was caught in a shrimp net. The body whorl has been cut away to reveal the massive columella. Photo by Mike Krzywonski.

They are apparently scarce in Tamaulipas. The greatest number of columella gouges found on the Delta are made from columellae of the Florida horse conch *(Pleuroploca gigantea)*, but a few are made from the columellae of *B. perversum*. Hester (1980:123, Figure 5.20c, d) illustrates two views of a gouge made from *Pleuroploca* columella. The tools were manufactured by unifacially grinding the siphonal (anterior) end of a columella at an angle producing a convex bit or contact edge. On the lower Rio Grande, a *Pleuroploca* columella gouge from south of Hwy 2 on the Rio Salado, Tamaulipas is the only marine shell tool known to have been found west of Hidalgo County (Mike Krzywonski personal communication 2010). Conch and whelk shell tools, including columella gouges, appear during the Late Archaic on the central Texas coast (Ricklis 2004a:169) and they may have appeared on the lower Texas coast at approximately the same time. Columella gouges are common along Oso Creek in Nueces County, where the columellae of *Pleuroploca* dominate the columellae of *B. perversum* (Ed Mokry, personal communication 2010).

Siphonal End Gouges. A second type of gouge, the siphonal end gouge, has not been identified in previous research. Twelve siphonal end gouges from Cameron County were examined and five are illustrated (see Figure 22). They were manufactured by breaking off the siphonal (anterior) end of a horse conch *(Pleuroploca gigantea)* and unifacially grinding the posterior-facing end of the fragment to produce a beveled bit at a right angle to the long axis of the shell. Those made on shorter siphonal end sections include little if any of the base of the columella. Bits were usually ground on the inner side of the shell, but some were ground from the exterior side of the shell and have generally smaller bits. The faces of bits are nearly always concave. Contact edges of bits may be relatively delicate and are straight, slightly convex, or slightly concave. Siphonal end gouges may have been hand held rather than hafted. The known specimens (22) are from Cameron County, including two in the Alfonso Garcia Collection, but provenance of the presumed large numbers of these in the Anderson Collection should be determined before assigning them solely to Cameron County. Some siphonal end gouges are heavily weathered and chalky; they are presumed to be Late Archaic, but possibly continuing into the Late Prehistoric. The twelve gouges examined are from 61 to 117 mm in length and have an average length of 84.6 mm. The Alfonso Garcia Collection, including two siphonal end gouges from Cameron County, is permanently on display at the San Benito Historical Society Museum.

Hammers

Whelk Shell Hammers. Prewitt (1974:59) lists conch/whelk hammers among the tools in the Anderson Collection. Hester (1980:123, Figure 5.20b) illustrates a whelk shell hammer from the south Texas coast. Steele and Mokry (1985:294, Figure 3) illustrate a *Busycon* hammer from 41NU102 on Oso Creek in Nueces County. Whelk shell hammers were made from large whelk shells by percussion; they have a complete columella and spire, but are minus the outer whorl and most of the inner whorl (Campbell 1947:51; Dockall and Dockall 1996:215). There are three whelk shell hammers from sites on the coast of the Rio Grande Delta in the Krzywonski Collection, but they show little use wear. Campbell (1947; 1952) reports whelk shell hammers at Archaic Period coastal sites in Texas and it is possible that the few whelk shell hammers from the Rio Grande Delta are from some part of the Archaic Period. Unmodified southern quahog valves were the common shell hammers on the coast of the Rio Grande Delta (see above) and they appear to have been in use during the Late Prehistoric Period.

Columella Hammers. The Krzywonski Collection includes several columella segments from sites on the coast of the Rio Grande Delta that resemble a type of hammer identified by Dockall and Dockall (1996:215-216) at Morhiss (41VT1), an Archaic site in Victoria County. They describe this type of hammer as a columella segment snapped at one end and heavily blunted or battered at the opposite end, which includes microscopic step fracturing, pitting, and blunting; they suggest that these may be expedient billets for the manufacture of stone tools.

Net Weights

Net Weights on Eastern Oyster Shells. There are eastern oyster shells *(Crassostrea virginica)* used as net weights in the Anderson Collection and they have large perforations (Steele 1988:233-234). Four oyster shell net weights with pecked perforations in the Mike Krzywonski Collection are on sizable valves, but have small perforations. They were found clumped together within a space of 3 feet in a Cameron County site near South Bay (see Figure 23a-d). The sturdy spines of a giant eastern murex shell that was found with the oyster shell net weights may have been used to perforate the oyster shells (see above). Perforated oyster shells have been documented in Early Archaic contexts at sites in Nueces and San Patricio counties and in Late Archaic and

Figure 22. Siphonal end gouges made on the siphonal (anterior) ends of *Pleuroploca*: a-e, Cameron County (none have been found in Tamaulipas). Siphonal end gouges are not identified in previous research. Photo by Mike Krzywonski.

Figure 23. Oyster shell net weights from Cameron County. From a site near South Bay, they were found together in a space of three feet and may not have seen use. They have unusally small perforations. Spines of a giant eastern murex shell found with the four oyster shells may have been used to make the perforations.

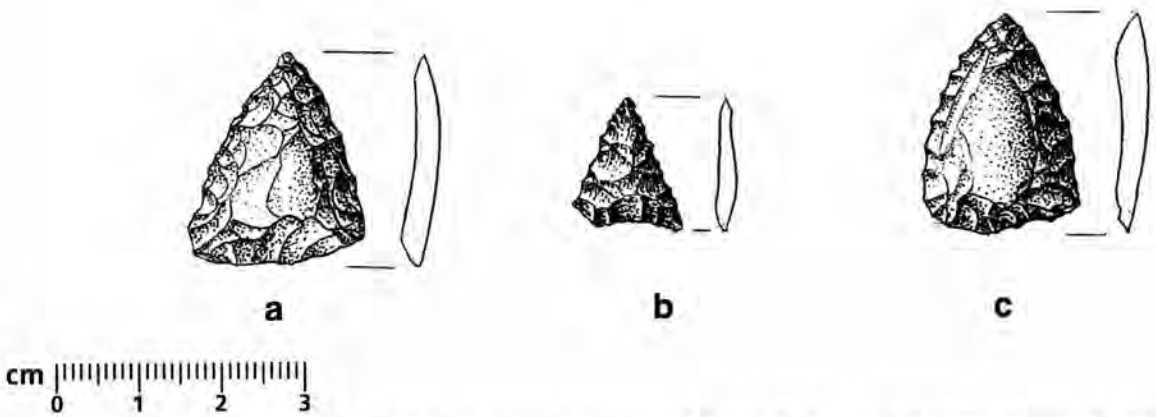


Figure 24. Chipped shell projectile points from Cameron County: a, 3.2 mm thick and unifacially chipped; b, 2.5 mm thick and bifacially chipped; c, 3 mm thick and unifacially chipped. All made from *Callista* sp. (*Callista nimbosa* or *Callista maculata*).

Late Prehistoric components at 41SP120 on Corpus Christi Bay (Ricklis 1996:102-103).

Projectile Points

Chipped Shell Points. Anderson (1932:31) remarks that chipped shell projectile points found on the Rio Grande Delta are triangular and quite rare. Three chipped shell points from Cameron County are illustrated (see Figure 24a-c). They were manufactured from *Callista* sp. and one is bifacially chipped (Figure 24b). The sunray venus *(Callista nimbosa)* and the calico clam *(Callista maculata)* are commonly found in sites on the coast of the Rio Grande Delta and these closely related species have fine microstructures suitable for flaking. Triangular chipped shell projectile points made from *Callista nimbosa* have been found in the Corpus area, on Oso Creek at 41NU101 (Steele and Mokry 1985:242, Figure 2j) and in sites on the laguna side of North Padre Island (Ed Mokry, personal communication 2010). Eighty-nine chipped triangular shell points are in the Kirchmeyer site (41NU11) shell collection, 88 chipped from sunray clam shells and one from southern quahog (Headrick 1993:29). Chipped shell points are quite rare in Cameron County, but appear to be comparatively common in Nueces County. Of the illustrated points in Figure 24: A is 3.2 mm thick and weighs 1.9 grams; b is 2.5 mm thick and weighs .3 grams; c is 3 mm thick and weighs 1.6 grams.

Columella Points. Anderson (1932:Plate 7, No.13) illustrates 7 columella points and Hester (1980:123, Figure 5.20e) illustrates one. MacNeish (1958:187, Table 29) lists "conical columella projectile points" and shows large numbers of these in some sites in Tamaulipas, but only a few in Cameron County. He remarks that they are between 25 and 75 mm in length. Columella projectile points were manufactured from sections of columella by grinding the distal end to a point and grinding the base on opposite sides until it was sufficiently thinned for hafting (see Figure 25a-l). Columella from both *B. perversum* and *Pleuroploca* was used (Salinas 1981:18-19). Columella points are rare in Cameron County, where the authors have found only two and Alfonso Garcia (recently deceased) found one, but they appear to be equally rare between the Rio Grande and Arroyo Cajas Pintas (Painted Boxes) in Tamaulipas, where the authors know of only one. They are common upon nearing the Laguna Barril and their distribution continues south to the north end of the Tamaulipas Laguna Madre and Arroyo El Diablo. The illustrated columella points range in weight from 1.6 to 11.2 grams with an average weight of 5.925 grams. Their average maximum thickness is 9.7 mm, eight (a-h) clustering between 10 and 11 mm. The Alfonso Garcia Collection, including a columella point from Cameron County, is permanently on display in the San Benito Historical Society Museum. Columella projectile points are apparently unique to the coast of the Rio Grande Delta.

Were Columella Points Used For Fishing? Cameron, Fresno, and Starr were the common arrow points on the coast of the Rio Grande Delta, where columella points were also manufactured (see Figure 2c-e and compare with Figure 25a-l). The stone arrow points are small, thin, light weight, finely pointed, and their basal corners served as barbs. In comparison, columella points are large, thick, and heavy; they lack barbs and

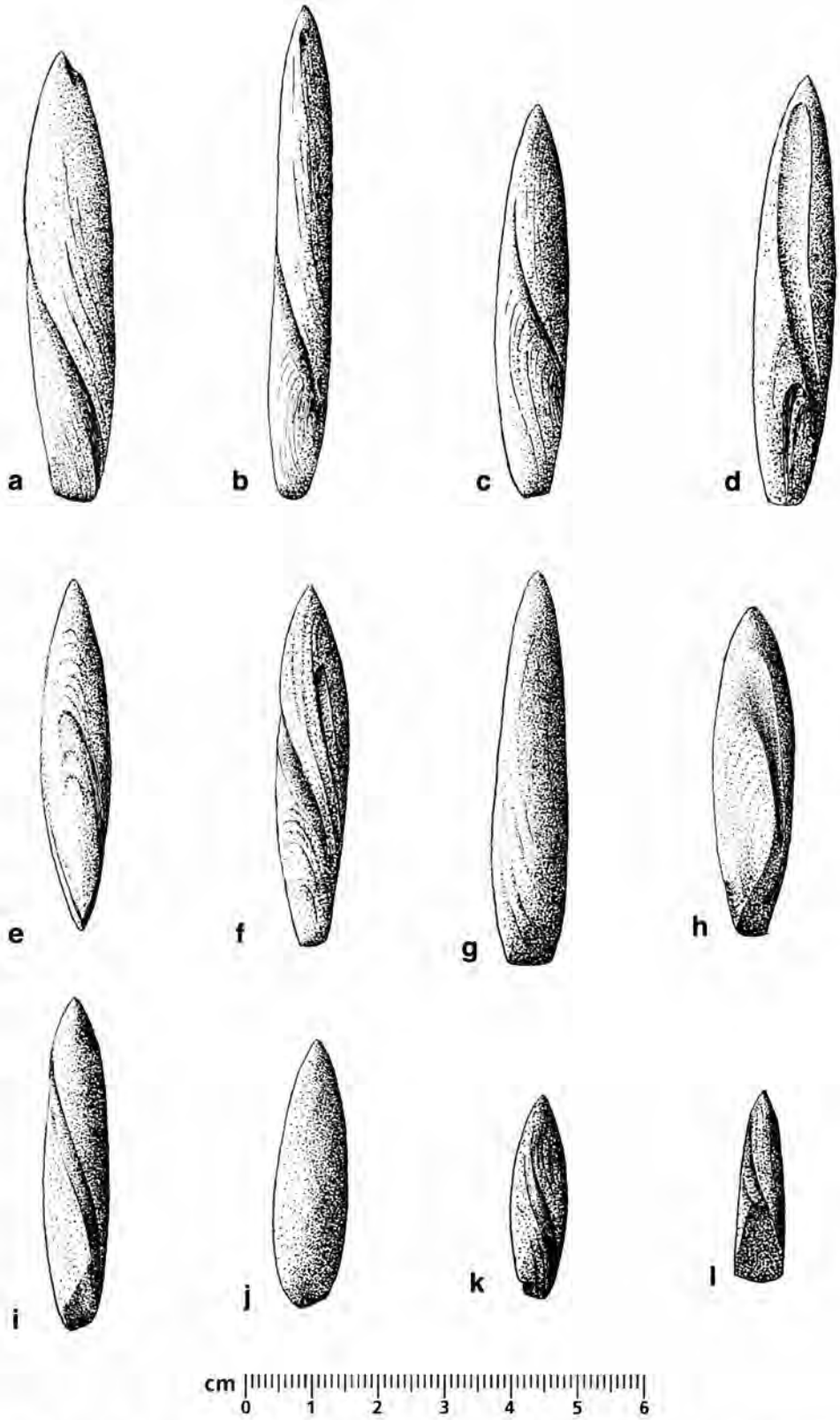


Figure 25. Collumella projectile points from the coast of the Rio Grande Delta in Tamaulipas (they are scarce in Cameron County). All were thinned for hafting by grinding two sides of the proximal end. The smallest have often been salvaged. Drawings by Richard McReynolds.

are sturdier than the stone arrow points. They also take longer to make. After grinding on a sizable columella with Gulf sandstone for 15 minutes it was apparent that the idea of replicating a columella point with the tool of the day was going slowly and the effort was abandoned. Shaping a columella point appears to be a lengthy task. Add to that the time and effort necessary to obtain the columella! Hunter-gatherers are noted for the efficiency of their foraging strategies and it appeared that there must have been a reason to work longer and harder to make columella points. Perhaps they were useful for shooting fish in shallow water.

The senior author and John R. Boland were in the company of Robert Lindsey when they witnessed the following account of bow fishing with standard archery equipment. Robert Lindsey (Hatchery Manager for U.S. Fish and Wildlife Service at Inks Dam National Fish Hatchery, personal communication 2009) remarks that, while wading and at distances of ten feet or less, he shot 22 sizable spawning common carp *(Cyprinus carpio)* in water from 10 to 18 inches in depth at Falcon Reservoir in 1961; he used a 45# bow (tested at 42#) with two wood arrows and one aluminum arrow tipped with 125 grain field points (brittle nocks on the wood arrows broke and the approximately 4 pound 22nd carp shot bent the aluminum arrow, which was his last). He also remarked that some arrows would pin the impaled carp to the mud bottom; other carp that were shot gave a short burst of speed, unless shot in the spine, then slowed and swam on their sides or swam erratically until he was able to run them down (no line was tied to the arrows).

The dimensions, shape, and sharpness of field points are comparable to the conical tips of columella points and it appears that columella points could have been used in the same way as the field points at Falcon Reservoir, to shoot fish (flounder, black drum, red drum, and others) at close range in shallow water, a task for which the delicate stone arrow points are unsuited. Sparrow (2008:39) remarks that tailing redfish are easy to approach in extra-marginal waters, 6 to 8 inches in depth, because they are there to feed and are visually focused on what is immediately in front of or beneath them. He also mentions that fish cannot fight very hard in such shallow conditions. The comparatively heavy weight of columella points could have been useful to carry an arrow in a straight path through a few inches of water and to penetrate fish shot at close range in shallow water. Columella points are sturdy and probably long-lived if used for fishing, but appear to offer no advantage to arrows used for any other purpose.

Scraping/Cutting Tools

Eight species of bivalves were edge-flaked for scraping or cutting tools on the coast of the Rio Grande Delta. Six species, *Dosinia discus, Dosinia elegans,Callista nimbosa, Mercenaria campechiensis, Codakia orbicularis,* and *Rangia cuneata*, have been reported. Two species, *Callista maculata* (the calico clam) and the Atlantic surf clam *(Spisula solidissima,)* are reported in this paper (see below and see Figure 26a-b). Dosinia, sunray, and the calico clam appear to have been the preferred species for cutting tools. The heaviest of the edge-flaked shell tools, the southern quahog, may have also been used for light chopping tasks (see above). Anderson (1932:29) mentions shell scrapers and MacNeish (1958:190) examined about 200 mollusk shell scrapers in the Anderson Collection, but neither of the authors mention species. Prewitt (1974:59) also makes no mention of species, but remarks that clam shell scrapers comprise the single largest artifact class in the Anderson Collection. Salinas (1981:17) remarks that the tiger lucina *(Codakia orbicularis)* is one of the "main" shells used for tools in the Anderson Collection, but there are only two edge-flaked tiger lucina tools in the authors' collections.

Atlantic surf clam *(Spisula solidissima)*. Atlantic surf clam valves with edge-flaked margins are reported in this paper (see Figure 26a). They appear to be scarce tools on the coast of the Rio Grande Delta and only two are in the authors' collections. The Atlantic surf clam may have been used to make cutting tools when the preferred shells, dosinia, sunray, and the calico clam, were unavailable. Andrews (1977:221) remarks that the Atlantic surf clam reaches a length of 127 mm and is a fairly common beach shell.

Calico clam *(Callista maculata)*. Edge-flaked calico clam tools are reported in this paper (see Figure 26b). They are common in sites near the Arroyo la Mula in Tamaulipas, where eight calico clam tools (all on left valves) were noted in one site (Kumpe n.d. a:812). They are found less often in other areas of the coast, but are also found in Cameron County. Edge-flaking on these tools may be only at the posterior end or extend the full length of the margin. The calico clam is closely related to the sunray venus *(Callista nimbosa)* and both have fine microstructures suitable for the manufacture of chipped shell projectile points. There are no calico clam tools in the Corpus area (Ed Mokry, personal communication 2010) and Andrews (1977:241) remarks that the shell is rarely found north of Port Isabel. She gives its maximum size as 63 mm, but calico clam tools found on the coast of the

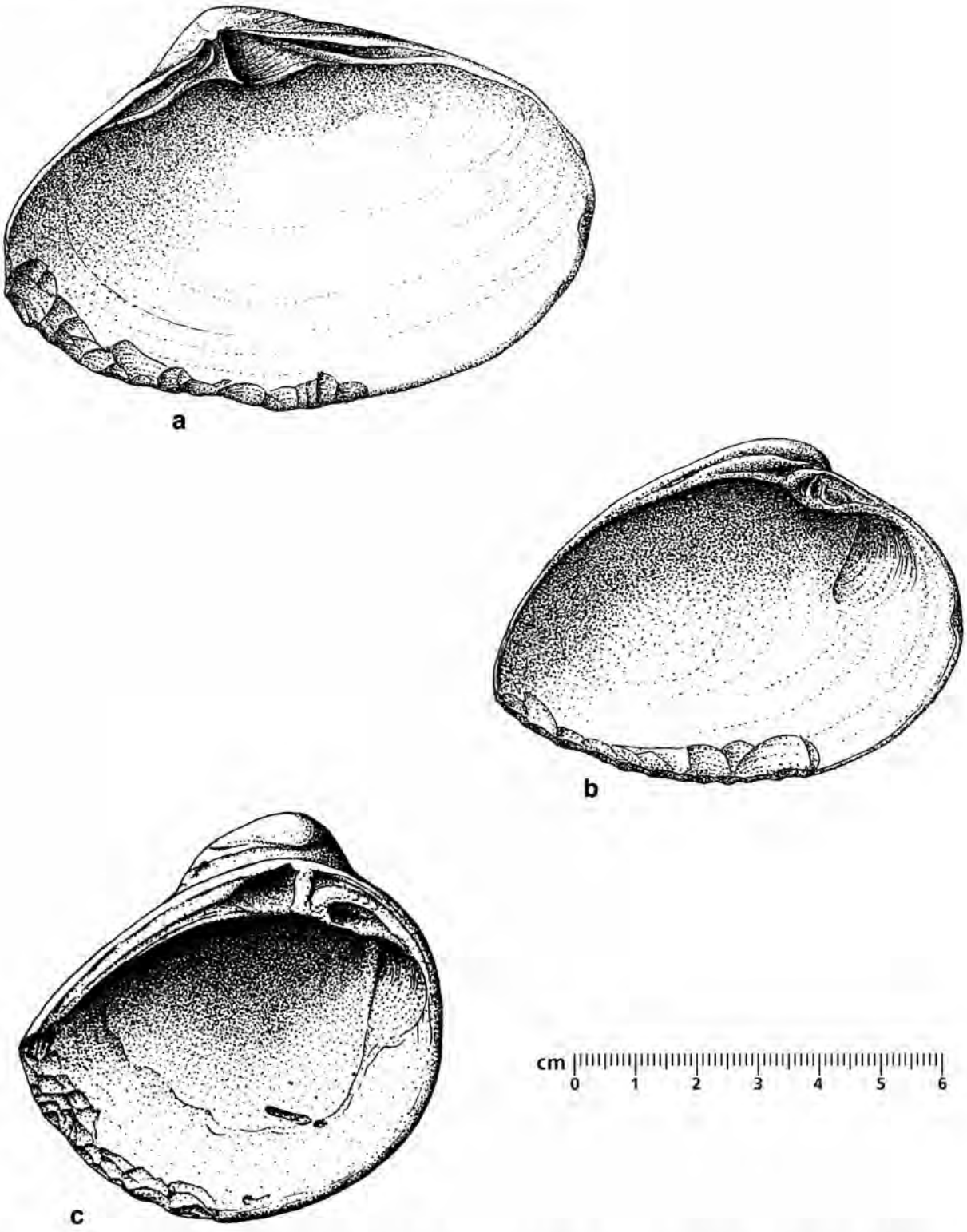


Figure 26. Edge-flaked cutting/scraping tools from the Rio Grande Delta: a, Atlantic surf clam (*Spisula solidissima*); b, calico clam (*Callista maculata*); c, common rangia (*Rangia cuneata*) (c is from Kumpe et al. 1998:30, Fig.5). Atlantic surf clam and calico clam tools are reported in this paper. Drawings by Richard McReynolds.

Rio Grande Delta reach a length of 85 mm. Humfrey (1975:254) shows the calico clam reaching a length of 88 mm. These are fairly common tools on the coast of the Rio Grande Delta and, although they are not previously reported, it is likely that a large number of calico clam tools are in the Anderson Collection.

Common rangia *(Rangia cuneata)*. Common rangia valves with chipped margins have been reported from sites in Cameron County and Tamaulipas (Kumpe et al. 1998:28). These are nicely edge-flaked shell tools (see Figure 26c), but are few in number and, like the Atlantic surf clam (above), may have been manufactured when the preferred shells, dosinia, sunray, and the calico clam, were unavailable. Andrews (1981:112) shows this brackish-water species reaching 80 mm in length, but Robert Howells (personal communication 1996) found common rangia to 90 mm in length in the Nueces River upstream from Nueces River Park.

Disk dosinia *(Dosinia discus)*. Salinas (1981:19) remarks that dosinia is the most common of the species used for tools in the Anderson Collection. He believed they were chipped or edge-flaked by percussion, but experiments found that dosinia tools were pressure flaked (see below). Hester (1980:123, Figure 5.20) illustrates a *Dosinia discus* scraper that was found in Tamaulipas by A.E. Anderson. In the author's collections, edge-flaked tools made on *Dosinia discus* outnumber tools of the remaining seven edge-flaked species combined. Three dosinia tools are illustrated, including a rare dosinia spokeshave (see Figure 27a-c). Despite its frequency on beaches and in sites on the coast of the Rio Grande Delta, *Dosinia discus* is only rarely found on beaches in the Corpus area and there are no dosinia tools in Nueces County (Ed Mokry, personal communication 2010).

Pressure Flaking *Dosinia discus*. Edge-flaked dosinia valves are remarkably common in sites on the coast of the Rio Grande Delta in Tamaulipas. The majority of these tools have broad random flake scars that follow the natural curve of the margin (see Figure 27b), while a smaller number have straight cutting edges with smaller flake scars at a steep angle (see Figure 27a). Salinas (1981:19) believed that dosinia tools were flaked by percussion, but the valves are so thin that pressure flaking seemed likely and experiments were undertaken with beach-gathered shells. More than a dozen dosinia valves were broken during attempts to pressure flake dosinia margins against the exterior surface of a quahog valve. The adapted method was to brace the dosinia valve by holding it firmly between thumb and forefinger with both hands, while positioning its margin at a steep angle against the quahog. Kneeling and resting on the heels with the quahog valve on the ground between the knees became the preferred position, as did "hunkering" over the work. Leaning or hunkering offered more control of pressure and made it easier to hold the dosinia margin against the quahog shell at the required steep angle. In this position, with the dosinia braced as described and held with the interior side of the shell facing outward, flaking was accomplished by pressing the dosinia margin into the quahog and leaning the dosinia valve slightly forward until angle and pressure were correctly applied to the interior edge of the margin. A sharp cutting edge could be quickly produced, although the comparatively wide contact area and slight slipping on the smooth exterior of the quahog valve left little control. Large random flake scars forced to follow the natural curve of the dosinia margin were the result, but the flaking was like that on actual dosinia tools (see Figure 27b). There was no slipping when dosinia valves were pressure flaked in the same way on Gulf sandstone, which is the hardest sandstone the authors have ever encountered. The gritty surface of Gulf sandstone locked the dosina margin in place and directed pressure into a shorter length of the margin. Pressure flaking on Gulf sandstone was easier, produced tiny flake scars at a steep angle, and could be easily controlled to produce straight edges or even a concave edge like that of a dosinia spokeshave (see Figure 27a,c). The different materials used for pressure flaking experiments produced edge-flaked dosinia margins that are like the edge-flaked margins seen on actual dosinia tools. Depending on the task, perhaps one type of cutting edge was preferred over the other.

