

NAUTICAL ARCHAEOLOGY

**SAONA ARTILLERY:
IMPLICATIONS FOR INTER-ISLAND TRADE AND SHIPBOARD
ARMAMENTS IN THE FIRST HALF OF THE SIXTEENTH CENTURY**

A Thesis

by

SAMUEL PETER TURNER

Submitted to the Office of Graduate Studies
Texas A&M University
in partial fulfillment of the requirements for the degree of
MASTER OF ARTS

May 1994

Major Subject: Anthropology

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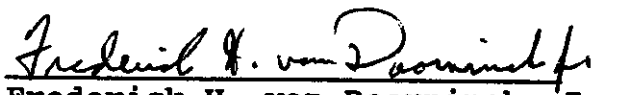
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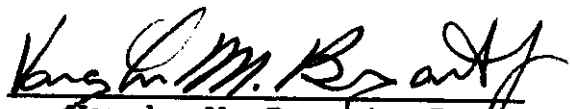
MASTER OF ARTS

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May 1994

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ABSTRACT**Saona Artillery:**

**Implications for Inter-Island Trade and Shipboard
Armaments in the First Half of the Sixteenth Century.**

(May 1994)

Samuel Peter Turner, B.A., Antioch College

Chair of Advisory Committee: Dr. Kevin Crisman

Between January and July, 1983, Burt D. Webber carried out an extensive survey for the shipwreck remains of the fleet of 1502 in the Mona Passage between the Dominican Republic and Puerto Rico. Many sites were found including three off the island of Saona which dated to the sixteenth century. Surviving remains included heavy iron objects such as wrought-iron artillery and anchors. The sites appeared to have been unsalvaged and probably represented complete artillery collections. Webber partially salvaged two of the sites by removing a number of cannons and swivel guns. This study examines the salvaged Saona artillery collection, and includes a history of the Mona Passage in the early sixteenth century, as well as an examination of wrought-iron artillery nomenclature and typologies, wrought-iron artillery construction, and sixteenth-century shipboard artillery tactics.

The objective of this thesis is to interpret and place the three sixteenth-century Saona sites and their artillery in their correct historical and operational contexts. Considerable trade developed between Santo Domingo, Saona Island, Salvaleón de Higüey, Mona Island, and San Germán in Puerto Rico during the first half of the sixteenth century. Sailing in relatively safe waters, vessels engaged in this trade frequently had small crews and therefore would have been lightly armed.

Two of the shipwreck sites represent the remains of lightly armed vessels which may have been involved in inter-island trade. The initial examination of these sites was brief and incomplete. The importance and rarity of the sites suggests a reinvestigation of all three sixteenth-century sites should be carried out in the future.

ACKNOWLEDGEMENTS

I would like to first collectively thank all the individuals who have helped me with this work be they in the Dominican Republic, Puerto Rico, Great Britain, Boston, New York or Texas. This work is the result of many people's efforts besides my own, and there is not time or room enough to acknowledge everyone individually.

First and foremost I must thank Don Pedro Borrell Bentz, Executive Secretary of the Comisión de Rescate Arqueológico Submarino, and Burt D. Webber, director of "Operation Saona", for their kind permission to study this fascinating material.

My sincerest and undying thanks go to Jerome Hall for taking me to the Dominican Republic, where I became familiar with the Altarazana Museum's holdings, as well as giving me the opportunity to gain invaluable field experience I could not have possibly gained elsewhere. This wonderful and fortuitous turn of events placed me on a career path which shows much promise and enjoyment. I also own him a great debt for introducing me to my fiancée Amanda, whom I otherwise would not have meet. Thank you Jerome.

Thanks are due Jemison Beshears for his crash course in 1:1 drawing which got me started on the recording project. I owe many thanks to Francis Tejeda, director

of the conservation laboratory in the Fortaleza Ozama, who first made me aware of Operation Saona and assisted me in innumerable ways during my stay in Santo Domingo, not the least of which was helping me find an apartment; and also thanks to Patricia, the secretary for the Comisión, who allowed me to store my equipment in her air-conditioned office and allowed me to work there when occasion warranted it.

The recording of the artillery in the Altarazana Museum collection was facilitated in every way by Luisa de Peña, director of the Museum, who went out of her way to see that I always had everything I needed for my work and provided hours of fascinating conversation during my many days at the Museum. Thanks also to Carlos and the rest of the museum staff, who helped me move the artillery during my many recording sessions.

A special thanks to my dear friend and companion Hector Julio Beras, with whom I shared the facilities of the Laboratory during my stay. His friendship, inspirational attitude towards life and excellent cooking made my stay in Santo Domingo a truly happy one which I will long remember. Thanks for everything Hector!

The entire staff of the Fortaleza Ozama laboratory made my stay easier. Francisco, Glenis, Felix Reyes (Cimarron!) and the good Sergeant Lima, who cooked the

best *yuca y arenque* in the whole of the Dominican Republic, helped in many, many, ways.

In the United States, a special and sincere thanks is due Joe J. Simmons III, who has been a continually enthusiastic supporter and a font of information and drawings involving wrought-iron artillery. Thanks are also due Mr. Conrad Knerr of Metlab, Inc., whose photos and X-rays of the artillery were enthusiastically and willingly shared. I am also indebted to Colin O'Bannon for giving me such a great deal on a camera and equipment when I desperately needed it, and Joe Cozzi, who put me in touch with Glenn Butler of Life Support Technologies, Inc., in New York who took an interest in my project and generously put me up and provided transportation to Precision Valve Inc., where a tube gun from one of the sites was in storage.

Hellen Jantz of Precision Valve Inc. worked on my behalf to obtain permission to record the tube gun at Precision Valve. Also a special thanks to Mr. Robert Abplanalp, who gave me permission to record the gun in his possession.

Bob Smith and the Library staff of the Royal Armouries, HM Tower of London, were extremely helpful, providing me with many sources which were crucial to the text of the thesis. Thanks are due Denise C. Lakey, who generously shared the fruits of her labors in the form of

transcribed armament lists of vessels sailing to the West Indies and to Dr. Don Keith, who shared the latest information on the Bahia de Mujeres Wreck. I would like to thank Mike Fitzgerald for his help on various occasions during the final preparation of this manuscript.

I am forever grateful to Amanda Sutherland, whose support, encouragement, and editorial help over the past nine months has kept me on the path. Great thanks are due my father Kenneth Turner, whose support and encouragement throughout these many years has given me the confidence and desire to accomplish what I have.

Lastly, I would like to thank three special people who have been crucial to the development of my career. Cynthia Bouton, not only for agreeing to sit on my committee, but especially for having put me on the road to History and Archaeology in the first place while my advisor at Antioch College in the mid-1980's. Without her guidance and enthusiastic support I would not be here. I thank my Committee Chair, Kevin Crisman for his tireless work on my behalf; may his red pen ever write. This work would be far less without his experienced and critical editorial eye. I wish to thank especially Frederick H. van Doorninck, whose unwavering support, encouragement, and sense of humor, throughout my stay has meant more to me than I can possibly express.

TABLE OF CONTENTS

	Page
ABSTRACT.....	iii
ACKNOWLEDGEMENTS.....	v
TABLE OF CONTENTS.....	ix
LIST OF FIGURES.....	xi
INTRODUCTION.....	1
NAVIGATION OF THE MONA PASSAGE IN THE FIRST HALF OF THE SIXTEENTH CENTURY.....	5
OPERATION SAONA AND THE SIXTEENTH-CENTURY SITES...	22
Pre-site One.....	25
Pre-site Two.....	30
The Caballo Blanco Site.....	36
Summary.....	45
ORDNANCE TREATMENT AND CONDITION.....	50
RESEARCH.....	56
SWIVELLED WEAPONS.....	59
Verso: Definition.....	59
The Saona versos.....	73
Verso #0032/0034A.....	73
Verso #0032/0034B.....	76
Verso #0037.....	81
Verso manufacturing.....	84
Construction of the Saona versos.....	91

	Page
Haquebut: Definition.....	95
Haquebut #0035.....	100
TUBE GUNS AND THEIR POWDER CHAMBERS.....	106
Tube gun #0036.....	111
Tube gun #0031.....	115
Powder chamber #0033.....	121
Powder chamber #0038.....	125
Summary.....	127
MOUNTING, MAINTENANCE, AND GUNNERY TACTICS.....	129
Archaeological and documentary evidence.....	149
New World contingencies.....	160
CONCLUSIONS.....	168
REFERENCES.....	173
APPENDIX A.....	181
APPENDIX B.....	186
VITA.....	191

LIST OF FIGURES

Figure		Page
1	Display of the best-preserved sixteenth-century artillery in the Alarazana Museum in Santo Domingo, Dominican Republic.....	2
2	View of a caravel.....	6
3	A nao with sails furled after the <i>mappa mundi</i> by Juan de la Cosa of c. 1500.....	7
4	Map of Española, Saona Island, Mona Island, and Puerto Rico including the principal towns mentioned in the text.....	10
5	A verso swivel gun with a powder chamber and a tube gun with its powder chamber.....	23
6	Map of Saona Island, Isla Catalanita, and Bajos del Caballo Blanco Reef and the three sixteenth-century sites.....	24
7	Map of Pre-site One just off of South Catalanita Reef.....	27
8	Map of Pre-site Two on South Catalanita Reef.....	31
9	Conglomerate 157 from the San Esteban wrecked on Padre Island.....	33
10	Map of the Caballo Blanco site.....	37

Figure	Page
11	Tube gun, tube gun powder chambers, and anchor features at the Caballo Blanco site..... 39
12	Verso swivel guns and modern sailboat wreckage to the north west of tube guns and anchors..... 40
13	Stacked anchors from the San Esteban illustrating examples of artifacts and information that may be contained within the Saona anchor concretions..... 44
14	Photograph taken at METLAB of the artillery when it first arrived..... 53
15	Another photo showing the artillery as it arrived in METLAB..... 53
16	An example of a SW1-type gun..... 64
17	An example of a SW2-type gun..... 64
18	An example of a SW3-type gun..... 66
19	A SW4-type gun..... 66
20	A SW5-type gun..... 67
21	Beer-stein swivel-gun powder chambers and a cylindrical tube-gun powder chamber..... 70
22	Simmons' nomenclature for verso swivel guns..... 71

Figure	Page
23	Simmons' nomenclature for wrought-iron tube guns..... 72
24	Plan view of <i>verso</i> #0032/0034A..... 74
25	The barrel of <i>verso</i> #0032/0034A drooping as a result of hydrogen reduction treatment... 74
26	Close up of the bottom of <i>verso</i> #0032/0034A's chamber holder showing its long drainage slit..... 75
27	Chamber holder, powder chamber, and wedge of <i>verso</i> #0032/0034A..... 77
28	Barrel of <i>verso</i> #0032/0034B..... 77
29	The remains of the yoke of <i>verso double</i> #0032/0034B after separation from the weapon's trunnions..... 79
30	The remains of the tiller and chamber holder base of <i>verso double</i> #0032/0034B after hydrogen reduction treatment..... 79
31	The trunnion hoop of <i>verso</i> #0032/0034B..... 80
32	<i>Verso double</i> MRW 36..... 80
33	<i>Verso double</i> 41 WY 3 No. 333 from Padre Island..... 82

Figure	Page
34	Wedge (inserted from left), powder chamber, and chamber holder of broken and untreated <i>verso double</i> #0037..... 83
35	Forward end of <i>verso double</i> #0037 showing the long chase reinforce and the yoke..... 83
36	Sectioned profile of <i>verso normal</i> MRW-66... 86
37	Illustration showing MRW-66 in planar form and profile..... 87
38	Exploded drawing of MRW-66's barrel and yoke..... 88
39	Exploded drawing of MRW-66's chamber holder powder chamber, wedge, and tiller assembly..... 90
40	Schematic drawing of <i>verso normal</i> #0032/0034A..... 93
41	Reconstruction drawing of #0032/0034A..... 94
42	A horseman firing a hand cannon..... 98
43	Haquebut #0035..... 101
44	Illustration of #0035's breech showing what may be the touch hole on the right side of the barrel..... 103
45	One of the haquebuts from the Molasses Reef Wreck..... 104

Figure	Page
46	Haquebut #0036's yoke, which fell off during the hydrogen reduction treatment.... 105
47	Trunnion hoop of haquebut #0035..... 105
48	Close up of tube gun #0036 showing the seam between two staves..... 107
49	The three types of tube guns in Smith's current typology..... 110
50	Tube gun #0036 at Precision Valve Inc. in Yonkers, New York..... 113
51	Reconstruction of #0036 based on pre-treatment photographs and x-rays..... 114
52	One of the two Highborn Cay tube guns salvaged in 1967..... 116
53	Reconstruction of tube gun #0031..... 117
54	The muzzle section of tube gun #0031..... 119
55	The main section of tube gun #0031..... 119
56	The two sections of #0031 shortly after the gun broke at METLAB..... 120
57	Reconstruction of powder chamber #0033 and the breech of tube gun #0031 showing how the two were joined for operation of the weapon..... 122

Figure		Page
58	Powder chamber #0033.....	124
59	End of powder chamber #0033 showing exposed inner tube and plug.....	124
60	Untreated tube gun powder chamber #0038....	126
61	A typical four ring chamber.....	126
62	An engraving by Frans Huys after Bruegel showing a sixteenth-century vessel armed with heavy guns and swivel guns protruding from small ports in the stern and fore castles.....	130
63	A swivel saddle for mounting versos.....	131
64	Drawings of Padre Island tube guns No. 156-3 (top) and No. 172-1, showing the remains of gun stocks and the lines used to secure the guns to the stocks.....	135
65	Reconstruction drawing of a tube gun and powder chamber in place in their stock.....	136

INTRODUCTION

Salvage Companies have been operating in the waters of the Dominican Republic for many years. Artifacts salvaged from numerous shipwrecks by treasure hunters Burt Webber, Tracey Bowden and Rick Berry are on display at the Altarazana Museum of Underwater Archaeology in Santo Domingo. Among the museum's collections are three pieces of sixteenth-century artillery raised by Burt Webber during "Operation Saona" in 1983 (Fig. 1).

I first became aware of this salvage operation when I arrived in Santo Domingo with Jerome Hall and Jemison Beshears to begin excavation of the Monte Cristi Pipe Wreck in the summer of 1991. Other salvaged Saona material that remained in the country was held in the Fortaleza Ozama conservation laboratory, which is run by the Dominican Government's Comisión de Rescate Arqueológico Submarino. I was both intrigued and disappointed by the sixteenth-century iron artifacts stored in the laboratory; the material was meager and in poor condition. I believed it to be the entire collection until my first trip to the Altarazana Museum of Underwater Archaeology in April 1992.

This thesis follows the format and style of the International Journal of Nautical Archaeology.

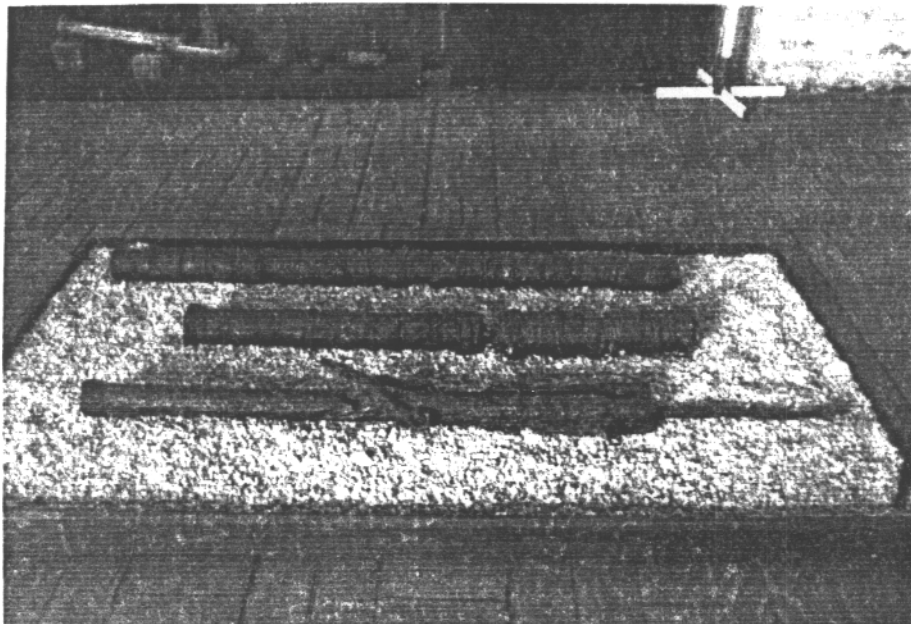


Figure 1. Display of the best-preserved sixteenth-century artillery in the Altarazana Museum in Santo Domingo, Dominican Republic. Note the powder chamber displayed with the muzzle section of the broken tube gun. (Photo by author).

I inquired about archaeological research on the Saona finds and discovered that no one had studied or published these guns. It was clear that this small collection of sixteenth-century artillery could make an important contribution to the literature already published on New World artillery finds from this period.

The prompt execution of this project was imperative, since the salvaged artillery was deteriorating at an alarming rate, despite prior conservation treatments. It was probable that the weapons would not survive for any great length of time and would soon be lost together with information intrinsic to an understanding of the first forms of artillery used in the New World.

I was further driven to study the material by my long-standing interest in sixteenth-century New World seafaring and particularly the marine activity which occurred in the Mona passage. This strait separates the east coast of the Dominican Republic from the west coast of Puerto Rico and constitutes one of the oldest Spanish navigational routes in the New World.

During Webber's "Operation Saona" shipwreck survey in the Mona Passage, a variety of sixteenth-century material was salvaged in addition to the artillery; the bulk of non-artillery artifacts consisted of earthenware ceramic shards. In addition to these a number of possible iron ship fittings and rigging elements were

recovered. Unfortunately the ceramics were mixed with eighteenth-century material of a very similar nature, and a number of the rigging elements could not be located. I therefore chose to study only the artillery.

In this study I have analyzed the salvaged artillery and described sixteenth-century wrought-iron artillery construction and use. The sites have been described and interpreted using information recorded by the salvors in 1983 and placed into historical context by an examination of the history of the Dominican Republic, Puerto Rico, and the waters surrounding Saona Island and the Mona Passage.

Using documentary sources which list sixteenth-century Iberian ship crews and artillery, I have investigated current theories about the number of men needed to operate the different weapons. I have also endeavored to place the Saona artillery into current wrought-iron artillery typologies to see if these are adequate or require modification.

**NAVIGATION OF THE MONA PASSAGE IN THE
FIRST HALF OF THE SIXTEENTH-CENTURY**

The types of vessels used by the Spanish in the New World during the first half of the sixteenth century fall primarily into two categories; caravels and naos. In general terms, caravels were sturdy, shallow-draught vessels with comparatively small holds. They sailed well into the wind and were perhaps the most seaworthy vessels of their time (Fig. 2). These were the primary vessels of exploration and discovery, as they were capable of navigating in dangerous and unknown waters where larger naos were more likely to be stranded and lost. Naos, by comparison, were larger ships which varied considerably in size. They were designed primarily as cargo vessels and consequently had large and bulky hulls with lots of cargo space. They therefore drew more water and were less manageable under sail (Fig. 3).

In September 1494, during his second voyage to the New World, Christopher Columbus explored the south coast of Española (now Haiti and the Dominican Republic). Having recently explored Jamaica and the south coast of Cuba, he had sailed along mountainous shores in his ship *Niña*, a caravel (Smith, 1993: 239), finding good harbors and landing in a number of them. One of these harbors was almost certainly the mouth of the Ozama River, which was

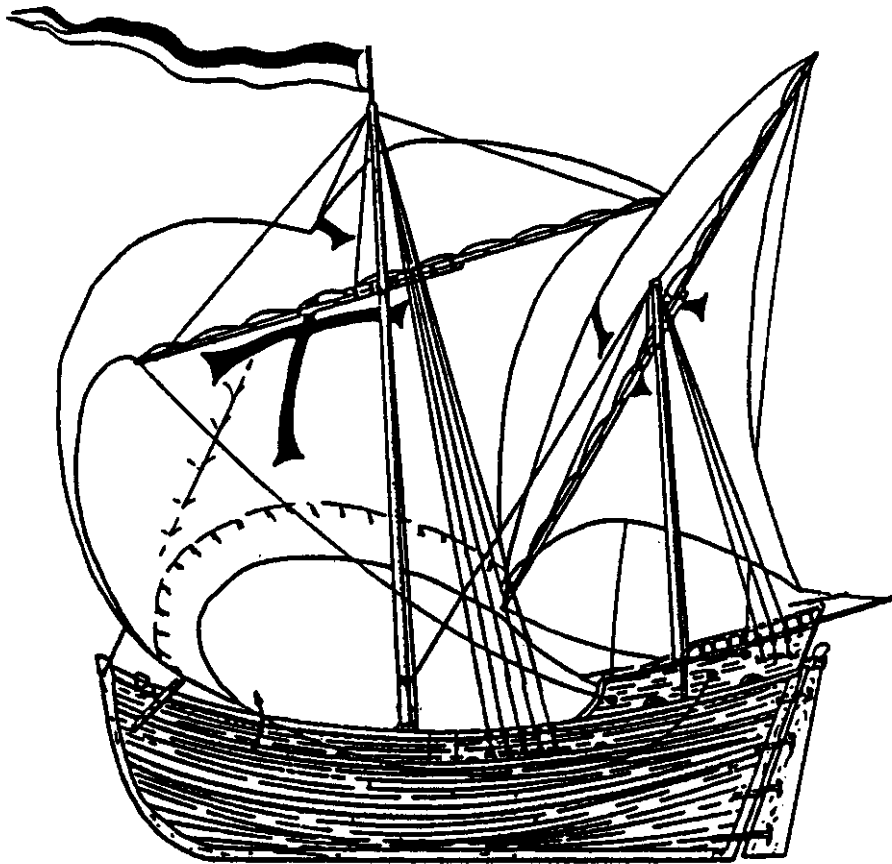


Figure 2. View of a caravel. (After Keith, 1987: frontis piece).

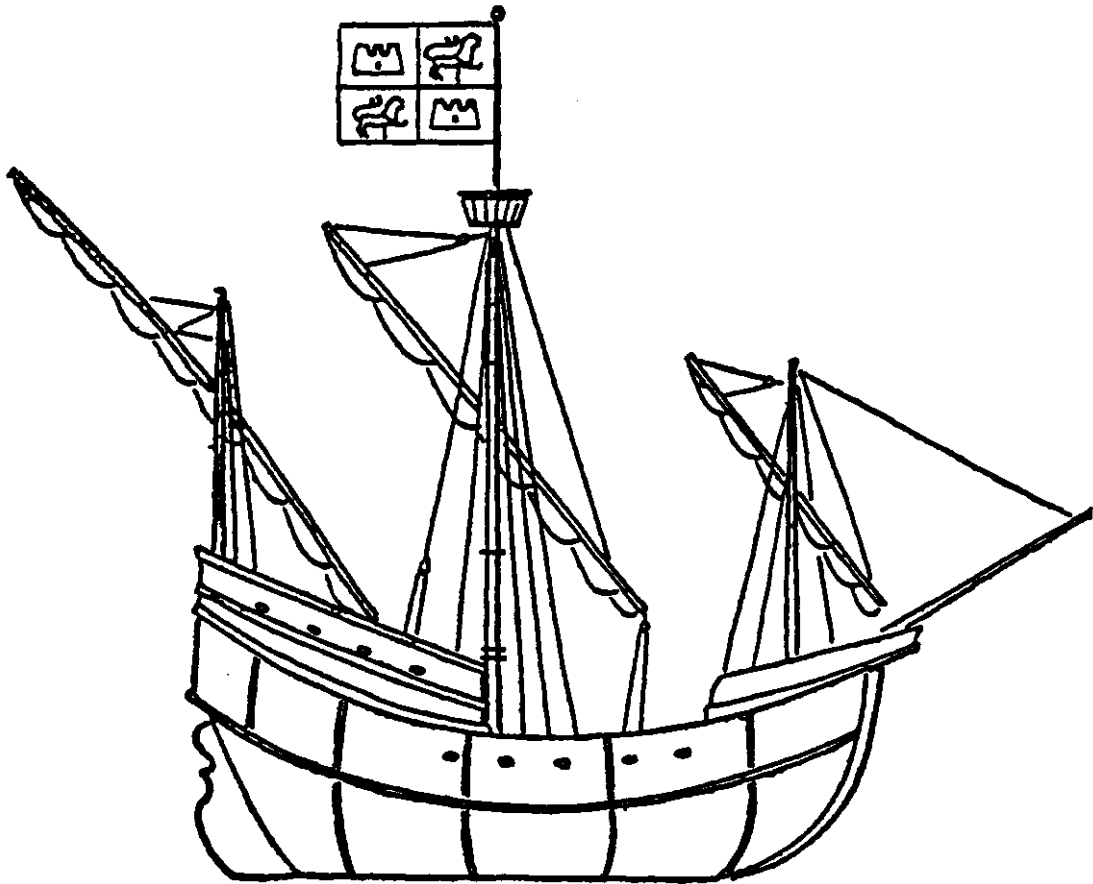


Figure 3. A nao with sails furled after the *mappa mundi* by Juan de la Cosa of c. 1500. (Morison, 1942: 111).

to become the port of Santo Domingo before the end of the century.