Elegant dosinia *(Dosinia elegans)*. A scraping tool made on the scarce elegant dosinia was found in a Cameron County site south of Port Isabel (Kumpe et al. 1998:28). It was nearly fully restored from eleven fragments found on Loma de la Draga; the names of lomas (clay dunes) have remained remarkably consistent through the years (Richard 2005:371-372). The broken valve weighs 17.7 grams and would have apparently exceeded 76 mm in anterior to posterior length (Kumpe n.d. a:705). A few elegant dosinia tools have also been found on the Tamaulipas side of the Rio Grande, but none are complete. *Dosinia elegans*, distinguished from *Dosinia discus* by its fewer and heavier concentric ribs, is an uncommon shell seldom found north of Big Shell (Andrews 1977:243). It is one of the rarest of the edge-flaked bivalves in the authors' collections and is not illustrated.

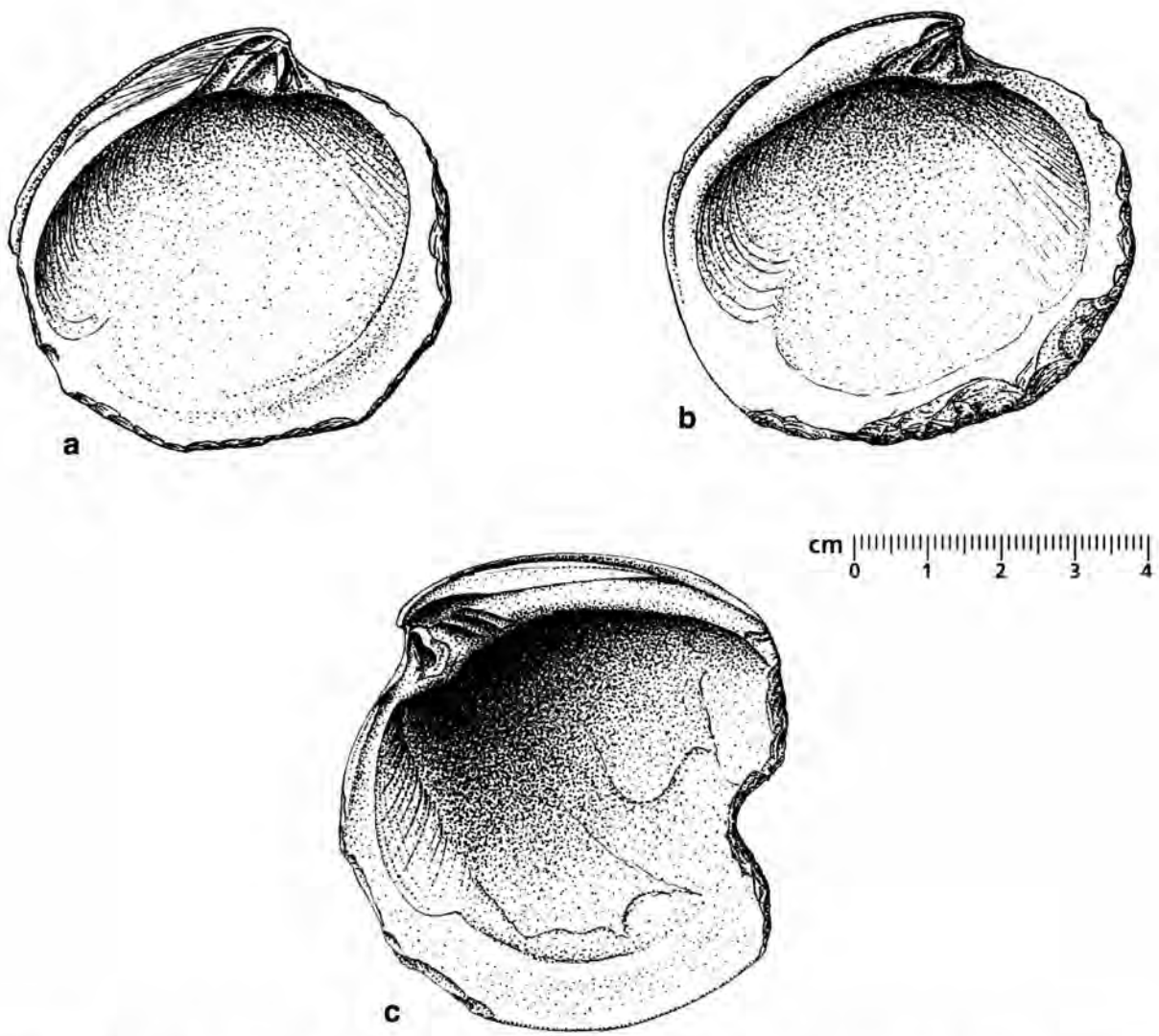


Figure 27. Edge-flaked cutting/scraping tools from the Rio Grande Delta, all *Dosinia discus*: a, steeply chipped with straight edges; b, random flaking that follows the natural curve of the margin; d, steeply chipped spokeshave. All apparently pressure flaked (see text). Drawings by Richard McReynolds.

Southern quahog *(Mercenaria campechiensis)*. Scrapers made on southern quahog valves have been reported by Hester (1980:123, Figure 5.20g) and by Chandler and Kumpe (1998), who illustrate edge-flaked quahog valves found on the coast of the Rio Grande Delta (see Figure 28a-c). There are similar specimens in the Anderson Collection (C. K. Chandler, personal communication 1997) and a quahog shell fragment that has been chipped on all sides is in the Krzywonski Collection; its maximum thickness is 7.8 mm and it weighs 31.6 grams (see Figure 29). While light weight dosinia shell tools are commonly found in sites 10 to 20 miles or more inland, the heavier quahog tools are usually found in sites within a few miles of the seashore. Their thick margins were chipped by percussion and experiments found that a convenient percussion tool for chipping the interior margin of a quahog valve is the rounded exterior of another quahog. Experiments also indicate that some edge-flaked quahog valves could have been useful for light chopping tasks related to food processing (see above). Quahog tools are rare in the Corpus area, but an edge-flaked southern quahog valve was recovered from 41NU163, a multi-component site (Late Archaic and Late Prehistoric) on Oso Creek in Nueces County (Ed Mokry, personal communication 2010). Despite the

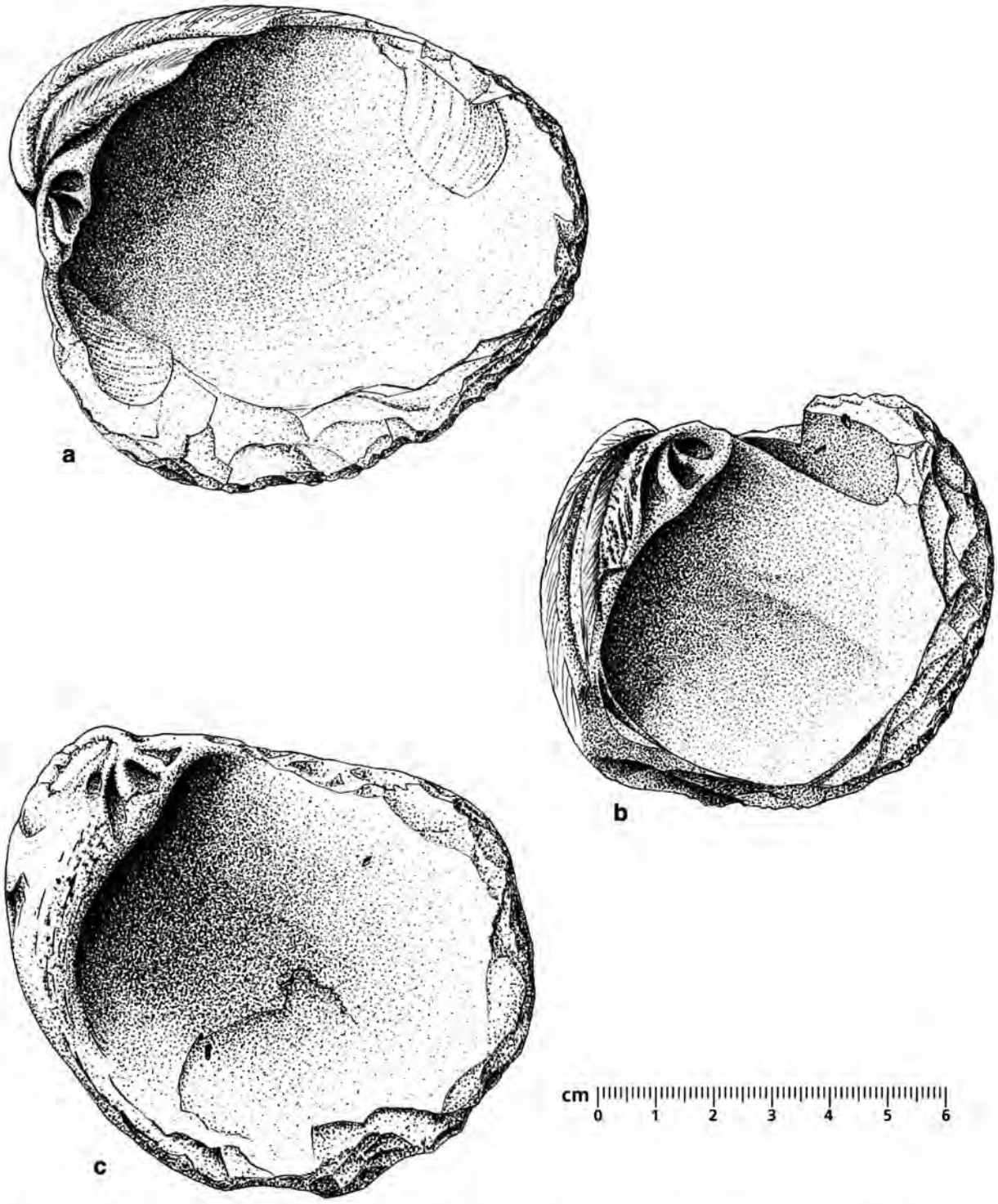


Figure 28. Quahog scraping/chopping tools from the Rio Grande Delta (from Chandler and Kumpe 1998:17, Fig. 1): a-c, percussion flaked valves of the southern quahog (*Mercenaria campechiensis*). The exterior of a quahog valve can be used to percussion flake the interior margin of another quahog.

Figure 29. Quahog fragment chipped on all sides. From the coast of the Rio Grande Delta in Tamaulipas.

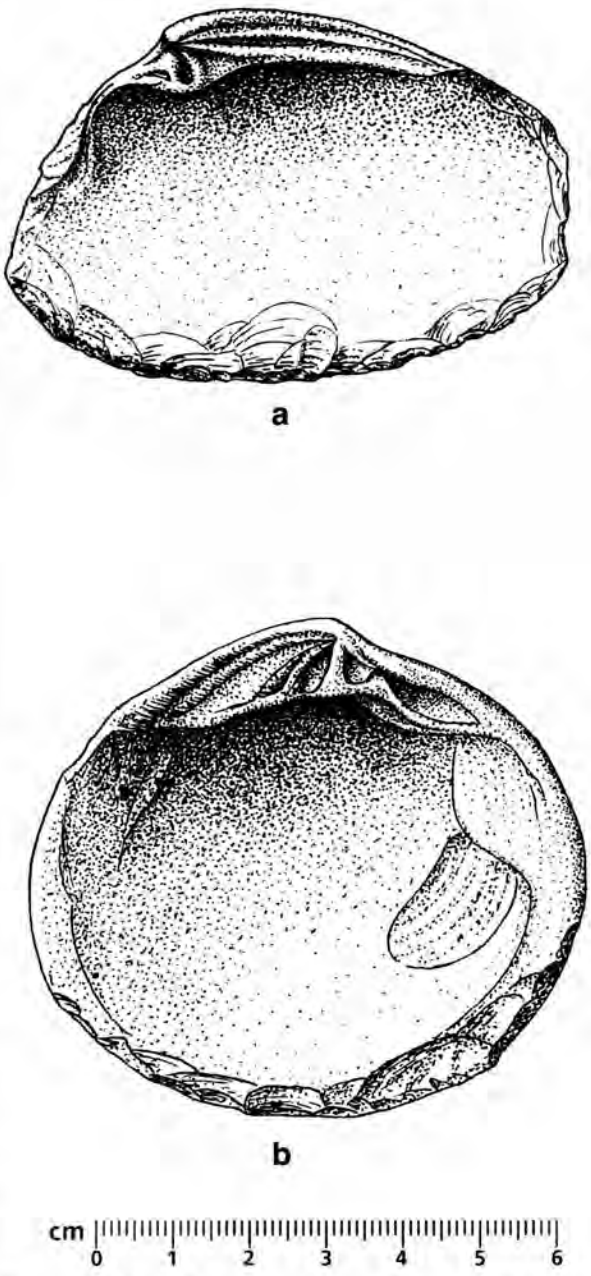


Figure 30. Edge-flaked cutting/scraping tools from the Rio Grande Delta: a, sunray venus (*Callista nimbosa*); b, tiger lucina (*Codakia orbicularis*). Drawings by Richard McReynolds.

rarity of southern quahog valves with chipped margins in the Corpus area (and despite the present day rarity of intact valves on beaches in the area), 28 southern quahog valves were found during a survey of seven sites in Nueces County (Steele and Mokry 1985:290, Table 1). The lightning whelk *(B. perversum)* opens bivalves by chipping the valve edges with its own shell (Andrews 1977:147), but Indians chipped the interior side of quahog margins and Luer (1986:131, Figure 5) shows that predators chipped the exteriors. Unmodified quahog valves were also used as tools on the coast of the Rio Grande Delta, as hand-held hammers (see Figure 9).

Sunray venus *(Callista nimbosa)*. Indians from most of the central and southern parts of the Texas coast used sunray valves for the production of cutting tools (Steele 1998:233). Excavations at 41SP120 on Corpus Christi Bay found edge-flaked sunray tools in both Late Archaic and Late Prehistoric components (Ricklis 1996 from Ricklis 1990), but now the sunray is probably fossil in Texas (Andrews 1977:242). Edge-flaked sunray tools are the most common artifact type in some sites in Cameron County (Mike Krzywonski, personal communication 2010) and sunray tools are also found in Tamaulipas (see Figure 30a). Although the sunray venus reaches a length of 127 mm (Andrews 1977:242), sunray tools from the Delta are nearly always greatly reduced by re-sharpening and sunray with edges broken so near the umbo that re-sharpening is impractical are common in some Delta sites. Unmodified intact sunray valves are rarely found in sites on the Delta; Mike Krzywonski (personal communication

2010) has found two unmodified intact sunray in one Cameron County site and none in sites in Tamaulipas. The senior author has found none in sites on the Delta. In the Corpus area, however, unmodified intact sunray valves are numerous in some sites. A site on Mustang Island (41NU250), for example, contained hundreds of unmodified (and modified/edge-flaked) sunray valves (Ed Mokry, personal communication 2010). It appears that the sunray population on the coast of the Rio Grande Delta was small in comparison to the population in the Corpus area. The illustrated edge-flaked sunray tool (Figure 30a) is from the coast of the Rio Grande Delta in Tamaulipas; it weighs 21.2 grams.

Tiger lucina *(Codakia orbicularis)*. The tiger lucina is a rare beach shell that reaches 87 mm in size, but only chalky, worn specimens are found and it is probably fossil in Texas (Andrews 1977:208). There are only two edge-flaked tiger lucina tools in the authors' collections, but Salinas (1981:17) remarks that *Codakia orbicularis* is one of the "main" shells used for tools in the Anderson Collection! More tiger lucina tools were apparently manufactured on the Delta than the few in the authors' collections would suggest. The illustrated tiger lucina tool is from a site on the coast of the Rio Grande Delta in Tamaulipas and the exterior side of the shell is heavily worn (see Figure 30b). It weighs 23.3 grams.

Vessels

Whelk Whorl Vessels. Vessels made of whelk whorl and variously described as containers, cups, ladles, dippers, or bowls, are widely distributed along the Gulf coast and in the Circum-Caribbean (Hester n.d.:17-19). In this paper they are cups. Prewitt (1974:59) lists "possible conch cups" among the shell tools recovered from the Delta by A. E. Anderson. Larger and more durable than valves of the giant Atlantic cockle, whelk whorl cups would appear to have advantages over cockle shells. Never-the-less, they are rarely found on the Rio Grande Delta and, besides those that may be in the Anderson Collection, only three are known to the authors. Jerry Hubbard (personal communication, 1997) remarked that he gave a whelk whorl cup from a burial at 41HG173 in southeastern Hidalgo County to a nearby landowner. The second known cup was found on the southern Mar Negro and examined by the senior author. It was bowl-shaped, apparently extracted by percussion, and the circumference was rounded and smoothed by grinding. The third whelk whorl cup is in the Krzywonski Collection.

Miscellaneous Tools

Perforated Shark's Eye. A sizable shark's eye *(Polinices duplicates)* with perforations pecked through opposite sides of the thick body whorl was found on a low peninsula jutting into the Laguna Mar Negro. It may have been used as a net weight, but one perforation (and the aperture) could have served to tie the shell to a net. The perforations in the shark's eye are aligned in the manner of "hafting holes" in whelk shell "cutting-edge tools" that are reported in Florida by Marquardt (1992:196, Figure 6), but the irregular rough-edged perforations in the shark's eye are small and there is no evidence that they were used for hafting. A large shark's eye that appeared to have been similarly perforated was on display in Presidio La Bahia near Goliad, Texas in 2002 (Kumpe n.d. a:275, 881).

THE MODIFIED SHELL ORNAMENTS

Flame Auger

Flame Auger Pendant. A pendant made from a flame auger *(Terebra taurina)* by perforating the body whorl is reported (see Figure 31). Found in a prehistoric site near the coast of the Rio Grande Delta in Tamaulipas, it has a U-shaped perforation that appears to have been made with Gulf sandstone. Its pointed posterior end (the apex) is missing, but this was a sizable pendant that may have originally been about 5 inches in length. Andrews (1977:140) remarks that these rare and attractive shells with reddish brown flame-shaped marks can reach 150 mm in length (nearly 6 inches). Broken flame auger shells that may have once been pendants were noted in sites near Loma Tio Guerrero and northwest of La Capilla in Tamaulipas, but the apertures and body whorls of the shells were missing (Kumpe n.d. a:600, 859).

Freshwater Mussel Shell

Plain Discs. Disc-shaped beads made from freshwater mussel shell are occasionally found on the Rio Grande Delta (Anderson 1932:30) and so plain discs made from mussel shell must have also been made, but plain discs are apparently rare and there are none in the authors' collections. Plain mussel shell discs may be in the Anderson Collection, but the only plain disc from mussel shell known to the authors is in the Bill Yoder Collection in Edinburg and it was found in Zapata County. The authors have recovered more than 20 freshwater mussel shell button blanks and a

Figure 31. Pendant made from a flame auger (*Terebra taurina*) by perforating the body whorl. From the Delta in Tamaulipas.

large number of button shells from property owned by Miguel Gomez in Mercedes, Texas. The button blanks are often weathered and some closely resemble plain discs from the Prehistoric Period, but they were apparently manufactured by a button company. The Continental Button Company opened in Mercedes in 1929 with 48 shell-cutting machines (Garrett 1929). Bill Burke of Harlingen (manager of the Rio Grande Button Company during the 1950s, personal communication 2009) remarks that the button factory changed hands during the 1930s and its name was changed to the Rio Grande Button Company; button blanks were manufactured in various sizes and shipped to Muscatine, Iowa for finishing into buttons, but inferior blanks were discarded in Mercedes. He also remarked that the local supply of Tampico pearlymussels *(Crytonaias tampicoensis)* was largely exhausted by the 1950s and the factory closed in 1955 because of the shortage of those mussels. During the Prehistoric Period, plain discs were also made from giant eastern murex, *Pleuroploca,* and whelk shell (see below).

Disc-Shaped Beads. Anderson (1932:30) remarks that beads made from freshwater mussel shell are occasionally found on the Rio Grande Delta. Mussel shells could have been obtained near the Gulf coast from the Arroyo del Tigre in Tamaulipas, from the Rio Grande, or from the Arroyo Colorado and the resacas (oxbows) in Cameron County. Freshwater mussel shell beads appear to be scarce on the coast of the Rio Grande Delta and there are none in the authors' collections. Salinas (1981:20) and MacNeish (1958:187, Table 29) mention bivalve beads and bivalves used to make flat beads, but the "bivalves" they refer to are not necessarily freshwater mussel shells. Ed Mokry (personal communication 2010) remarks that the only known freshwater mussel shell bead from Nueces County was found at 41NU33.

Pendants. Anderson (1932:30) remarks on freshwater mussel shell "gorgets" on the Rio Grande Delta (in this paper they are pendants). He describes them as incised or plain and illustrates a mussel shell

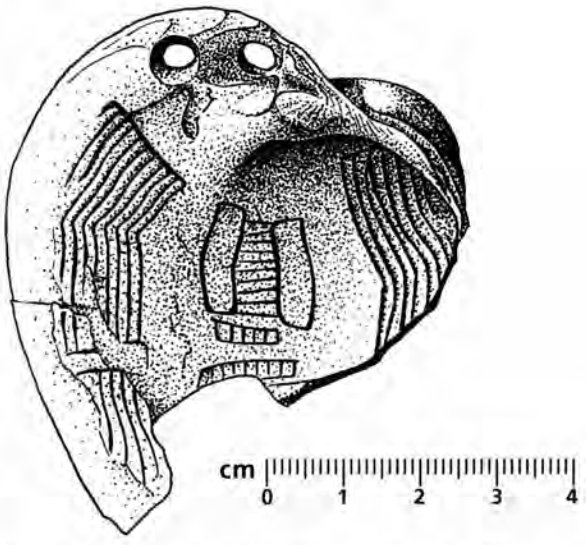


Figure 32. Decorated freshwater mussel shell pendant found in Cameron County in two pieces and partially restored (from Chandler and Kumpe 1997:12, Fig. 2c).

pendant with two perforations at one end. Zavaleta (1991: Figures 19 and 22) illustrates another mussel shell pendant from the Anderson Collection; it has two perforations at one end and appears to be incised with a design that includes chevrons. Chandler and Kumpe (1992: Figure 1F) illustrate a broken mussel shell pendant from Cameron County that is incised with 11 parallel vertical lines and a horizontal line across the top ends of the vertical lines. Another decorated mussel shell pendant from Cameron County is reported by Chandler and Kumpe (1997: Figure 2c). It is decorated with 2 longitudinal panels of parallel chevrons that are mirrored, each panel a repeat of the other with right and left reversed. The mirrored panels are equidistantly separated by a longitudinal medial panel of small glyph-like designs (see Figure 32). Seven pendants in the mirrored style were reported by Chandler and Kumpe (1992; 1997). Kumpe (2008) illustrates the seven pendants for comparison, reports an eighth specimen, and describes the mirrored style of mussel shell pendant.

Giant Atlantic Cockle

Pendants. Salinas (1981:20) remarks that the giant Atlantic cockle *(Laevicardium robustum)* was employed to make ornaments, but only three cockle shell pendants from sites on the coast of the Rio Grande Delta are in the authors' collections. Two of the pendants are complete and are illustrated; the largest is 4.8 mm thick and weighs 4.8 grams (see Figure 49b-c). The third pendant was apparently similar to Figure 49c. Cockle shell pendants were also manufactured at inland sites in Starr and Zapata counties (see Figure 54a-b), probably from broken cockle shell valves that were originally acquired for use as cups, bowls, ladles, scoops, and containers. A large cockle shell pendant was recovered from a burial at 41NU173 in Nueces County (Ed Mokry, personal communication 2010).

Giant Eastern Murex

Andrews (1977:150) remarks that the giant eastern murex *(Murex fulvescens)* can be found along the "entire" Texas coast, but Ed Mokry (personal communication 2010) remarks that there are no giant eastern murex shells in prehistoric sites in Nueces County and he has found none on beaches in the Corpus area. Despite its absence in Nueces County, the giant eastern murex is a common shell on beaches along the coast of the Rio Grande Delta, and is particularly common on the shell bar east of the southern Mar Negro in Tamaulipas (senior author's personal experience).

Plain Shell Discs. The body whorl of the giant eastern murex seems an unlikely material for the manufacture of discs and ultimately disc-shaped beads, but Salinas (1981:21), describing artifacts in the Anderson Collection, remarks that murex shell is broken, ground to remove the rough outer surface, and made into flat beads. There are a few plain murex shell discs in the authors' collections that appear to be blanks for beads. Plain discs were also made from whelk shell, *Pleuroploca*, and freshwater mussel shell (see).

Disc-Shaped Beads. Salinas (1981:21) remarks that murex shell is broken to make flat beads and ground to remove the rough outer surface. Beads made from the shell (body whorl) of the giant eastern murex *(Murex fulvescens)* appear to be rare on the Rio Grande Delta, but a few murex shell discs are in the authors' collections (see above).

Pendants. Salinas (1981:25), describing artifacts in the Anderson Collection, remarks that spines of the giant eastern murex (*Murex fulvescens)* were removed by percussion, ground into smooth conical form, and perforated at the tips to make pendants. There are no known murex spine pendants outside of those in the Anderson Collection.