Sailing east of Ozama, Columbus noticed a change in weather and sought a shelter from the impending storm along the coast ahead. In the course of his search, he discovered a small island which the Indians called *Adamaney*. The island was first spotted by Michele de Cuneo of Savona, possibly a boyhood friend of Columbus who accompanied him on that voyage (Morison, 1963: 224):

"And thus ranging the coast toward our settlement we found not too far from a cape a very beautiful island which also, I was the first to sight, the which was some 25 leagues in circumference, and again out of love for me, the Lord Admiral called it *La Bella Saonese*."

Thus was Saona first discovered by the Spanish. According to Las Casas (Vol. 1, 1951: 395), who in all probability was not privy to De Cuneo's letter, either Christopher, or later his brother Bartolomé, named the island Saona.

On the 15th of September, Columbus anchored *Niña* in the small and shallow body of water between Saona Island and Española and made preparations for the storm. The

two accompanying vessels were unable to make it in to safety, perhaps because they were larger vessels or their crews were not as able as those of the *Niña* (Fig.4).

That evening Columbus and his crew witnessed a lunar eclipse which allowed Columbus to calculate that there was a five hour and twenty-three minute difference between Saona and Cadiz (Las Casas, Vol.1, 1951: 396). The severe weather lasted seven or eight days, during which the other vessels managed to slip into the shelter, perhaps on the storm tide.

On September 24th, the *Niña* and her two companions left Saona and sailed up the Mona passage until they reached Cabo Del Engaño. They then steered east and headed to Mona Island, which lay 10 leagues distance from the Cape and 8 leagues from the Island of San Juan Bautista (now Puerto Rico). Las Casas (Vol. 1, 1951: 396) states that the island may have been called Mona by the Indians, but speculates that Columbus perhaps named it after an island off the coast of England.

Upon leaving Mona Columbus set sail for San Juan Bautista, where, upon approaching the coast, he was taken gravely ill due to the strain and lack of sleep during the course of the voyage. Fearing he was near death, the vessels steered directly for the Spanish settlement of La Isabela, sailing north through the Mona Passage and then west with the prevailing winds. They arrived at La

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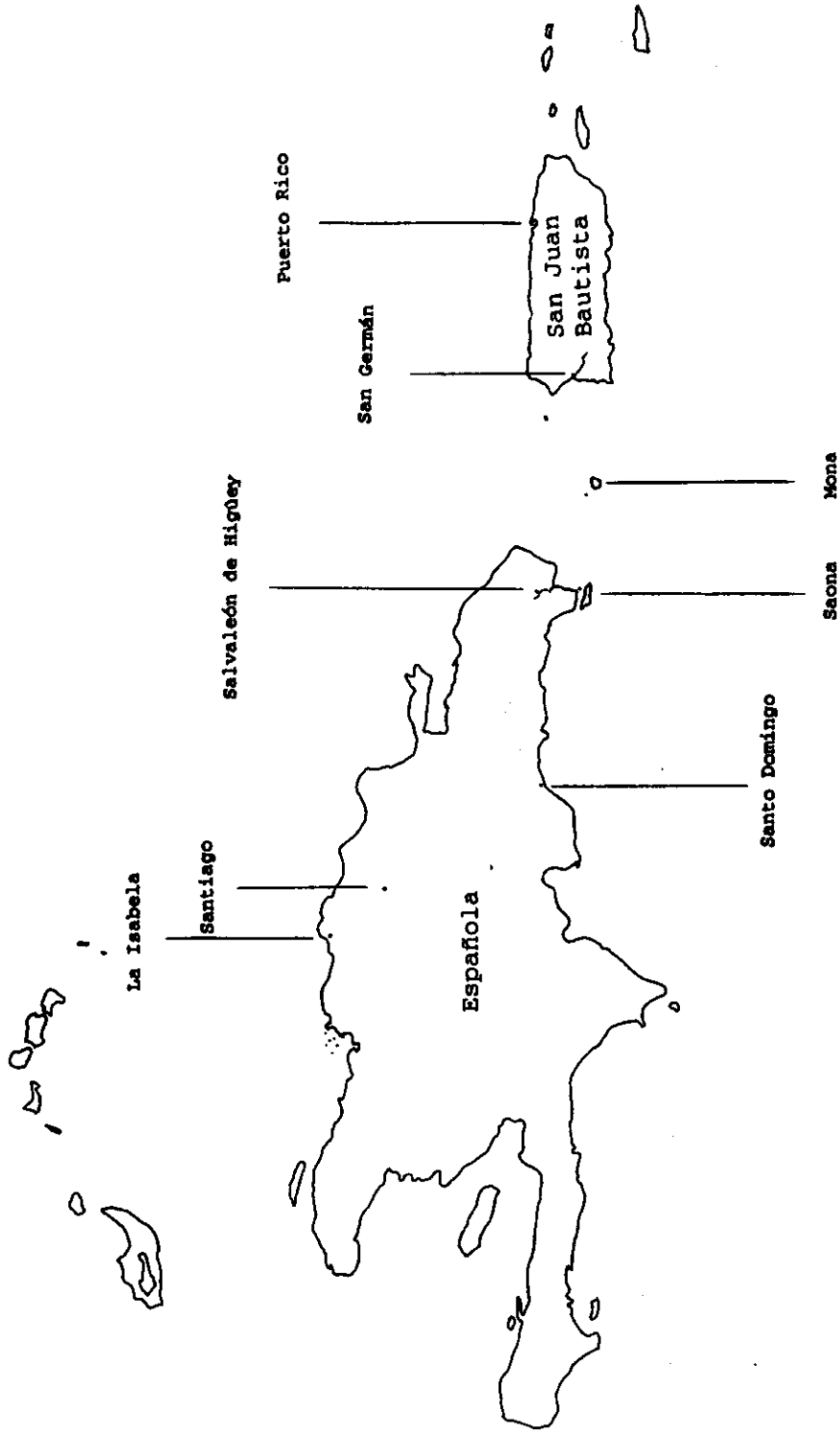


Figure 4. Map of Española, Saona Island, Mona Island, and Puerto Rico including the principal towns mentioned in text.

Isabela on the 29th of September 1494 to find the colony in complete disarray. Shortly thereafter, and much to Columbus's relief, his brother Bartolomé Colón arrived from Spain on one of the four ships commanded by the distinguished mariner Antonio de Torres. Columbus slowly regained his health over the course of the following five months. His second voyage marked the first thorough exploration of the Mona Passage and the major islands of Saona and Mona.

Vessels sailing between Spain and Isabela from 1494 to 1496 occasionally passed through the Mona passage if they had passed along the south coast of San Juan Bautista. Such vessels stopped occasionally to water at La Aguada, where Columbus made his first landing on the west coast of San Juan Bautista (Tió Figueroa, 1956: 27-39). There may even have been a few shipwrecks during these years, but there are no known accounts of shipwrecked Spaniards found in eastern Española or western San Juan Bautista. The year 1497 was remarkable in that for the first time since 1492, not a single ship crossed the Atlantic between Spain and Española. During this period and the previous year, Bartolomé Colón, Miguel Díaz de Aux (an Aragonese), Columbus's brother-in-law Francisco de Garay, and their loyal followers, ranged along Española's southern rivers and coast after gold deposits had been found on the Haina River by Díaz and de

Garay. This led to the establishment of a fort on the Ozama River in 1496 which two years later became known as Santo Domingo (Floyd, 1973: 34).

Many of the disgruntled Spaniards remaining in Isabela felt excluded from the gold rush on the south coast. They believed the absence of shipping meant that Columbus, who had returned to Spain in 1496, was out of favor. Led by the *Alcalde Mayor*, Francisco Roldán, they rose in revolt against Bartolomé Colón and his followers. A number of Taíno tribes joined Roldán's forces after being promised liberation from paying tribute.

There followed a ten month standoff at Fort Concepción during which a number of heated exchanges occurred between the two factions which only served to increase their mutual hatred. The deadlock was broken in March 1498 by the arrival in Santo Domingo of two caravels under the command of Pedro Hernández Coronel with the news that Columbus's contract had been renewed and that Bartolomé Colón had been promoted to *Adelantado* (Floyd, 1973: 37). This may be the first instance of ships calling directly at Santo Domingo from Spain. This inaugurated the opening of the Mona Passage as a major navigational route, since almost all ships departing Santo Domingo used the passage to reach the westerly Atlantic winds which returned them to Spain. With very

few exceptions, all ships inbound or outbound must have passed Saona Island.

By 1498 complaints about the Columbus administration on Española were so widespread that the Crown sent an investigator to the island named Francisco de Bobadilla. Upon arrival in Santo Domingo he was greeted by the sight of former Spanish rebels hanging from gallows along the Ozama River. He immediately arrested all three Columbus brothers and sent them back to Spain to be judged by the Catholic Monarchs (Floyd, 1973: 45-46). Bobadilla did not exert strong control over the colonists and gave in to their desire to reduce the King's share of the gold. This, plus rampant smuggling of gold and pearls, caused King Ferdinand V to realize he needed someone he could trust to bring Española under full and permanent Royal control. He selected Nicolás de Ovando of the Order of Alcántara (Floyd, 1973: 51).

It took over a year to fit out the great fleet that would take Governor Ovando and thousands of Spaniards hoping to find riches in the New World. The fleet of thirty sail reach Santo Domingo in two flotillas in April 1502. After off-loading, the fleet tarried for two months loading cargo, prisoners, and discontented Spaniards for the return to Spain. It departed Santo Domingo in late June and was struck by a hurricane in the Mona Passage (Floyd, 1973: 55). Most of the ships were

lost but a few made it back to Spain and three or four damaged vessels managed to make it to Saona Island where they weathered the storm in the lee of the island.

Saona Island, besides being located on the main navigational route in the New World, was essential to the survival of the mining industry in and around Santo Domingo. The Taino population of the island grew yuca, a root which they made into cassava bread, the mainstay of the Indian diet and, if he was interested in surviving for any length of time, the Spaniard's diet as well. By 1500, Saona had become the main supplier of cassava bread to Santo Domingo (Floyd, 1973: 57) and therefore of paramount importance to the survival and expansion of Spanish interests. The Spaniards enjoyed friendly relations with the natives of Saona until early 1502, when a Spaniard whose vessel was calling there, in a poor jest, urged his dog to attack a native. The dog, obeying his master, broke loose from his grasp and disemboweled the cacique of the island (Las Casas, Vol.2, 1951: 230).

The Indians of Saona Island were attached to the greater cacicazgo of Higüey, which encompassed most of eastern Española. The Tainos of Saona and Higüey were outraged by the incident and rose in revolt. The Spaniards, in response, levied troops under a captain from each town. Three to four hundred Spanish troops under the command of Juan de Esquivel ransacked and

slaughtered their way throughout Higüey during the summer and fall of 1502 (Las Casas, Vol. 2, 1951: 231). At least one vessel was sent to Saona, where the Spaniards disembarked, slaughtered, looted, and left with enslaved prisoners. (Las Casas, Vol.2, 1951: 233).

The island was left considerably depopulated, and Spanish abuses caused a second revolt to break out in Higüey two years later with similar results. A captain named Juan Ponce de León headed the troops levied from Santiago de los Caballeros (Las Casas, Vol. 2, 1951: 258). Again Higüey was pacified. This time, a raid on Saona Island netted the Cacique of Higüey, Cotubanamá, who was later hanged in Santo Domingo by order of Nicolás de Ovando (Las Casas, Vol.2, 1951: 258-268; Floyd, 1973: 58). As always, thousands of Taínos were enslaved and sent to either the gold mines or yuca farms as laborers.

After the conquest of Higüey, Juan Ponce de León was made lieutenant for the eastern zone and helped found and settle a new settlement on the lower Yuma River which was named Salvaleón de Higüey (Floyd, 1973: 58, 82). Here he had a large estate where he cultivated yuca and raised cattle (Parry & Keith, Vol. 2, 1984: 288). At this time Juan Ponce became involved in the shipping business, transporting cassava and probably meat to Santo Domingo from his lands and possibly cassava from Saona as well. He soon became interested in San Juan Bautista (Puerto

Rico), which lay across the Mona Passage from Higüey. In view of his activity in shipping and the relatively short distance across the passage, it is probable that Juan Ponce did a certain amount of scouting before his documented crossing in 1506.

On June 24th, 1506, four naos and a caravel, with approximately one hundred men under the command of Juan Ponce de León, arrived off the mouth of the Guaorabo River (Río Grande de Añasco) in western San Juan Bautista. At the time the place was called "la Aguada", or watering place, its name since the second voyage of Columbus. This was the favorite spot for filling ships' water casks on the west coast of San Juan Bautista, and numerous ships put in there. The crews of these vessels frequently attacked the local Taino Indians. Juan Ponce arrived by order of the King of Spain, or so he claimed, to establish settlements and to protect the Indians from passing ships and the Carib Indians (Parry & Keith, Vol.2, 1984: 290). The Spaniards settled in a nearby Indian village they called Mapo el Grande, where in all probability they built a wooden fort with surrounding thatched houses (Tió Figueroa, 1968: 41). Juan Ponce may have had a secret agreement with Governor Ovando in 1506, since Vicente Yáñez Pinzón's contract to settle the island of San Juan was in effect from 1505 until 1508 (Tió Figueroa, 1956: 37).

This settlement was the primary base from which the island was scouted. In the months that followed, an overland party was led by Indians to the northeastern coast, where a spacious harbor sheltered by a large island was found. The excellent harbor facilities and the early success in prospecting for gold in the region led to the establishment of a settlement that would eventually give rise to a port called "Rico" (Parry & Keith, Vol. 2, 1984: 290-291). In the course of their exploration and settlement, the Spaniards under Juan Ponce treated the Indians considerably better than on the island of Española (Floyd, 1973: 96).

It appears that Juan Ponce was active in Puerto Rico and probably at his estate in Salvaleón, Española during 1507 and 1508. He had mining and settlement contracts in both 1508 and 1509 from Governor Ovando, during which time he continued his settlement efforts in the northeast of San Juan Bautista which became the mining town of Caparra. He supplied this town with food by sea from Salvaleón and Mona Island using a caravelon (large caravel) of which he was apparently owner or part owner.

Juan Ponce's smooth operation in Puerto Rico was, however, not to last long. The replacement of Nicolás de Ovando by Diego Columbus, the discoverer's eldest son, ended all harmony on the island. He

arrived in Santo Domingo in August 1509 bringing with him the belief that all the lands discovered by his father were his by the 1492 contract between the Spanish monarchs and his father. He was intensely jealous of Juan Ponce de León's success and influence on the island of San Juan.

Diego Columbus appointed his own officials, who showed up at San Juan Bautista with hundreds of immigrants wanting to attain wealth through mining with forced Indian labor. This began a string of abuses which led to an Indian uprising in early 1511 (Floyd, 1973: 102). Most of the Spaniards in western San Juan Bautista were killed and their small, scattered settlements burnt. The settlement at Aguada was one of those destroyed. It was refounded in early 1512 as the town of San Germán soon after the revolt was put down. It was Diego Columbus's idea that the town should be the capital of the island and surpass Caparra in the northeast.

Beginning at this time and continuing up to roughly the middle of the sixteenth century, a substantial trade developed between the islands of Española and San Juan. A good deal of this trade moved between the port of Yuma, which serviced Salvaleón de Higüey, on the east coast of Española

north of Saona Island, and San Germán on the west coast of San Juan.

The vessels involved in this trading were known by numerous names, all of them vague. There are naos, caravels, navíos, and barcos (Tanodi, 1971). The sizes of the crews varied as well from around 25 to as few as six (Tanodi, 1971: 232). Eight to eleven men was common. This trade frequently dealt with food and livestock being imported by San Germán, and to a lesser extent the port of Puerto Rico (now San Juan, Puerto Rico), from Salvaleón, Saona, and Mona. There was also a certain amount of inter-island passenger traffic. Manufactured products from Spain were transhipped through Santo Domingo or occasionally arrived in San Germán directly from Spain.

This traffic thrived relatively undisturbed until the third decade of the sixteenth century. The capture by French privateers in 1523 of two Spanish ships bearing Aztec treasure off the Azores inspired King Francis I of France to use privateers in the Caribbean. He let it be known that French mariners who pushed into the Caribbean would be well regarded by the crown (Roberts, 1942: 15).

One of the first recorded attacks, and a good example of French depredations in the Mona Passage,

occurred in 1528. A French nao of 240 tons crossed the Atlantic with a Spanish caravel it had captured off the Canary Islands. After an unsuccessful raid on Tierra Firme (the north coast of South America), they headed north to the Mona Passage. Off the coast of Cabo Rojo, the south west corner of San Juan Bautista, they captured another caravel returning from the pearl fisheries off the coast of South America (Cardona Bonet, 1989: 69).

They continued north and arrived at San Germán on the 12th of August, 1528. Disembarking 60 to 70 troops, they sacked and burned the town and two caravels in the harbor. Their work done, the French then departed (Perea, 1972: 53).

During the course of this voyage, they first headed south towards Cabo Rojo, perhaps hoping to find another pearl-laden prize. While cruising off Cabo Rojo, they scuttled one of their Spanish prizes before heading to Mona, where they awaited more Spanish prey. After waiting nine uneventful days, they departed Mona and headed east towards the Virgin Islands (Cardona Bonet, 1989: 71).

Though San Germán suffered a serious blow, local gold mining provided sufficient economic stimulus for the residents to rebuild their town and continue their way of life (Perea, 1972: 54). A series of

attacks during the following three decades were to be more than San Germán could endure. The persistent French naval presence in the Mona Passage, the continuous destruction of the town, declining gold production in the western sector, and the construction of fortifications at Puerto Rico, led to San Germán's decline and eventual relocation to Guayanilla on the south coast in 1554 (Cardona Bonet, 1989: 63). Attacks continued, however, forcing the town to eventually move inland to its present location in 1573 (Vélez Dejardín, 1985: 208).

The relocation of San Germán in 1554 (Vélez Dejardín, 1985: 208), inadequate costal defenses (Haring, 1918: 233), the development of an adequate food base on Española and San Juan Bautista, and the establishment of sizable herds of live stock on San Juan Bautista during the first half of the century probably led to a decline in the amount of inter-island shipping between Española and San Juan by the beginning of the sixth decade of the century. The shift of Caribbean trade from Santo Domingo to Havana, Cuba during the 1550's seriously reduced the number of ships calling at Santo Domingo. All of these factors led to a drastic decline in the amount of shipping passing through the Mona Passage and the vicinity of Saona Island.

OPERATION SAONA AND THE SIXTEENTH-CENTURY SITES

Operation Saona was a joint venture between the Dominican Government's Comisión de Rescate Arqueológico Submarino and Burt D. Webber, who is well known for his salvage of the Spanish silver galleon *Concepción* on the Silver Shoals off the north coast of the Dominican Republic.

The objective of Operation Saona was to locate and salvage the Spain-bound ships of Governor Nicolás de Ovando that were destroyed by a hurricane in the Mona Passage in 1502. The flagship was of particular interest to the salvors as it carried a large consignment of gold, including the largest gold nugget discovered in the New World.

The operation ran from January 14 through July 8, 1983. Numerous sites were found, including three that were dated to the sixteenth-century by their artillery (which included tube guns and verso swivel guns, Fig. 5). Two of these sixteenth-century sites were found on South Catalanita Reef, which runs south from Catalanita Island towards Saona Island (Fig. 6). The third site was found off the south-east coast of Saona Island on the Bajos del Caballo Blanco Reef (Fig. 6). The addition of these sites to the known

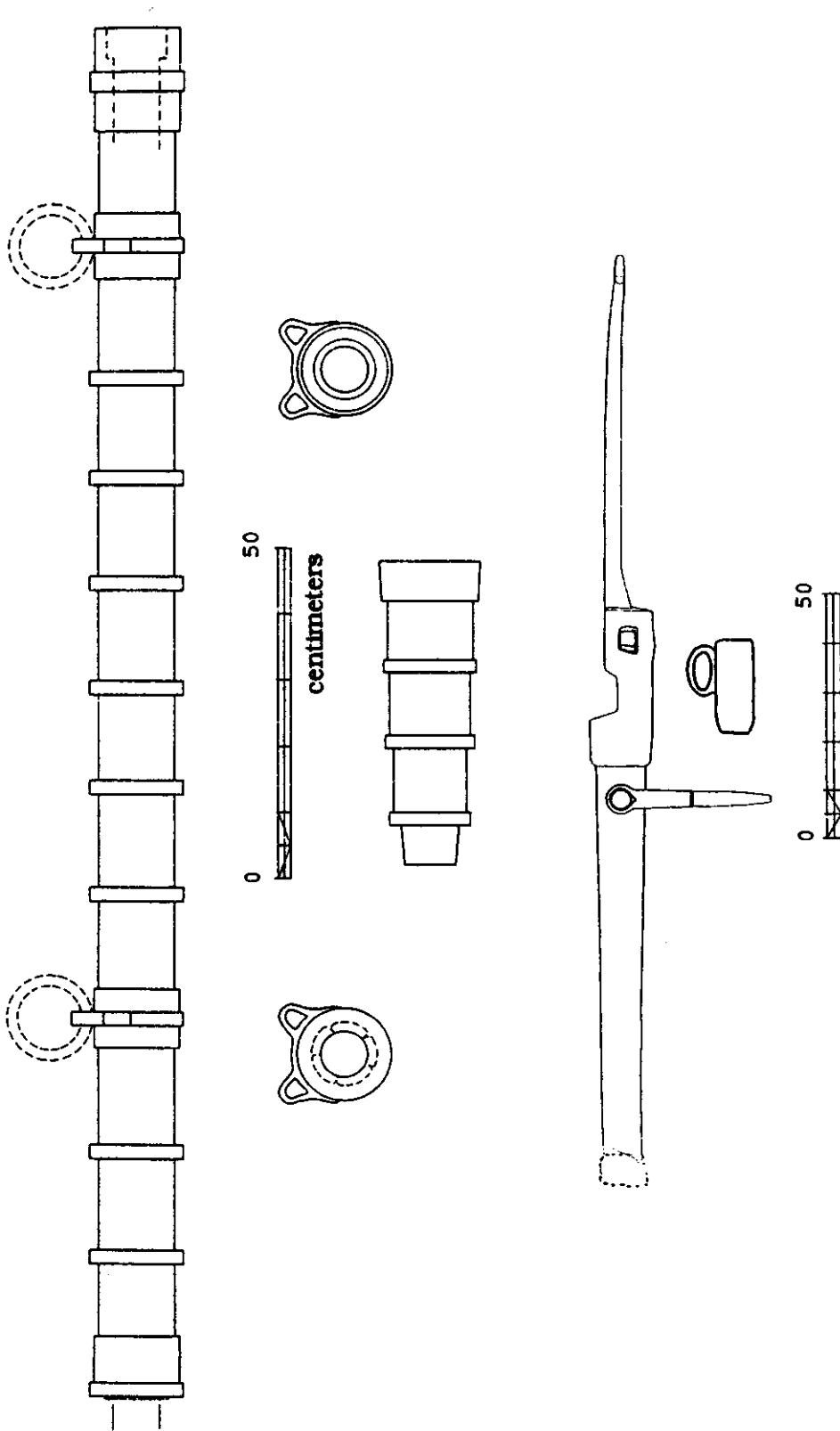


Figure 5. A verso swivel gun with a powder chamber and a tube gun with its powder chamber. (After Keith, 1987: Figures 24, 136).

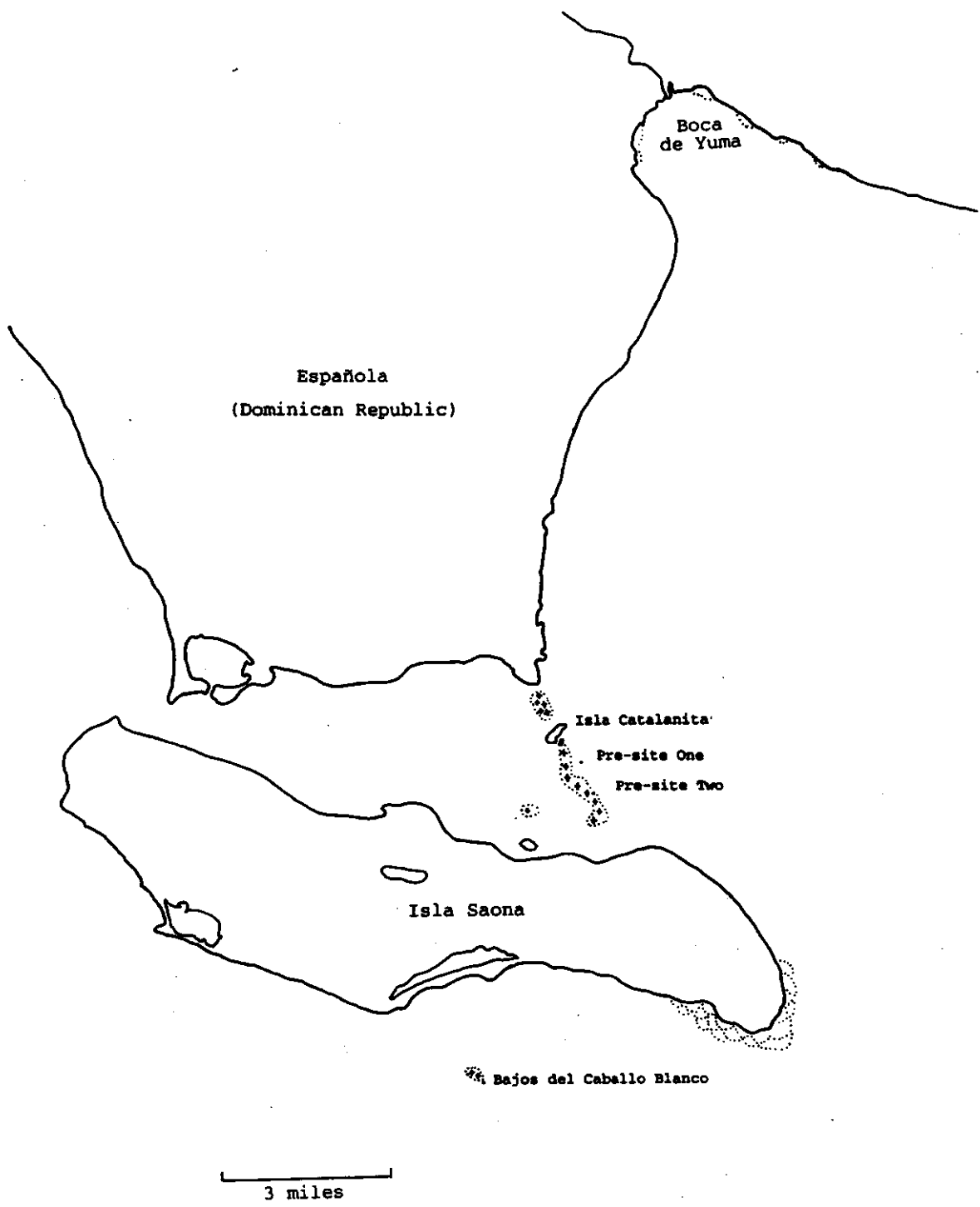


Figure 6. Map of Saona Island, Isla Catalanita, Bajos del Caballo Blanco Reef and the three sixteenth-century sites.

sixteenth-century sites in the New World constitutes an invaluable addition to the current data base.

Of the three sixteenth-century sites, the two on South Catalanita Reef were designated as "pre-sites" by the salvors because they appeared to be impact sites. The distribution of artifacts suggested that the vessels struck the reef and then rolled and probably broke up on the reef, spilling the heavy ordinance and anchors (Webber, 1983: 27). The third sixteenth-century site at Caballo Blanco was designated a "site" rather than a "pre-site", because it was believed that a hull could exist nearby, although conclusive evidence was lacking.

Pre-site One

Pre-site one was located on South Catalanita Reef on February 8, 1983 by using a V-85 proton magnetometer. The site lay in 6 to 6.7 meters (20-22 feet) of water and consisted of 5 pieces of artillery: 4 *versos* and a single tube gun (possibly a *cerbatana*). With them were found 2 tube gun powder chambers and 2 anchors, one of which was broken. There were no spare powder chambers for the *versos*. On April 25, 1983, the tube gun (#0036), a *verso* missing most of its tiller (#0037), and a breech block (#0038) were raised from the seabed. Webber decided not to raise any of the

additional pieces, since they were all apparently in a very poor state of preservation (Webber, 1983: 89).

The site lay on a hard coral bottom on the windward side of the reef. All the artillery and anchors were heavily encrusted in coral (Fig. 7; Webber, 1983: 26). A ballast trail led away from the site and over the reef top. In line with this trail, in 1.5 meters (5 feet) of water, numerous olive jar shards and rims were found. The ballast trail was quite complex as it was contaminated with stone ballast, copper hull sheathing, and brass pins from a nineteenth-century wreck.

The size of the overall collection is suggestive of a fairly small vessel. If a caravel or small craft drew 1.8 meters (6 feet) of water, in calm weather she would have a comfortable 4.3 meters (14 feet) of water under her keel in depths of 6 meters (20 feet). In such a place during severe weather, she might have some added depth due to the storm tide, but the shallowing of the bottom would cause the seas to begin to crest and break. In such a situation the vessel would be in grave danger of having her rigging damaged, decks washed, and possibly receive structural damage on top of what may have already been suffered at sea. There is some probability that a breaker might have caught her at a

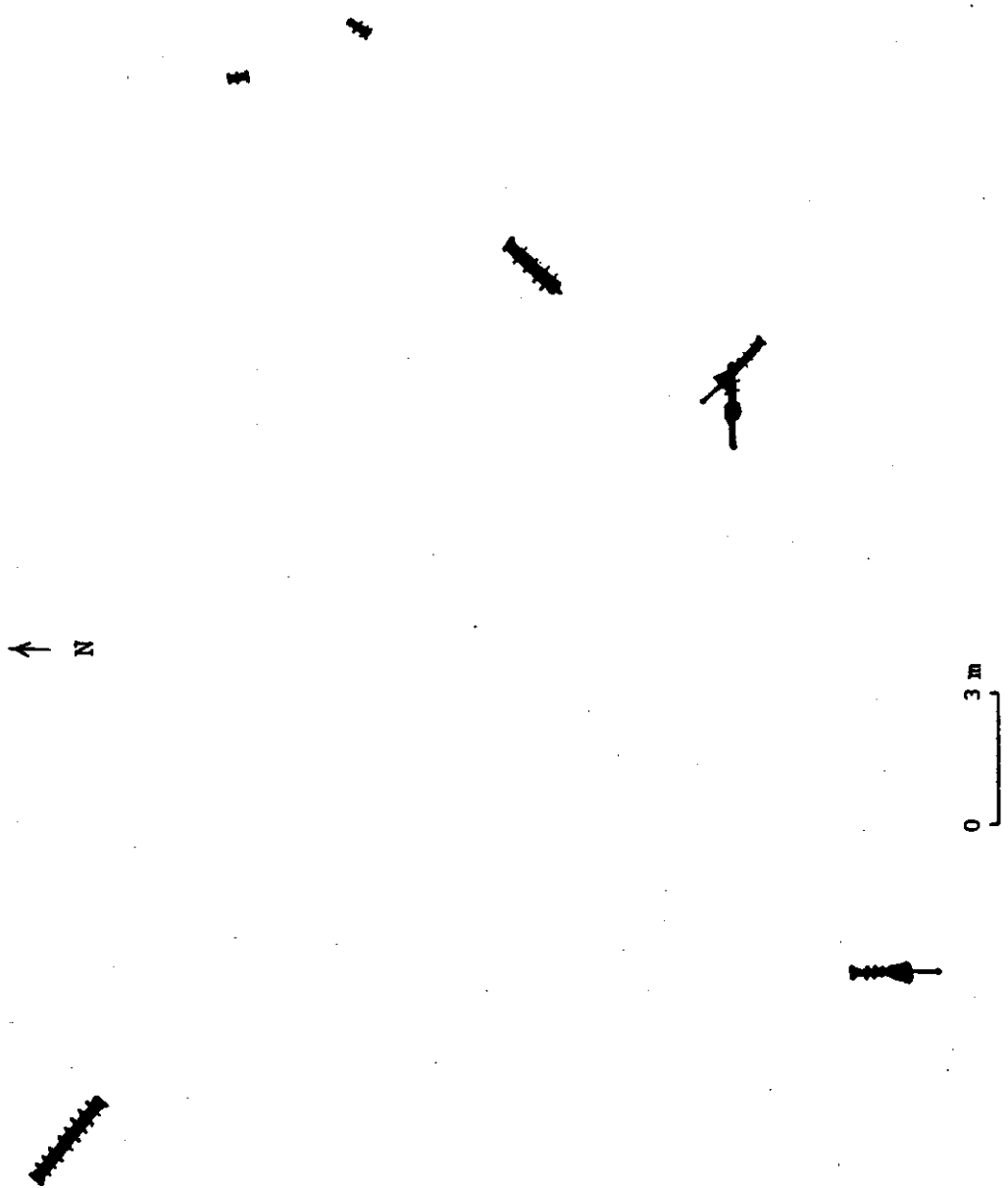


Figure 7. Map of Pre-site One just off of South Catalanita Reef. (After Kahl, 1983).

disadvantage and heeled her over past the point of no return. In such weather one would expect all the hatches to be battened down with all hands on deck, unless it was so dangerous above that all hands were below deck praying to God.

In any event, the vessel in question foundered in approximately 6 meters (20 feet) of water or more, depending on the storm tide, either coming to rest on the bottom with her decks submerged and the surviving masting and rigging protruding above the surface, or laying on her side with nothing showing above the surface. The hull would have been pounded by the sea until it split apart spilling artillery and ballast. The hull wreckage was probably further broken up as it washed towards the reef leaving a thin trail of ballast towards the west that eventually disappeared on the other side of the reef.

The salvaged tube gun was not stored with a loaded powder chamber wedged in place as both chambers were found over 21 meters away in the vicinity of the versos. The tube gun was also curiously distant from the rest of the material. Two of the versos left undisturbed appeared to have been lashed and stored together and were fused together on the bottom. The other two, the eastern-most of which

was salvaged, were apparently stored or deployed apart as they were separated by over 15 meters.

According to Webber, 2 anchors belonged to the site. One intact anchor lies approximately 38 meters seaward of the site (Webber, 1983: 28). Though it seems a little close to the site, the casting of this anchor may have been a last attempt to prevent the ship from going on the reef, or the anchor may simply have been knocked overboard by rough seas. The lower shank and arms of a second anchor lay to the south west. It may have been rigged for deployment and broken during the wrecking event. The wooden stock and remaining shank, secured by an anchor cable to the wreckage, may have been carried away by the sea. Breakage was typical of sixteenth-century Spanish anchors and has been attributed to the poor quality of Spanish iron, thus giving rise to the Dutch saying "As meager as a Spanish anchor" (Martin, 1975: 253).

Little of the above can be stated with absolute certainty. However, we can confidently say that a lightly armed and ballasted vessel came to grief in extremely foul weather in approximately 6 meters (20 feet) of water before South Catalanita reef. Her hull was pounded to pieces, causing spillage of its armaments in a localized area, followed by dispersal of the ballast and wooden hull wreckage.

The dating of this site depends entirely upon the artillery. Wrought-iron tube guns and wrought-iron swivel guns in the New World are generally assigned to the late fifteenth century or the first half of the sixteenth century. Such a date also corresponds with the peak maritime activity in the Mona passage.

Pre-site Two

This site was found the day after Pre-site One during a visual reconnaissance near the south end of South Catalanita Reef (Webber, 1983: 27). The site lies approximately three quarters of a mile southeast of Pre-site One in 2.4 meters (8 feet) of water on a hardpan bottom. It consisted of 9 pieces of artillery: one *cerbatana* tube gun with 3 powder chambers and 8 *versos*. In addition there was one *haquebut*, a kind of small, hand-held cannon, and in a cluster covering a broken anchor, what may have been 7 more *haquebuts* or small caliber weapons and assorted broken pieces (Fig. 8). No spare *verso* powder chambers were found on the site.

The *cerbatana* tube gun (#0031), two *verso* swivel guns (#'s 0032 & 0034), a tube gun powder chamber (#0033), and the *haquebut* (#0035) were salvaged on April 24, 1983 (Webber, 83: 88).

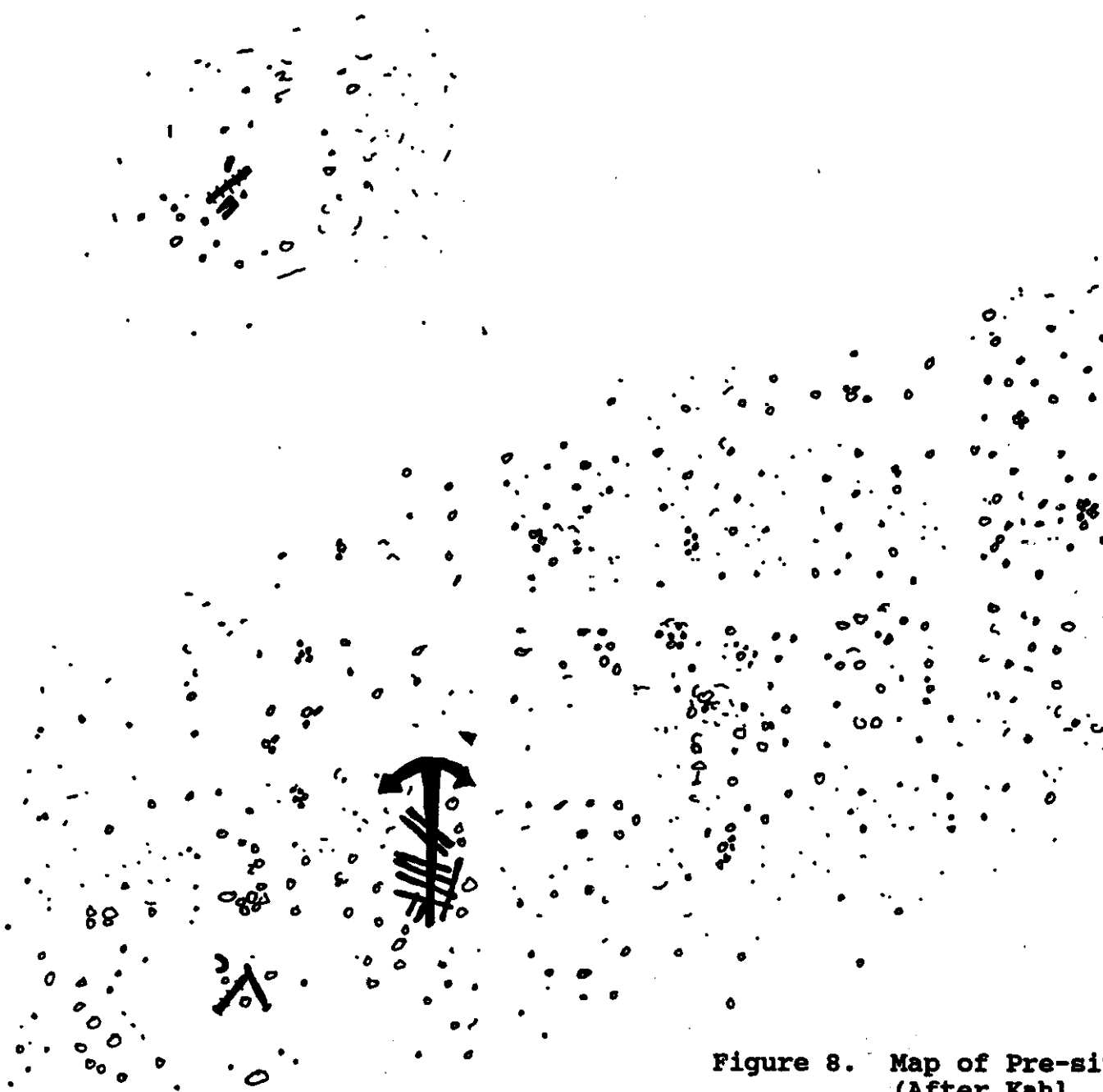
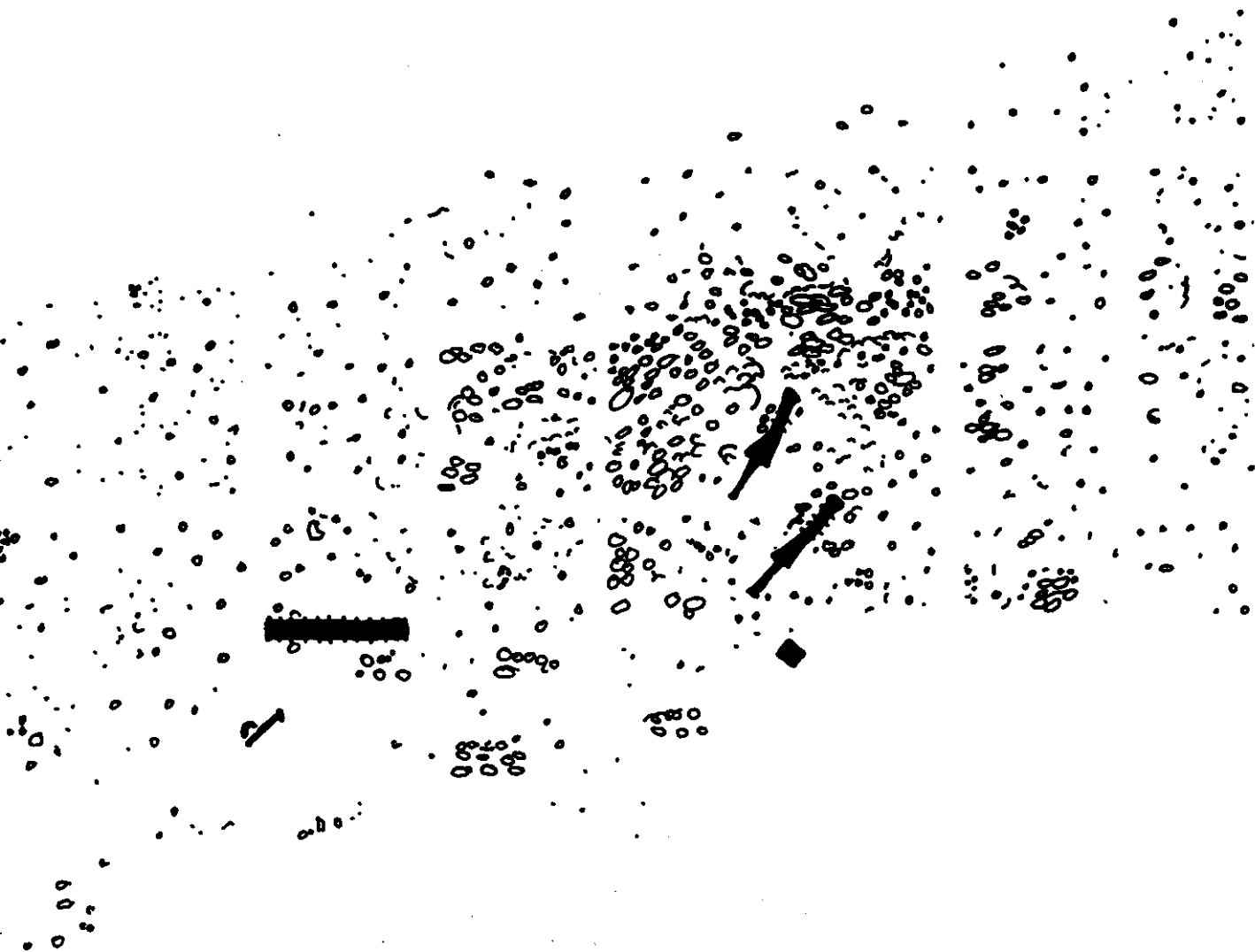


Figure 8. Map of Pre-sit
(After Kahl, :



0 3 m

on South Catalanita Reef.

A considerable amount of ballast was spilled in the vicinity of the *versos* and tube gun, and the site was characterized by Webber (1983: 27) as a "shipwreck striking point". Further searching just beyond the reef revealed a "touch-down spot" in 1.5 meters (five feet) of water where a quantity of ballast was spilled along with olive jar shards (Webber, 1983: 29). This indicates a substantial piece of hull wreckage made it further up the reef from the artillery and anchor deposit.

The most interesting feature of this site is the anchor and light arms deposit. Four of these concreted guns lie on top of, and perpendicular to, the shank. Two more guns, closer to the arms of the anchor, lie on top at an angle. What may be two gun fragments or smaller objects lie underneath the gun closest to the broken shank.

Lying underneath the four perpendicular guns and almost parallel to the anchor is another length of concreted iron believed by the salvors to be a gun. This may be the other half of the broken anchor shank. There were three examples from the 1554 Padre Island wrecks of anchors which were broken mid-shank with both halves stored side by side below deck (Fig. 9; Arnold & Weddle, 1978: 224).

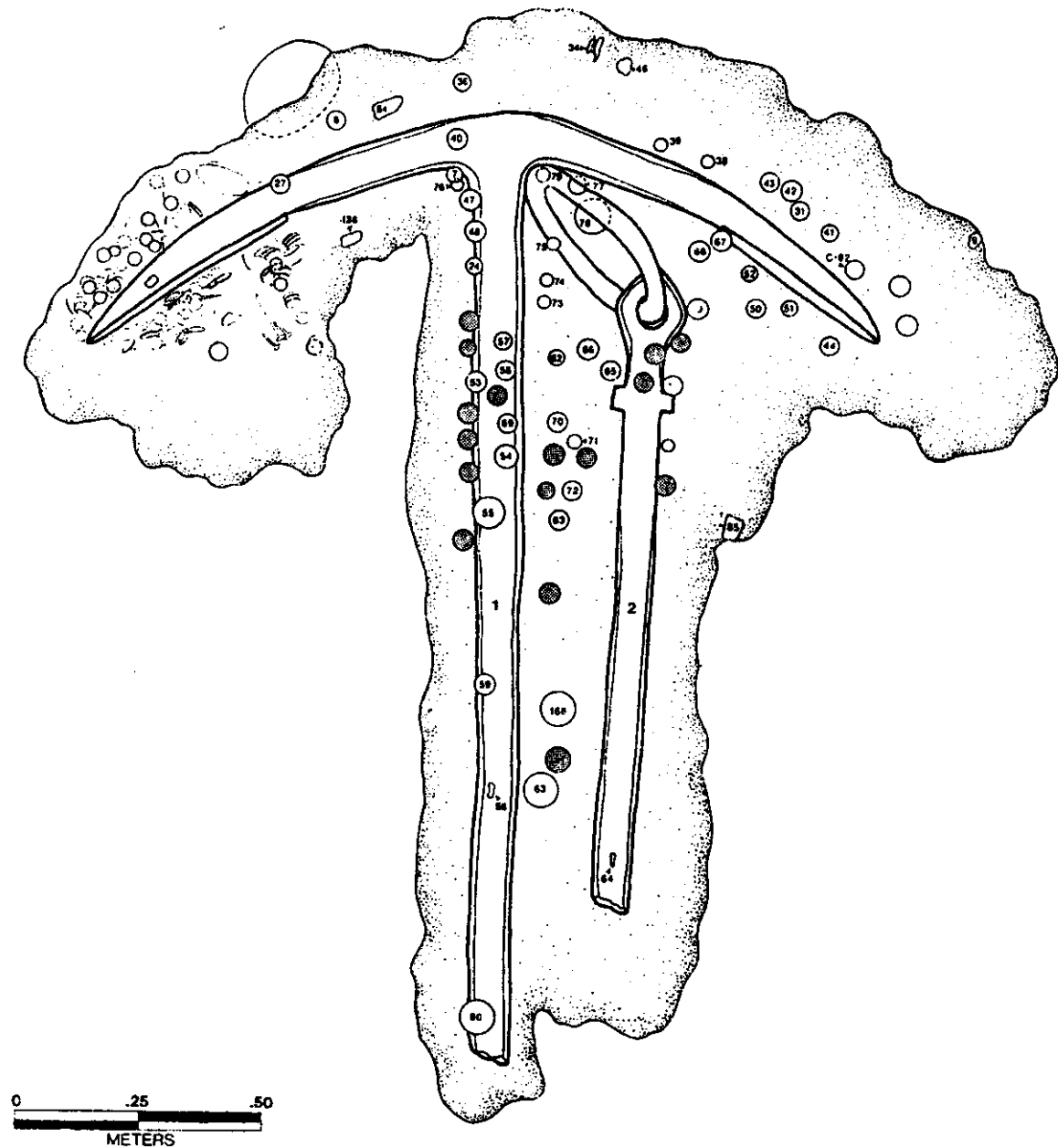


Figure 9. Conglomerate 157 from the San Esteban wrecked on Padre Island. It contains an anchor broken mid-shank with both halves stored side by side. (Courtesy of the Texas Historical Commission and the Texas Antiquities Committee).