Oliva sayana

The bulk of sites which contain *Oliva* beads and tinklers are along the (lower) Rio Grande (Terneny 2005:210). The *Oliva* whorl pendants described below (see Figure 34) are common artifacts in the coastal zone of the Rio Grande Delta. They are rarely found elsewhere, but an *Oliva* whorl pendant perforated at one end was found in northeastern Hidalgo County (Kumpe n. d. b), and an *Oliva* pendant with a transverse perforation was found in Zapata County (see Figure 54c). Newton (1963:10) illustrates a perforated section of *Oliva* whorl from Arroyo los Olmos in Starr County; it may have been worn as a pendant, but it is unlike *Oliva* whorl pendants from the coast.

Oliva Beads. These simple artifacts were made from the lettered olive *(Oliva sayana)* by removing varying lengths of the spire (see Figure 33c). They are common finds in sites on the coast of the Rio Grande Delta and may sometimes occur as grave goods in burials farther inland (see Hester 1980:74, Figure 4.10b-c). Harvey Bruns (recently deceased) recovered 28 *Oliva* beads (27 complete) from a burial

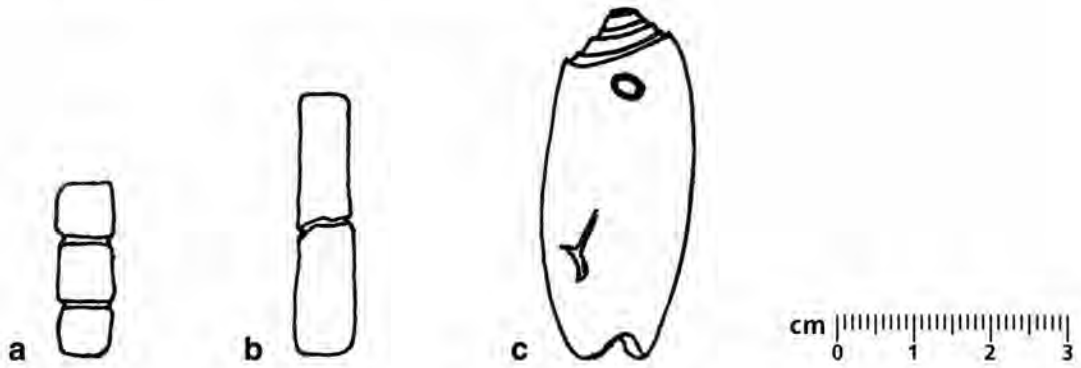


Figure 33. Artifacts from a burial at the Bruns site south of Alamo in Hidalgo County: a-b, incised bone beads; c, *Oliva* bead perforated by marine organisms is one of 28 that were apparently dead-gathered.

near the Arroyo Colorado south of Alamo in Hidalgo County (10 disc-shaped whelk whorl beads and 57 tubular bone beads were also recovered). Examined by the senior author, the 27 intact *Oliva* beads from the Bruns site ranged from 41.5 to 60 mm in length with an average length of 49.2 mm. All 28 of the beads were either perforated by marine organisms or had damaged apertures consistent with beach-rolled shells. All but 7 had both types of damage and it appeared that all of the *Oliva* beads from the Bruns burial had been dead-gathered; the illustrated bead has been perforated by marine organisms (see Figure 33c). Three *Oliva* beads are reported from a burial at Southern Island in Falcon Reservoir, Tamaulipas (Boyd et al. 1997:399, Figure 13). Ekholm (1944:480, Figure 52V) reports *Oliva* beads in use among the Huasteca in Mexico. Dockall and Dockall (1996:214, Table 2) report 18 *Oliva sayana* beads at Morhiss (41VT1), an Archaic site in Victoria County, Texas. Terneny (2005: Table 9.3) lists *Oliva* beads from Archaic Period sites in Texas and along the lower Rio Grande in Tamaulipas. Ed Mokry (personal communication 2010) remarks that *Oliva* shells are rare on beaches in the Corpus area and only 4 or 5 *Oliva* beads have been found on Oso Creek, at 41NU33, 41NU164, and three from an unrecorded coastal praire site. By contrast, more than 100 sizable *Oliva* may come ashore in a matter of hours at a well known shell bar east of the southern Mar Negro in Tamaulipas (senior author's personal experience). During an examination of the species and quantities of shells used to decorate 20th century graves in rural Matamoros County, Tamaulipas, it was found that locals see the *Oliva* shell as sexually symbolic and therefore unsuitable to decorate graves; the symbolism attached to the *Oliva* shell appears to be a local carry over that may give insights into the use of *Oliva* beads (Kumpe n. d. c).

Oliva Pendants. Roughly rectangular sections of body whorl from the lettered olive *(Oliva sayana)* were used to manufacture pendants that usually have a single perforation at one end or a single perforation at or near center (see Figure 34), but a few have two perforations at or near center. Anderson (1932: Plate 7, Figure 13) illustrates *Oliva* whorl pendants that were identified by C. K. Chandler (personal correspondence 1993), all four perforated at or near center. MacNeish (1958) makes no mention of *Oliva* whorl pendants. Salinas (1981:23) calls them beads, probably because they are often centrally perforated. He mentions a lack of manufacturing debris in the Anderson Collection that would indicate how the sections of *Oliva* whorl were removed (by cutting or percussion). Fortunately, Lily Kumpe recovered rarely intact *Oliva* pendant manufacturing debris with overlapping cuts from grooving-and-snapping (see Figure 34a-aa); the narrow cuts or grooves in the *Oliva* whorl may have been made by a flake tool or thin biface. Finished *Oliva* pendants are sometimes much thinner than the shell they were made from because the exteriors of some *Oliva* pendant blanks were apparently ground to remove the natural brownish markings of the shell (see below).

The Ground Exteriors of *Oliva* Pendants. After noticing that some *Oliva* whorl pendants seemed unusually thin, a section of *Oliva* body whorl was cut from a beach-gathered shell and the extracted whorl was indeed much thicker than the whorl of some finished pendants. *Oliva* shells have a cream-colored background with brownish zigzag markings (Andrews

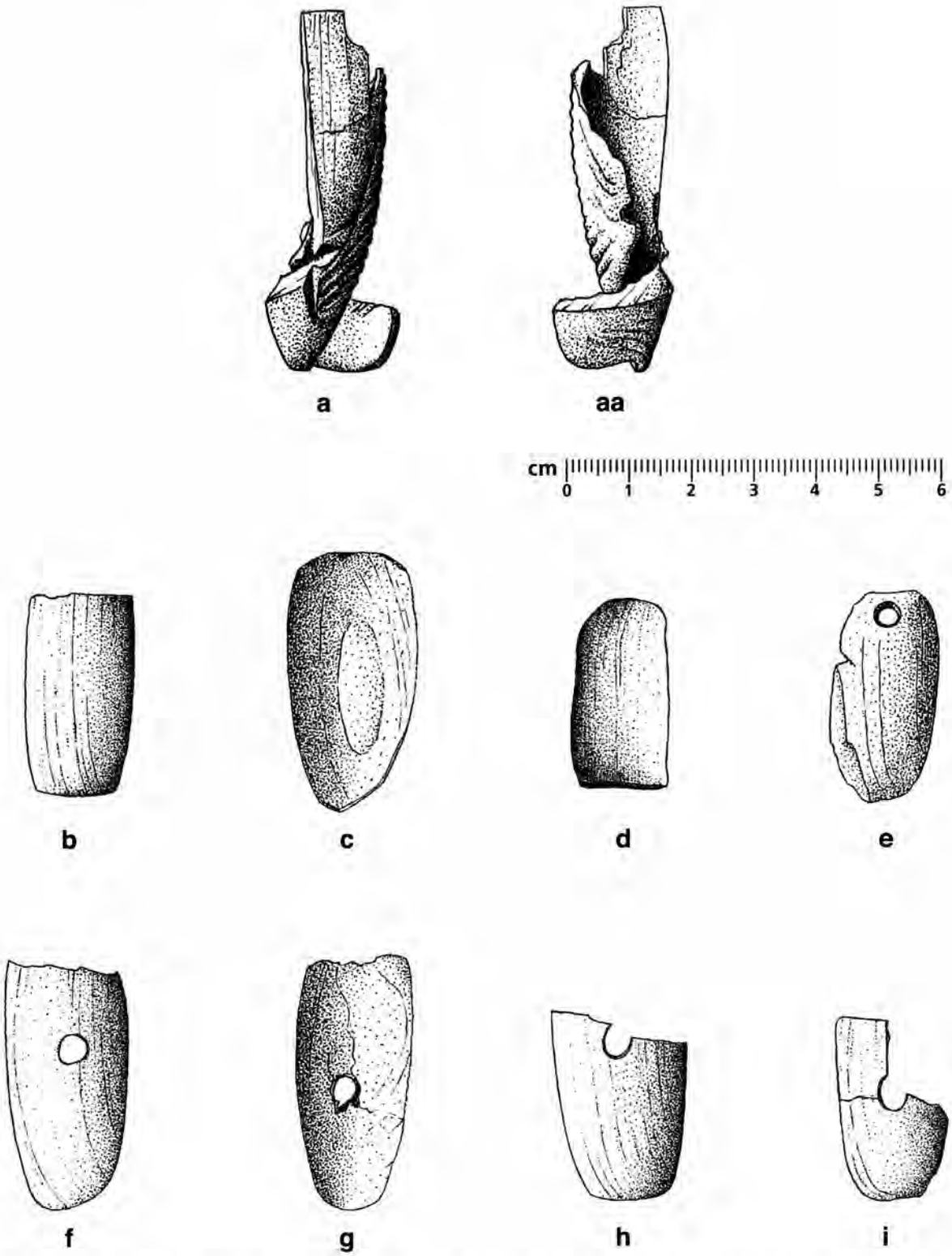


Figure 34. *Oliva* whorl pendants and related artifacts: a, aa, rarely intact manufacturing debris; b-d, preforms; c, oval facet at center of this preform is the start of grinding to remove the shell's natural markings; e, a pendant perforated at one end; f-i, *Oliva* whorl pendants perforated at or near center. Some pendants are delicate, thinned by grinding to remove the shell's markings.

1977:153) and Indians apparently ground the exteriors of some *Oliva* whorl pendant blanks to remove the brownish markings. More than half a millimeter of the shell was removed to achieve a uniform cream color. Removing the brownish markings was apparently a two step process of grinding and then smoothing. A ground facet in the center of an *Oliva* whorl pendant blank (or preform) is apparently an initial effort to remove the markings (see Figure 34c). The facet exhibits numerous abrasions from the coarse grains in Gulf sandstone that are not seen on finished *Oliva* pendants. The brownish markings were apparently removed by grinding with Gulf sandstone and then the shell was smoothed to remove abrasions, perhaps with wet pumice which Salinas (1981:29) found to be an effective polishing tool.

Oliva Tinklers. Small shell bells known as tinklers were made from the lettered olive *(Oliva sayana)* (see Figure 35) and are common artifacts of the Brownsville and Barril Complexes (MacNeish (1958:187, Table 29). Perforated coyote (or dog?) canines usually served as clappers. Salinas (1990:120) remarks that most of the Indians of northern Tamaulipas and southern Texas probably kept dogs. However, a tinkler from a burial on the coast of the Rio Grande Delta contained a tiny whelk shell pendant that served as a clapper; a second tinkler from the same burial contained a typical canine clapper (Anderson (1932: Plate 7, No. 14). Examined by the senior author at TARL during the mid 1980s, the whelk shell clapper is similar to tiny whelk shell pendants that are usually found in sites on the Tamaulipas side of the Rio Grande (see Figure 46a-c). Tinklers are rare in the Corpus Christi area (Ed Mokry, personal communication 2009), but they are common surface finds in sites on the coast of the Rio Grande Delta, where large numbers were apparently manufactured. They are also commonly found in burials. Four tinklers, two with perforated canine clappers in place, were found in a burial at the Floyd Morris site (41CF2) north of Harlingen in Cameron County (Collins et al. 1969:144), which dates to the Archaic Period (Terneny 2005:198). Two tinklers were associated with a burial at the Ayala site (41HG1) south of McAllen in Hidalgo County (Hester and Ruecking 1969:149), which dates in the Late Prehistoric (Terneny 2005:197). Flores (1995) describes tinklers found with their canine clappers, the *Oliva* shells and canines found clumped around the hand bones, in the Guerra site (41HG173), a burial north of Edinburg in Hidalgo County. Tinklers from inland sites along the lower Rio Grande are also reported in this paper (see below and see Figure 53c-d). Mokry (1979) reports a tinkler at 41SR251 in Starr County. Boyd et al. (1997:399) report five tinklers from a burial at the Southern Island site in the northern portion of Falcon Reservoir, Tamaulipas; two of the tinklers from Southern Island are perforated by drilling

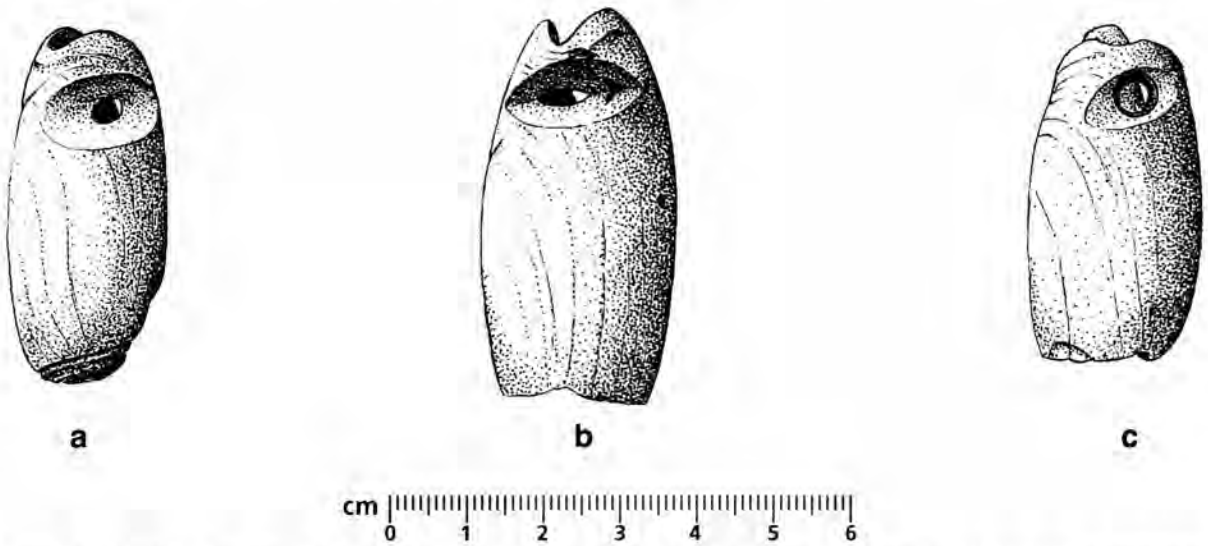


Figure 35. *Oliva* tinklers, small shell bells from the coast of the Rio Grande Delta: a, has a u-shaped transverse perforation made by grinding with Gulf sandstone; b, a V-shaped transverse perforation made by a biface tool; c, a U-shaped transverse partial perforation completed by drilling. Conical perforations made by drilling straight through are rare on the coast, but comparatively common in tinklers from inland areas along the lower Rio Grande. Drawings by Richard McReynolds.

straight through (a method for perforating tinklers that is rarely seen on the coast). They also remark that tinklers are occasionally reported as isolated finds in Falcon Reservoir sites. Two transversely perforated tinklers were found as burial goods at the Mitchell Ridge site (41GV66) on Galveston Island; one is decorated by notches, an incised line, and punctates (Ricklis 2004b:198, Figure 6.17). Tinklers have been documented at 41NU11, 41NU233, and 41NU164 in Nueces County (Ed Mokry, personal communication 2010). Widely dispersed in Mexico, tinklers have been found among the Huasteca (Ekholm 1944:480, Figure 52p-t), in Coahuila (Avelyra Arroyo de Anda et al. 1956; Utberg 1969:Part 1, 38-40), in a burial at Chupicuaro, Guanajuato (Flores 1992:156), and tinklers may still be in use among the Yaqui. Luis Reynoso (Obispo de Cuidad Obregon, Sonora, personal communication 1990) remarked that a Yaqui dancer representing the deer during the *Danca de Casirea de Venado* in Potam, Sonora in 1982 wore 4 layers of *Oliva* tinklers on each of his wrists and ankles.

To Manufacture *Oliva* Tinklers. The spire of the *Oliva* was removed by percussion (Salinas 1981:22-23), but the shell lacked resonance until a few additional hammer blows severed the whorl connection. Using a wood anvil and a quahog shell as a hammer it took an average time of 36 seconds to remove the spire and sever the whorl connection (Chandler and Kumpe 1998:20). Indian craftsmen sometimes smoothed the crushed edges, but always made a perforation near the siphonal end to suspend the tinkler and to suspend a clapper within the tinkler (see Figure 35a-c). Transverse U-shaped perforations were made by grinding with Gulf sandstone (Figure 35a), transverse V-shaped perforations were made by cutting with flake or biface tools (Figure 35b), or transverse partial perforations were made with one of these tools and completed by drilling (Figure 35c). Conical perforations made by drilling straight through are seldom found on tinklers from coastal sites, but are comparatively common on tinklers from inland sites along the lower Rio Grande (authors' personal observations). After replicating *Oliva* tinklers, it was found that a greater part of the melodic sound is derived from contact between the resonant suspended *Oliva* shells, far less sound deriving from contact between the clappers and shells. Anderson (1932: Plate 7, No. 14) illustrates an *Oliva* tinkler tied to a clapper made from whelk whorl, but clappers were usually coyote (or dog?) canines, which are easily perforated and narrow enough to fit within the majority of tinklers. Tiny whelk whorl pendants that closely resemble Anderson's whelk shell clapper are sometimes found in sites on the coast of the Rio Grande Delta in Tamaulipas (see Figure 46a-c).

Pleuroploca Columella

Columella Pendants and Columella Tubular Beads. Salinas (1981:21) remarks that *Pleuroploca* was used in the production of columella beads and pendants (see Figure 21). Also see whelk columella (below).

Pleuroploca Whorl

Plain Shell Discs. A well rounded plain shell disc in the senior author's collection is easily identified as *Pleuroploca* because the exterior side of the shell is not ground. It has a maximum diameter of 21.2 mm and it is from 2.3 to 9.2 mm thick. The interior side of the disc is partially flattened by grinding, but remains concave at center. In cross section the disc is concave-convex. It may have been discarded because of the work required to grind it flat (to 2.3 mm), perhaps hardly worth the effort. There are also plain discs made from *Pleuroploca* whorl in the Krzywonski Collection. Plain shell discs were also made from freshwater mussel shell, giant eastern murex, and whelk shell.

Disc-Shaped Beads. *Pleuroploca* body whorl was broken, ground to remove the rough outer surface, and used to make flat beads (Salinas 1981:21). Plain discs in the authors' collections also indicate that *Pleuroploca* whorl was used to make flat or disc-shaped beads, but the finished beads are apparently indistinguishable from those made from whelk whorl (see below).

Gorgets and Pendants. Gorgets in this paper have at least two centrally placed perforations, but MacNeish describes the engraved basal half of a broken triangular "gorget" perforated at the corners (see below). From a recent photo by Tom Hester, it can be seen that a large *Pleuroploca* gorget in the Anderson Collection has two perforations at center, parallel rows of punctuates that create a cross-shaped design on the interior side of the shell, and edge notches around the circumference of the ornament that incline toward the deeply concave interior side of the shell (see Figure 36).There is a broken pendant made from *Pleuroploca* whorl in the Krzywonski Collection (his specimen # 333), but pendants or gorgets made from *Pleuroploca* whorl appear to be rare. Discrete *Pleuroploca* reduction stations are sometimes encountered in sites near the coast in Tamaulipas, where fragments of conch whorl and spire litter the ground. Plain discs, perforated fragments of conch whorl, and cut (grooved-and-snapped) fragments

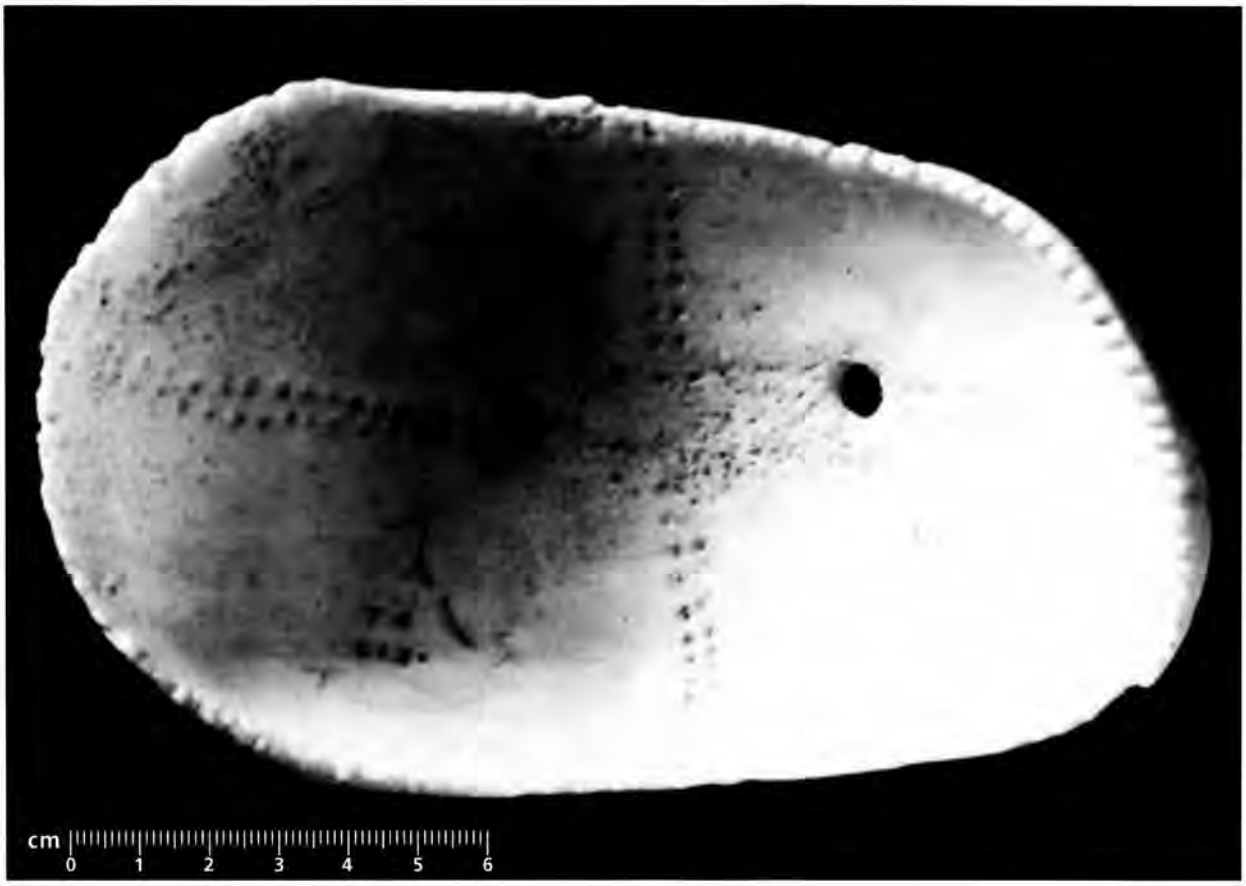


Figure 36. *Pleuroploca* gorget from the Anderson Collection. Photo is of the deeply concave interior side of the shell, which is decorated with edge notches and parallel rows of punctuates. Perforations are off-center. Photo by Tom Hester

of *Pleuroploca* whorl are sometimes found in the reduction debris, but the columella is always missing. Reduction stations and the artifacts recovered from them suggest that more use was made of *Pleuroploca* whorl for ornaments than the few conch whorl ornaments in the authors' collections would suggest. Two broken pendants (or gorgets?) made from *Pleuroploca* whorl are reported from inland sites near Falcon Dam in Starr County, but only outlines of the artifacts were available and they may be from the Archaic Period (see Figure 55a-b).

Scallop

Scallop Shell Arm Band. MacNeish (1958:188, Table 29) lists one "scallop shell arm band" in the Anderson Collection; it is from a site in Tamaulipas, but he gives no further description. The lion's paw *(Lyropecten nodosus),* which reaches a size of 152 mm (Andrews 1977:203), appears large enough for the manufacture of an arm band. The lion's paw is occasionally found on beaches on the coast of the Rio Grande Delta in Tamaulipas, but the authors have not found it in prehistoric sites. Arm bands were also made from whelk whorl (see below).

Small Gastropods

Marginella Beads. The common Atlantic marginella *(Prunum apicina)* is a small (to 12 mm) cream colored gastropod with a short spire; not recently reported alive, it is probably fossil on the Texas coast (Andrews 1977:155). This small sturdy shell was widely popular with Indians who used it for beads and found various ways to perforate the shell. MacNeish (1958:187, Table 29) lists only a few marginella beads in a few of Anderson's sites, 14 from three Cameron County sites and 2 from a site in Tamaulipas. There may, however, be hundreds in burials. The illustrated marginella beads are perforated just below the spire near the aperture (see Figure 37), but Collins et al. (1969: 143, Figure 9) report marginella beads from

Figure 37. *Marginella apicina* beads from the Rio Grande Delta: a, one of 254 carefully drilled beads exposed by erosion near El Huizachol; b-c, exposed by plowing activities in Cameron County, these are two of 1,178 beads that were perforated by breaking.

the Floyd Morris site (41CF2) in Cameron County that were perforated by removing the short spires (probably by percussion). A. E. Anderson uncovered a burial on 14th Street in Brownsville that contained numerous marginella beads (Hester 1969a from Anderson 1933), but there is no description of the perforations. Other burials on the Rio Grande Delta have contained large numbers of marginella beads. A burial exposed by erosion near El Huizachol, Tamaulipas contained 254 carefully perforated marginella beads and there was a confetti-like scatter of shell bits, the remnants of beads crushed by cattle. Marginella beads from the Huizachol burial were uniformly perforated by drilling (see Figure 37a). Mike Krzywonski recovered 1,178 marginella beads from a burial exposed by plowing activities in Cameron County; the beads were perforated by breaking, which is a method for perforating shell that was mentioned by Anderson (1932:31) (see Figure 37b-c). Marginella shells and/or beads were widely transported or traded. There were 3,045 marginella beads at Morhiss (41VT1), an Archaic site in Victoria County, Texas (Dockall and Dockall 1996:214, Table 2). Heartfield (1980:73-74) remarks on marginella beads found in or near Laguna Mayran and in the Desierto de Charcos de Risa in southwestern Coahuila, Mexico. Ladassor (2001), from Titterington (1948), remarks on thousands of marginella beads that were found in the Powell Mound in Missouri.