The reason the light gun feature is so important is that these tubes are too small to be *versos* (Kahl, 1993: P.C.). It is undoubtedly due to their small size that they were labeled in notes and drawings as "*versos* (?)". Laying approximately 4 meters to the southwest of the broken end of the anchor shank was a small gun called a "serpentine" by the salvors. This turned out to be the haquebut (described in greater detail below). This feature may contain a number of haquebuts or other varieties of small portable arms and is therefore of great interest.

A *verso* lay next to the recovered haquebut, and another, somewhat removed, lay 13.5 meters north of the *verso*/haquebut find. This weapon broke at its chamber holder apparently dislodging its powder chamber. Since this powder chamber is not identified specifically as a *verso* powder chamber, there is a small chance it could be a tube gun chamber.

The distribution of artifacts is very scattered and difficult to interpret in terms of hull orientation. The task is rendered all the more impossible by the incomplete site map. Three *versos* and two tube gun powder chambers were never mapped. The only thing we can say with some certainty is that the anchor and associated tubes were in all probability stored below the main deck.

Two broken anchor shanks (only one appears on the site map) may indicate that the ship's crew deployed anchors in deeper (unsurveyed) water in an attempt to save themselves. These anchors appear to have failed and broken at the shank and therefore their lower halves are missing from the site. In any event, this moderately armed and ballasted vessel foundered when it hit the reef in 2.4 meters (8 feet) of water. The ship broke up spilling most of its ballast, the tube gun, *versos*, and the anchor with the small caliber weapons. Some of the wreckage was blown further up the reef where it spilled more ballast and ceramics.

The haquebut and anchor feature (if it indeed includes many more haquebuts) argues for an early date for this site, as the haquebut was being replaced during the early sixteenth-century. A large assemblage of eight or nine haquebuts is more likely to occur during the period in which such weapons were in common use. This site can therefore probably be assigned a date of roughly between 1498, when Spanish shipping first began to arrive at Santo Domingo, and 1525, a date after which such a large collection of outdated haquebuts was unlikely to occur.

The mapping of this site occurred during different times between February and April when sea

conditions in the Mona Passage are rough. This may explain the incomplete site map. The incomplete nature of the mapping and the importance of the anchor feature with possible haquebuts argues for reinvestigation of this site.

The Caballo Blanco Site

Caballo Blanco reef is about half a mile long on an east-west axis and is divided into 4 topographical zones (Fig. 10). To the south in 7.6 meters (25 feet) of water, there are coral ridges which project up in finger-like structures to about 3 meters (10 feet) above the bottom. To the north of this is a transitional zone with an irregular bottom containing coral rubble with a water depth of 4.6 to 3 meters (15 to 10 feet). This continues to the crown of the reef where there is considerable surge. Over the reef to the north, the water deepens and the bottom changes to coral rubble, sand and turtle grass (Webber, 1983b).

The site at Caballo Blanco was found on April 26, 1983 during a visual reconnaissance of the windward side of the reef. This site is different from the previous two sites in that it is composed of two major deposits approximately 152 meters apart. One deposit consists of 2 tube guns, 2 anchors, and 2

4 Verso Swivel Guns
 ↑ N
 Modern Sailboat Wreckage
 ← 18th c. Cannon

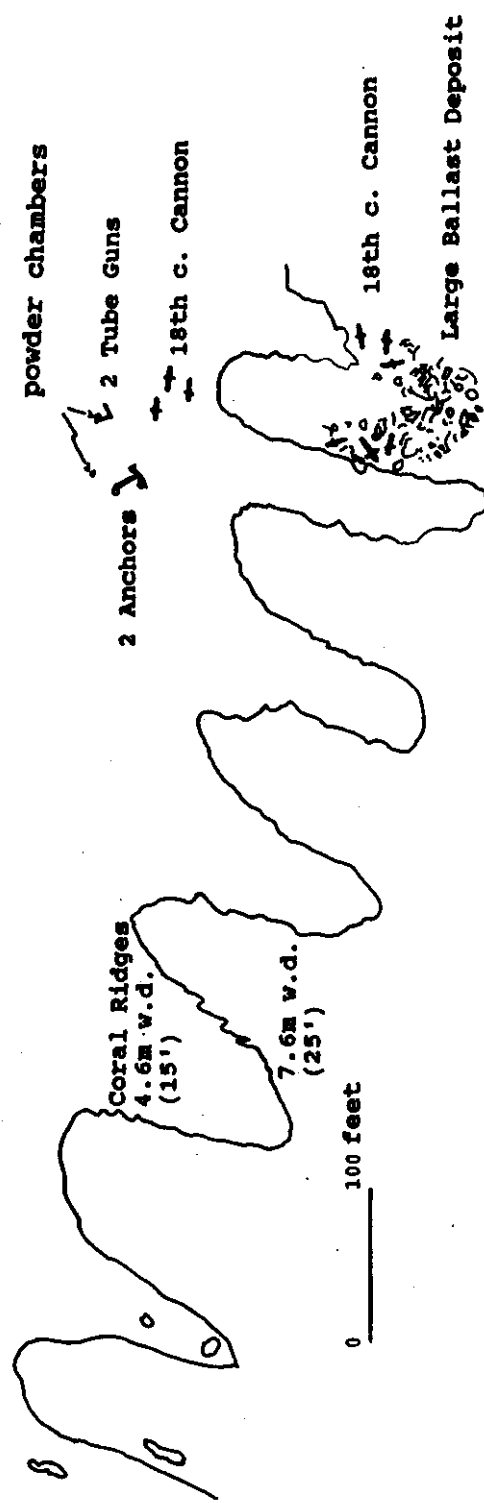


Figure 10. Map of the Caballo Blanco site. Note the large ballast deposit and eighteenth-century cannon in the lower right hand corner. (After Kahl, 1983).

tube gun powder chambers. This deposit was found just beyond one of the coral ridges mentioned above (Fig. 11). The other group was a cluster of 4 *versos* found further up, on the other side of the reef, where the water begins to deepen again (Fig. 12). No extra *verso* powder chambers were found.

The considerable distance between the two deposits suggests the possibility of separate wrecking events. It seems likely, however, that these deposits are related to a single wrecking event, since the material, taken together, constitutes the usual compliment of artillery on a single vessel. This is demonstrated by other early sixteenth-century New World wrecks, including those found at Highborn Cay, Molasses Reef, Bahia de Mujeres, St. John's Bahamas, Padre Island and the two other Saona sites (Keith, 1987; Olds, 1976; Webber, 1983; Malcom, 1993: P.C.). All of these sites had a mix of tube and swivel weapons. Documentary records also support this contention.

The site is contaminated by the wreckage of two other ships, an eighteenth-century vessel and a modern steel-hulled sailing yacht. Webber believed that a sixteenth-century hull lay on the other side of the reef. This was based on the fact that no

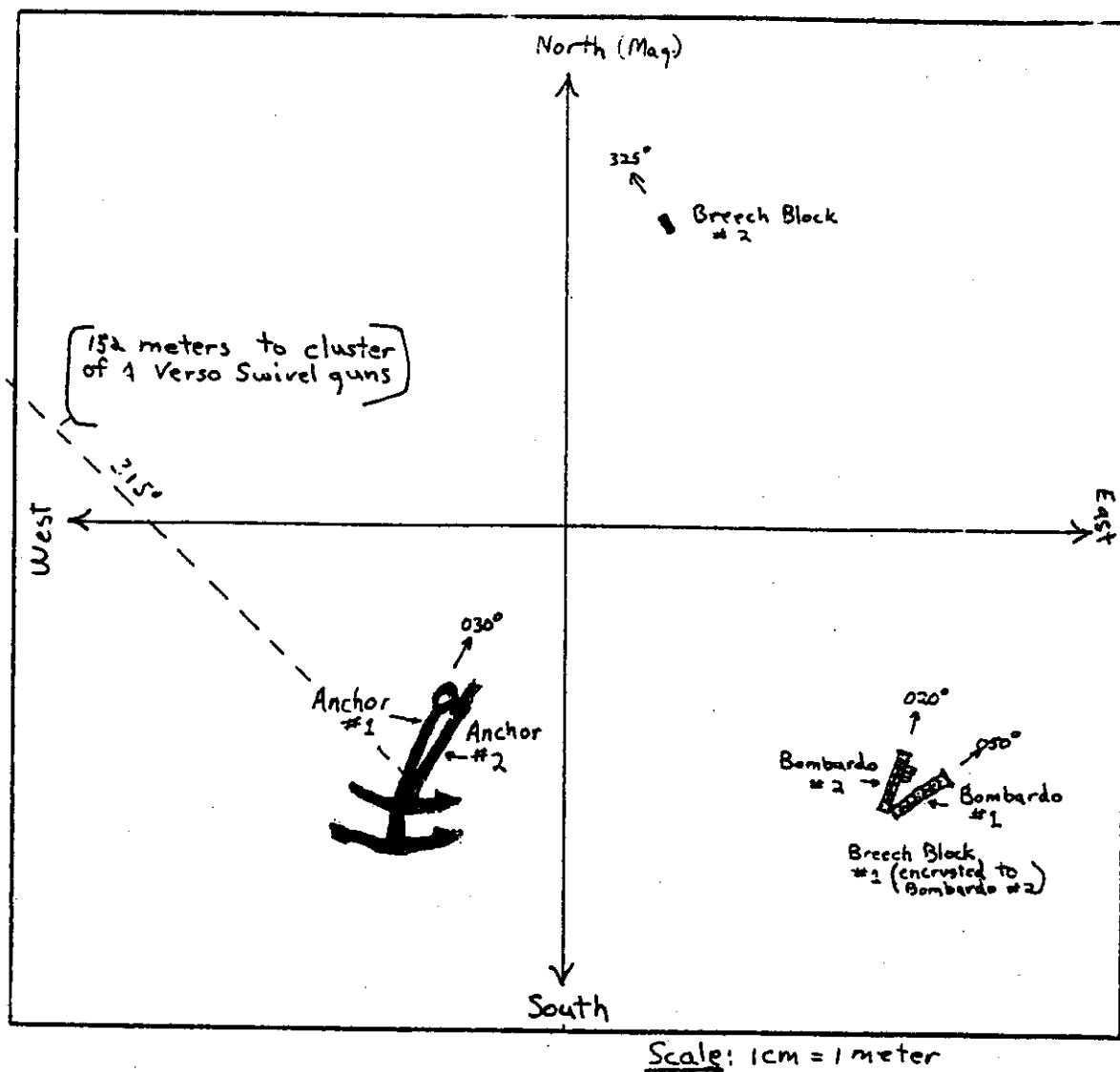


Figure 11. Tube gun, tube gun powder chambers, and anchor features at the Caballo Blanco site. (After Kahl, 1983).

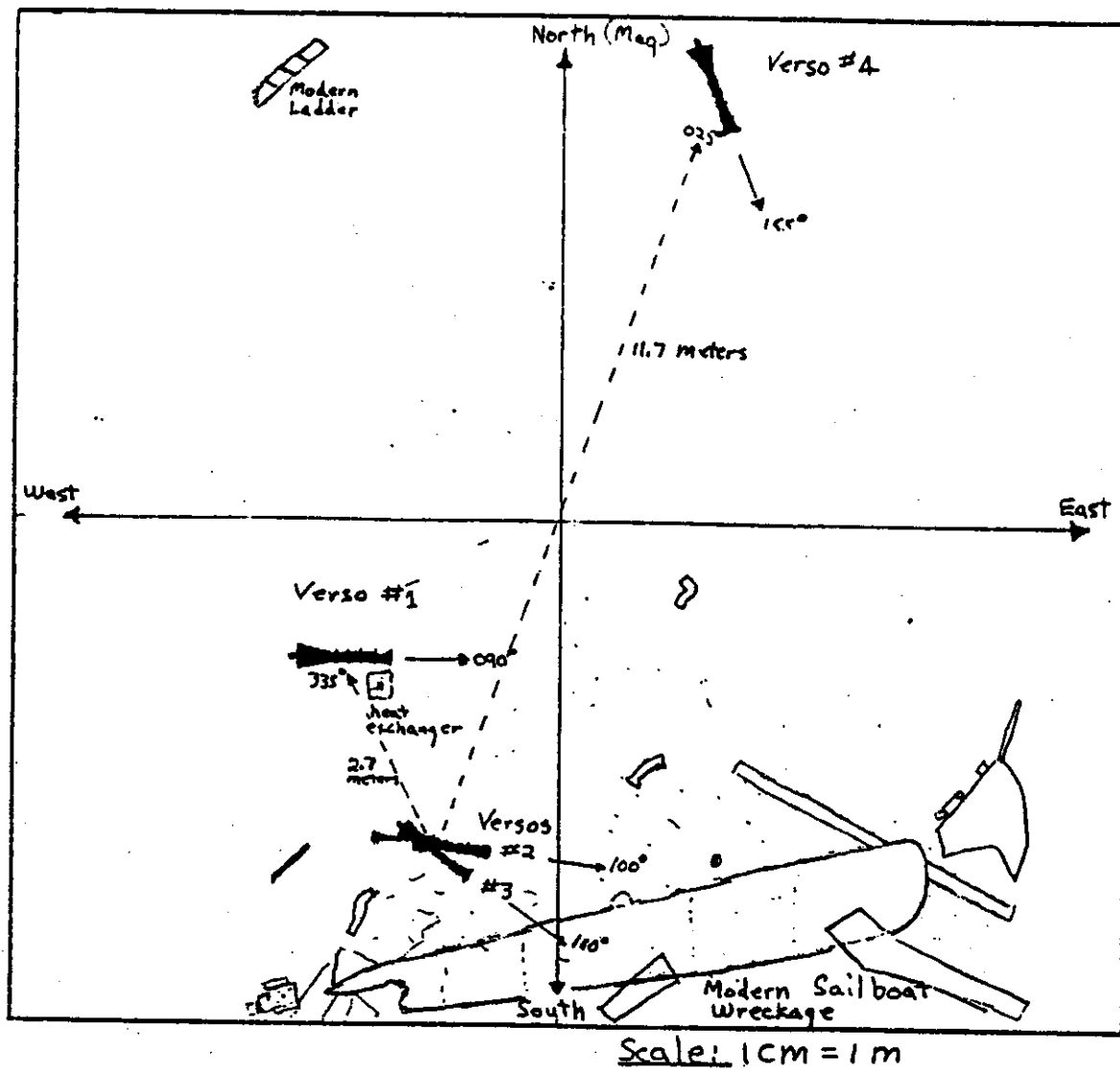


Figure 12. Verso swivel guns and modern sailboat wreckage to the north west of tube guns and anchors. (After Kahl, 1983).

major ballast scatter was found between the *versos* and the tube guns and anchors.

The eighteenth-century wreck may yield some clues to how the sixteenth-century wreck occurred. The two wrecks may have occurred on the same reef projection in 4.6 meters (15 feet) of water. A major ballast deposit and 6 eighteenth-century cannon were found in the depths on either side of the projection. Beyond, in the transitional zone, the irregular bottom was filled with ballast and 3 more eighteenth-century cannon, with the ballast trailing off in a northwesterly direction. Approximately 137 meters to the north-northwest lay another eighteenth-century cannon and small ballast clusters. Approximately 152 meters to the northwest lies yet another eighteenth-century cannon in the almost indistinguishable ballast scatter. Due west of the main ballast and cannon deposit are two more eighteenth century guns, one at approximately 320 meters and the other at 457 meters distance. Though at a great distance from the main site, these two guns may be from the same ship.

It would appear that the eighteenth-century ship struck the projection and was stove in, spilling most of its ballast and 6 cannon on the windward side of the projection. The vessel then broke up, portions of the hull spilling more ballast and 3 cannon to the

lee of the projection. The other guns, probably well secured to portions of the now-buoyant wooden superstructure were carried a considerable distance from the initial impact site.

The sixteenth-century ship may have wrecked in the same way. After hitting the projection she was badly holed, or possibly broken in half, and dumped most of her ballast in the depths beside and beyond the projections. The wreckage, now buoyant, then drifted in to the transitional zone. The forward half spilled what ballast was left, along with the tube guns, powder chambers, and anchors, before being demolished on the reef and dispersed. The stern half of the hull containing the *versos*, which were probably lashed to the hull some way, finished dumping its ballast as well and drifted on, probably awash, and was eventually demolished in 1.5 to 2.4 meters (5 to 8 feet) of water approximately 152 meters to the northwest. The reason that Webber did not find any major ballast scatter from this wreck, in all probability, was because it lies beneath and intermixed with that of the eighteenth-century wreck. The steel-hulled sailing yacht seems to have been of shallow enough draft, or was in less severe weather, and therefore escaped the projection but was

demolished in the same place that the stern of the sixteenth-century vessel met its end.

In this instance, it would appear that the tube guns and their powder chambers were stored in the same area (which was not done in the case of the tube gun on the ship that sank at Pre-site One). One of the powder chambers was more distant from the group of tube guns and the other single chamber. Perhaps this solitary find was the last to roll out of the broken hull as it began its drift to the northwest.

The two anchors were stored with their arms stacked on top of one another and are reminiscent of a pair found on the *San Esteban* at Padre Island. In the case of the Caballo Blanco anchors, the top anchor was placed, or shifted during the wrecking event, so that the arms were no longer stacked directly on top of one another. The anchor concretion from Padre Island, in addition to the anchors, contained a tube gun, 2 powder chambers, a length of chain, and other small iron and organic artifacts (Fig. 13; Arnold & Weddle, 1978: 304). This is a good example of the artifacts and information which may still be found in all of the Saona sixteenth-century anchor concretions.

The Caballo Blanco assemblage is similar to that of Pre-site One, the difference being that this site

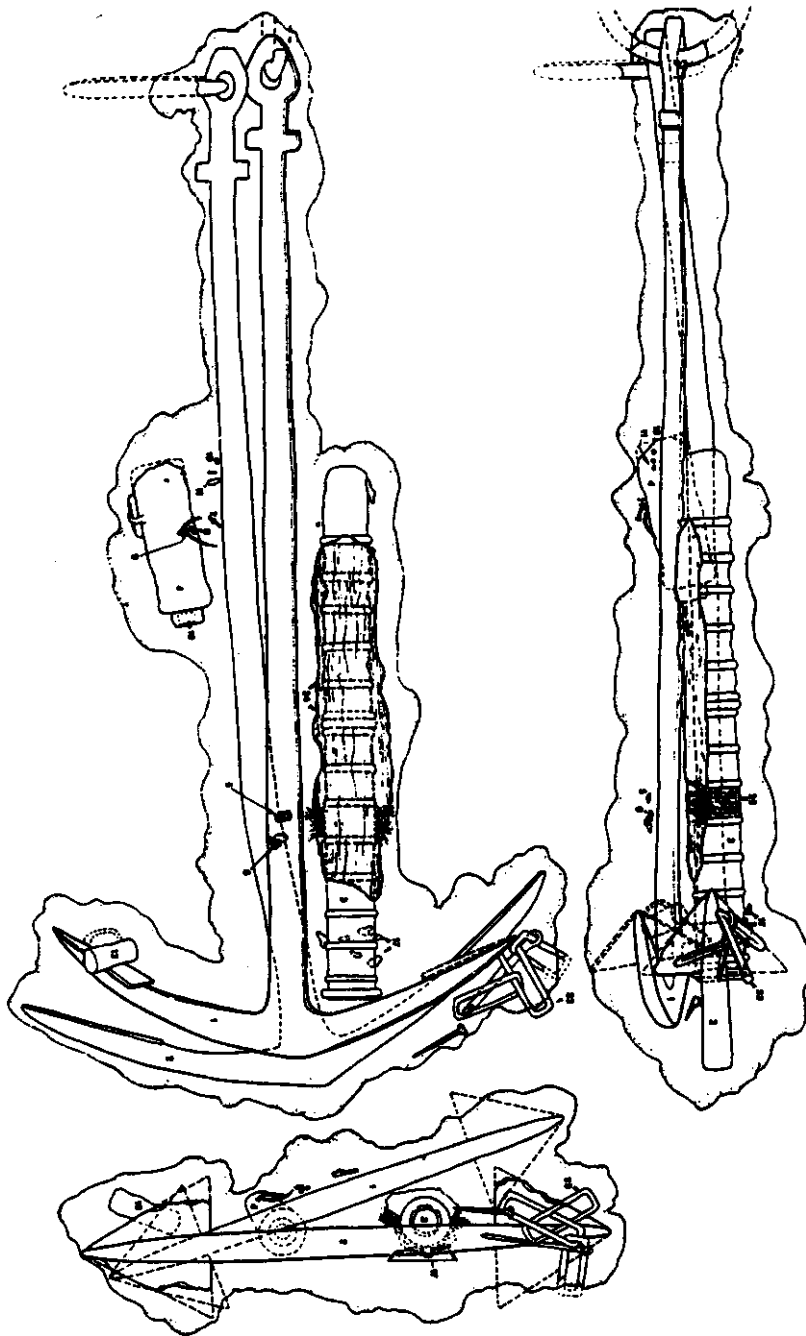


Figure 13. Stacked anchors from the San Esteban illustrating examples of artifacts and information that may be contained within the Saona anchor concretions (Courtesy of the Texas Historical Commission and the Texas Antiquities Committee).

has two tube guns rather than one. Webber decided to leave the site completely intact for a through archaeological investigation in the future and so none of the artillery was raised from the bottom. Like Pre-site One, Caballo Blanco may be assigned to the late fifteenth- or first half of the sixteenth-century in view of the wrought-iron artillery carried on board and the fact that the peak of sixteenth-century maritime activity in the Mona passage occurred during the first half of the century.

Summary

These three sites are the only early sixteenth-century sites located so far in the waters adjacent to the island of Española, the first European colony in the New World. All three are impact sites in high energy zones around reefs and are made up of heavy iron artillery and anchors, along with some ceramics and a few iron fittings. Little else appears to remain of the vessels and their equipment.

The site assemblages, including both salvaged and undisturbed material, may be regarded as representing three complete ordnance collections for the following reasons: first, the sites and the surrounding areas were surveyed extensively, visually and by towed and handheld magnetometers. Given the

strong intent and experience of the salvors, it is highly unlikely that any of the artillery on the three sites was overlooked. Second, based upon the sixteenth-century shipwreck sites thus far examined in the New World, it appears to have been standard practice to store large tube guns, and sometimes the smaller swivel guns, below deck to keep a vessel's center of gravity as low as possible. This would have improved stability in extremely foul weather, of which these vessels were apparently the victims. The presence of tube guns on the reef surrounded by widely scattered ballast rather than distinct ballast mounds suggests that the vessels in question were violently broken up in the wrecking event.

Third, since the wrecking event in all three cases occurred off-shore, probably during severe storms that were almost certainly accompanied by poor visibility, no witnesses besides the mariners themselves would have been present to note the locations of the wrecks. The distance of all three sites from land argues against survivors unless they were able to escape in ship's boats. Such an escape would have been very difficult in seas rough enough to demolish the ships so thoroughly against the reefs.

The ships were probably not salvaged by the Spanish directly after the wrecking event, because these are scattered sites with no major deposits, and little, if anything, would have remained exposed above the surface to indicate where the wrecks lay. If the Spaniards had known where the wreck sites were, they would likely have been salvaged, as the shallow depths of the sites would have made salvage very easy and cheap. In all probability, therefore, these sites represent three complete sets of ship armaments that reflect, to an extent, the mission for which the vessels were intended.

The lack of spare *verso* powder chambers on all three sites is intriguing. *Versos* were frequently equipped with multiple powder chambers for maintaining a high rate of fire (Fig. 5). Though not always interchangeable, there were undoubtedly many instances where a powder chamber made for one *verso* fit another. Under these circumstances, there may have been occasions where a gun owner would sell his surplus powder chambers to another. I have come across two cases of what appear to be the sale of single powder chambers, called *servidores*, listed in cargo manifests, belonging to men involved in the cross-passage trade (Tanodi, 1971: 217, 353). It seems possible that ship owners whose vessels

operated in low risk waters may have sold surplus powder chambers to those more likely to need them.

During the study of the area around Saona, salvagers found a conch shell worked by man from a prehistoric level in an exploratory pit (Webber, 1983: 90). This led them to the conclusion that the area was probably a fishing ground during the prehistoric and contact periods. It seems likely that natives of Saona were aware that ships had been wrecked when flotsam washed up on the beaches. Diving from canoes for conch, they may occasionally have come upon the shipwreck sites. Not having metal working technology, the large iron guns lying in the shallows were of no use to them. Nor is it likely they would tell the Spaniards about the lost guns, since they were probably all too familiar with their use. Among the items of potential use, as well as light enough to bring to the surface by a free diver were the verso powder chambers. These tankard-like iron objects would have made effective, if unique, yuca root pounders for Saona Island's cassava bread industry. This is another possible explanation for the lack of verso powder chambers on all three sixteenth-century sites.

Two of the sites, Pre-site One and Pre-site Two, were partially salvaged by Webber in 1983. One tube

gun, a tube-gun powder chamber, and a verso swivel gun were salvaged from Pre-site One. One tube-gun powder chamber, 3 versos, and 2 anchors remain on the site. One tube gun, a tube-gun powder chamber, 2 verso swivel guns, and a haquebut were salvaged from Pre-site Two. Remaining on this site is the intriguing anchor and small gun feature, 6 verso swivel guns, 2 tube-gun powder chambers, and 2 broken anchor shanks. The Caballo Blanco site was not salvaged. Remaining on this site are 2 tube guns, 2 tube-gun powder chambers, 2 anchors, and 4 verso swivel guns.

In addition to the artillery and anchors which remain on these sites, there are still scattered ceramic remains and iron ship fittings. Though partially compromised by their salvage in 1983, these are still very important archaeological sites containing a wealth of information on the kinds of armaments, particularly portable arms, carried by vessels operating in these waters during the late fifteenth or first half of the sixteenth-century.

ORDNANCE TREATMENT AND CONDITION

The artillery at the Saona sites had lain in highly oxygenated, high-energy surf zones and over the course of five centuries had suffered extensively from corrosion. The salvors chose what they believed to be the best preserved pieces for removal and study. These were chiseled from the bottom and reinforced to distribute the weight properly during raising. The pieces were hoisted onto the deck of the work vessel *M/V Samala*, where they were wrapped in blankets and secured to wooden deck chocks. They were continually hosed down with sea water to prevent them from drying out. Six days after the first pieces were salvaged, the *Samala* arrived in Santo Domingo, where the guns were subsequently transferred to the conservation lab at the Fortaleza Ozama and stored in fresh water tanks. There they probably underwent some initial cleaning and concretion removal before most of the sixteenth-century artifacts were shipped to METLAB in Philadelphia. With the exception of tube gun powder chamber #0038 and verso #0037, both from Pre-site One, all sixteenth-century artillery was sent to METLAB for conservation treatment. The artillery remained at the plant for approximately five years undergoing treatment and observation.

Much of the eighteenth-century material and a small amount of untreated sixteenth-century material was stored in large water tanks in the Fortaleza Ozama laboratory. Over the intervening nine years since the salvage, the identification tags, secured with a narrow-gauge copper wire, had mostly fallen off the untreated material still in the tanks. Much of the material was therefore unidentified. This necessitated a considerable expense of time working with the Operation Saona log and inventories. The majority of the sixteenth-century ceramics, earthenware olive jar fragments, were mixed together and stored with similar eighteenth-century olive jar fragments. These could not be fully sorted without a considerable investment of time and funding for the laboratory analysis of fabrics and glazes. They were therefore left unstudied. It is extremely unfortunate that the materials from the various salvaged sites, and the three sixteenth-century sites in particular, were not maintained as distinct collections.

Most of the artillery apparently arrived at METLAB without identification tags. These tags had either fallen off or were possibly removed during the first phase of concretion removal in the Dominican Republic, prior to shipment to Philadelphia. This is evident in photographs made available by METLAB showing the material as it arrived at their facility without the outer layers of

concretion and covered by patches of bright red corrosion, indicating some post-salvage corrosion exacerbated by concretion removal, shipment conditions and possibly extra time spent in customs storage (Figs. 14, 15).

Metallurgical analysis was not carried out.

The outer layers of concretion and corrosion were removed by chipping, probably using hammers and chisels, apparently in the Dominican Republic. Further cleaning by chipping and brushing using wire brushes, as well as by sandblasting, occurred in Philadelphia. It is presumed that ordinary (non-inert) beach sand was used as the abrasive. It is not clear how much surface was removed at this stage. This was followed by treatment in a hydrogen reduction furnace. Further details of the reduction treatment are unspecified or unknown (for example the temperature at which the artifacts were fired). Hydrogen reduction treatment entails raising the temperature of the iron object to a little over 1000 degrees Centigrade in a hydrogen-gas environment. Temperatures are gradually increased to this level over a period of one week, driving off all moisture and volatilizing all chloride corrosion compounds. The hydrogen reduces iron corrosion products back to a metallic state and combines with the oxygen in the corrosion products to form water which is evaporated by the heat (Hamilton 132: 1993).

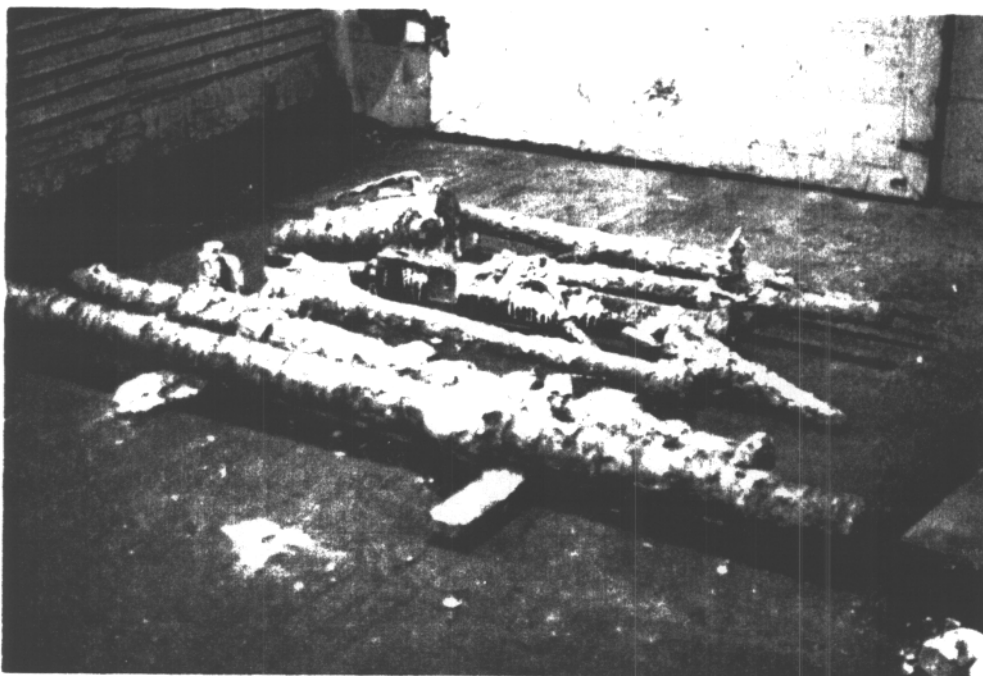


Figure 14. Photograph taken at METLAB of the artillery when it first arrived. Note that concretion has been removed and that objects show active corrosion in some places. (Photo courtesy of METLAB INC.).

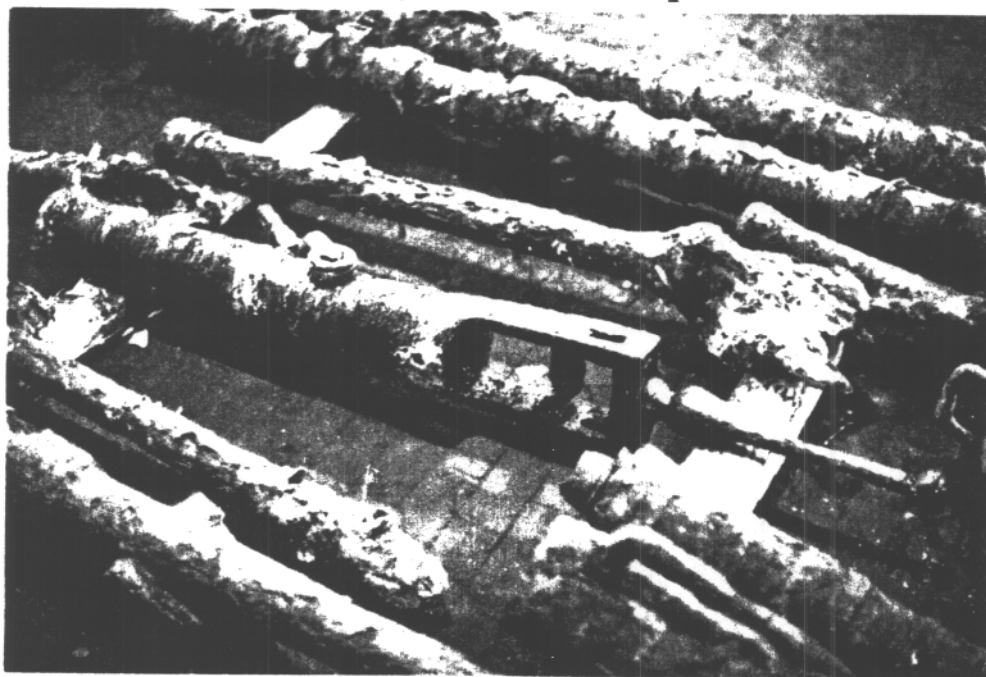


Figure 15. Another photo showing the artillery as it arrived in METLAB. Note the broken verso double with a straight barrel. (Photo courtesy of METLAB INC.).

This entire process of abrading and hydrogen reduction was repeated twice. The artifacts were then soaked in a solution of tannic acid (concentration unspecified), allowed to "drain," and then air-dry. At this stage three of the guns were painted with three coats of "urethane" (probably polyurethane-based paint). Which guns received this coating was unspecified. All the weapons were subsequently coated with the following paint system:

1 coat of Chesterton Nr.763 Rust Transformer

1 coat of Chesterton 745 Universal Primer

2 coats of Chesterton 411 Urethane Black enamel

They were then dipped in Chesterton 740 Heavy Duty Rust Guard and allowed to dry.

The hydrogen reduction process had clearly caused damage to some of the barrels by bending. The barrel surfaces were also extensively pitted. The damage was partly due to the presence of concretion within the bores of the guns since the pieces were judged too fragile to bore out (See Appendix A).

Examination of the guns in 1992 indicated that they had been coated with a wax since their treatment in Philadelphia. The exterior surfaces were dark, dirty and discolored, and the surface coatings were so heavy that many surface details were difficult to see.

Evidence of "weeping," that is, the development of rust colored drops of liquid (hydrochloric acid) on surfaces, indicated on going corrosion. There was little further external evidence of instability in the usual form of spalling outer layers. This would not have been possible however, given the number and strength of the heavy coatings. These will have exacerbated any internal stresses resulting from active corrosion, increasing the likelihood of internal disintegration of the objects. Fluctuating humidities and temperatures in storage and in the museum are also, unfortunately, contributing to a fast corrosion rate (Sutherland, 1993: P.C.).

RESEARCH

The following is a list of the sixteenth-century artillery salvaged during Operation Saona and where it currently resides:

Pre-site One:

tube gun (#0036)- Property of Mr. R. Abplanalp and currently in storage at Precision Valve Inc., Yonkers, New York.

tube gun powder chamber (#0038)- Untreated and in wet storage at the conservation laboratory in the Fortaleza Ozama, Santo Domingo.

verso (#0037)- Untreated and in two pieces. Currently in wet storage at the conservation laboratory at the Fortaleza Ozama, Santo Domingo.

Pre-site Two:

cerbatana tube gun (#0031)- In two pieces, on display in the Altarazana Museum of Underwater Archaeology, Santo Domingo.

tube gun powder chamber (#0033)- On display in the Altarazana Museum of Underwater Archaeology, Santo Domingo.

verso swivel gun (#0032/0034A)- On display in the
Altařana Museum of Underwater Archaeology,
Santo Domingo.

verso swivel gun (#0032/0034B)- In dry storage at the
conservation laboratory at the Fortaleza Ozama,
Santo Domingo.

haquebut (#0035)- In dry storage at the conservation
laboratory at the Fortaleza Ozama, Santo Domingo.

The first objective of this study was to record the dimensions and details of the artillery and obtain documentation of the salvage operation and conservation treatment. With the exception of the uncleaned material in wet storage, verso #0037 and tube gun powder chamber #0038 which were only photographed, all material was drawn at a 1:1 scale and photographed using a scale. It was also necessary to obtain documents, maps, and the logbook of Operation Saona, which were on file in the office of the Comisi3n de Rescate Arqueol3gico Submarino in Santo Domingo. These sources were used to familiarize myself with the events of Operation Saona, to determine which pieces came from which site, and to interpret the sites where possible. Other documentation was obtained from METLAB INC. in Philadelphia, the facility which treated the artillery using hydrogen reduction. The pre-treatment

X-rays and photographs shed considerable light on the artillery.

The second objective of this study was to attempt to identify the Spanish names for these guns and to review documentation and literature which deals with these particular kinds of weapons. An examination of the manner in which these guns were constructed was undertaken, as well as a review of current wrought-iron artillery typology and nomenclature.

I also reviewed early to mid-sixteenth-century naval tactics, weapons operation, the manner in which ships were armed, and the ratio of crewmen to artillery on different ships. This information was sought to place the guns in their correct historic and operational contexts.

SWIVELLED WEAPONS

Verso: Definition

The verso was a breechloading wrought-iron swivel gun which used an independent chamber to contain the powder charge. The gun was mounted on a swiveling yoke so that it could be quickly trained on a target by using its iron tiller (Fig. 5).

The earliest reference to the term verso which has come to my attention is found in a document transcribed by Denise Lakey and dated 1523 (AGI, Casa de Contratacion, legajo 1079, #1-ramo5). This document, a registry for the Indies-bound caravel *San Vicente*, lists two versos among other swivel weapons.

According to Alexandro López Pérez, a nautical archaeologist in Cuba who has read Diego Palacio's *Instrucion Nauthica* (Palacio, 1587) in the original Castillian, the term verso is not used in this document. Palacio uses the term *falcon* instead. This possibly indicates that the term had fallen out of use by that time (López Pérez, 1993: P.C.).

The Portuguese were using *berços* in the early sixteenth century. One of them, in the Museu Militar in Lisbon, is known to date from 1514 (Simmons, 1993: P.C.). This is no assurance that the Spanish used a similar name to describe a very similar piece. During the latter part

of the fifteenth and early sixteenth century, such definitions were frequently hazy. During both of these centuries the names of weapons varied from one nation to another and just as often pieces were known by another name twenty years later (Smith, 1988: 5). The transcription of Spanish Indies-bound ship registries predating 1514 could determine whether or not Spaniards used the term *verso* in the earliest part of the sixteenth century.

In the homebound register of the *Santa María de Yciar*, one of the ships wrecked on Padre Island in 1554, are listed 32 *versos* as the light artillery carried on board (McDonald & Arnold, 1979: 128). This vessel is the only one of the three shipwrecks that remains unexcavated at this time and therefore none of its artillery has been recovered. It is also the only one of the Padre Island shipwrecks whose register has been found.

Versos were found and recovered from the 1554 Padre Island wrecks *San Esteban* and *Espíritu Santo*. It is very unlikely indeed that the third ship of the fleet would be carrying an entirely different sort of light armament. We can therefore say with some confidence that the swivel guns recovered from the *San Esteban* and the *Espíritu Santo* are indeed *versos* and were known as such by the Spaniards of the time. That does not rule out the possibility that *versos* were known by other names as well, or that the term

verso was even in use in the earliest part of the sixteenth century.

With the exception of a single *Falconete Grande* found on the Bahia Mujeres wreck, all the breech-loading swivel guns from excavated and studied sixteenth-century New World sites are of the style we call versos. Establishing a positive date for artillery is usually difficult. Museums frequently have their material dated by "experts", whose knowledge may be excellent, but a date so obtained is not the same thing as a date established by an inscription, a stamp, or a dated archaeological context. A solid, forty-one year period for the use of versos in the New World may be established between 1513, the *terminus ante quem* for the Molasses Reef shipwreck (Keith, 1987: 287-289), and 1554, the year the three Spanish ships were wrecked at Padre Island. This period will undoubtedly be lengthened when swivel guns from Spanish shipwrecks of the second half of sixteenth century, such as one of the sites at IMHA 3 in Bermuda and the *Nuestra Señora del Rosario* in Cuba, are studied and published.

The problem of identifying and describing wrought-iron artillery has necessitated the development of typology and nomenclature. The two leading and published authorities who have been working on this problem are Joe J. Simmons III of *Ships of Discovery* and Robert D. Smith of the Royal Armouries at H.M. Tower of London. The many

and varied names of similar guns in different countries and during different time periods led Smith (1988) to develop a new typology that allows researchers to accurately classify and subdivide types of wrought-iron guns in order to avoid the confusion of multiple names for the same type of gun.

This system was designed to allow a basic understanding among researchers on what constitutes specific gun types without being encumbered by innumerable names for the same gun. With time and research, Smith hopes that names will be matched with distinct gun types, as he is doing with English wrought-iron swivel weapons (Smith, 1993).

Robert Smith has divided wrought-iron ordnance into the following six categories: Swivel guns, short muzzleloaders, chambered muzzleloaders, muzzleloaders, tube guns, and chambers. For the purpose of this thesis we shall only examine and explain the categories of swivels, chambers, and tube guns.

According to Smith, swivels are defined as any gun which can be maneuvered by means of a swivel. His belief that all swivel guns have separate powder chambers is mistaken, since muzzleloading haquebuts from collections in Holland (Kempers, 1983: 69, 72) as well as the archaeological examples (Keith, 1987:

210-211), were equipped with swivels. There are also at least two different muzzleloading swivel weapons in a collection in Spain identified as *sacabuches* and *medio ribadoguines* (Catalogo General, Vol. 1, 1909: 26-7, 67-8).

Smith has divided the swivel class into five types. Swivel Weapon 1, or SW1, numerically the most common, has a barrel with alternating hoops and bands (Fig. 16). A subsidiary number is given to describe the number of hoops between the chamber holder and muzzle, SW1-6 for example. The chamber holder is open and secured to the breech of the barrel over a pair of transverse lugs. The trunnions are attached to a trunnion hoop rather than the barrel. The tiller is an iron bar usually ending in a finial.

The SW2 type, also fairly common, has a relatively short barrel with alternating hoops and bands (Fig. 17). Like the SW1, a subsidiary number is assigned based on the number of hoops between chamber holder and muzzle. It is common for one of the hoops of the barrel to be decorated, frequently by twisting the metal before attaching to the barrel. The chamber holder is welded directly to the end of the barrel and is more enclosed than the SW1 type. The tiller is usually short and upturned.

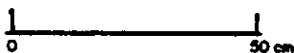
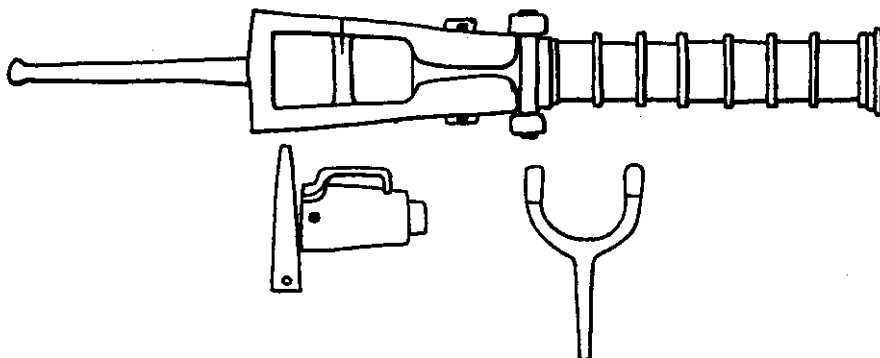
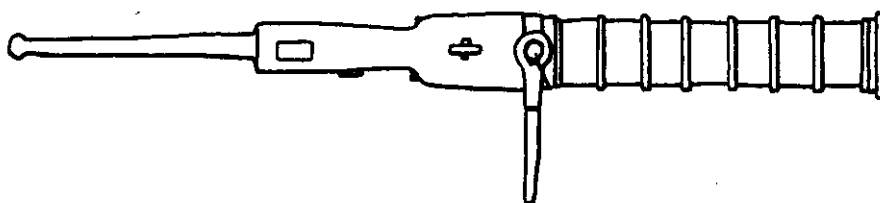


Figure 16. An example of a SW1-type gun. This one would be termed SW1-6. (After Smith, 1988: Fig. 2).

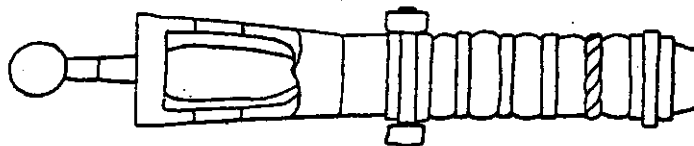
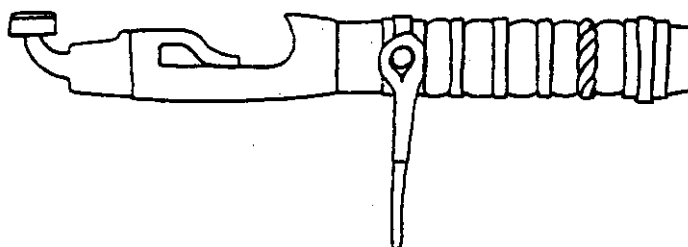


Figure 17. An example of a SW2-type gun. This example being an SW2-4. (After Smith, 1988: Fig. 3).

The SW3 type is extremely rare (Fig. 18). It has a long barrel with an internal chamber holder formed by cutting out a cover, which is then hinged, in the breech of the barrel. The powder chamber would then be placed into the breech of the gun. Trunnions were welded directly to the barrel and the tiller was a straight iron bar ending in a finial.

The SW4 type has a fairly long barrel with a single muzzle band (Fig. 19). The chamber holder is completely enclosed on the bottom with a small hole to allow for drainage. The chamber holder is welded to a breech ring on the end of the barrel (Simmons, 1992: 135) and frequently has a lanyard eye for chaining or tying the breech wedge. This eye or loop is welded onto the top of the chamber holder next to the tiller, usually a straight iron bar ending in a loop. The trunnions are attached to the barrel forward of the chamber holder.