Nerite Beads. A few virgin nerite *(Neritina virginea)* beads from sites on the coast of the Rio Grande Delta are in the authors' collections. They were all perforated by grinding. Salinas (1981:23) remarks that small gastropods like *Neritina reclivata* (the olive nerite) were perforated by grinding or drilling to form pendants (with no other alteration), but in this paper they are beads. Andrews (1977:75-76) remarks that *N. reclivata* is rare, while *N. virginea* is common, occurring more to the south, but both reach a size of 12 mm. It appears that both species were perforated and used as beads.

Plicate Horn Shell Beads. Beads made from the plicate horn shell *(Cerethida pliculosa)* are in the Anderson Collection (Steele 1988:235). The few plicate horn shell beads in the Krzywonski Collection were perforated by breaking, which is the same method used to perforate the 1,178 marginella beads from a burial in Cameron County (see above).

Shark's Eye Beads. There is a juvenile shark's eye *(Polinices duplicates)* with a ground perforation in the Krzywonski Collection. Although the shark's eye reaches a diameter of at least 72 mm (Krzywonski 2004), the perforated juvenile (19.8 mm in diameter) is included here as it is similar in size to the small gastropods and appears to have been used as a bead in the same manner as the small gastropods.

Sunray

A large, centrally perforated sunray venus *(Callista nimbosa)* shell disc with decorative edge notches was found in the Corpus area (Ed Mokry, personal communication 2010), but there are no known sunray ornaments from the coast of the Rio Grande Delta.

Whelk Columella

MacNeish (1958:187-188, Table 29) lists 21 "columella fragments" from 9 sites in Cameron County as "aberrant artifacts"; they may be analogous to columella manufacturing debris the authors refer to as siphonal end discards. Columella discards are small sections of columella that were grooved-and-snapped to separate them from the larger missing sections that may have been used to make one or more ornaments or plugs. Some columella discards are siphonal ends that were heavily ground, some to a point, before they were severed from the larger section (see Figure 38). The majority of siphonal end discards retain a portion of the siphonal canal on one side (see Figure 38gg) and a few were opportunistically used as blanks to make small columella pendants. A siphonal end discard used to make a small pendant was perforated at the pointed end after the point was ground flat (and after notches were ground on two sides to facilitate drilling). The opposite end was ground to remove the jagged edges of snapped shell, but the prominent groove was left in place (see Figure 39l). Another siphonal end discard was apparently intended for a pendant, but left in a late stage-of-production (see Figure 38g-gg).

Columella Pendants. Five columella pendants are illustrated by Anderson (1932:Plate 7, No. 13), but these common ornaments are not mentioned by MacNeish (1947, 1958). Prewitt (1974:59) lists columella pendants among the ornamental shell artifacts from Rio Grande Delta sites. Twelve columella pendants found on the coast of the Rio Grande Delta are illustrated (see Figure 39a-l). They all have a single perforation at one end and most retain the twist in the columella, but four (b, f, k-l) are so heavily ground that the twist in the columella is eliminated. Six (a, e, g, i, k-l) were ground on two sides with Gulf sandstone to facilitate drilling. One (k) is decorated with edge notches around the circumference of its proximal end and one (l) is made from manufacturing debris, from a siphonal end discard (see Figure 38). All of the known columella pendants found in the immediate vicinity of the coast have a single perforation at one end, but a columella pendant found in Hidalgo County is grooved for suspension and may be from the Archaic Period (see Figure 54g).

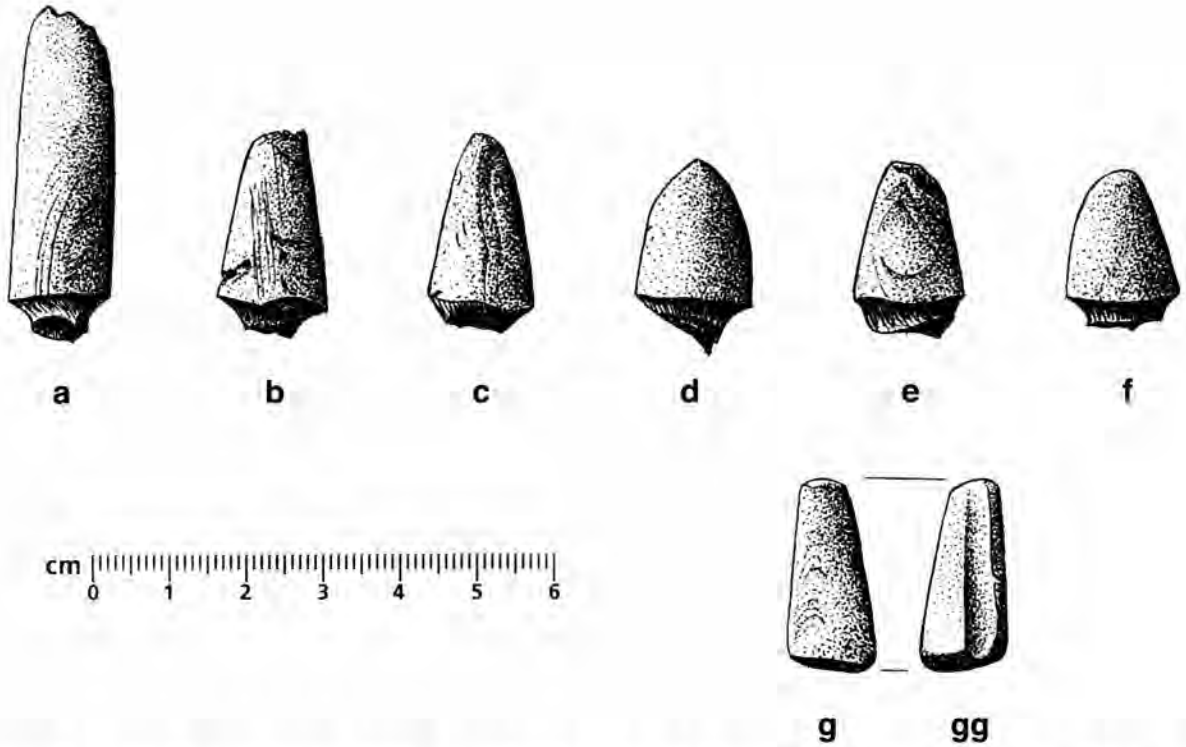


Figure 38. Columella manufacturing debris: a-g, siphonal end discards from sites on the coast of the Rio Grande Delta in Tamaulipas; g-gg, apparently intended for a pendant like Figure 39l, but left in a late stage-of-production. All have been grooved-and-snapped at the wide end.

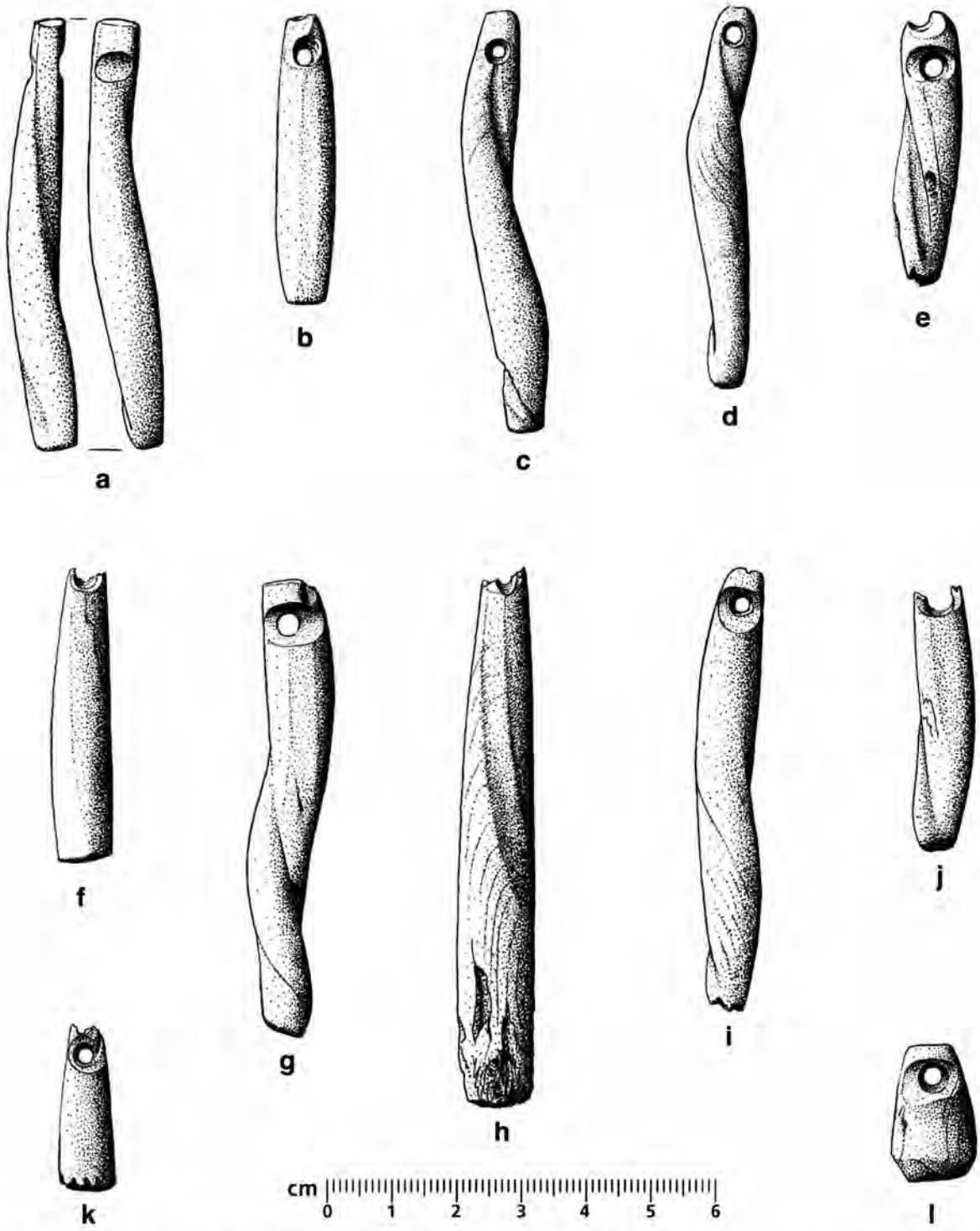


Figure 39. Columella pendants from sites on the coast of the Rio Grande Delta, Tamaulipas and Cameron County: a, a late stage-of-production; a, e, g, i, k, l, ground on two sides to facilitate drilling; b, f, k, l, ground so heavily that twist in the columella has been eliminated; e, salvaged; k, decorated with notches; l, made from a siphonal end discard (see Figure 38). Drawings by Richard McReynolds.

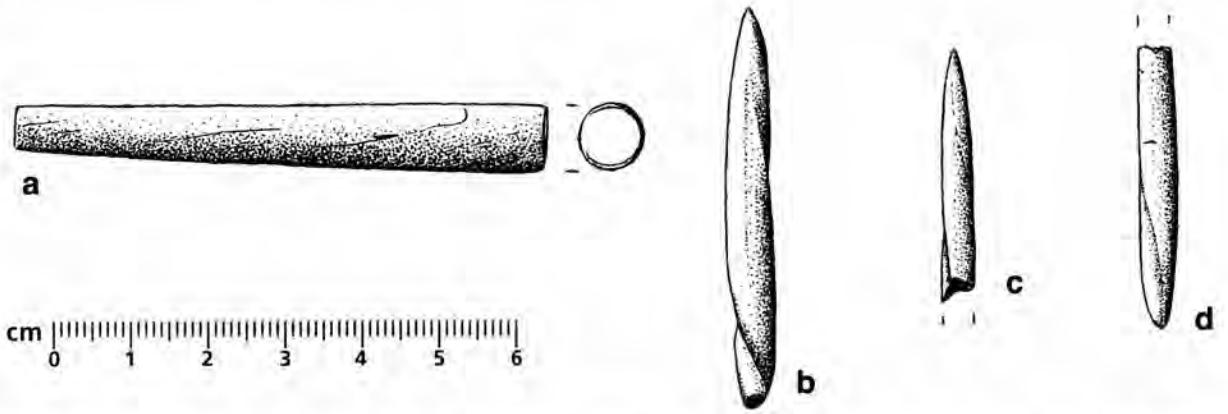


Figure 40. Columella plugs: a, columella plug round in cross-section with flattened ends; b-d, pointed end columella plugs, possibly the same as Anderson's (1932:30) "plugs for drills" and MacNeish's (1958:188, Table 29) "columella drills".

Columella Plugs Round in Cross-Section. MacNeish (1958:191) remarks that these are the same as the tubular beads except that they have not been pierced lengthwise. He apparently views these heavily ground artifacts with flattened ends solely as blanks for tubular beads and he makes no mention of the heavily ground columella pendants illustrated by Anderson (1932: Plate 7, No. 13). Columella pendants are sometimes so heavily ground that all trace of twist in the columella is eliminated (see Figure 39b, f, k-l). Salinas (1981:22, Figure 2), illustrating shell technology, demonstrates that columella plugs round in cross-section were used as blanks for both columella tubular beads and columella pendants. A finely crafted columella plug from 41CF8 in Cameron County is illustrated; it is highly polished, tapered, has flattened ends, and may be a finished ornament (see Figure 40a). However, the overwhelming majority of columella plugs round in cross-section are apparently blanks, preforms used to make tubular beads or columella pendants.

Columella Plugs Square in Cross-Section. Ranging from 8 to 25 mm in width and from 7 to 40 mm in length, these are in both the Brownsville and Barril Complexes (MacNeish 1958: 191). They may be an earlier stage-of-production, a method of producing columella plugs that are round in cross-section. Columella plugs that are square in cross-section appear to be scarce and there are none in the authors' collections.

Columella Tubular Beads. Anderson (1932: Plate 7, No. 14) appears to illustrate columella tubular beads, but they are not identified and some may be plugs. Columella tubular beads in the Anderson Collection range between 11 and 22 mm in diameter and are from 4 to 100 mm in length (MacNeish 1958:191). They are sometimes polished (Salinas 1981:21) and may be so heavily ground that the twist in the columella is eliminated. Specimens in the authors' collections are often in various stages-of-production and some were discarded because of failed perforations. Mike Krzywonski (personal communication 2009) found a cache containing seven columella tubular beads in Cameron County, but he recovered only five of the seven beads (see Figure 41a-e). Tapered at each end, Krzywonski's five beads have an average maximum thickness of 10.2 mm, range in weight from 5.8 to 8.2 grams, and have an average weight of 6.65 grams. Two of the seven beads in the Cameron County cache were recovered by Alfonso Garcia (recently deceased) of San Benito. The Alfonso Garcia Collection, including the beads from the Cameron County cache (Alfonso's site C23), is permanently on display in the San Benito Historical Society Museum. MacNeish (1958: 188, Table 29) lists a "columella drilled at the side" from one of Anderson's sites in Cameron County, but gives no further description. A columella tubular bead (13 mm thick and 60 mm in length) from one of the Wedemeier sites in Victoria County is drilled in the side at the center of the bead to connect by-passed holes drilled from the ends (Janota 1980:40, Figure 3). A columella tubular bead packed with red ocher was found in Nueces County at 41NU163 (Ed Mokry, personal communication 2010). Columella tubular beads are also reported from inland sites along the lower Rio Grande (see Figure 54e, h, j).

Drilling Columella Tubular Beads. Janota (1980:36) remarks that a soft bone drill used with an abrasive, usually sand, is useful for drilling deep holes

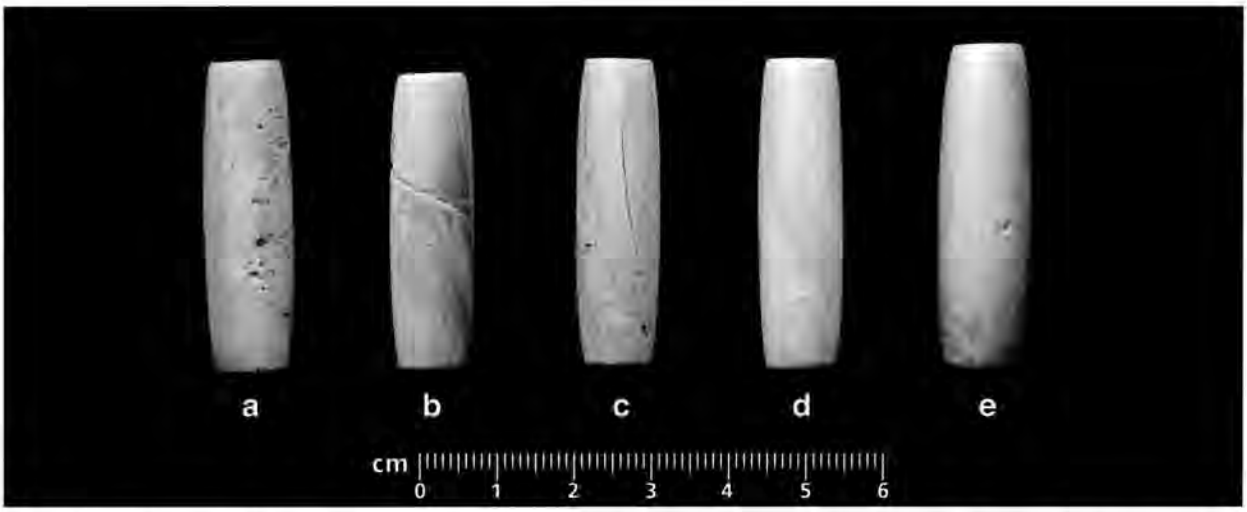


Figure 41. Columella tubular beads: a-e, five of seven beads from a Cameron County cache. These were recovered by Mike Krzywonski; two others were recovered by Alfonso Garcia of San Benito. All seven of the beads taper slightly at their ends. Photo by Mike Krzywonski.

in long tubular beads. Salinas (1981:28) mentions a bone drill found embedded in a columella tubular bead in the Anderson Collection; he also remarks that the tips of bone drills may remain rounded or a delicate cylindrical tip may form. Cylindrical tips on bone drills were probably formed as the partial perforation from one end of a tubular bead began to grind into the partial perforation drilled from the opposite end. Cylindrical tips might also form when a bone drill encountered a natural perforation made from the side of the columella by a marine organism. A bone drill found on Loma Ochoa in Cameron County has a rounded, highly polished tip and the proximal end was ground on two sides to thin it for hafting. Failed perforations in discarded columella tubular beads in the authors' collections show that drilling was from both ends.

Pointed Columella Plugs. These delicate, well made artifacts are finely pointed at one end and bluntly rounded at the other (see Figure 40b-d). Found in Cameron County and Tamaulipas, pointed columella plugs are round in cross-section and appear to be finished ornaments to pierce a part of the body. They are possibly the same as Anderson's (1932:30) "plugs for drills" and MacNeish's (1958:188, Table 29) "columella drills," but no use wear can be found on the tips and the proximal ends are usually blunt. Mike Krzywonski (personal communication 2001) recovered two pointed columella plugs from a site near South Bay in Cameron County, one within inches of the other. Speculation is that they pierced cartilage in the top of the ear.

Whelk Whorl

The whelk whorl ornaments are divided into three parts: small shell discs, long rectangular ornaments, and pendants. Anderson (1932: Plate 7, No. 14) illustrates 26 small shell discs, including plain shell discs, disc-shaped beads, and one imperforate decorated disc. MacNeish (1958:190-191) reports "shell discs" and "perforated shell discs." They are plain shell discs and disc-shaped shell beads (or flat beads) in this paper, which includes imperforate decorated discs and decorated bead-like ornaments (see below). The conch/whelk shell gaming discs mentioned by Anderson (1932:30) are presumed to be small shell discs, but were tools for gambling (see above).

Small shell discs

Plain Shell Discs. Anderson (1932: Plate 7, No. 14) illustrates plain shell discs that appear to be made from whelk whorl. MacNeish (1958:187, Table 29) shows large numbers of shell discs from Cameron County and Tamaulipas in the Anderson Collection. Plain shell discs are generally small and usually have percussion-shaped edges, but all stages of bead manufacture are present (see Figure 42d-e). Salinas (1981:20-21) remarks that flat beads may be round, square, rectangular, or triangular and so plain shell discs may also take these shapes. The majority of shell discs were apparently intended for the manufacture of disc-shaped beads, but some were used

to manufacture other types of ornaments, including imperforate decorated discs (see below and see Figure 42a-b). Plain shell discs are common surface finds in sites on the coast of the Rio Grande Delta, where large numbers of disc-shaped beads were apparently manufactured, but they are rarely found in sites farther inland. Plain shell discs were also made from *Pleuroploca*, giant eastern murex, and freshwater mussel shell (see above).

Manufacturing Plain Shell Discs From the Knobs of Large Whelks. On the coast of the Rio Grande Delta, the overwhelming majority of plain shell discs (and ultimately disc-shaped beads) were made from whelk whorl. However, plain shell discs were also made from the knobs (spines) of large whelks. Rough discs made from knobs, flattened and rounded discs made from knobs, and partially perforated discs made from knobs are in the authors' collections (see Figure 42d-e). During experiments to flatten the knobs of large whelks with a quahog hammer (Chandler and Kumpe 1998), it was found that continuing to hammer a whelk knob after it was flattened would eventually punch a roughly circular disc of shell (with the reduced knob at its center) through an otherwise intact large whelk. Discs extracted by hammering may have a distinctive raggedy look (see Figure 42d-e). Plain discs made from whelk knobs in the authors' collections demonstrate that Indians on the coast of the Rio Grande Delta used hammering to manufacture plain discs from knobs and used the discs to make thick beads. Although they are often unusually thick, the origin of finished beads made from knobs can seldom be determined, but see Figure 42f.

Imperforate Decorated Discs. Anderson (1932: Plate 7, No.14) illustrates a small, imperforate shell disc with an incised design; although imperforate, it appears to be a finished artifact. Three imperforate decorated discs are reported in this paper, each incised with a ray-like design on the interior sides of the shells. The three shell discs are described (below) and two are illustrated (see Figure 42a-b). All three are delicate, ranging from 1.5 to 2.2 mm in thickness, and were found along the lower Rio Grande, in Cameron, Hidalgo, and Zapata counties. The ray-like design on the discs may be symbolic (Krzywonski refers to his specimens as "sunbursts") and the distribution of these artifacts probably indicates a region of cultural contact and shared beliefs.

Figure 42a illustrates the largest of three imperforate shell discs with a ray-like design. There are 34 closely spaced notches around the circumference of the disc. The notches extend into incisions toward the center of the disc in tapering, generally triangular shapes of varying lengths and widths. Although it lacks a suspension hole, it is apparently a finished ornament. The diameter of the disc is 22.8 mm. It is 2.2 mm thick, and weighs 1.8 grams. Richard Brady recovered this ornament from a site on the northeast corner of Ware Road and Expressway 83 in McAllen. The new McAllen Civic Center was later built directly over the site, which was well known and often visited by local collectors.

Figure 42b illustrates the smallest of three imperforate discs with a ray-like design. It has a maximum diameter of 19.2 mm, a maximum thickness of 1.5 mm, and weighs 0.7 grams. There are 21 closely spaced notches around its circumference on the interior side of the shell. The notches, like those of the other discs with a ray-like design, extend toward the center of the disc in tapering, generally triangular-shaped incisions of varying lengths and widths. This artifact has a tiny off-center hole (left of center in the drawing), apparently formed when a small bit of the thin shell layer beneath one of the incisions broke away. If the hole was created during manufacture it is believed to have been unintentional, but the break probably occurred later. Mike Krzywonski found this ornament near Resaca de los Fresnos in Cameron County.

The third imperforate disc with a ray-like design (Krzywonski's specimen # 253) is not illustrated. Its incised design is like that of the previous two ornaments (above), but there are 28 notches around its circumference that extend into incisions on the interior side of the shell. This ornament has a maximum diameter of 22 mm, a maximum thickness of 2 mm, and weighs 1.4 grams. It was recovered from a burial in Zapata County (T. L. Donohoo, personal communication to Mike Krzywonski 1997).