Simmons (1988a: 29) in his study of the Molasses Reef Wreck artillery collection identified the three distinctly different kinds of *versos* from the site as *verso lisos*, *verso normales* and *verso doubles*. The SW4 type is the category into which the New World *verso normales* fall.

The SW5 type has a relatively long barrel and, like the SW4, a single muzzle band (Fig. 20). The

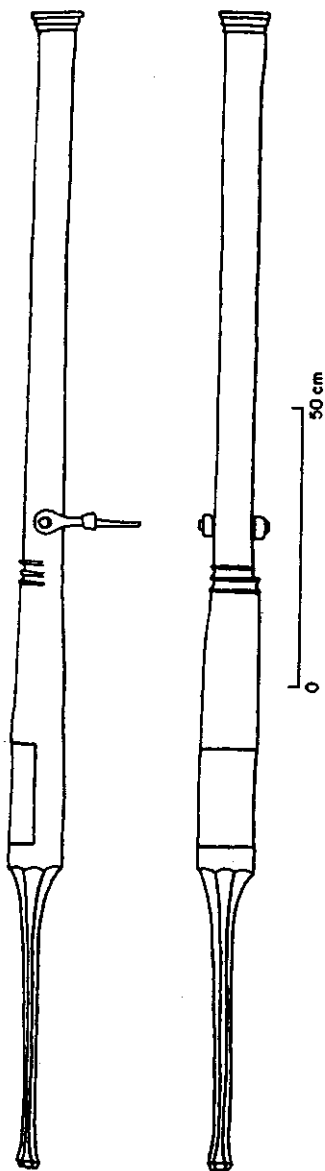


Figure 18. An example of a SW3-type gun. (After Smith, 1988: Fig. 4).

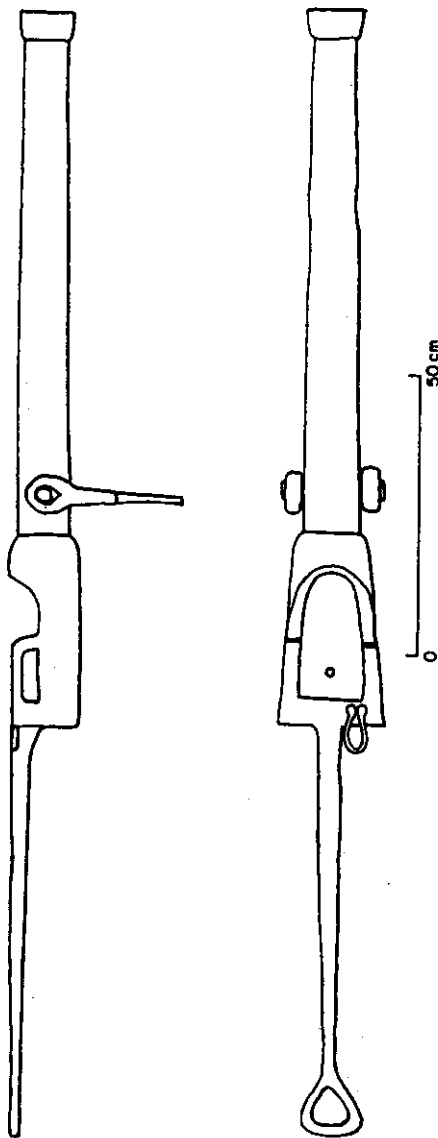


Figure 19. A SW4-type gun. The New World *verso normales* fall into this category. (After Smith, 1988: Fig. 5).

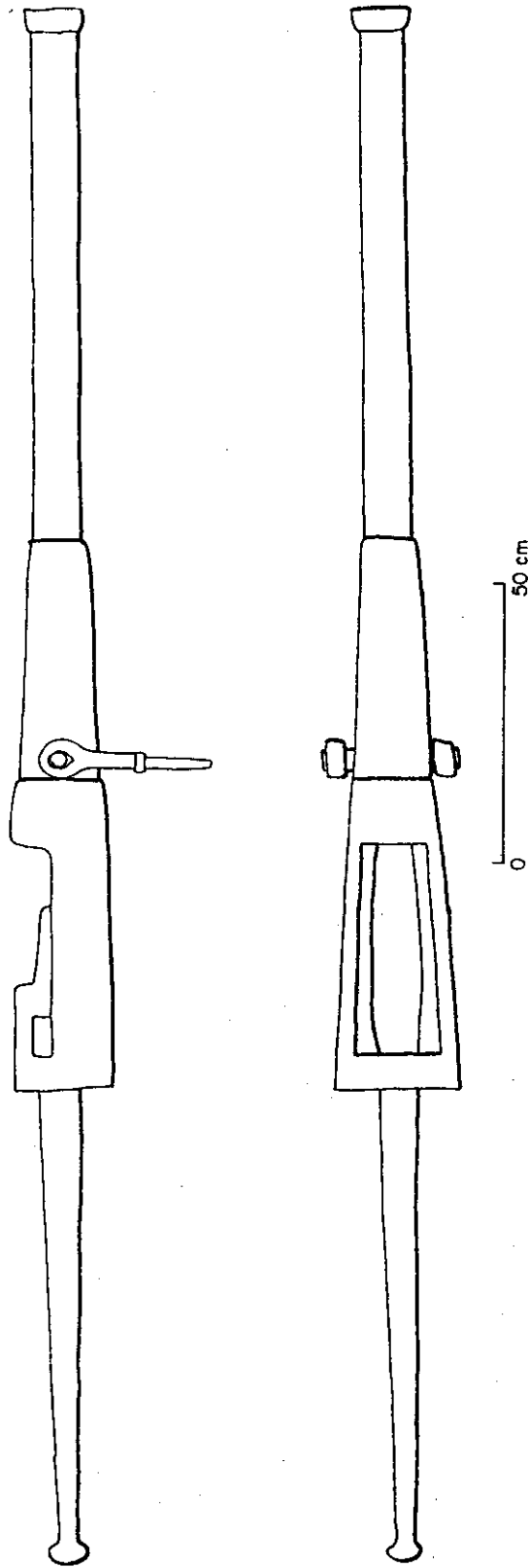


Figure 20. A SW5-type gun. New World verso doubles fall into this category. (After Smith, 1988: Fig. 6).

chamber of this weapon is open in the bottom allowing water to drain. The trunnions are welded to the chamber holder, though the term chase reinforce seems to be a more accurate description of this component located forward of the actual chamber holder. This is the category into which the New World *verso doubles* fall.

The reliance on chamber holder construction to distinguish between types seems to be unwise in light of Saona Island *verso* #0032/0034A discussed below. This weapon has an open-bottomed chamber holder like that described for SW5, yet it lacks the chase reinforce and barrel length common to the SW5 or *verso double* type. It seems best to rely more on barrel length and chase reinforcement in distinguishing between SW4 and SW5 types. As far as chamber-holder construction is concerned, the important question is whether or not the chamber is an integral part of the barrel, as it is in the SW3 type.

Smith has divided chambers into two types: those made of staves, used with tube guns, and those made in one piece and rolled, used with swivel guns. He has subdivided the latter, which resemble beer stein, into two types. The first type, CH1, tapers slightly from its base to the front and has an inset

neck. A handle is welded on to facilitate operation, and there is a touch hole punched through the chamber wall on one side of the handle (Fig. 21). The second group, CH2, is very similar, but the chamber is more tapered, with the neck beveled rather than inset. Two verso powder chambers were recovered during Operation Saona, but they remained in place in verso chamber holders, and their necks are therefore unavailable for examination. It seems likely, however, that they are of the CH2 type, as almost all verso powder chambers recovered from sixteenth-century New World sites are of this variety (Olds, 1976: 84; Keith and Smith, N.D.: 9; Keith, 1987: 53, 208).

During his examination and study of the wrought-iron ordnance from the Molasses Reef and Highborn Cay wrecks, Simmons (1988b: 123-124) developed detailed nomenclature for verso swivel guns (Fig. 22) and tube guns (Fig. 23). In most instances these are in agreement with the nomenclature developed by Smith and are described in the same publication as his typology (Smith, 1988). A synthesis of the two nomenclatures is needed in order to lessen confusion in what is already a very complex and often confusing field.

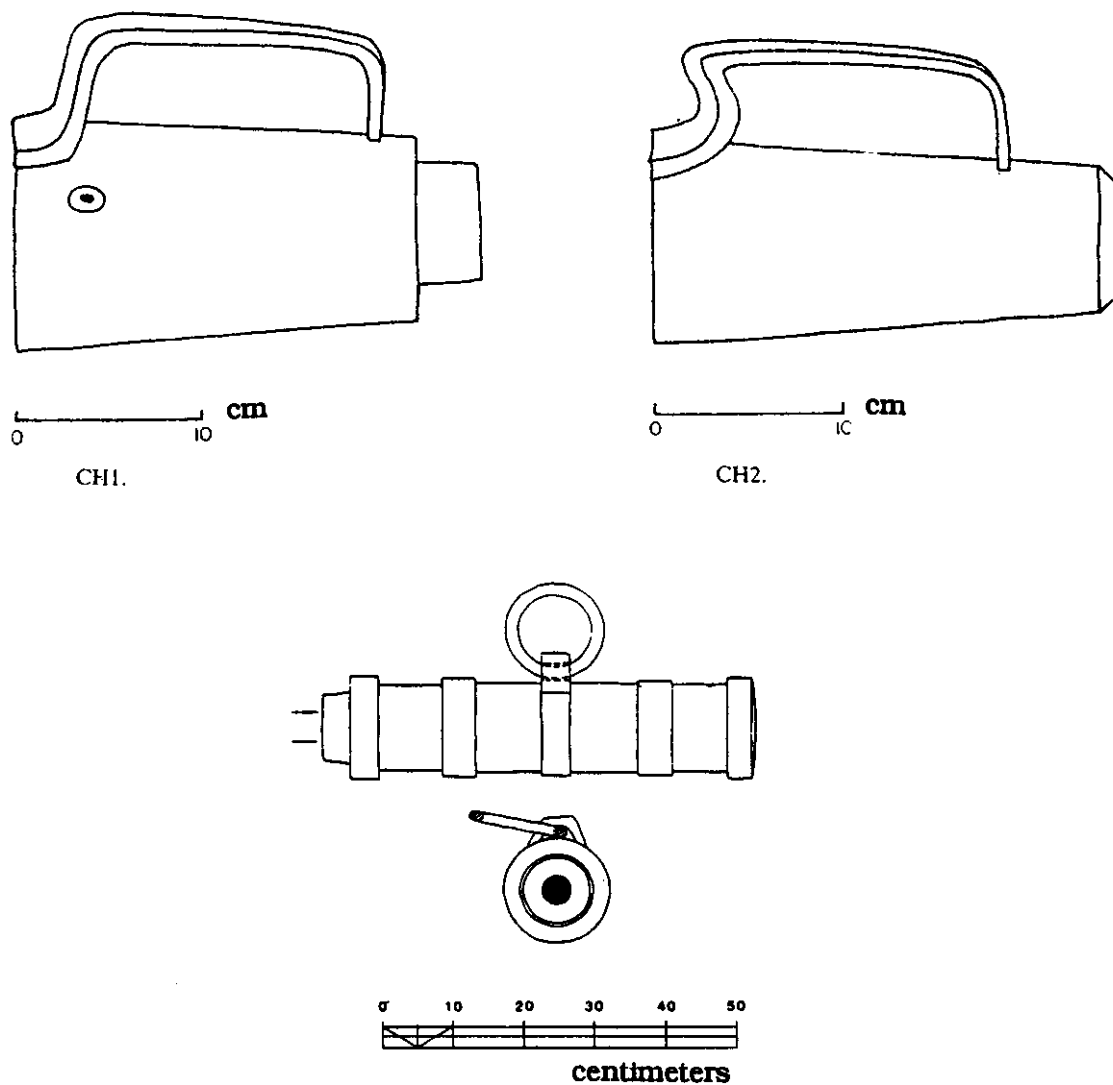


Figure 21. Beer-stein swivel-gun powder chambers and a cylindrical tube-gun powder chamber. (After Smith, 1988: Figs. 11, 12; Simmons, 1988a: Fig. 4).

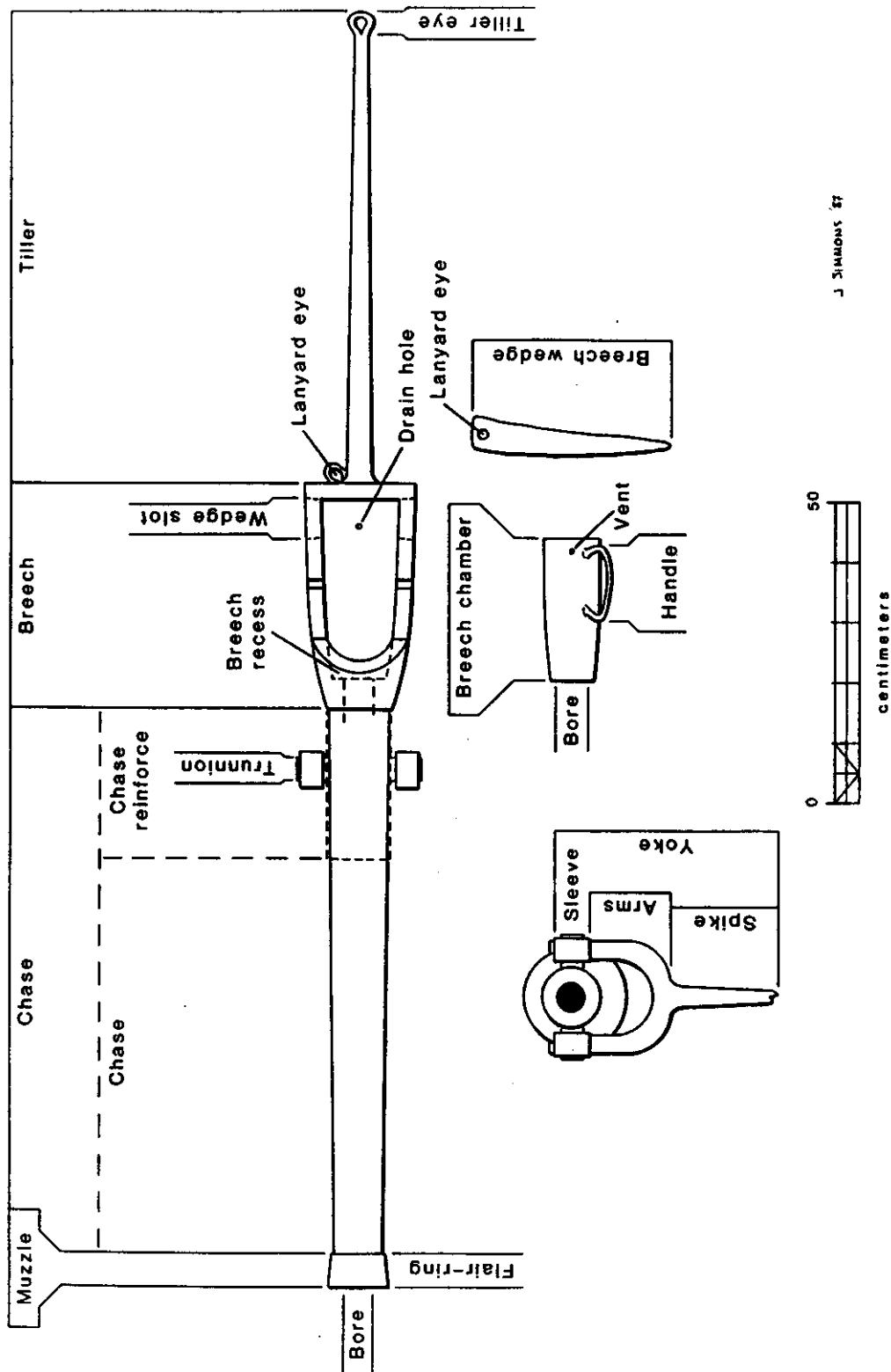


Figure 22. Simmons' nomenclature for verso swivel guns.
(Courtesy of Joe J. Simmons III).

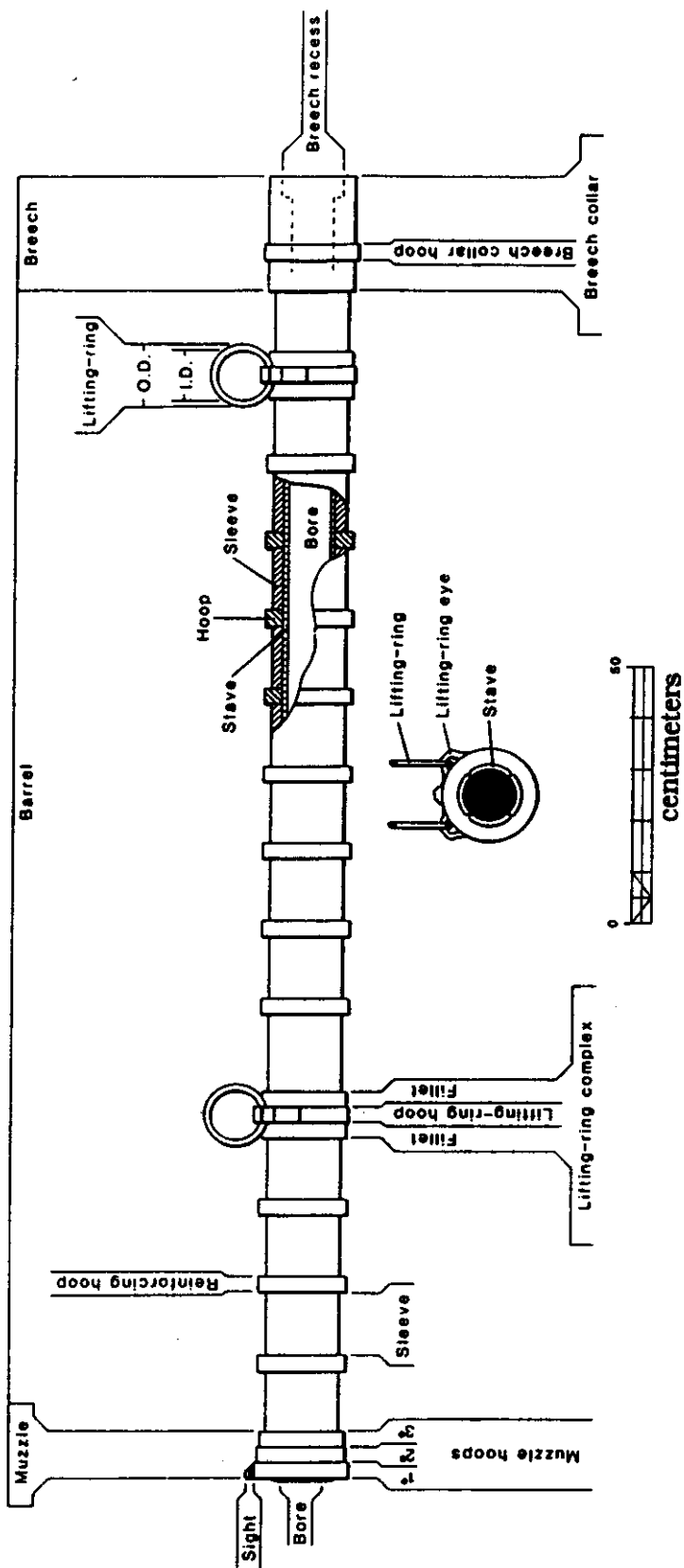


Figure 23. Simmons' nomenclature for wrought-iron tube guns. (Courtesy of Joe J. Simmons III).

The Saona versos

A total of three versos were salvaged during Operation Saona, one from Pre-site One (#0032) and two from Pre-site Two (#0032 and #0034). The versos from Pre-site Two have lost their identification tags, and I have therefore labeled them as #0032/0034A and 0032/0034B.

Verso #0032/0034A

This weapon was 181.7 cm long from muzzle to the end of its incomplete tiller. The length of the barrel was 100.0 cm and its bore diameter approximately 3.7 cm, giving a caliber of 27.02 (Fig. 24). The barrel was slightly bent, drooping down at the muzzle, a consequence of hydrogen reduction treatment (Fig. 25).

This gun was an SW4 type, or *verso normal*, but has chamber-holder construction which resembled that of the SW5, or *verso double*, type, which has a long slit for water drainage rather than the small hole customary to the SW4 type (Fig. 26; Smith, 1988: 11). The chamber holder was slightly out of line with the barrel in being off-center to the left from the gunner's point of view, a result of the original construction. Lack of symmetry was a common characteristic of wrought-iron verso chamber holders

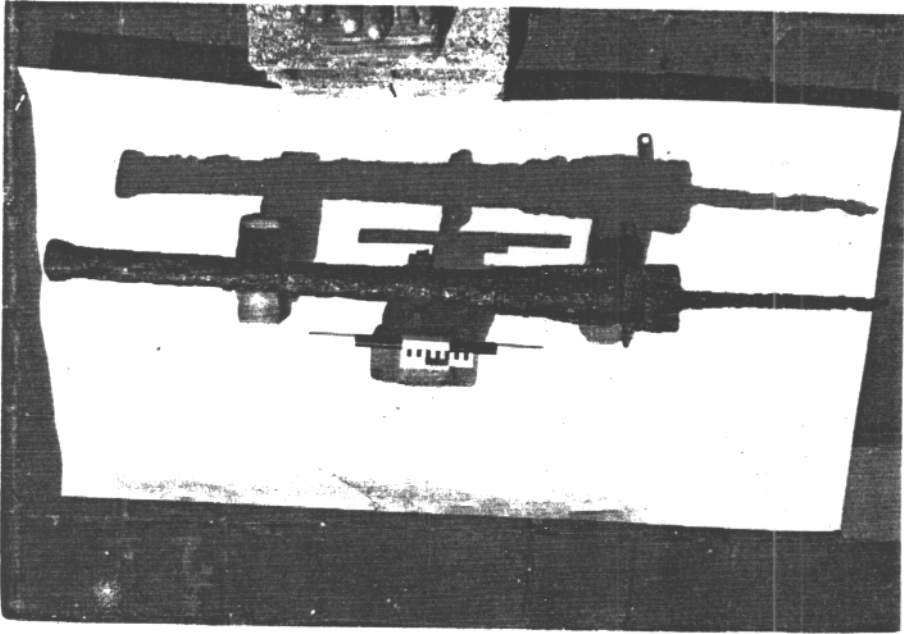


Figure 24. Plan view of verso #0032/0034A. (Photo by author).

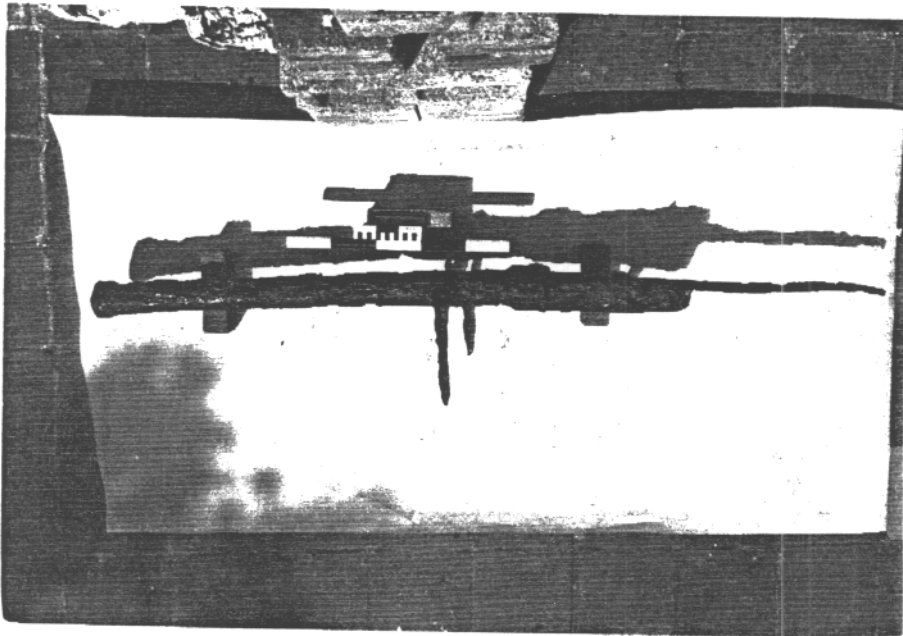


Figure 25. The barrel of verso #0032/0034A drooping as a result of hydrogen reduction treatment. (Photo by author).