Disc-Shaped Beads. Disc-shaped shell beads, also called flat beads, may be round, square, rectangular, or triangular (Salinas 1981:20-21). They are centrally perforated, but sometimes off-center, and perforations may be conical or biconical. Usually the perforations are biconical, although the overwhelming majority of perforations were apparently initially made by drilling straight through from the interior side of the shell (see below). Anderson (1932: Plate 7, No.14) illustrates centrally perforated disc-shaped shell beads that appear to be made from whelk whorl, but *Pleuroploca* whorl was also utilized and the finished beads made from *Pleuroploca* are apparently indistinguishable from those made from whelk shell (see above). Nevertheless, the overwhelming majority of plain shell discs, which are usually blanks for disc-shaped beads,

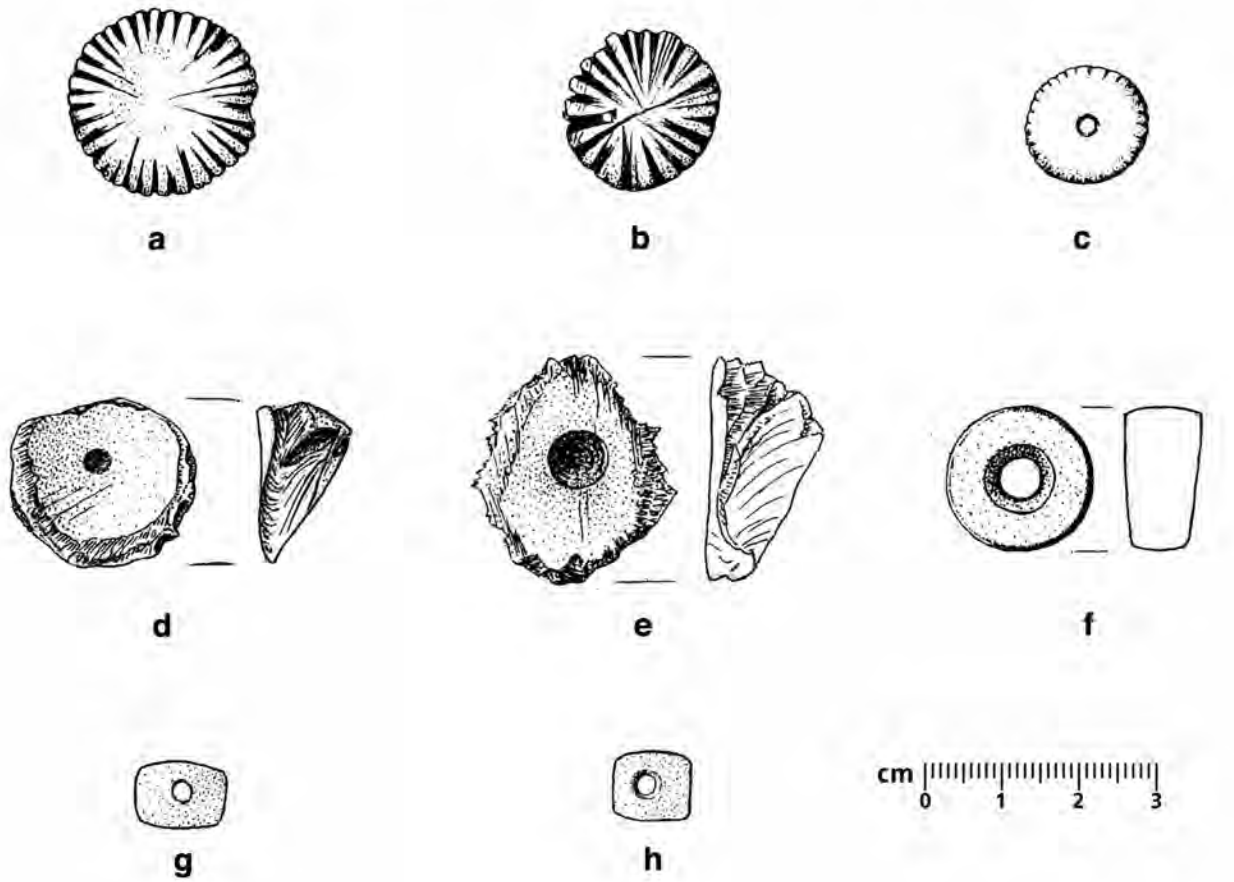


Figure 42. Small shell discs: a-b, imperforate decorated discs with a ray-like design; c, decorated bead-like ornament; d-e, partially perforated whelk knobs flattened and extracted by hammering; f, a thick disk-shaped bead possibly made from a knob; g, a small rectangular bead; h, a square bead perforated slightly off-center. Drawings by Richard McReynolds.

appear to be made from *B. perversum*, and so then are the overwhelming majority of finished beads. Large numbers of disc-shaped beads were apparently manufactured in coastal areas of the Rio Grande Delta; MacNeish (1958:190-191) shows large numbers of centrally perforated shell discs (disc-shaped beads) in some of Anderson's sites. Although the majority of disc-shaped beads were apparently intended for stringing, Dreiss (1995:536) remarks that they were probably also used as buttons, garment ornaments, and for other utilitarian functions. Examples of their diverse use include disc-shaped whelk shell "beads" that were tied into rattle-like objects at Cueva de la Candleria (Avelyra Arroyo de Anda et al 1956), the macabre eye sockets of skulls from one of Canada's Rainy River Mound sites that contained disc-shaped shell beads set in clay to represent irises (Stuart 1972:796-797), and three asphalt bands encircling a tubular steatite bead from a drowned site at Corral Beach, California that were embedded with tiny disc-shaped beads for decoration (Muche 1978:105, Figure 7a). Disc-shaped beads are common surface finds in sites on the coast of the Rio Grande Delta, but are usually single finds. They are also found in burials on the Gulf coast and along the length of the lower Rio Grande. They are found in Archaic Period contexts as well as during the Late Prehistoric (Terneny 2005). Fifty-eight disc-shaped beads were in association with parts of a robust skull that had eroded from a rise near the shoreline of the southern Laguna Barril in Tamaulipas (Kumpe n.d.a:553-554). Five flat or disc-shaped shell beads (9 to 11 mm in diameter and from 2 to 4 mm thick) were found with Burial 3 and six beads (10 to 18 mm in diameter and from 2 to 3.5 mm thick) were with Burial 5 at the Ayala Site in Hidalgo County (Hester and Ruecking 1969:154). Ten disc-shaped beads (from 16 to 20 mm in diameter and from 6 to 10 mm thick) were recovered by Harvey Bruns

from a Brownsville Complex burial south of Alamo in Hidalgo County. The ten beads weigh from 3.1 to 6.1 grams with an average weight of 4.39 grams; their average diameter is 18.94 mm and their average thickness is 7.53 mm (Kumpe n.d. a:663). Farther inland, Boyd (1998:43) reports ten flat whelk shell beads in a marine shell ornament cache at 41ZP7 in Zapata County. He also mentions five rectangular flat beads from a nearby burial in the same site. Disc-shaped beads were also made from *Pleuroploca*, giant eastern murex, and freshwater mussel shell (see above).

Perforating Disc-Shaped Beads. It appears that perforating beads by drilling straight through from the interior side of the shell is nearly a constant. All of the conical perforations of beads known to the authors are made from the interior sides of the shells and all but one partial perforation of shell disks in the collections are also made from the interior sides of the shells (the exception is partially perforated from both sides). Experiments to perforate whelk whorl with a replica biface tool, by simply twisting it in hand, indicated that drilling straight through from the softer, nacreous interior side avoids the harder, drill-tip-crushing exterior layer of shell, which is described by Andrews (1977:44-45) as conchiolin (flexible protein) imbedded with crystals of aragonite. Indians took advantage of the hard exterior layer by placing the contact edges of adzes on the exterior sides of whelk shells, but generally avoided it when perforating or decorating whelk whorl. An immense *Pleuroploca* gorget in the Anderson Collection has punctates on the concave inner side of the shell (see Figure 36) and it appears that shell ornaments made from the whorl of *Pleuroploca* or *B. perversum* were nearly always decorated on the interior sides of the shells (See Hall 1981:203, Figure 47, Form 7; Chandler 1998:44, Figure 2; and Dreiss 1995:532-533, specimens 9342-9344, 11,490. Also see Figure 42a-c, Figure 48d,g, and Figure 53b in this paper). It appears that the overwhelming majority of perforations in disc-shaped beads were made from the interior side of the shell and then enlarged from the exterior side.

Decorated Bead-Like Ornaments. Some perforated small shell discs are decorated and have a definite obverse, a side meant to face the observer (see Figure 42c). The illustrated specimen is decorated by 28 shallow notches around its circumference that incline toward the interior side of the whelk shell, which is apparently the obverse. It has a maximum diameter of 14.5 mm, a maximum thickness of 2 mm, and weighs 0.7 grams. Armando Vela found this artifact northwest of the salt lake, La Sal del Rey, in Hidalgo County. Salinas (1981:22, Figure 2), illustrating shell technology, includes two line drawings of decorated bead-like ornaments; one, like Figure 42c, is decorated by small notches around the circumference. The second is decorated by incisions on the face of the perforated shell disc.

Long rectangular ornaments

Arm Bands and Bracelets. These curved, long rectangular ornaments made from whelk whorl are usually narrow with two holes drilled at each end at an oblique angle (holes drilled from the ends connect with holes drilled from the interior side of the shell) (see Figure 43a, d-e), but a few made from thinner sections of whelk whorl are drilled straight through (see Figure 43c). Anderson (1932:30) apparently calls these "band ornaments" (arm and wrist bands/bracelets), but MacNeish (1958:191) calls them "long rectangular pendants." He gives their dimensions (from 90 to 175 mm in length and 18 to 45 mm in width) and remarks that they are confined to the Barril Complex. However, Chandler and Kumpe (1995) report two long rectangular "pendants" from Cameron County (see Figure 45) and four similar but shorter artifacts (54 to 70 mm in length) from a juvenile burial at Falcon Lake (see Figure 44). They believed long rectangular ornaments were strung end to end and worn around the neck in the manner of a choker, but it appears that they were usually worn in pairs as arm bands or bracelets (wrist bands). Extended full length burials lying on the back have been found on the Rio Grande Delta (Hester 1969a from Anderson 1933) and Jim Walker (personal communication to Mike Krzywonski 2010) remarked that he and former Texas Ranger Frank Mills (deceased), in the late 1960s in Cameron County, carefully excavated an extended burial with arms crossed at the waist; they recovered two pairs of long rectangular ornaments (about 3 inches in length) in the vicinity of the wrists. He also mentioned that the ornaments had two perforations drilled at an oblique angle at each end. Depending on their lengths, long rectangular ornaments appear to have been worn in pairs as arm bands or bracelets, although it remains possible that some, perhaps the longest, could have been strung end to end and worn around the neck. Prewitt (1974:54) lists bracelets of conch/whelk shells in the Anderson Collection, possibly referring to shorter examples of long rectangular ornaments (like those that were excavated in Cameron County and from the juvenile burial at Falcon Reservoir). Chandler and Kumpe (1995)

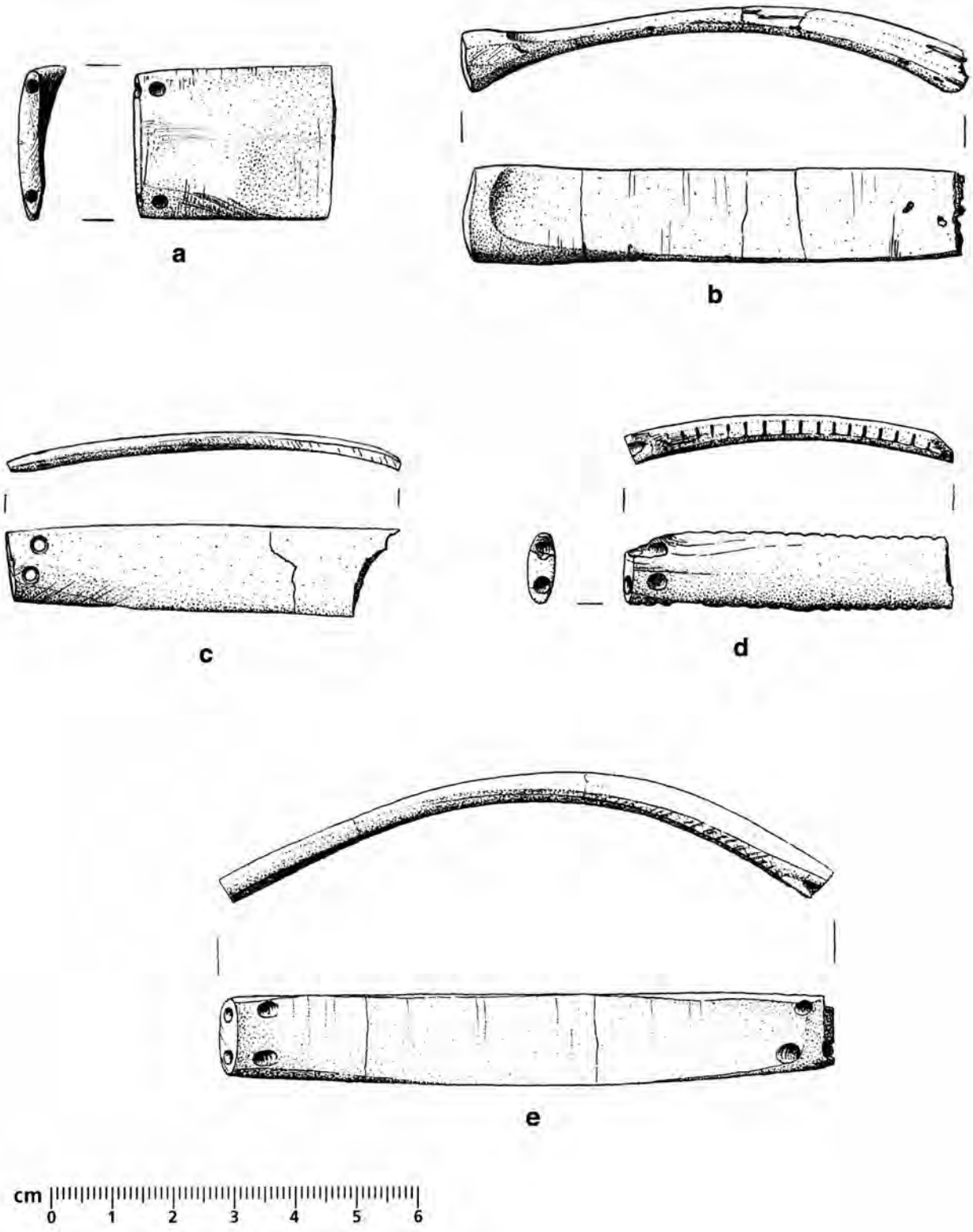


Figure 43. Long rectangular ornaments (from Chandler and Kumpe 1995:4, Fig. 1): a,d-e, perforated at an oblique angle; b, partially restored preform with a heavily ground knob on one end; c, a thin, partially restored ornament that was drilled straight through; d, has been notched on the sides for decoration; e, is fully restored from three fragments. All from coastal sites in Tamaulipas.

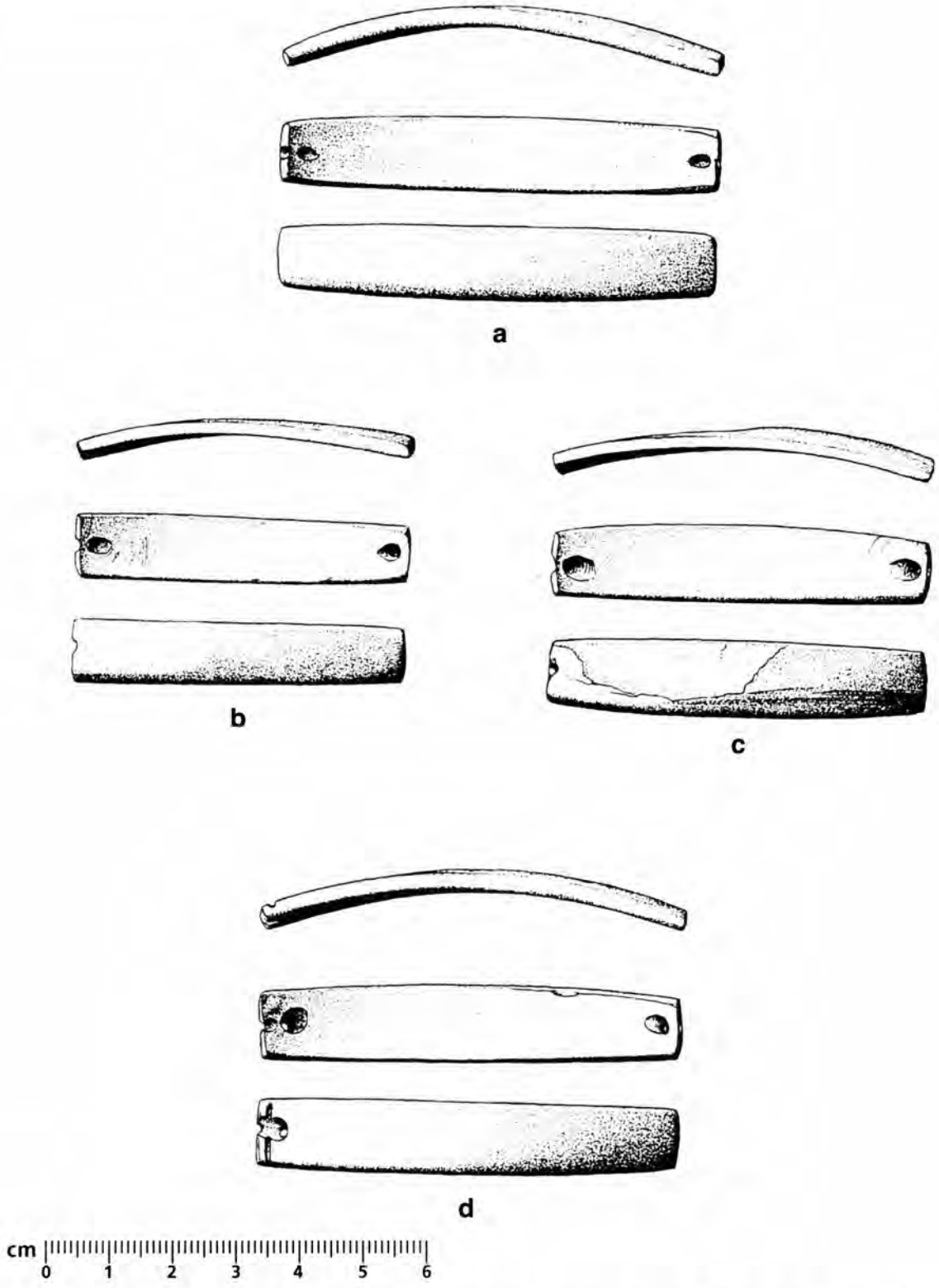


Figure 44. Four long rectangular ornaments from a juvenile burial at Falcon Reservoir in Tamaulipas (from Chandler and Kumpe 1995:5, Fig. 2). Drawings by Richard McReynolds.

followed MacNeish's lead in calling these artifacts pendants, but this paper follows Anderson (1932:30), who apparently believed they were band ornaments. The long rectangular ornaments reported from the coast by Chandler and Kumpe (1995) are from 13 to 25 mm wide, from 3 to 4.7 mm thick, and the one complete specimen (Figure 43e) is 103 mm in length (restored). The four long rectangular ornaments from the juvenile burial at Falcon Reservoir are from 10.4 to 12.4 mm wide, from 3.6 to 4 mm thick, and from 54 to 70 mm in length (see Figure 44a-d). The short length of the ornaments from the reservoir suggests that they were worn as bracelets, but it seems possible that they could have served as arm bands for a juvenile. Anderson (1932: Plate 7, No. 15) appears to illustrate the obverse of a decorated long rectangular ornament (perforations are not visible on the obverse of long rectangular ornaments that are perforated at an oblique angle). Obliquely perforated ornaments are not unique to the Rio Grande Delta or to the lower Rio Grande. Five columella ornaments from a burial at the Pat Dunn site in DeWitt County were perforated at an oblique angle on both ends (Hudgeons and Hester 1977), as was a similar columella ornament from the San Antonio area (Greer 1977).

Pendants

Anderson (1932:Plate 7, Nos. 14 and 15) illustrates at least 10 pendants that appear to be made of whelk whorl, including rectangular, triangular, square, cut-out, and effigy shapes or types. MacNeish (1958:191) describes round, rectangular, triangular, square, and long rectangular shell pendants, but the latter are long rectangular ornaments (arm bands and bracelets) in this paper, which follows Anderson (1932:30). MacNeish (1947:6; 1958:191) describes three engraved square pendants (see below) and describes the engraved basal half of a triangular gorget perforated at the corners, that he suspects was traded into the area from the Huasteca. He remarks that the latter is decorated with a full-face view of a human head carved in relief, a roll, which may be a snake, frames the face, and, rising from the head are two incised lines which cross, become wavy, and form into five or six small lines at their ends; the crossing wavy lines may represent an outer headdress and hanging from the ears are two thick round earrings. Prewitt (1974:59) remarks that there are "a variety" of engraved shells from Rio Grande Delta sites. Salinas (1981:21) remarks that pendants take any shape and that appears to be the case; this paper includes miscellaneous pendant shapes (scallop-shaped, barrel-shaped, and octagonal). There are still other shapes in the authors' collections and probably in the Anderson Collection as well. Never-the-less, the miscellaneous shapes are each few in number and the round, rectangular, triangular, and square shapes described by MacNeish (1958:191) appear to describe the overwhelming majority of shell pendants found on the Delta. This paper then largely follows MacNeish (Ibid.) in his descriptions of pendants, but adds cut-out pendants, effigy pendants, and miscellaneous shapes. A tiny whelk shell pendant used as a clapper for a tinkler is illustrated by Anderson (1932: Plate 7, No. 14); it was examined at TARL during the mid 1980s

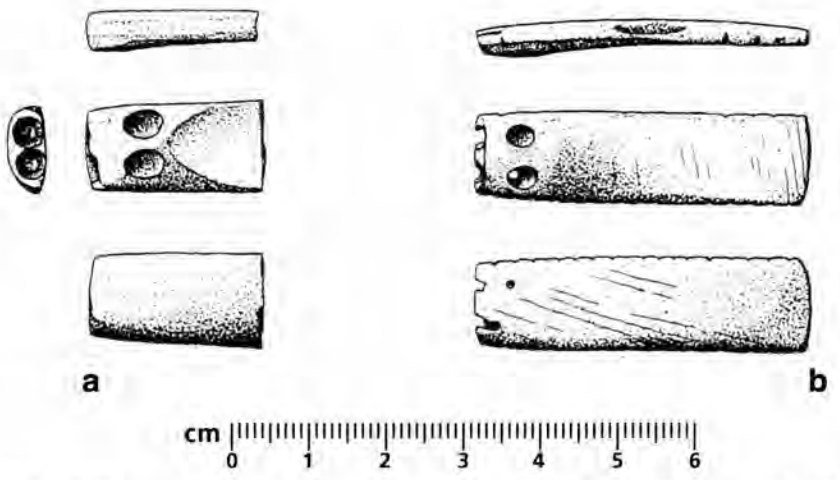


Figure 45. Long rectangular shell ornaments from Cameron County (from Chandler and Kumpe 1995:5, Fig. 3). Depending on their lengths, long rectangular ornaments appear to have been worn in pairs as arm bands or bracelets.

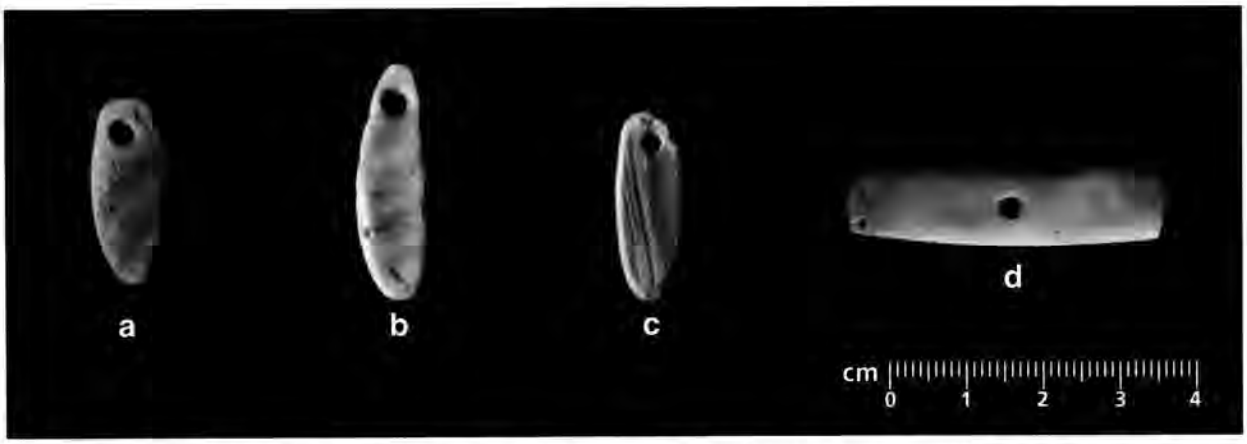


Figure 46. Small whelk whorl pendants: a-c, small pendants similar to one that Anderson (1932: Plate 7, No. 14) found serving as a clapper in a tinkler; d, centrally perforated rectangular pendant. Photo by Mike Krzywonski.

and found to closely resemble tiny pendants that are usually found in coastal sites on the Tamaulipas side of the Rio Grande (see Figure 46a-c). The majority of the whelk shell pendants in this paper were surface finds and it is impossible to know how they were used. Shell pendants may have been suspended from various parts of the body or clothing, from multiple perforations in other pendants, from objects, or from the hair. An example of their diverse use is the triangular shell pendant worn by a White Mountain Apache girl during her coming of age ceremony; the pendant is tied to locks of her hair to suspend it on her forehead and is the sign of Changing Woman, mother of all Apache people (Quintero 1980).

Cut-Out Pendants. Anderson (1932: Plate 7, No. 15) illustrates a triangular pendant from Cameron County with a triangular (Starr point-like) shape cut out of its center. The design that was cut out is in line with the long axis of the pendant and the perforations are centered on one of the long sides. The pendant was apparently attached or suspended so that its long axis was presented horizontally to the observer. The same pendant was recently photographed by Tom Hester and sets of side notches can be seen, indicating that the interior side of the shell is the obverse (see Figure 47). Mercado-Allinger and Ricklis (1996:69, Figure 2.1.14) illustrate the same pendant and two smaller cut-out pendants from the Anderson Collection. One of the smaller pendants is triangular and has a triangular (Fresno point-like) shape (an isosceles triangle) cut out of its center in line with the long axis of the pendant. Perforations are centered on one of the sides. The second of the smaller cut-out pendants is subrectangular with slightly concave ends and the same shape is cut out of its center in line with the long axis of the pendant. Like the triangular pendants, its perforations are centered on one of the sides. It appears that cut-out pendants are not defined by shape, there are rectangular and triangular shapes, but by the cut-out method of decoration. All three of the cut-out pendants have perforations that center on one of the sides and the horizontal presentation of these ornaments appears to be characteristic.

Effigy Pendants. Anderson (1932: Plate 7, No. 14) illustrates a zoomorphic effigy pendant. It appears to be made from whelk whorl and is fish-shaped, the perforation representing the eye.

Rectangular Pendants. These occurred in Brownsville and Barril sites and range from about .8 to 2.4 inches wide and between 25 to 100 mm long; they may be perforated at one or both ends and occasionally have 2 holes at each end (MacNeish 1958: 191). However, those rectangular pendants with two holes at each end may be long rectangular ornaments (see Figure 43c). Some small rectangular pendants are centrally perforated (see Figure 46d); the maximum thickness of the centrally perforated rectangular pendant is 3 mm and it weighs 2.4 grams. Rectangular pendants are also found in the Huasteca (Ekholm 1944:482).

Round Pendants. MacNeish (1958:191) remarks that round pendants in the Anderson Collection range from about 25 to 130 mm in diameter, are centrally perforated, often have notched edges, and are occasionally engraved. He also remarks that they are only in the Barril Complex. However, Mike Krzywonski (personal communication 2010) found a cache of five round shell pendants in Cameron County. The one intact pendant from the cache is illustrated (see Figure

Figure 47. From the Anderson Collection, a triangular cut-out pendant found in Cameron County: a, exterior side of the shell; aa, sets of side notches indicate that the interior side of the shell is the obverse of the pendant. Perforations typically center on one of the sides of cut-out pendants and the horizontal presentation appears to be characteristic. Photos by Tom Hester.

48b). Its maximum thickness is 2.3 mm and it weighs 5.7 grams. A round shell pendant from Falcon Reservoir in Tamaulipas is also reported (see Figure 53b).

Square Pendants. MacNeish (1947:6; 1958:191) remarks that square shell pendants in the Anderson Collection range in size from 22 x 22 mm to 75 x 75 mm; they are always centrally perforated, but a few also have perforations at 2 corners or at all four corners. He remarks on three square pendants with engraved crosses and one of the crosses is inside a circle. A cross engraved inside a circle on a round shell pendant from Gillespie County is reported by Chandler and Highley (1998:44, Figure 2). A nearly perfectly square shell pendant is illustrated (see Figure 48f) and, although MacNeish (1958:191) gives perfectly square dimensions for centrally perforated square shell pendants (see above), it appears that they may vary from square by more than a few millimeters; those that do are "nearly square" in this paper (see Figure 49e and Figure 53a). A few small rectangular pendants found on the coast of the Rio Grande Delta are also centrally perforated, but are more elongate than the "nearly square" pendants in this paper (see Figure 46d). The nearly square shell pendant from the coast of the Rio

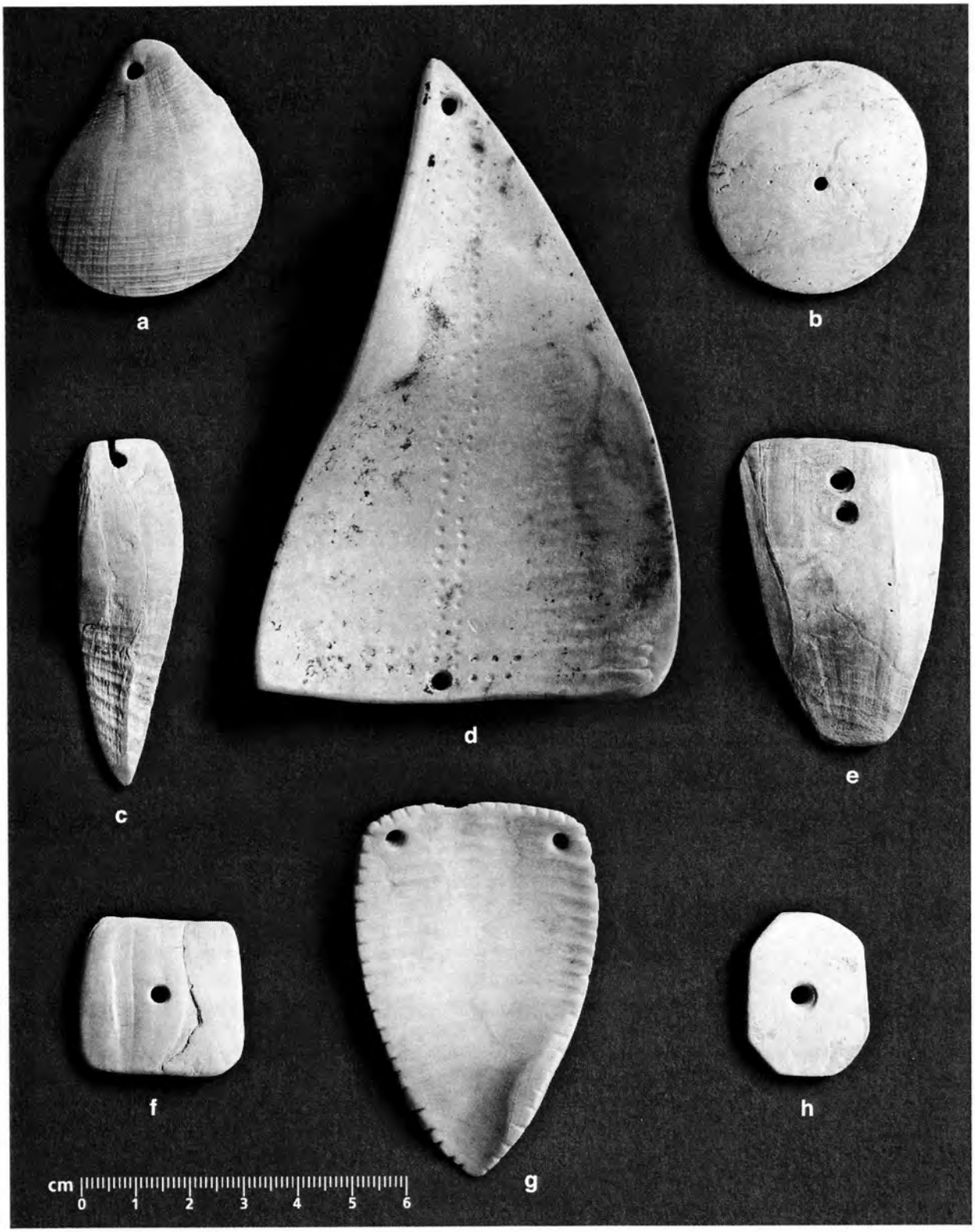


Figure 48. Whelk whorl pendants from the Rio Grande Delta: a, scallop-shaped; b, round (one of five from a Cameron County cache); c, narrow triangular pendant with an s-shaped cross-section; d, triangular with parallel rows of punctates; e, triangular with vertically aligned perforations; f, square; g, triangular with decorative edge notches; h, octagonal. Photo by Mike Krzywonski.

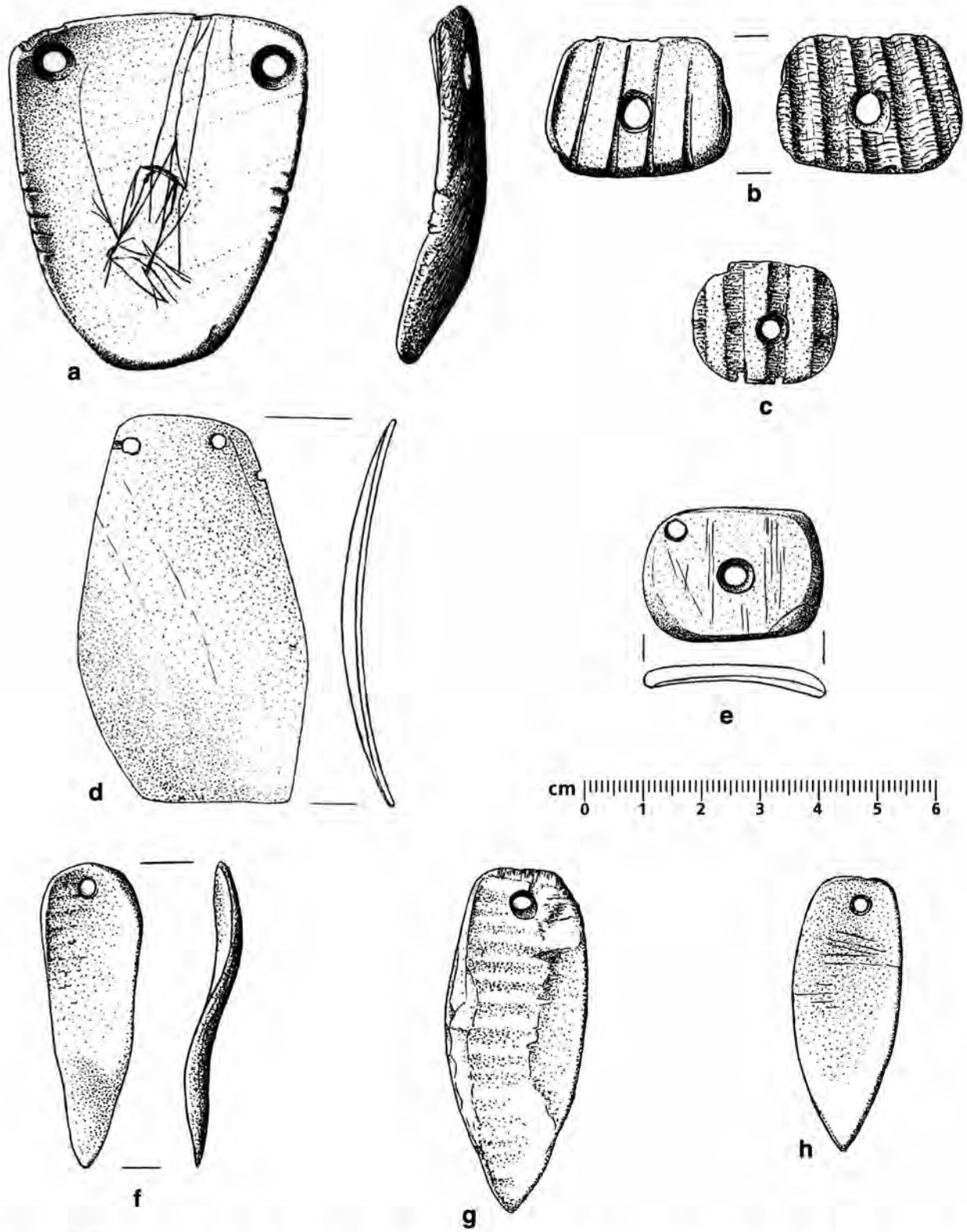


Figure 49. Whelk whorl and cockle shell pendants from the Rio Grande Delta (whelk whorl unless otherwise noted): a, triangular pendant with sets of side notches; b-c, cockle shell pendants; d, barrel-shaped pendant; e, "nearly square" shell pendant; f-h, narrow triangular pendants. Drawings by Richard McReynolds.

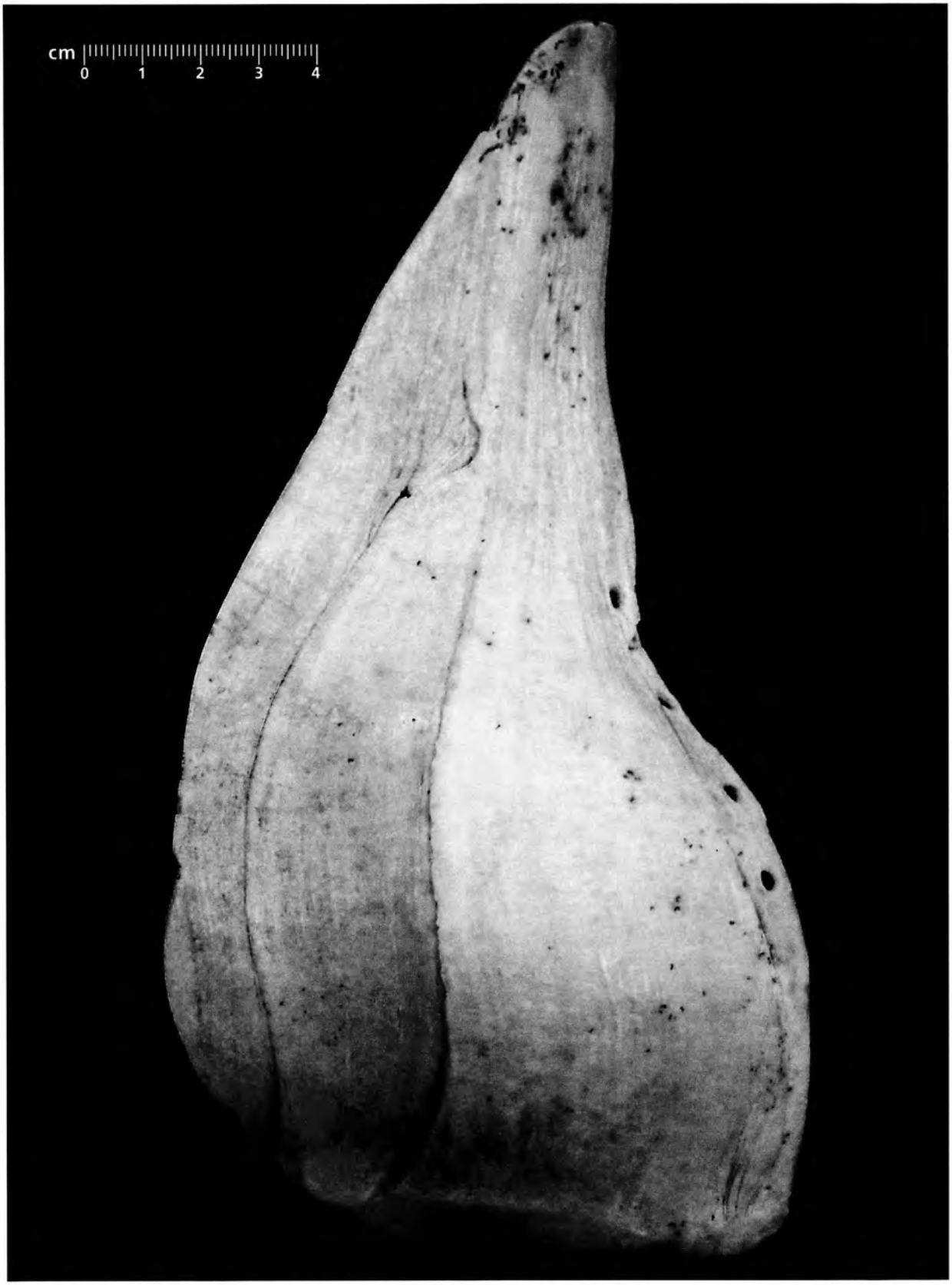


Figure 50. A large trianguloid pendant with four perforations on one of the sides. This artifact is in the Anderson Collection at TARL. Photo by Tom Hester.

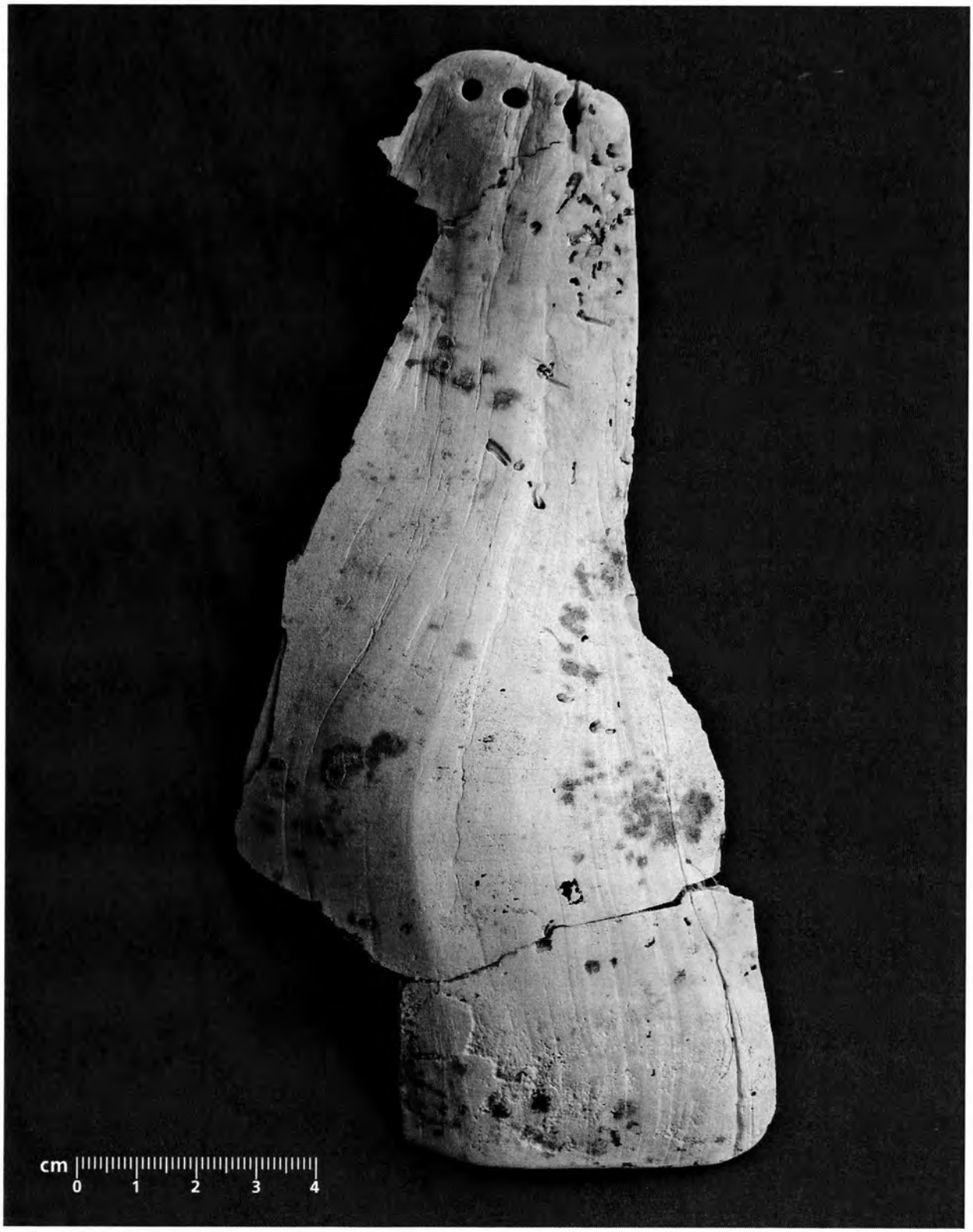


Figure 51. Trianguloid whelk whorl pendant. It was found in a field road in the coastal area of the Rio Grande Delta and partially restored from three fragments. Photo by Mike Krzywonski.

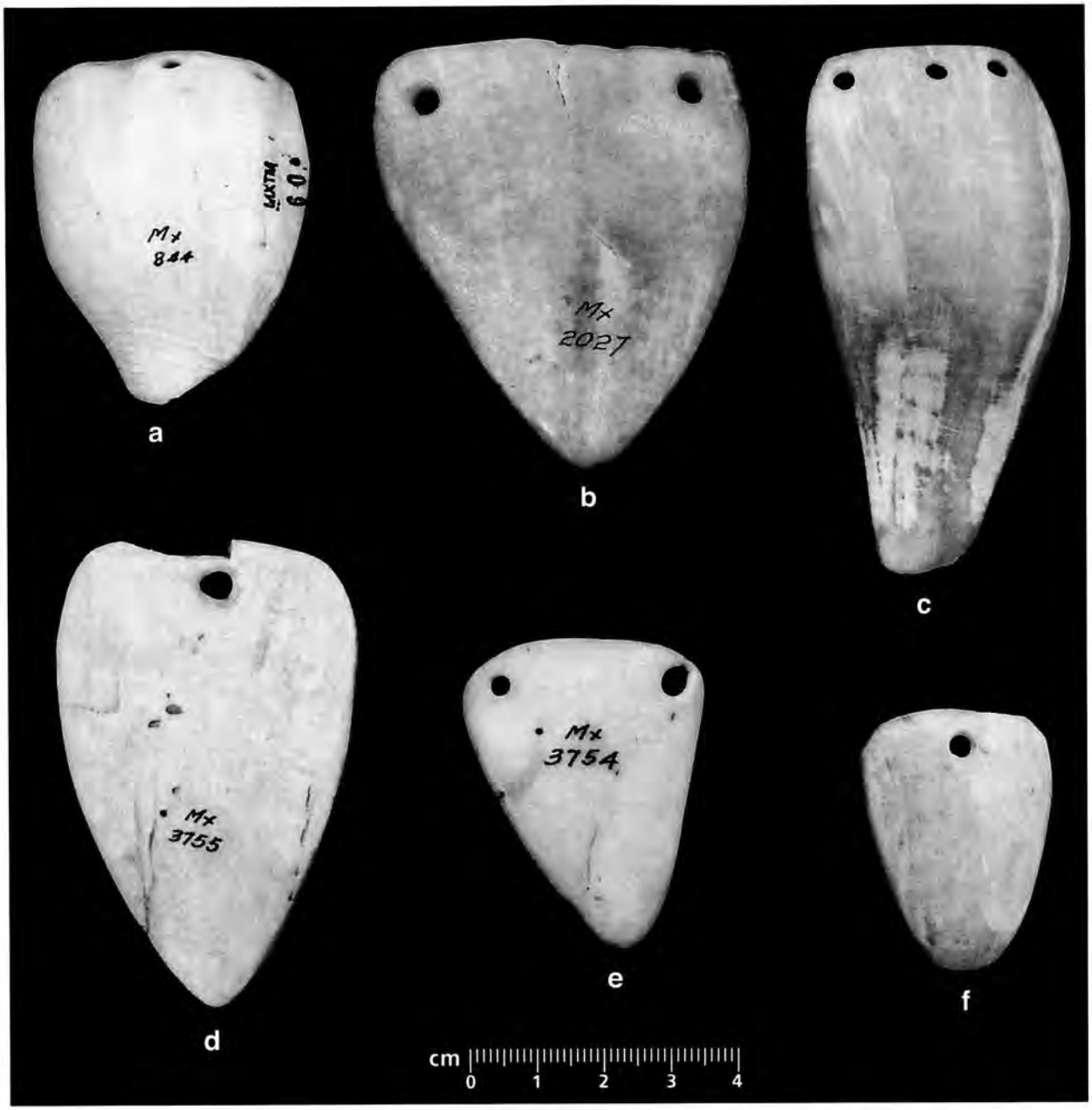


Figure 52. Triangular whelk whorl pendants from the Anderson Collection. They have from one to three perforations and at least four (a-b, d-e,) are from Tamaulipas. Photo by Tom Hester.

Grande Delta (Figure 49e) is centrally perforated, has a second perforation at one corner, and was found on a clay dune north of La Bartolina, Tamaulipas. It weighs 3.41 grams.

Triangular Pendants. Triangular pendants described by MacNeish (1958:191) range in size from 50 mm wide and 80 mm long, to 100 mm wide and 260 mm long. He also remarks on the placement of perforations, "There may be one perforation at the corners of the base of the triangle, 2 perforations at each corner of the base, one in each corner and in the center of the base, or there may be only one perforation in the center of the base." However, a triangular pendant illustrated in this paper has a perforation at the center of the base and another at the pointed end (see Figure 48d). Apparently it is only safe to say that the number and placement of perforations are varied. Triangular pendants in this

paper include trianguloid or sub-triangular shapes. There are also smaller triangular pendants, including narrow, generally sub-triangular pendants that appear to be remarkably consistent in size and usually have one perforation in the base; they occasionally have rounded corners (see Figure 48c and Figure 49f-h). Those narrow triangular pendants that include the siphonal end portion of the whorl have a sinuous (s-shaped) cross-section (see Figure 48c and Figure 49f), while others have a c-shaped cross-section. Figure 48c is 2.5 mm thick and weighs 4.8 grams. In Figure 49: F is 3 mm thick and weighs 3.7 grams; g is 3 mm thick and weighs 5.9 grams; h is 2.5 mm thick and weighs 3.1 grams. A large trianguloid pendant from a burial at the Ayala site in Hidalgo County is 163.5 mm in length; it has two perforations at the distal end and numerous tiny notches along both lateral edges and the proximal edge (Hester and Ruecking 1969:199). The pendant from the Ayala site is also illustrated by Hester (2004:148, Figure 4.27g). A large trianguloid pendant in the Anderson Collection has four perforations on one side (see Figure 50). A large trianguloid pendant from a field road in coastal Tamaulipas has three perforations at the distal end and is partially restored from three fragments (see Figure 51). Six triangular pendants from the Anderson Collection have from one to three variously placed perforations (see Figure 52).

Miscellaneous Shapes. This paper largely follows MacNeish (1958:191) in describing the various shapes or types of pendants made of whelk whorl (see above), but scallop-shaped (Figure 48a), octagonal (Figure 48h), and barrel-shaped (Figure 49d) pendants are illustrated; some might consider the latter to be sub-rectangular. Pendants take any shape (Salinas 1981:21) and there are still other shapes in the authors' collections. There are probably other shapes in the Anderson Collection as well, but it is likely that many miscellaneous shapes are one of a kind while others may be few in number.