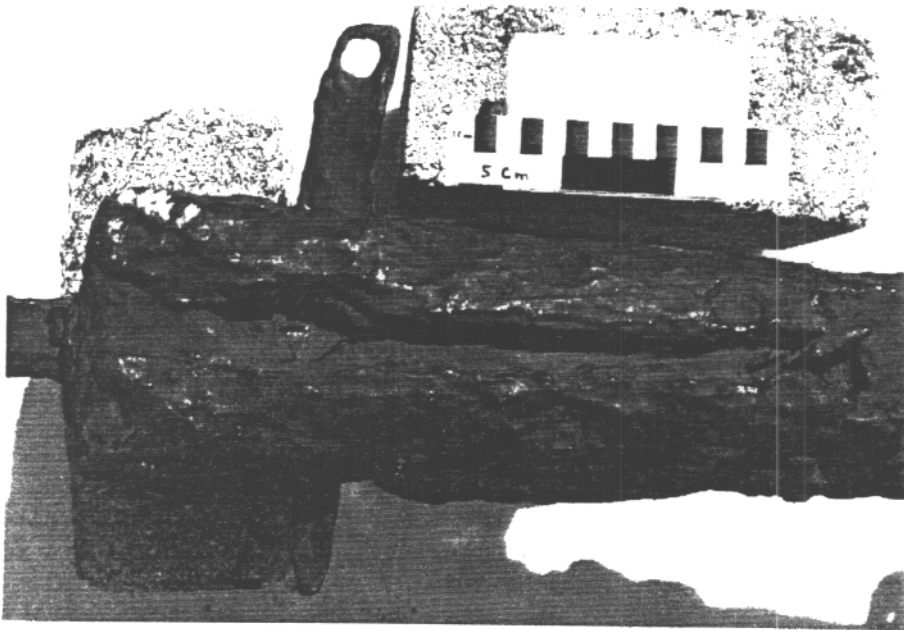


Figure 26. Close up of the bottom of verso #0032/0034A's chamber holder showing its long drainage slit. (Photo by author).

(Simmons, 1988a: 29; Olds, 1976: 80, 82). The powder chamber was wedged in place, missing its handle, and was also slightly out of line with the barrel (Fig. 27). The trunnions were welded directly to the barrel of the gun.

The breech wedge, inserted from the right side of the weapon, was in the so-called "incorrect" position with the hollow of the curve facing forward (Fig. 27; Keith, 1987: 200). Keith calls this position incorrect as the opposite orientation would bring more mechanical force to bear on the powder chamber, making a tighter and safer fit between the chamber and the breech. The wedge slots in the chamber holder looked as though they had not been properly cleaned prior to conservation treatment and still contained large amounts of corrosion products. The lanyard eye (the loop to which the wedge lanyard was fastened) was missing as was approximately half the tiller (Figs. 20, 22, 25).

Verso #0032/0034B

This gun was of the SW5, or *verso double*, type and in very poor condition. Its overall length, or barrel length, is 109.0 cm and its bore diameter is approximately 4.25 cm, giving a caliber of 25.88 (Fig. 28). This gun barrel was also bent during the

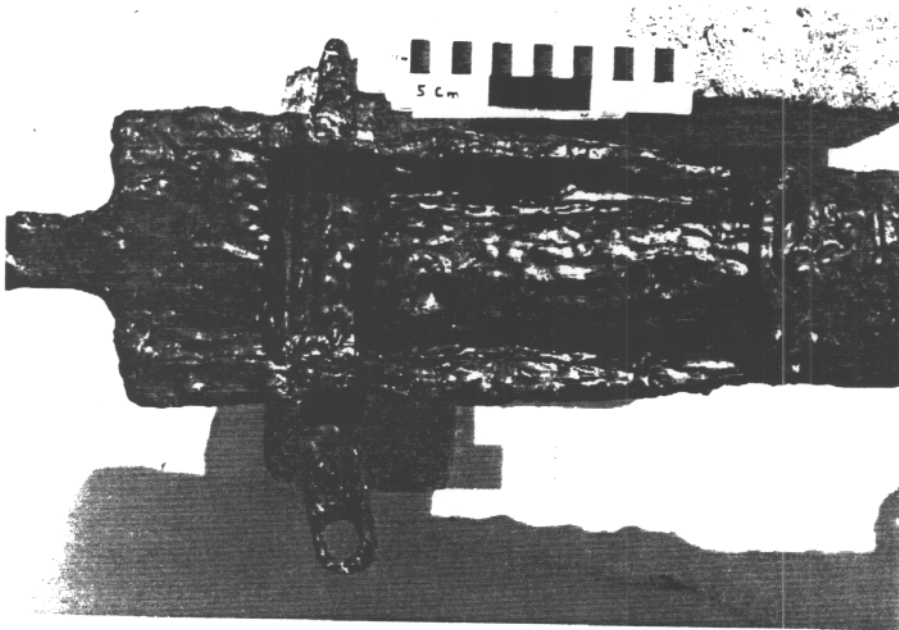


Figure 27. Chamber holder, powder chamber, and wedge of verso #0032/0034A. (Photo by author).

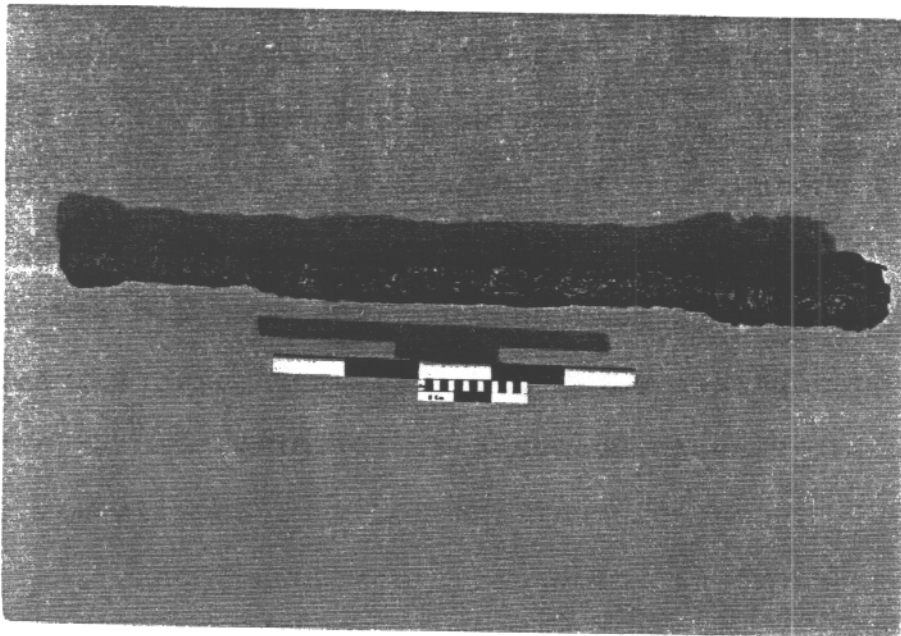


Figure 28. Barrel of verso #0032/0034B. (Photo by author).

hydrogen reduction treatment. Photographs of the gun when it arrived at METLAB show the barrel to have originally been straight (Fig. 15). The chamber holder and most of the tiller were missing. This makes it difficult, if not impossible, to identify the top or bottom of the gun. Photographs show that it arrived at METLAB in two pieces, having broken at the chamber holder. Further deterioration during treatment led to the complete loss of the chamber holder, as well as the separation of the yoke from the *verso's* trunnions. The base/tiller component may also have lost some of its length (Figs. 29, 30). The lack of a powder chamber for this *verso*, and the delicate condition of the chamber holder prior to treatment, indicates that either the weapon was not loaded at the time of the shipwreck, or that the wedge and chamber were knocked out by a strong blow during the wrecking event.

This weapon had a trunnion hoop slipped over the barrel following what appeared to be a single chase reinforce band (Fig. 31). A second chase reinforce band was slipped on after the trunnion hoop.

The chase reinforce arrangement in front and behind the trunnion hoop is very similar to the two examples of *verso doubles* (MRW 35 & 36) from the Molasses Reef Wreck (Fig. 32). However, these three

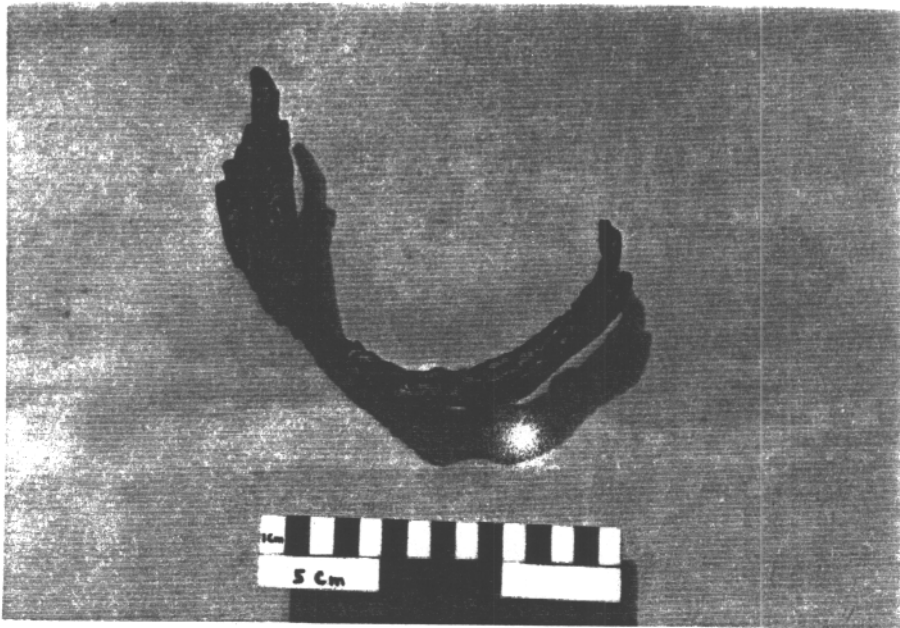


Figure 29. The remains of the yoke of *verso double* #0032/0034B after separation from the weapon's trunnions. (Photo by author).

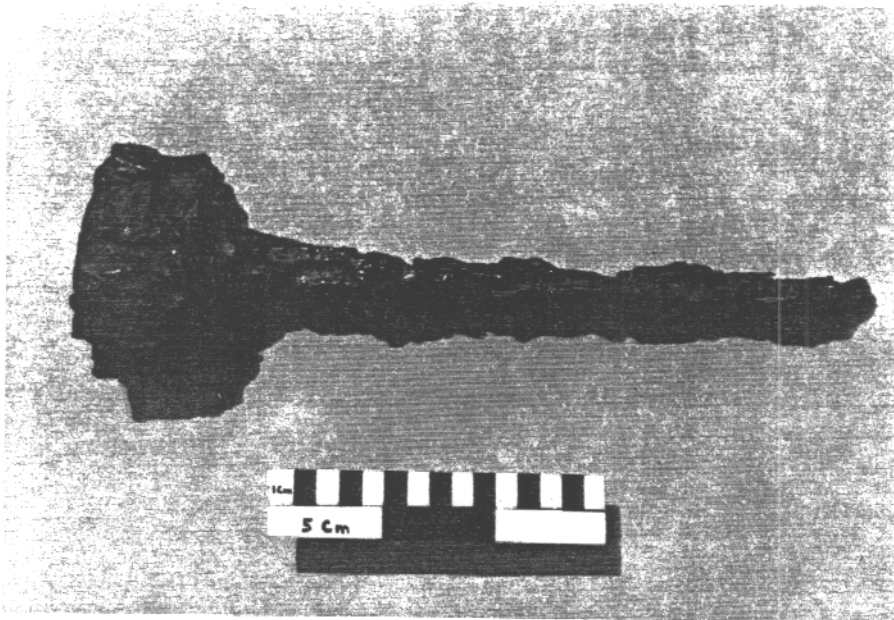


Figure 30. The remains of the tiller and chamber holder base of *verso double* #0032/0034B after hydrogen reduction treatment. (Photo by author).

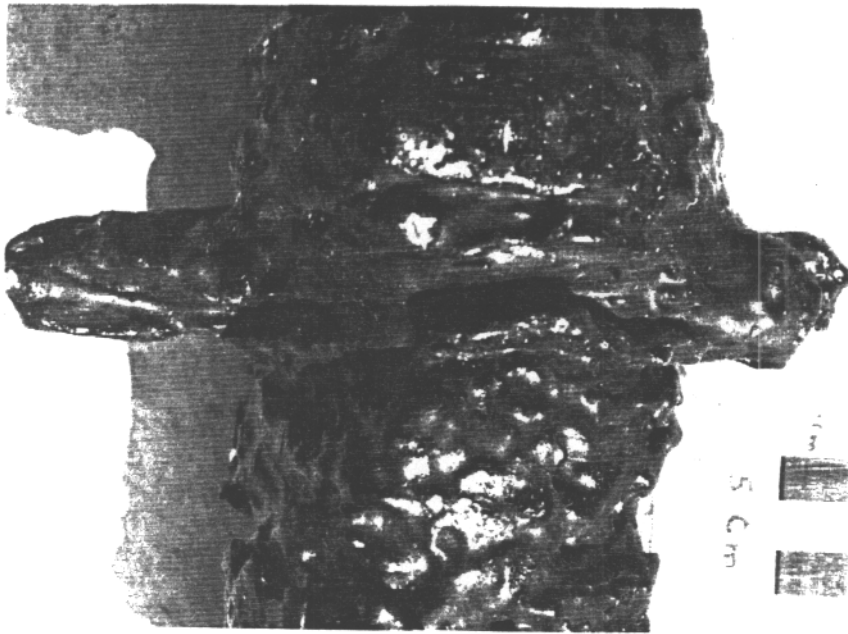


Figure 31. The trunnion hoop of verso #0032/0034B.
(Photo by author).

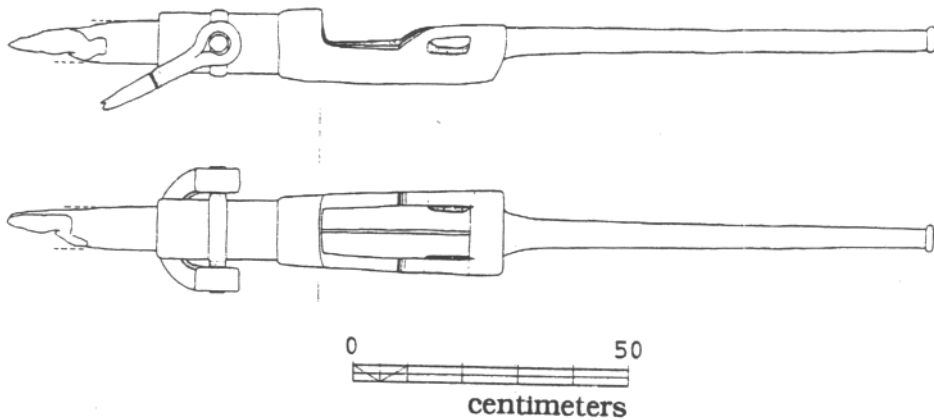


Figure 32. Verso double MRW 36. Note the chase reinforcement both in front and behind the trunnion hoop. (After Simmons, 1988a: Fig. 5).

examples differ from the *verso doubles* from the Padre Island Wrecks (no. 328 & 330), which have larger chamber holders and trunnions welded directly onto the chase reinforce (Fig. 33). The Padre Island *verso double* chase reinforces are almost double the length of those on the Saona Island and Molasses Reef examples, and they also have considerably longer barrels than the Saona Island and Molasses Reef *verso doubles*. This may be indicative either of an evolutionary change in SW5 *versos* over the first half of the sixteenth-century or of a heavier but contemporary class of SW5 *verso*. A Highborn Key *verso double* as seen in a photograph (Keith, 1987: Figure 32) appears to have trunnions welded directly to the barrel just in front of the chase reinforce and would seem to be different from either the Padre Island and the Molasses Reef Wreck weapons.

Verso #0037

This gun, from Pre-site One, had not been completely cleaned or treated and is broken in two (Figs. 34, 35). The forward barrel section was approximately 67 cm long, and the breech end with the chamber holder was approximately 53 cm long. The barrel appears to have suffered damage to its

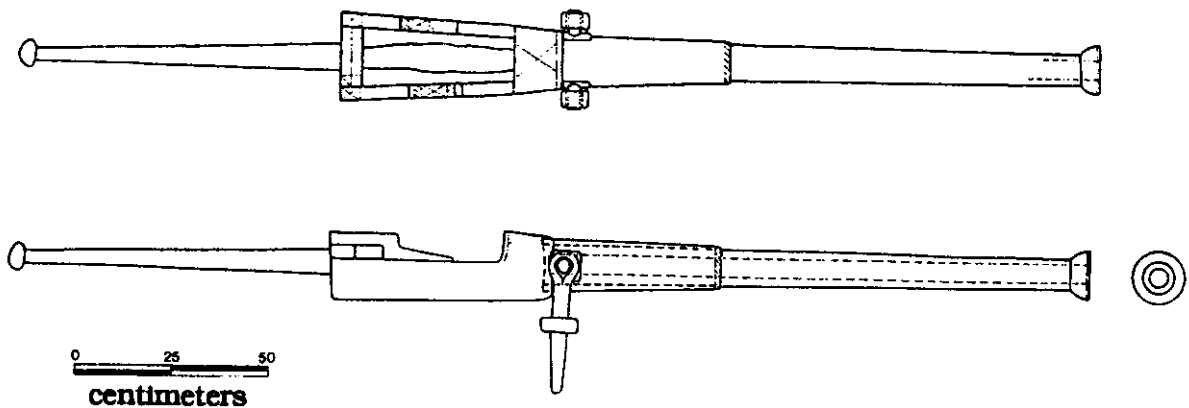


Figure 33. Verso double 41 WY 3 No. 333 from Padre Island. This gun's trunnions were welded directly onto the long chase reinforce. (Courtesy of the Texas Historical Commission and the Texas Antiquities Committee).

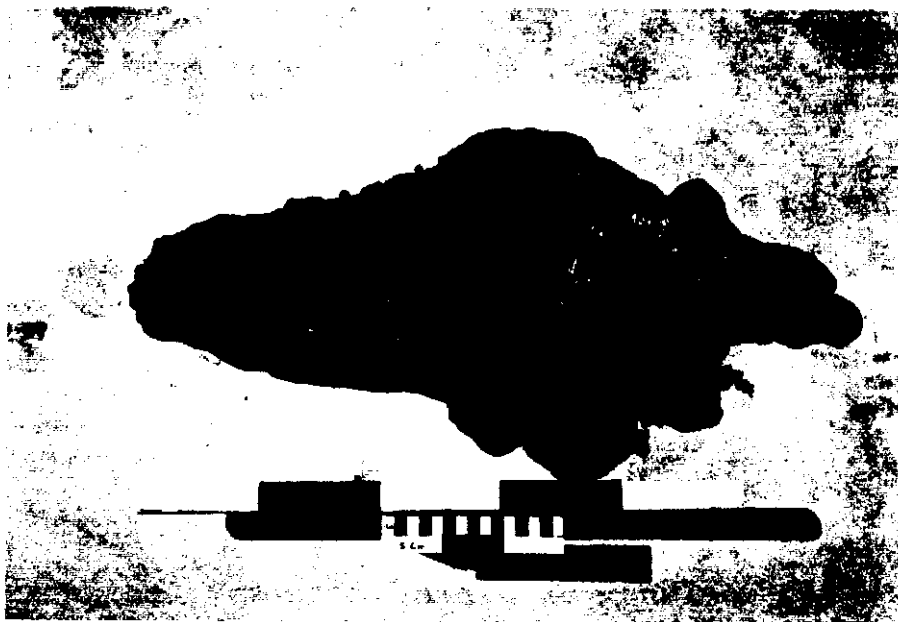


Figure 34. Wedge (inserted from left), powder chamber, and chamber holder of broken and untreated *verso double* #0037.
(Photo by author).

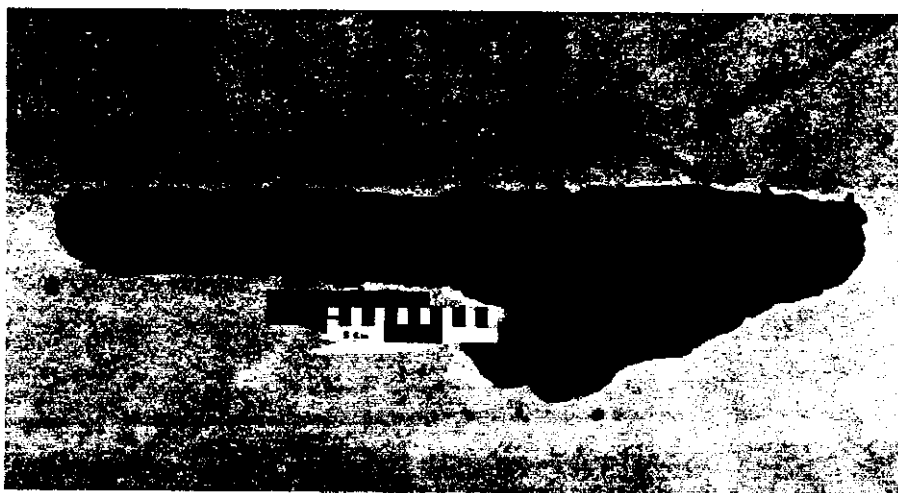


Figure 35. Forward end of *verso double* #0037 showing the long chase reinforce and the yoke.
(Photo by author).

concretion layer or was partially cleaned. It was listed as a small cannon but appeared to be a *verso*. Half of the barrel and most of the tiller were missing. Black and white photographs were taken of this piece, but no detailed drawings were made, since it was not found and identified until the end of the study season.

The gun was apparently a SW5 type (Smith, 1988: 11), as the barrel has a chase reinforce forward of the trunnions. This reinforce is considerably longer than those from Molasses Reef and the other example from Saona Island, but it lacks the greater dimensions of the *verso doubles* from Padre Island.

The chamber, minus its handle, is in place with the breech wedge inserted from the left hand side of the weapon. It is interesting to note that most wedges illustrated in situ from Padre Island and Molasses Reef have been inserted from the right side of the weapon (Olds, 1976: figures 38, 39, 40; Keith, 1987: figure 133).

Verso manufacturing

While investigating the swivel guns from the Molasses Reef Wreck, Joe Simmons III sectioned an SW4- type *verso normal* (MRW-66) lengthwise, in order to better ascertain the technologies and construction

techniques used in its manufacture (Fig. 36; Simmons, 1988b: 125).

The barrel was made of five cylindrical barrel sub-assemblies, each apparently fashioned from a number of individual plates to form 2- or 3-ply sections (Fig. 37; Simmons, 1992: 132). These sections were laid out and lap-welded to form a single sheet which was rolled at very high temperature around a parallel-sided mandrel and joined with a single longitudinal lap weld to form the barrel (Simmons, 1992: 133). This longitudinal weld was the single most important weld in the construction of the gun, as it had to withstand the force of the ignited powder charge's expanding gases. After the *verso's* barrel was fashioned, a flair ring was added to the muzzle for reinforcement and possibly to affix the gun sights. The other end of the barrel had a breech ring added to give significant reinforcement, as well as to provide a base to affix the larger coupler section of the chamber holder (Fig. 38; Simmons, 1992: 135).

The chamber holder, consisting of the main body and coupler, was also assembled in planar form. The sections were shaped and wedge slots were punched or chiseled out of the main body and then "drifted-out", or enlarged, using a tapered drift tool (Fig. 37).