MARINE SHELL ARTIFACTS FROM INLAND SITES ON THE LOWER RIO GRANDE

Inland refers here to Starr and Zapata counties and those parts of northern Tamaulipas and northeastern Nuevo Leon that are across the Rio Grande from those counties. This inland area of the lower Rio Grande was apparently outside the usual range of the coastal people. Never-the-less, the marine shell ornaments from inland sites often resemble those found on the coast, the long rectangular ornaments from Falcon Reservoir (Figure 44), the square and round whelk whorl pendants (Figure 53a-b), and the *Oliva* tinklers (Figure 53c-d) for example. However, some shell artifacts from inland sites have no coastal counterparts. An example of this is a pendant made from the common sundial *(Architectonica nobilis)* that was recovered by Mike Ryan near Mier, Tamaulipas. Examined earlier, but no longer available for illustration, the sundial was 34 mm in diameter with a shallow conical perforation in the apex, which was flattened by grinding before it was drilled (Kumpe n.d. a:604). Other curiosities include a circular bead made from the spire of a lettered olive *(Oliva sayana)* (Boyd et al. 1997:399) and a small *B. perversum* from 41ZP7 in Zapata County that was perforated for suspension at its siphonal end (Boyd 1998). The latter may have been largely shaped by beach-rolling, but it has no counterpart on the coast. Pendants made from beach-rolled fragments of the southern quahog are only found in inland sites, although the quahog shell fragments used to make them are commonly found in sites on the coast (see Figure 11 and Figure 53f-g). Marine shell ornaments from inland sites along the lower Rio Grande have been reported by others: Boyd 1996; 1997; 1997b; 1998; Boyd et al. 1996; 1997; Chandler and Kumpe 1995; Mokry 1979; Newton 1963; Weir 1956. Seventeen marine shell artifacts from inland areas of the lower Rio Grande and two marine shell artifacts from Hidalgo County that appear to be from the Archaic Period are described (below). A few ornaments from inland sites were described earlier in this paper, the long rectangular ornaments in Figure 44 (from Falcon Reservoir) and the third imperforate disc with a ray-like design (which is from Zapata County and similar to the discs in Figure 42a-b). The artifacts described below were found by eight individuals while surface collecting over a period of several decades.

Figure 53

Figure 53a is a nearly square shell pendant made from the body whorl and penultimate whorl of *B. perversum*. It is centrally perforated and there is an abrupt bend at the center where the penultimate whorl has been included. A knob may have been at the center of this artifact, but completely obliterated by grinding. The concave interior side of the shell appears to be the obverse. This pendant is from Falcon Reservoir at the confluence of the Rio Salado with the Rio Grande.

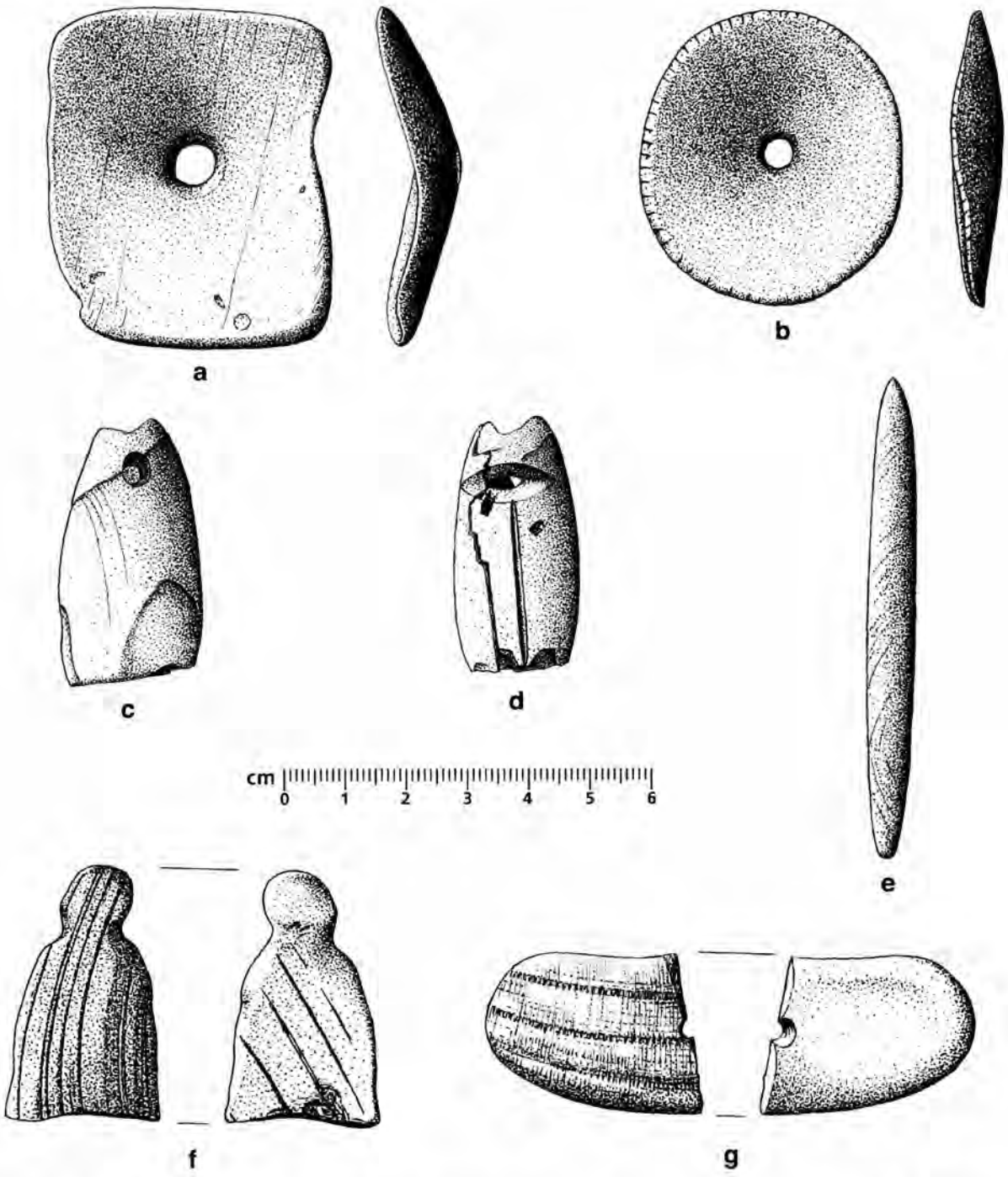


Figure 53. Marine shell ornaments from inland sites along the lower Rio Grande: a, "nearly square" whelk whorl pendant; b, round whelk whorl pendant decorated with notches; c, *Oliva* tinkler with a conical perforation; d, *Oliva* tinkler with a transverse perforation and decorative incision; e, pointed columella plug; f, quahog shell pendant notched for suspension; g, perforated quahog shell pendant. Provenance: a, c-d, g, Tamaulipas; b, f, Zapata County; e, Starr County. Drawings by Richard Reynolds.

Nance (1964:540, 552) remarks on a Carrizo Indian village at approximately the same location on the Rio Salado in 1843; one of the Carrizo "huts" in the village is interestingly described as about 40 by 20 feet, half underground, built of stone covered with earth, and with 6 or 8 loop holes in it. However, the pendant was a surface find and cannot be associated with the Carrizo village or with the Historic Period. Never-the-less, the use of centrally perforated round and square shell pendants apparently survived well into the Historic Period in many parts of North America (see below).

Figure 53b is a round shell pendant made from the body whorl of *B. perversum*. Found in Tamaulipas on the shoreline of Falcon Reservoir, it is perforated at center and decorated on the interior side of the shell with notches around the circumference. Placement of the notches indicates that the interior side of the shell is the obverse. Early photographs of North American Indians, including photos from the Smithsonian Institution National Anthropological Archives, show that centrally perforated round shell pendants, often worn snugly at the neck, were widely popular among North American Indians throughout much of the Historic Period (Kavanagh and Dixon 1996:27, 65, 93, 137, 147; Scherer 1973:22-23, 34, 167, 173, 180; Yenne 1976:79).

Figure 53c, an *Oliva* tinkler found in Tamaulipas at Falcon Reservoir, was perforated by drilling straight through. Boyd et al. (1997:399) illustrate five tinklers from Burial 1 of the Southern Island site in the northern portion of Falcon Reservoir, Tamaulipas; two of the five tinklers are also drilled straight through and have conical perforations. Perforations in tinklers from the coast were most commonly transverse, made by cutting with flake and biface tools or by grinding with Gulf sandstone (see Figure 35a-b); transverse partial perforations were sometimes made with one of the three tools and the perforations completed by drilling (see Figure 35c), but perforations made by drilling straight through are rarely seen on the coast and are more often seen in tinklers from inland areas.

Figure 53d is an *Oliva* tinkler found near the Rio Alamo south of Mier, Tamaulipas. It has a transverse V-shaped perforation and is decorated by a finely crafted incision in line with the long axis of the shell.

Figure 53e is a columella plug found by Frank Dudley on the Arroyo Minita in Starr County. It appears to be an ornament to pierce a part of the body, but it is unlike the plugs that are found on the coast of the Rio Grande Delta (see above).

Figure 53f is the suspension end of a broken pendant that was made from a beach-rolled fragment of the southern quahog *(Mercenaria campechiensis)*. It was notched for suspension, has a shallow groove on one side of the notch, and slanted parallel lines are incised on the interior side of the shell. It was found in Zapata County by Bill Yoder. Beach-rolled quahog shell fragments are common in sites on the coast of the Rio Grande Delta (see Figure 11), where Indians apparently gathered them from beaches and traded them to inland groups as blanks for pendants (Kumpe 1996). Quahog ornaments have not been found on the coast, but, like this notched pendant and the perforated pendant (below), are sometimes found in inland sites along the lower Rio Grande.

Figure 53g is a second broken pendant made from a beach-rolled fragment of the southern quahog. The first was notched for suspension (see above), but this ornament had at least one perforation. It was found near the Rio Alamo south of Mier, Tamaulipas in 1979 by Terry Kumpe. Its maximum thickness is 5 mm.

Figure 54

Figure 54a is from Zapata County and appears to be an early stage in the manufacture of a pendant from a fragment of *Laevicardium robustum*. The only modification is a partial perforation on the interior side of the shell. One of the sides and both ends are breaks. The long side is a length of the cockle shell's margin and has tapering interior ribs that resemble notches.

Figure 54b is a cockle shell pendant made from a fragment of *Laevicardium robustum*. Apparently in a late stage-of-production, the distal end retains a remnant lip from snapping. One lateral edge is a smoothed length of the shell's margin. This pendant is from 41SR172 in Starr County, where Bell points are among the Archaic Period artifacts that were found in eroded portions of the site (Chandler and Kumpe 1993a), but the cockle shell pendant was found on the surface above the eroded areas. Farther inland, Hester (1970:87) reports two cockle shell pendants at the Hines Ranch site in Dimmit County. Cockle shell pendants manufactured on the coast of the Rio Grande Delta are also illustrated (see Figure 49b-c).

Figure 54c appears to be a pendant made from a section of *Oliva* whorl that was salvaged from a tinkler. The transverse perforation is typical of tinklers and, although broken, it may have once served to suspend the salvaged ornament. This artifact was found on the point of a peninsula between Arroyo Molletes and Arroyo Ranchito in Zapata County. A. E. Anderson found a similarly perforated *Oliva* whorl pendant in coastal Tamaulipas (C.K. Chandler, personal correspondence 1993).

Figure 54d is a columella ornament with one perforation at each end. It is made on a small columella and weighs 5.15 grams. The craftsman has included the attractive spiral or twist of the columella as a part of its design. Found near the east bank of the Rio Alamo south of Mier, Tamaulipas, it is like Hall's (1981: Figure 48) Form 5 "beads" from Burial 187 at the Ernest Witte site (41AU36) in Austin County. It is also like Janota's (1980:39, Figure 1a) columella ornament (109 x 9 mm) from the McDonald Bayou site in Victoria County. A similar columella ornament in the Mike Krzywonski Collection was found on the coast of the Rio Grande Delta in Tamaulipas. Like the columella ornaments from the Rio Alamo, from the Ernest Witte site, and from the McDonald Bayou site, Krzywonski's columella ornament is perforated at both ends by drilling straight through. Hudgeons and Hester (1977) report five columella ornaments from DeWitt County in south Texas that are similar in size to those described here, but have an oblique perforation at each end; Greer (1977) reports an obliquely perforated columella ornament from the San Antonio area.

Figure 54e is a heavily ground columella tubular bead that weighs 7.76 grams. It was found in 1968 by John R. Boland between 10 and 15 miles north of US 83 near Loma Blanca Road in Starr County. It was a surface find in Boland's site 14ZF, one of many sites near Loma Blanca Road that are strewn with small, thermally altered stones. The rock strewn sites off Loma Blanca Road contain dart points, Matamoros, Darl, Ensor, and Catan, from the Late Archaic and Transitional Archaic periods (Turner and Hester 1999). Columella beads are often found in Archaic Period contexts in Texas (Terneny 2005:209, Table 9.3). A larger columella tubular bead recovered from the surface of a site in northeastern Nuevo Leon by Carlos Galvan measured 79 mm in length, 13 mm in maximum thickness, and weighed 21.3 grams (Kumpe n.d. a:804). A still larger columella tubular bead was found in Starr County (see Figure 54j).

Figure 54f is the remnant of a small *B. perversum* found at Falcon Reservoir in Zapata County by Bill Yoder. The body whorl is missing and there are 3 cuts or grooves in the shell that appear to be efforts to remove the last small section of inner whorl. Although the body whorl is missing, its relatively small size can be estimated by the small diameter of the columella. This artifact weighs 11.5 grams.

Figure 54g is a columella pendant. John R. Boland recovered this artifact from a citrus orchard on the north side of 9 Mile Line in Hidalgo County. It has been grooved completely around the smaller siphonal end for suspension and weighs 5.1 grams. Although found in Hidalgo County, it is included with the inland shell artifacts as it has no counterpart on the coast, where columella pendants were perforated for suspension (see Figure 39). An immense eolian depression once nearly encircled this site. Now smaller in area, the depression may still hold water for more than a year after torrential rains and it appears that water attracted Indians to this site for thousands of years. Artifacts found here include the proximal end of a Paleo-Indian Plainview, Tortugas and Matamoros points from Archaic periods, and various arrow points (Starr, Fresno, Cameron, and Caracara) from the Late Prehistoric (Turner and Hester 1999). The columella pendant from this site is thought to be Archaic.

Figure 54h is a very small columella tubular bead from a site south of Falcon Heights in Starr County. It was found by John R. Boland and it weighs only .36 grams. Although it is the smallest columella tubular bead known to the authors, it may have counterparts on the coast. MacNeish (1958:19) remarks that columella tubular beads in the Anderson Collection range from 4 to 100 mm in length.

Figure 54i is a small columella plug with rounded ends. It is heavily weathered, chalky, round in cross-section, and weighs 1.3 grams. Rounded ends set it apart from the majority of plugs that are round in cross-section on the coast, which usually have flattened ends. This small plug with rounded ends appears to be a finished ornament that pierced a part of the body, perhaps a lip, nostril, or cheek. It was recovered from Tommy Thompson's Orchard, a multi-component site on Los Ebanos Road in Hidalgo County (Kumpe n.d. b:116). Although found in Hidalgo County, it is included here as its severely weathered condition suggests it may be from the Archaic Period.

Figure 54j is a columella tubular bead from a site at the convergence of the two branches of the Arroyo Morteros in Starr County. It was found by John R. Boland in 1959 and it retains the spiraling twist of the columella from end to end. The craftsman drilled this bead from both ends and there are partial perforations in the sides that were made by marine organisms. This bead is thought to be from the Archaic Period, as are the overwhelming majority of projectile points from the site on the Arroyo Morteros. Measuring 114.47 mm in length, it is the largest columella tubular bead known to the authors. Its maximum thickness is 15.28 mm and it weighs 38 grams. Columella tubular beads found in Archaic Period contexts in Texas and Tamaulipas are listed by Terneny (2005:209, Table 9.3).

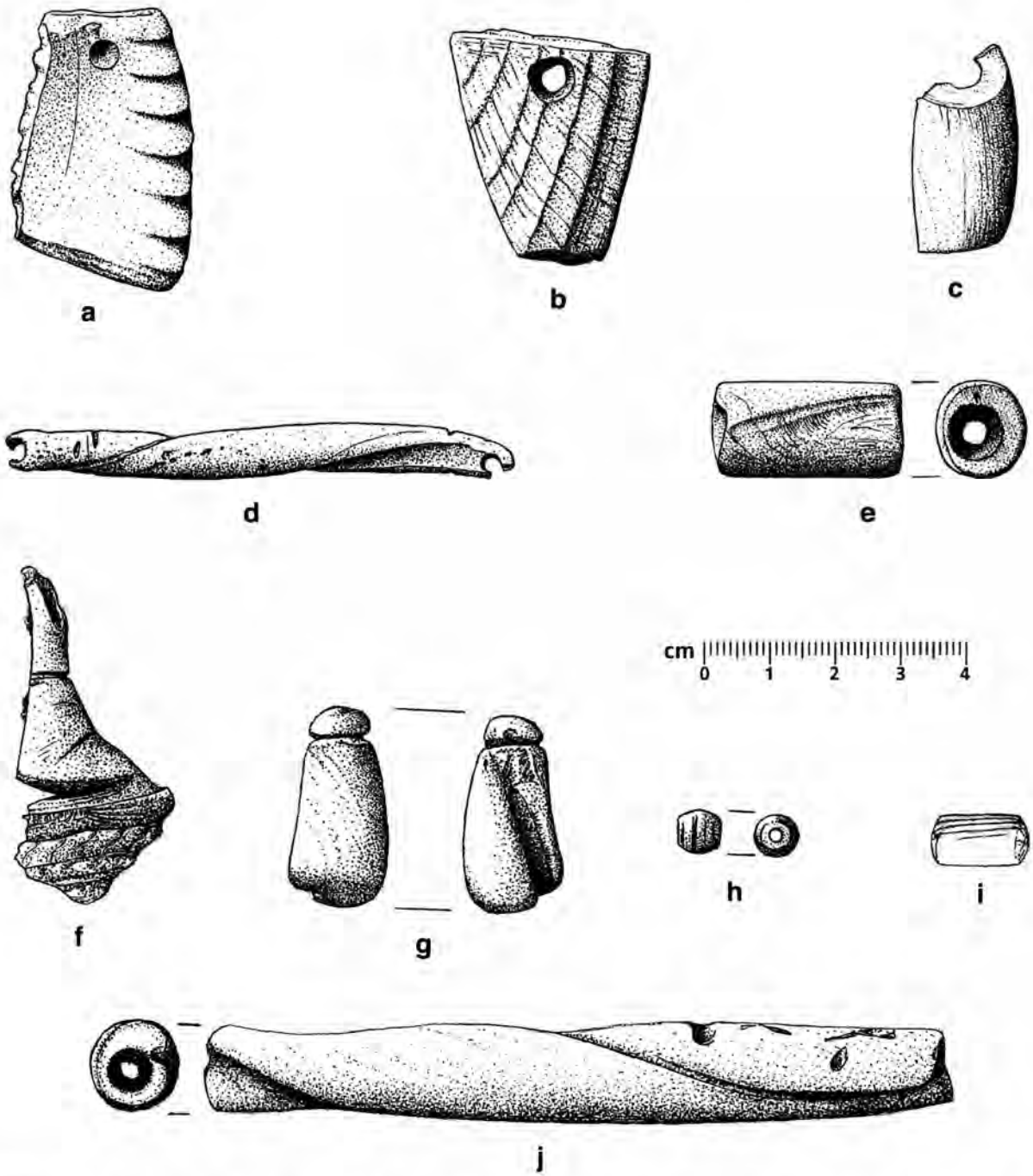


Figure 54. Marine shell artifacts from inland sites along the lower Rio Grande, but two are from Hidalgo County: a, partially perforated cockle shell fragment; b, cockle shell pendant; c, salvaged section of *Oliva* tinkler; d, columella ornament; e, h, j, columella tubular beads; f, *B. perversum* in a late stage-of-reduction; g, columella pendant grooved for suspension; i, columella plug with rounded ends. Provenance: a, c, f, Zapata County; b, e, h, j, Starr County; d, Tamaulipas; g, i, Hidalgo County. Drawings by Richard McReynolds.

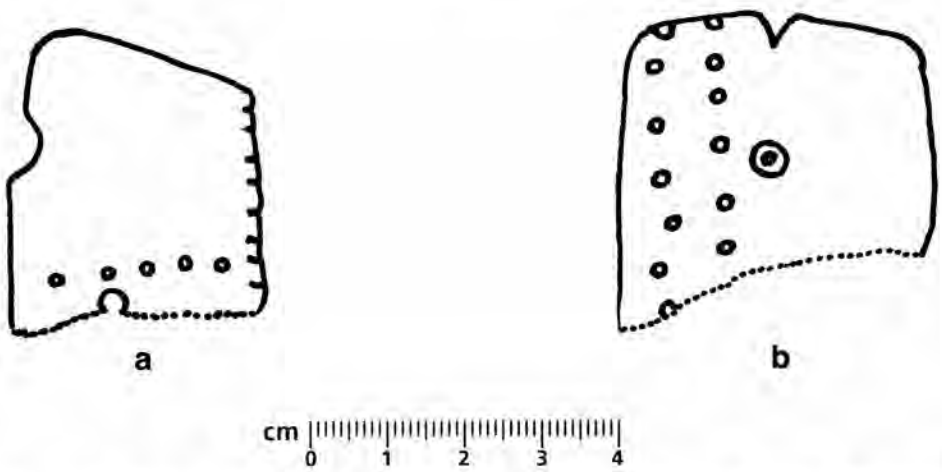


Figure 55. *Pleuroploca* pendants (or gorgets?) from Starr County: a, broken pendant from Arroyo Morteros; b, broken pendant from Peña Ranch near Falcon State Park

Figure 55

Figure 55a is the outline of a broken pendant (or gorget?) made from the thin body whorl of *Pleuroploca gigantea*. It was found in a site at the convergence of the two branches of the Arroyo Morteros near the Rio Grande in Starr County. The broken end dissects a perforation and there is a row of punctuates immediately below and parallel with the broken end on the inner side of the shell. One of the sides is decorated with small notches and there is a large notch in the opposite side. This pendant is from the same site on the Arroyo Morteros as the columella tubular bead in Figure 54j and both are thought to be from the Archaic Period. A similar *Pleuroploca* pendant was found within a few miles of this one (see below).

Figure 55b is the outline of a broken pendant (or gorget?) made from the thin body whorl of *Pleuroploca*. It was found by Bill Hughes on the Armando Pena Ranch near Falcon State Park in Starr County. It has a large V-shaped notch in the complete end, a perforation at the approximate center of the fragment, and two parallel rows of punctuates on the inner side of the shell. It was found only a few miles northwest of the *Pleuroploca* ornament from the Arroyo Morteros (above) and is thought to be from the Archaic Period.

DISCUSSION

Without the barrier of the Texas or Tamaulipas Laguna Madre, Indians on the coast of the Rio Grande Delta established sites near shallow inland lagunas within a few miles of the seashore, where they had unequaled subsistence opportunities and easy access to beaches and dunes. Most of the sites near the seashore are in Tamaulipas, where 39 of the 47 miles of Delta coastline are located. Sand wells on the landward side of dunes were reliable and accessible sources of potable water for Indians, and beaches provided the majority of their shell working tools. The use of Gulf sandstone, pumice, coral, sand, bone drills, and two species of shells, the southern quahog and the giant eastern murex, to work shell reduced the need for imported chert, which was used sparingly to make diminutive tools and projectile points (see Figure 2). Immense quantities of useful shells were apparently collected by Indians after cold fronts, storms, or hurricanes and stored at shell collecting depots on the peripheries of sites within a few miles of the seashore, where Anderson (1932:29) remarks that archeological material is most often found. Cold fronts apparently provided the majority of useful shells. Useful materials like asphaltum and driftwood were collected on beaches and Indians collected European materials on beaches during the Early Historic Period; they may have collected stone artifacts from Paleo and Archaic periods on South Padre Island.

Indians on the coast of the Rio Grande Delta were dependent on hurricanes. Yearly lake evaporation near the coast exceeds precipitation by 36 inches (Orton 1977:87-88), but hurricanes reconstituted the wetlands by refilling and restocking coastal lagunas and other water features. The reconstituted wetlands

attracted immense numbers of migrating waterfowl. Hurricanes brought shells, pumice, sea beans, coral, Gulf sandstone, shale stones, silicified bones, and driftwood (including immense trees) ashore. Hurricanes also leveled the forebeach (a natural pathway for Indians) and cut washover channels (convenient lanes) through dunes. Torrential rains associated with hurricanes and tropical storms also ensured the reliability of sand wells and it appears that Indians on the coast of the Rio Grande Delta could have scarcely survived without periodic hurricanes.

Shells and other materials are distributed unevenly along the Gulf coast. Indians on the coast of the Rio Grande Delta, for example, made a great use of Gulf sandstone and five species of shells, *Dosinia discus*, *Mercenaria campechiensis*, *Murex fulvescens*, *Oliva sayana,* and *Callista maculata*, which are scarce, rare, or non-existent in the Corpus area. Fewer shells come ashore on South Padre Island and Boca Chica in Cameron County than on Mexican beaches between the Rio Grande and the Tamaulipas Laguna Madre, and the shells on Mexican beaches are distributed unevenly; the majority of shells coming ashore on the coast of the Rio Grande Delta in Tamaulipas wash in on a shell bar, *La Barra de Conchial,* east of the southern Mar Negro. La Barra de Conchial has its share of broken shell, but lacks the steep, high-tide crest with soft shell on the backshore that makes passage difficult in Big Shell and Little Shell on Padre Island (see Andrews 1977:12). Currents and the configuration of the sea floor appear to quickly funnel dead or cold-shocked shells from a wide offshore area onto this shell bar. More than a hundred *Oliva sayana* may wash ashore in a matter of hours and large numbers of dosinia and giant eastern murex are found on La Barra de Conchial in winter, as are many other gastropods. Most of the thousands of giant Atlantic cockle shells collected by the shell dealer mentioned earlier were gathered from this shell bar, which is anything but a well-kept secret. During winter, from the 1970s through the 1990s, van loads of tourists on shell collecting expeditions from South Padre Island and Port Isabel arrived on the north end of the shell bar every morning (senior author's personal observation). La Barra de Conchial appears to have existed during prehistoric times, when it probably produced an even larger number of shells than today. Shell bars appear to be long-lived because they are created by currents and the configuration of the sea floor. Shell bars similar to Little Shell and Big Shell, but from late Pleistocene-early Holocene times, are part of the geologic record, outcropping today as coquina (Tunnell and Judd 2004:34-35).

The uneven distribution of shells on beaches in Cameron County and Tamaulipas appears to be reflected in the archeological record. Sites in Cameron County generally contain less shell debris and fewer shell artifacts than sites in Tamaulipas. MacNeish (1958:187, Table2) shows the greater number of disc-shaped beads, plain shell discs, columella projectile points, and long rectangular ornaments found in sites in Tamaulipas. The stringent use of *Dosinia discus* by Indians in Cameron County is another example. Fragments of dosinia in virtually every site in Cameron County demonstrate the importance of this shell, but intact dosinia valves, whether modified or unmodified, are rarely found in Cameron County sites. Indians in Tamaulipas, on the other hand, were cavalier in their treatment of dosinia. Intact dosinia valves are commonly found in sites in Tamaulipas, often in large numbers (authors' personal observations), and there appears to be a direct correlation between the quantities and types of shells found on various local beaches and the amount of shell debris, numbers of shell artifacts, and numbers of shells in coastal sites immediately west of those beaches. Indians accessed La Barra de Conchial and its profusion of shells by wading a shallow connective channel of the Arroyo la Mula, which separates the Mar Negro from the Barril. Dozens of sites immediately inland from the access to this shell bar contain unusually large amounts of shell debris and unusually large numbers of shell artifacts. This is in the area of the northern Barril where large numbers of columella projectile points begin to appear and it is also where large numbers of dosinia valves were left in some sites. Perhaps the apparently fewer collumae available to Indians living north of the shell bar were more valuable as pendants and tubular beads than as projectile points.

It appears that Indians living on the coast of the Rio Grande Delta usually had varied and easily harvested foods throughout most of the year, with fish supplying the bulk of the food. Reliable food resources may have extended as far north as the Arroyo Colorado in Texas. Documents relating to Fransico Garay's unsuccessful attempt to colonize the Rio Grande Delta in 1523 indicate a remarkable population density for hunting and gathering groups (Salinas 1990:22-24), but by the time of Escandon's exploration in 1747 it seems likely that European diseases have swept through the Delta and decimated Indian populations. Salinas (1990:108, 140) remarks on epidemics that reduced Indian populations in Nuevo Leon, at Camargo on the lower Rio Grande, at Reynosa on the Rio Grande Delta, and on the San

Fernando River. There may have been many more epidemics than the few that were recorded.

The inland Delta with its woody vegetation has largely vanished, its eolion depressions leveled by farmers and its sabal palm forests burned out of existence. The woody vegetation is covered now by canals, roads, fields, orchards, and mushrooming urban areas. The coastal zone with its miles of saline flats, particularly in Tamaulipas, has, however, largely survived to the present. Some of the loma tops are farmed, but there are few paved roads in coastal Tamaulipas and hurricanes eventually demolish the inexpensive wooden structures that are usually built near the coast. The brackish nature of the many water features is their own protection and the subsistence standard of living in coastal Tamaulipas ensures a degree of continuity with the past. Large numbers of people in coastal Tamaulipas continue to rely on sand wells, yucca blossoms are still harvested, salt is still collected from the floors of lagunas, nets are still woven on the shorelines of the Mar Negro and Barril, and the beach continues in use as a natural pathway.

Indians on the coast of the Rio Grande Delta made innovative use of shells for tools and ornaments. The acquisition of trade goods appears to have been their incentive to make massive quantities of shell ornaments and create a far-flung network of trade, a degree of industry apparently unmatched by any other group or groups of hunter-gatherers in Texas or Tamaulipas.

ACKNOWLEDGMENTS

The authors would like to thank Thomas R. Hester for his photos of artifacts in the Anderson Collection and for his help with references. Thanks are also due Richard McReynolds for his excellent drawings. Ed Mokry was helpful with references and generously shared his knowledge of shells and shell artifacts in the Corpus Christi area. Carolyn Spock provided useful information on Anderson's (1932) paper. We also thank John Boland, Richard Brady, Harvey Bruns, Mary Catherall, Dick Clardy, Van T. Deyo, Frank Dudley, Danny Harper, Larry Hess, Lily Kumpe, Terry Kumpe, Harold Redman, Mike Ryan, Tim Savage, Philip Schulz, Armando Vela, Reba Vietta, and Bill Yoder, who loaned artifacts for documentation and drawings.

REFERENCES CITED

Allison, T.C.
1987 Molluscan Communities of Laguna Madre, Texas: Man's Impact. *Coastal Zone '87: Proceedings of the Fifth Symposium on Coastal and Ocean Management*, pp. 2110-2125. Seattle.

Anderson, A.E.
1932 Artifacts of the Rio Grande Delta Region. *Bulletin of the Texas Archeological and Paleontological Society* 4:29-31.

1933 Rio Grande Delta Archaeology: Burial Customs. Manuscript on file at the Texas Archeological Research Laboratory, The University of Texas at Austin.

Andrews, J.
1971 *Shells and Shores of Texas*. Dill Russell Spencer Foundation Series 5. University of Texas Press, Austin.

1977 *Shells and Shores of Texas*. Dill Russell Spencer Foundation Series 5. University of Texas Press, Austin.

1981 *Texas Shells: A Field Guide*. University of Texas Press, Austin. (Revised 1992 as *A Field Guide to Shells of the Texas Coast)*. Gulf Publishing, Houston.

Anonymous
2009 *Edible Wild Plants*. Department of the Army. Skyhorse Publishing, Inc., New York.

Apple, H.F.
2004 Notched Shell Artifacts From Nueces Bay, Texas. *La Tierra* 31(2):15-33.

Arnold, J.B. III
1978 The *Flota* Disaster of 1554. In *Beneath the Waters of Time: The Proceedings of the Ninth* Conference *on Underwater Archaeology*, edited by J. Barto Arnold III, pp. 25-28. Texas Committee Publication 6, Austin.

Aten, L.E., C.K. Chandler, A.B. Wesolowsky, and R.M. Malina
1976 *Excavations at the Harris County Boys School Cemetery: Analysis of Galveston Bay Area Mortuary Practices*. The Texas Archeological Society Special Publication 3.

Aveleyra Arroyo de Anda, L., M. Maldonado-Koerdell, and P. Martinez del Rio
1956 *Cueva de la Candelaria*. I. N. A. H. Memorias V, Vol. 1. Mexico, D. F.

Blair, F.W.
1950 The Biotic Provinces of Texas. *Texas Journal of Science* 2(1):93-117.

Boyd, J.B.
1996 The Arroyo Diablo Burial, Tamaulipas, Mexico. *La Tierra* 23(4):42-45.

1997a A Rock Alignment at Al Punto Final, An Archaic Site in Tamaulipas, Mexico. *La Tierra* 24(1):32-36.

1997b Ornamental Artifacts from the Cardinal Site, Rio Salado, Tamaulipas. *La Tierra* 24(1):47-50.

1998 A Marine Shell Ornament Cache from 41ZP7, Zapata County, Texas. *La Tierra* 25(2):41-47.

Boyd, J.B. and D. Wilson
1996 A Prehistoric Burial from the Rio Grande Drainage, Tamaulipas, Mexico. *La Tierra* 23(3):13-17.

Boyd, J.B., D.E. Wilson, and T.R. Hester
1997 Southern Island, A Prehistoric Cemetery Site in the Falcon Reservoir, Tamaulipas, Mexico. *Bulletin of the Texas Archeological Society* 68:387-425.

Breuer, J.P.
1962 An Ecological Survey of the Lower Laguna Madre of Texas, 1953-1959. *Publication of the Institute of Marine Science* 8:153-185.

Buroker, N. E.
1983 Population Genetics of the American Oyster *Crassostrea Virginica* Along the Atlantic Coast and the Gulf of Mexico. *Marine Biology* 75:99-112.

Campbell, T.N.
1947 The Johnson Site: Type Site of the Aransas Focus of the Texas Coast. *Bulletin of the Texas Archeological and Paleontological Society*, Vol. 18:40-75.

1964 *Appraisal of the Archeological Resources of Padre Island, Texas*. Report submitted to the National Park Service by The University of Texas, Austin.

Chandler, C.K. and C.L. Highley
1998 Marine Shell Pendants from South and South-Central Texas. *La Tierra* 25(1):42-45.

Chandler, C. K. and D. Kumpe
1992 Decorated Freshwater Mussel Shell Artifacts from the Lower Rio Grande of South Texas. *La Tierra* 19(3):8-14.

1993a Stemmed Points with Massive Barbs from the Lower Rio Grande Valley. *La Tierra* 20(3):26-28

1993b Pin Drills from Tamaulipas, Mexico. *La Tierra* 20(4):5-7.

1995 Long Rectangular Shell Pendants from the Lower Rio Grande Area of Tamaulipas, Mexico. *La Tierra* 22(4):3-7.

1997 Decorated Mussel Shell Artifacts. *La Tierra* 24(1):9-13.

1998 Quahog Shells As Hammers. *La Tierra* 25(2):16-21.

Collins, M.B., T.R. Hester, and F.A. Weir
1969 The Floyd Morris Site (41CF2). A Prehistoric Cemetery Site in Cameron County, Texas. Pt. 1. *Bulletin of the Texas Archeological Society* 40:119-146.

Dockall, H. and J.E. Dockall
1996 The Shell Assemblage From Morhiss (41VT1). An Archaic Site On the West Gulf Coastal Plain. *Southeastern Archaeology* 15(2):211-229.

Donohue, G.S.
1980 *Native and Cultivated Trees of the Magic Valley*. Privately printed, Penitas, Texas.

Dreiss, M.L.
1995 Shell Artifacts. In *Archeological Investigations at the Loma Sandia Site (41LK28)*, Vol. 2:531-547. Studies in Archeology 20. Texas Archeological Research Laboratory, The University of Texas at Austin.

Ekholm, G.F.
1944 *Excavations at Tampico and Panuco in the Huasteca, Mexico*. Anthropological Papers, American Museum of Natural History, Vol. 38, pt. 5, New York.

Flores, D.
1992 *Ofrendas Funerarias de Chupicuaro, Guanajuato*. INAH, Mexico, D. F.

Flores, J.
1995 Ancient Enigma. *The Monitor*, McAllen, Texas, April 30, sec.10A.

Garrett, B.
1929 Pearl Buttons from Valley Clams. *Monty's Monthly* 11(6):48-49.

Greer, J.W.
1977 A Columella Bead from the San Antonio Area of South Central Texas. *La Tierra* 4(2):17-19.

Hall, G.D.
1981 *Allens Creek: A Study in the Cultural Prehistory of the Lower Brazos River Valley, Texas*. Research Report 61, Texas Archeological Survey, The University of Texas at Austin.

Headrick, P.
1993 *The Archeology of 41NU11, the Kirchmeyer Site, Nueces County, Texas: Long-Term Occupation of a Coastal Clay Dune*. Studies in Archeology 15. Texas Archeological Research Laboratory, The University of Texas at Austin.

Heartfield, L.
1980 Comparisons of Artifact Assemblages From Southwestern Coahuila, Mexico. In *Papers on the Prehistory of Northeastern Mexico and Adjacent Texas*, ed. by J. F. Epstein, T. R. Hester, and C. Graves, pp. 71-80. Special Report 9. Center for Archaeological Research, The University of Texas at San Antonio,

Heizer, R.F.
1949 Curved Single-Piece Fishhooks of Shell and Bone In California. *American Antiquity* 15(2):89-97.

Hester, T.R.
1969a *Archeological Investigations in Kleberg and Kenedy Counties, Texas, August, 1967*. Report 15. State Building Commission, Archeological Program. Austin.

1969b The Floyd Morris and Ayala Sites: A Discussion of Burial Practices in the Rio Grande Valley and the Lower Texas Coast. *Bulletin of the Texas Archeological Society* 40:157-166.

1970 Marine Shells from Archeological Sites in Southwestern Texas. *Texas Journal of Science* 22(1):87-88.

1980 *Digging into South Texas Prehistory*. Corona Publishing Company, San Antonio.

1994 The Contexts of Trade Between the Brownsville Complex and Mesoamerican Cultures. *La Tierra* 21(2):1-4.

2004 The Prehistory of South Texas. In: *The Prehistory of Texas*, ed. by T. K. Perttula, pp. 127-154. Texas A & M University Press, College Station.

n. d. A Technological Study of Prehistoric Shell Implements in the Circum-Caribbean and Gulf of Mexico Regions. Unpublished manuscript on file with the authors.

Hester, T.R., J.B. Boyd, F. Asaro, F. Stross, R. Giauque, D. Kumpe, and J. Bourbon
1996 Notes on South Texas Archeology 1996-3: Mesoamerican Obsidion at Sites in the Falcon Reservoir and Lower Rio Grande Area of Southern Texas and Northeastern, Mexico. *La Tierra* 23(3):2-6.

Hester, T.R. and F.A. Ruecking, Jr.
1969 Additional Material from the Ayala Site, A Prehistoric Cemetery Site in Hidalgo County, Texas. Pt. 2. *Bulletin of the Texas Archeological Society* 40:147-157.

Hildebrand, H.
1980 The Laguna Madre de Tamaulipas: Its Hydrography and Shrimp Industry. Unpublished manuscript submitted to National Marine Fisheries Service. On file at Texas A & M University-Corpus Christi, Center for Coastal Studies Library.

Howells, R.G., R.W. Neck, and H.D. Murray
1996 *Freshwater Mussels of Texas*. Texas Parks and Wildlife Department, Inland Fisheries Division, Austin.

Hudgeons, M.D. and T.R. Hester
1977 An Aboriginal Burial at the Dunn Site, DeWitt County, Southern Texas. *La Tierra* 4(3):10-14.

Hughes, J.T.
1947 An Archaeological Reconnaissance in Tamaulipas, Mexico. *American Antiquity* 13(1):33-39.

Humfrey, M.
1975 *Sea Shells of the West Indies*. Taplinger Publishing Company, New York.

Jackson, A.T.
1940 Tubular Pipes and Other Tubes in Texas. *Bulletin of the Texas Archeological and Paleontological Society* 12:99-137.

Janota, B.
1980 A Preliminary Study of the Shell Ornaments of the Texas Coast Between Galveston Bay and the Nueces River. In *Papers on the Archaeology of the Texas Coast*, edited by L. Highly and T. R. Hester, pp. 29-49. Special Report No. 11. Center for Archaeological Research, The University of Texas at San Antonio.

Kavanagh, T.W. and J. Dixon
1996 *North American Indian Portraits: Photographs from the Wanamaker Expeditions*. Konecky and Konecky, Old Saybrook, Connecticut.

Krzywonski, M.
2004 Notes on an Unusual Shell Container from the Rio Grande Delta. *La Tierra* 31(2):73-76.

Kumpe, D.
1996 Occurrence, Distribution, Origins, and Use of Beach-Rolled Quahog Shell Fragments in the Deltaic Plain of the SCC. In *Archeology In the Central and Southern Planning Region, Texas: A Planning Document*, edited by P. A. Mercado-Allinger, N. A. Kenmotsu, and T. K. Perttula, pp. 199-200. Office of the State Archeologist, Special Report 35 and the Department of Antiquities Protection Cultural Resource Management Report 7, Texas Historical Commission, Austin.

2008 A Decorated Mussel Shell Pendant from Nuevo Leon, Mexico. *La Tierra* 35(1 & 2):41-43.

n.d. a Archeological records from 1969 – 2003.

n.d. b Archeological records in Hidalgo County.

n.d. c The Shells Used to Decorate Graves in Matamoros County, Tamaulipas.

Kumpe, D., C. K. Chandler, and R. McReynolds
1998 Occurrences of *Rangia Cuneata* In Cameron County, Texas and Northeastern Tamaulipas, Mexico. *La Tierra* 25(1):22-35.

Kumpe, D. and M. Krzywonski
2008 Knapped Glass Tools from a 20th Century Site in Hidalgo County, Texas. *La Tierra* 35(1 & 2):61-70.

Kumpe, D., R. McReynolds, and C.K. Chandler
2000 A Highly Serrated Arrow Point Form From Falcon Reservoir, Zapata County, Texas. *La Tierra* 27(1):33-45.

Ladassor, G.
2001 Cahokia Ornaments. In *Cahokia Brought To Life*, pp. 32-47. The Greater St. Louis Archaeological Society. Messenger Printing Co., Kirkwood, Missouri.

Luer, G.M.
1986 Some Interesting Archaeological Occurrences of Quahog Shells on the Gulf Coast of Central and Southern Florida. *The Florida Anthropologist* 39(3):124-159.

MacNeish, R.S.
1947 A Preliminary Report on Coastal Tamaulipas, Mexico. *American Antiquity* 13(1):1-15.

1958 Preliminary Archaeological Investigations in the Sierra de Tamaulipas, Mexico. *Transactions, American Philosophical Society* Vol. 48, Pt. 6.

Mallory, R.
1994 Ancient Mysteries. *Texas Highways* 41(2):42-47.

Mallouf, R.J., B.J. Baskin, and K.L. Killen
1977 *A Predictive Assessment of Cultural Resources in Hidalgo and Willacy Counties, Texas*. Survey Report 23. Office of the State Archeologist, Texas Historical Commission, Austin.

Marquardt, W.H.
1992 Shell Artifacts from the Caloosahatchee Area. In *Culture and Environment in the Domain of the Calusa*, edited by W. H. Marquardt, pp. 191-227. Monograph No. 1. Institute of Archaeology and Paleoenvironmental Studies, University of Florida, Gainesville.

McKee, D.A.
2008 *Fishes of the Texas Laguna Madre*. Gulf Coast Books, Texas A&M University-Corpus Christi. Texas A&M University Press, College Station.

McReynolds, R.
2008 Aboriginal Use of Glass on the Texas Coast and Nearby Areas. *La Tierra* 35(1 & 2):71-80.

McGowen, J. H., L. F. Brown, Jr., T. R. Calnan, J. L. Chin, J. P. Herber, and C. L. Lewis
1977 *History and Processes Involved in Development of South Padre Island, Laguna Madre, and Los Bancos de en Medio*. Report to Texas General Land Office. Bureau of Economic Geology, The University of Texas, Austin.

Meggers, B.J., C. Evans, and E. Estrada
1965 *Early Formative Period of Coastal Ecuador: The Valdivia and Machalilla Phases*. Smithsonian Contributions to Anthropology, Washington, D.C.

Mercado-Allinger, P.A. and R.A. Ricklis
1996 Introduction. In *Archeology In the Central and Southern Planning Region, Texas: A Planning Document*, edited by P. A. Mercado-Allinger, N. A. Kenmotsu, and T. K. Perttula, pp. 47-76. Office of the State Archeologist, Special Report 35 and the Department of Antiquities Protection, Cultural Resource Management Report 7, Texas Historical Commission, Austin.

Miles, C.
1963 *Indian and Eskimo Artifacts of North America*. Bonanza Books, New York.

Mokry, E.R., Jr.
1979 Survey of Archaeological Sites In Starr County, Texas. *La Tierra* 6 (4):16-25.

1980 Notes on Conch Shell Adze Technology, Texas Coast. In *Papers on Archeology of the Texas Coast*, edited by L.Highly and T. R. Hester, pp. 60-61. Special Report 11. Center for Archaeological Research, University of Texas at San Antonio.

Muche, J.F.
1978 An Inundated Aboriginal Site, Corral Beach, California. In *Beneath the Waters of Time: The Proceedings of the Ninth Conference on Underwater Archaeology*, edited by J. Barto Arnold III, pp. 101-108. Texas Antiquities Committee Publication 6, Austin.

Nance, J.M.
1964 *Attack and Counter-Attack*. University of Texas Press, Austin.

Newcomb, W.W., Jr.
1961 *The Indians of Texas*. University of Texas Press, Austin.

Newton, M.B.
1963 Summary of Reconnaissance on Arroyo los Olmos, Starr County, Texas. Paper distributed at the annual meeting of the Society of American Archeology, Boulder, Colorado.

Orton, R.B.
1977 Climate. In *Soil Survey of Cameron County, Texas* by D. Williams, C. M. Thompson, and J. L. Jacobs. United States Department of Agriculture, Soil Conservation Service, and Texas Agricultural Experiment Station.

Prewitt, E.
1974 Preliminary Archeological Investigations in the Rio Grande Delta of Texas. *Bulletin of the Texas Archeological Society* 45:55-66.

Quintero, N.
1980 Coming of Age the Apache Way. *National Geographic* 157(2):262-271.

Richard, N.L.
2005 The Clay Dunes in Eastern Cameron County. In *Studies in Rio Grande Valley History*, edited by M. Kearney, A. Knopp, and A. Zavaleta, pp. 371-377. The UTB/TSC Regional History Series, Vol. VI. The University of Texas at Brownsville and Texas Southmost College.

Ricklis, R.A.
1990 A Historical Cultural Ecology of the Karankawan Indians of the Central Texas Coast: A Case Study in the Roots of Adaptive Change. Unpublished Ph.D. dissertation, Department of Geography, The University of Texas at Austin.

1996 Hunter-Gatherer Economic Strategies and Mobility Patterns in the Southern Coastal Corridor. In *Archeology in the Central and Southern Planning Region, Texas: A Planning Document*, edited by P. A. Mercado-Allinger, N. A. Kenmotsu, and T. KI. Perttula, pp. 85-165. Office of the State Archeologist, Special Report 35 and the Department of Antiquities Protection, Cultural Resource Management Report 7, Texas Historical Commission, Austin.

2004a Prehistoric Occupation of the Central and Lower Texas Coast. In *The Prehistory of Texas*, edited by T. K. Perttula, pp. 155-180. Texas A & M University Press, College Station, Texas.

2004b The Archeology of the Native American Occupation of Southeast Texas. In *The Prehistory of Texas*, edited by T. K. Perttula, pp. 181-202. Texas A & M University Press, College Station, Texas.

Salinas, M.

1981 The Shell Technology of the Rio Grande Delta. Manuscript on file at the Texas Archeological Research Laboratory, the University of Texas at Austin.

1990 *Indians of the Rio Grande Delta*. University of Texas Press, Austin.

Sayles, E.B.

1935 *An Archaeological Survey of Texas*. The Medallion Papers 17, Globe, Arizona.

Scherer, J.C.

1973 *Indians*. A Ridge Press Book, Crown Publishers, Inc., New York.

Sparrow, Capt. S.

2008 Outside the Margins. *Tide* 32(2):38-46.

Steele, D.G. and E.R. Mokry, Jr.

1985 Archeological Investigation of Seven Prehistoric Sites Along Oso Creek, Nueces County, Texas. *Bulletin of the Texas Archeological Society* 54 (for 1983):287-308.

Stuart, G.E.

1972 Who Were the "Mound Builders"? *National Geographic* 142(6):783-801.

Terneny, T.T.

2003 A Re-evaluation of Late Prehistoric and Archaic Chronology in the Rio Grande Delta of South Texas. Unpublished Ph.D. dissertation, The University of Texas at Austin.

Titterington, P.F., Dr.

1948 *The Cahokia Mound Group and Its Village Site Materials*. Privately printed, St. Louis, Missouri.

Torres, E.

2006 *Healing with Herbs and Rituals*. The University of New Mexico, Albuquerue.

Tunnell, J.W., Jr. and F.W. Judd

2002 *The Laguna Madre of Texas and Tamaulipas*. Texas A & M University Press, College Station.

Turner, E. S. and T. R. Hester

1999 *A Field Guide to Stone Artifacts of Texas Indians*. Rowman and Littlefield, Lanham, Maryland..

Utberg, N.S.

1969 *The Indian Artifacts of Mexico and South Texas*. Privately printed, Edinburg, Texas.

Wagner, W. J., III

2003 An Introduction to the Brownsville-Barril Complexes and the A. E. Anderson Collection. *Mono y Conejo* Vol. 1:25-30. Mesoamerican Research Laboratory, The University of Texas at Austin.

Weddle, R.S.

1968 *San Juan Bautista*. University of Texas Press, Austin.

Weir, F. A.

1956 Surface Artifacts from La Perdida, Starr County, Texas. *Bulletin of the Texas Archeological Society* 26:59-78.

Weise, B.R. and W.A. White

1980 *Padre Island National Seashore*. Bureau of Economic Geology, The University of Texas, Austin.

Weniger, D.

1991 *Cacti of Texas and Neighboring States*. University of Texas Press, Austin.

Yenne, Bill

1986 *Encyclopedia of North American Indian Tribes*. Crescent Books, Avenel, New Jersey.

Zavaleta, A.N.

1991 Mr. A.E. Anderson, "The Father of Valley Archeology" and His "Indian Relic Collection." In *Still More Studies in Brownsville History*, edited by M. Kearney, pp. 131-152 (plus 25 figures on 16 additional pages not numbered), The University of Texas at Brownsville and Texas Southmost College.

Zimmerman, L.S., D.G. Steele, and J.D. Meyer

1988 A Visual Key for the Identification of Otoliths. *Bulletin of the Texas Archeological Society* 58:175- 200.