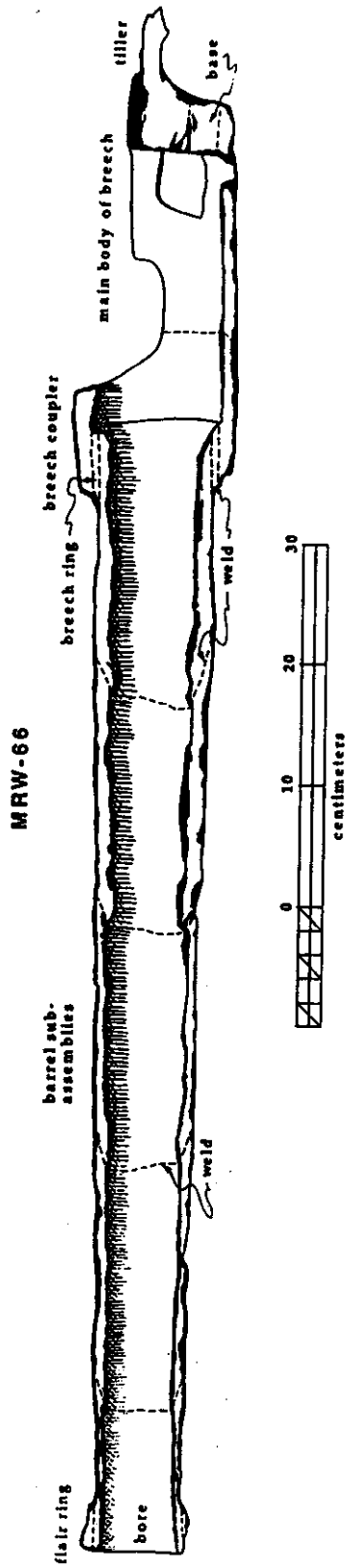


Figure 36. Sectioned profile of verso normal MRW-66.
(Courtesy of Joe J. Simmons III).

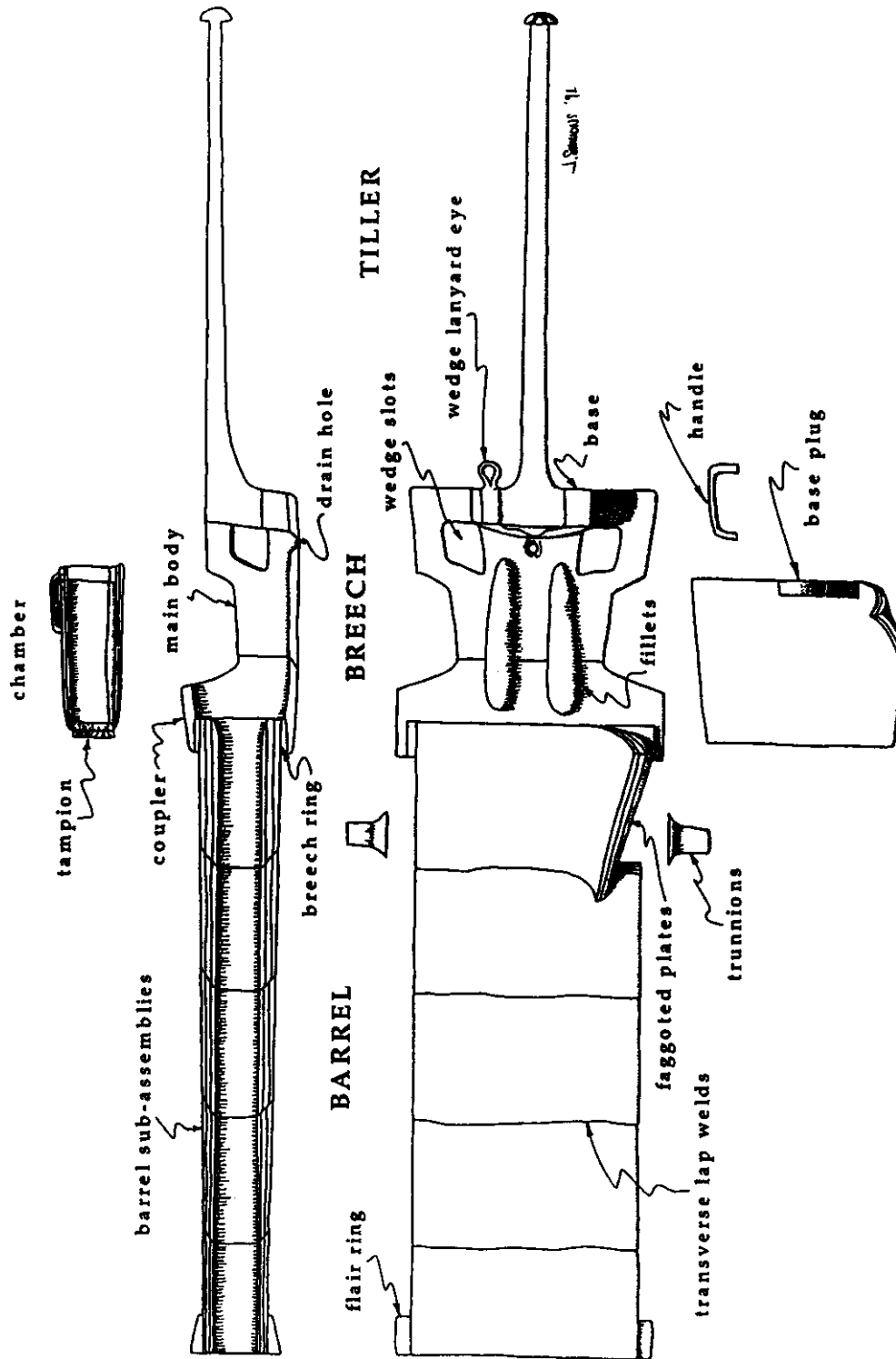
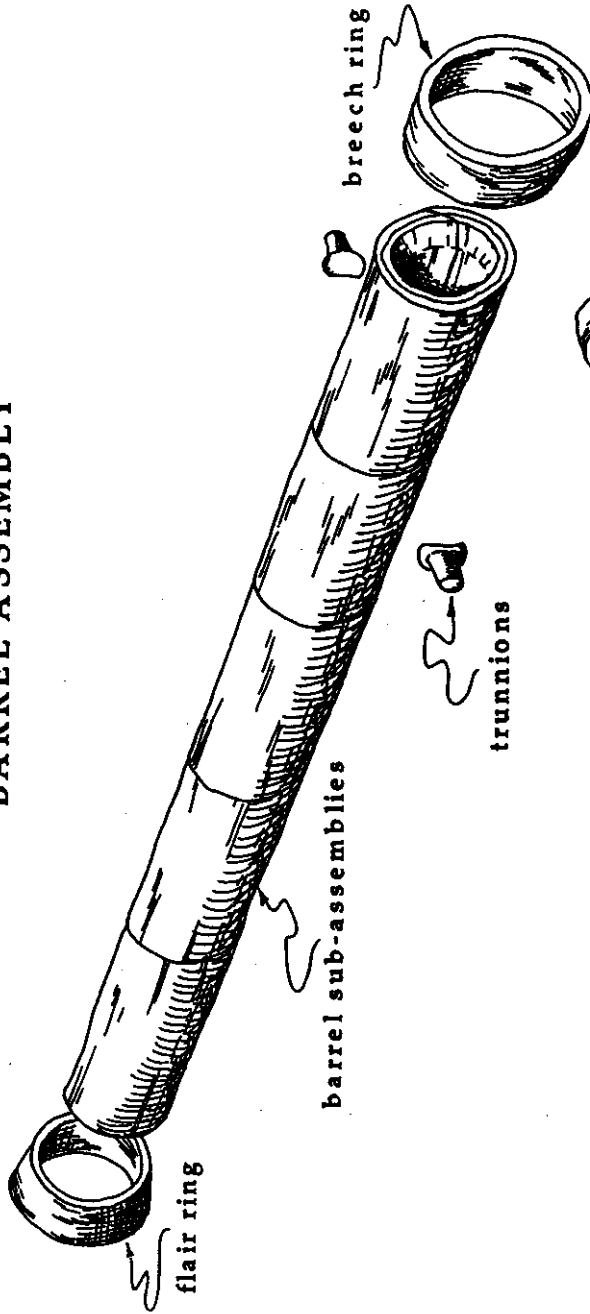
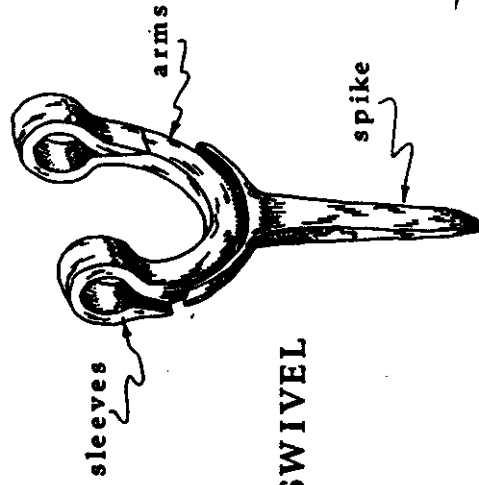


Figure 37. Illustration showing MRW-66 in planar form and profile. (Courtesy of Joe J. Simmons III).

BARREL ASSEMBLY



SWIVEL



J. SIMMONS '71

Figure 38. Exploded drawing of MRW-66's barrel and yoke. (Courtesy of Joe. J. Simmons III).

This portion of the chamber holder was joined to the coupler with a transverse lap weld. Fillets, small batten-like inserts, were laid across the coupler/main-body weld (Figs. 37, 39). These served to trim the fit of the powder chamber into the bore and minimize the escape of combustion gases (Simmons, 1992: 135).

The chamber holder was then attached to the breech ring on the end of the gun barrel. This was done over a mandrel which required that the end of the chamber holder be left open in order to slip it onto the mandrel. The end of the chamber holder consisted of a base and tiller component. The end of the tiller was either shaped into a hoop or finial knob. The tiller was inserted into the base and the complete assembly was welded to the end of the chamber holder. A drain hole was punched in the bottom of the chamber holder to prevent water accumulation (Simmons, 1992: 135).

The wedge was made of a single piece of iron curved in form. It may have been curved to accommodate somewhat differently shaped powder chambers. The wedge had an eye to which a retaining lanyard would have been attached that secured the wedge to a loop, or lanyard eye, welded to the base of the chamber holder.

BREECH ASSEMBLY

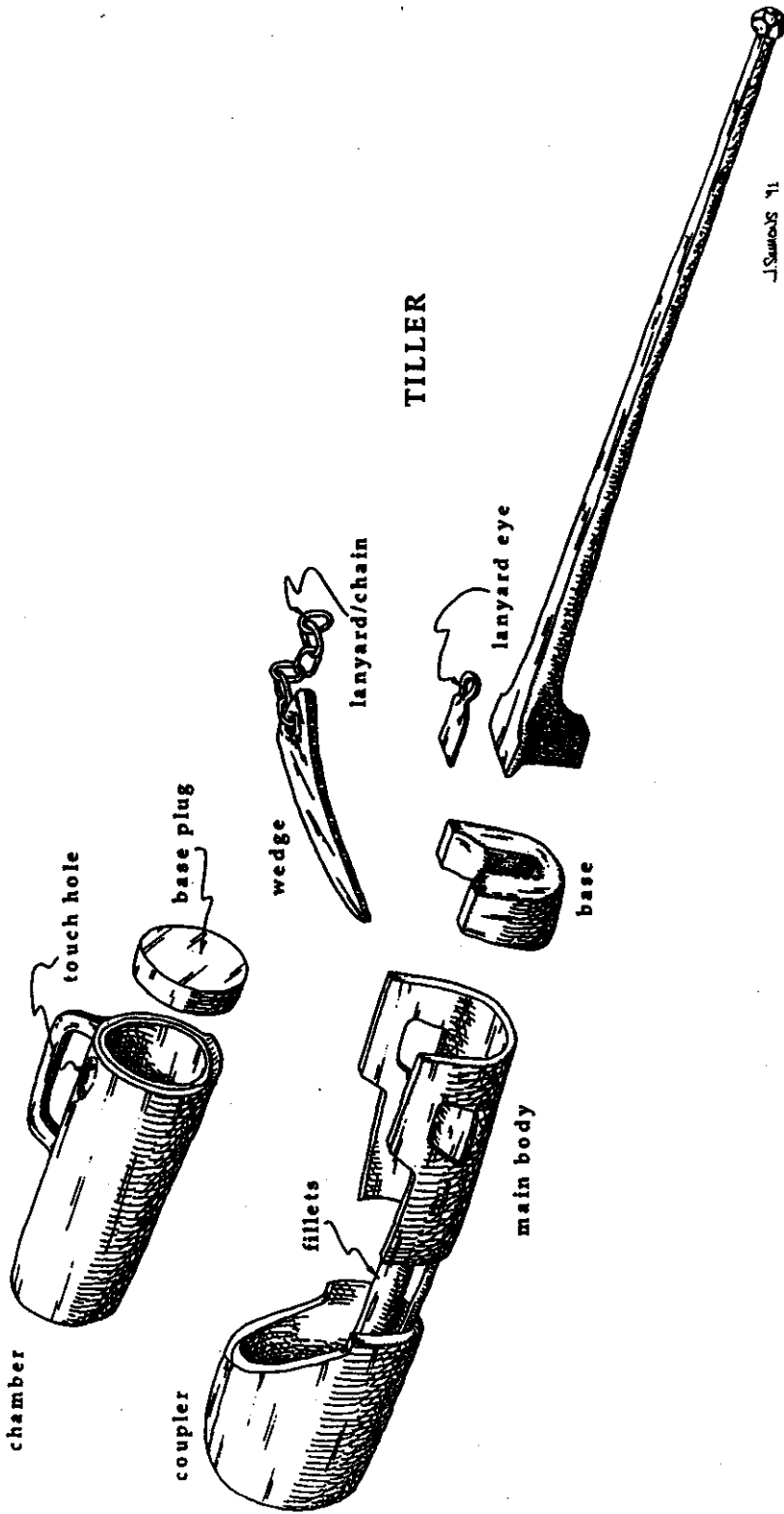


Figure 39. Exploded drawing of MRW-66's chamber holder, powder chamber, wedge, and tiller assembly. (Courtesy of Joe J. Simmons III).

Versos had a number of interchangeable powder chambers to enable the gun to maintain a high rate of fire. These powder chambers had to be very close in size and weight in order to fit well and maintain the gun's balance (Simmons, 1992: 136). Chambers were made from a single sheet of multi-ply iron rolled into a slightly tapering tube joined by a longitudinal lap weld carried out on a parallel-sided mandrel (Fig. 39). A base plug was then welded into the wider end of the tube and the mouth was shaped to accomplish a good fit in the breech of the gun. A handle was added and a touch hole punched into the end of the plugged tube. A small "lip" was added to the base of the powder chamber to catch the wedge when the weapon was fired. Finally, trunnions were butt-welded to the verso's gun barrel at locations which were determined to be the "loaded" balance points. The swiveling yoke was then fashioned over the trunnions (Figs. 38, 39; Simmons, 1992: 136-7).

Construction of the Saona versos

The barrels of the three versos from the Saona Island sites were probably manufactured in a manner similar to the Molasses Reef example, an undetermined number of multi-ply plates being employed. The

construction of the chamber holders appears to have varied more than that of the barrels.

The following description is based on visual examination of Saona verso #0032/0034A and Simmons' findings discussed above. The chamber holder of the relatively well-preserved Saona verso normal, the only one in a condition to be examined, was different from that of MRW-66. It appeared to be made of five individual pieces of iron; the coupler, two sides which were shaped to form the bottom as well, and two small bars placed over the notches that were to hold the chamber wedge (Fig. 40). They were probably all joined in planer form before the chamber holder was shaped with the aid of a mandrel.

The top of this verso's chamber holder is unusually flat (Fig. 41). Besides this Saona verso and two verso doubles, one from Highborn Cay (Keith, 1987: Figure 32) and another from the St. John's Bahamas wreck (Malcom, 1993: P.C.), all other versos I have seen seem to have recesses in the sides of their chamber holder to accommodate the powder chamber handles. The base/tiller assembly is similar to that from Molasses Reef. Unfortunately, due to its incomplete condition, we can not say whether it ended in a hoop or finial.

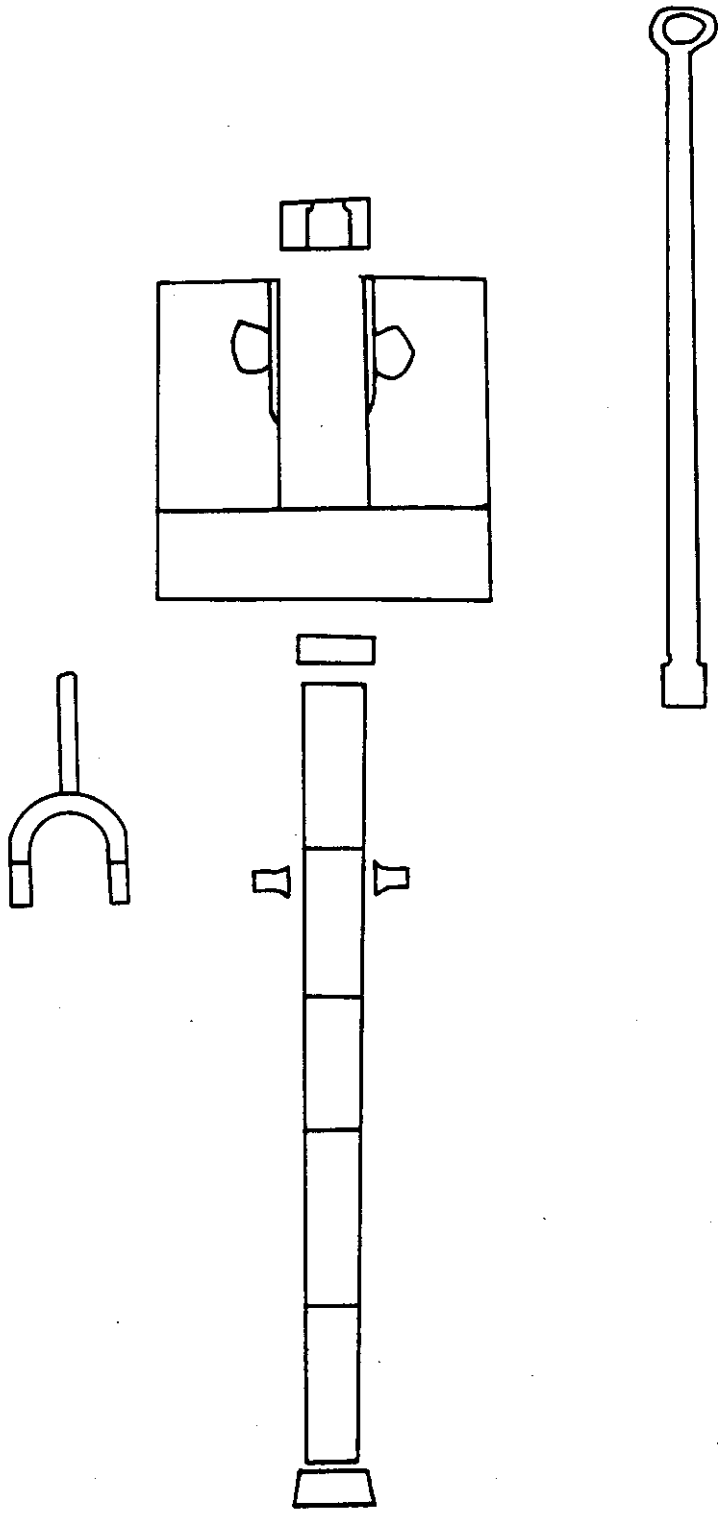


Figure 40. Schematic drawing of verso normal #0032/0034A.

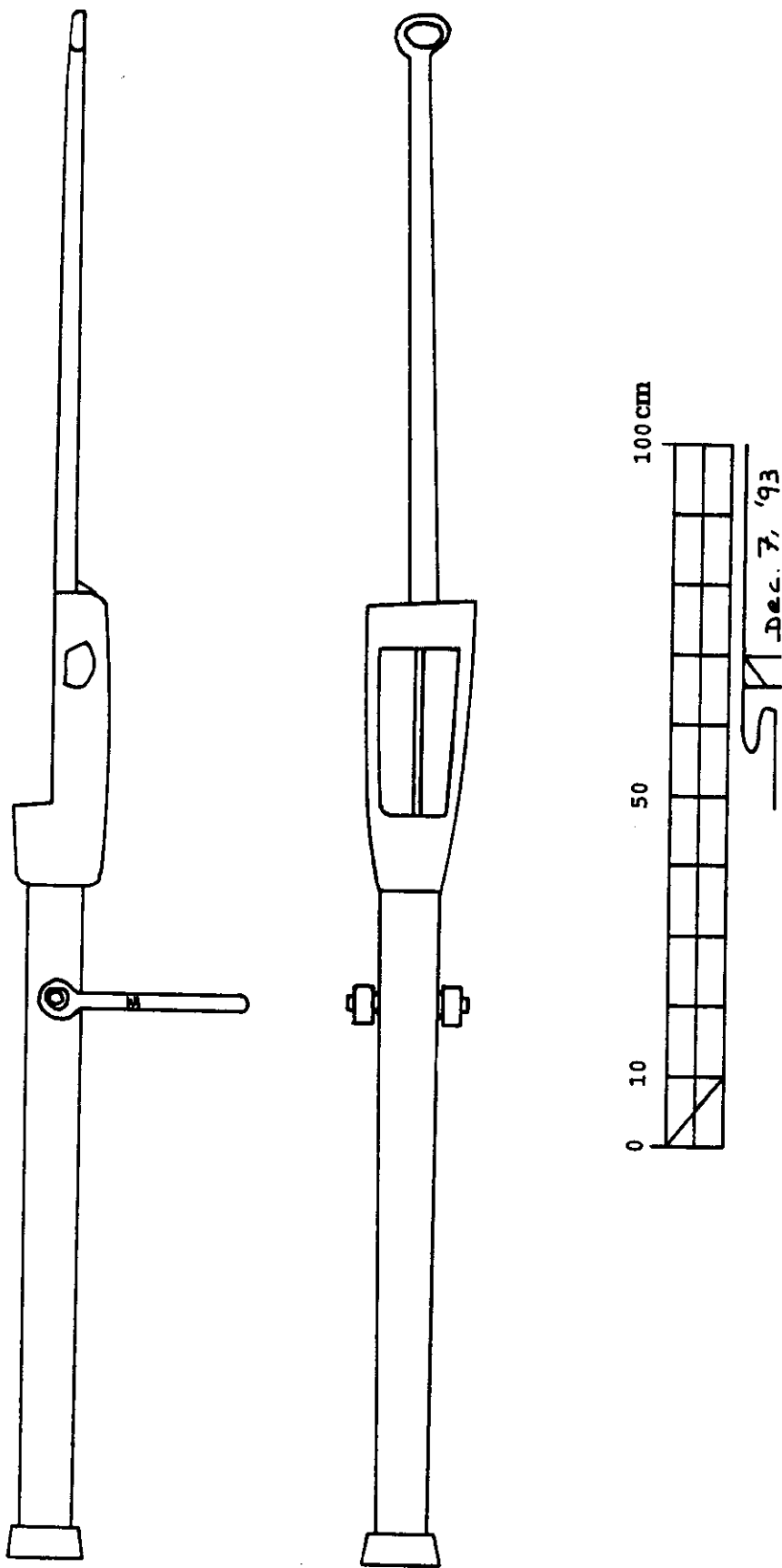


Figure 41. Reconstruction drawing of #0032/0034A.

Trunnions were added at the pre-determined balance point of the loaded weapon. The trunnion welds were one of the most critical welds in the gun. A failure here during firing, which in all probability occurred from time to time, would send the gun spinning back into the gun crew and any unfortunate deck hands who happened to be in the way at the time.

Finally, the yoke of the gun was made by forming trunnion sleeves or loops on both ends of an iron bar. It was then further heated and shaped into a rough "U" shape to form the arms of the yoke and beaten into its final configuration over the trunnions. The yoke's spike (Fig. 40) was subsequently hammer-welded to the middle of the front side of the arms to complete the weapon.

Haquebut: Definition

The word haquebut is derived from the German term *hackenbusch*, meaning hook gun, and was applied to all guns that had a metal flange or recoil stop welded to the bottom of the barrel. This gun type had come into use by the middle of the fourteenth century and saw quite widespread use during the fifteenth century. The term haquebut, as used by the English, applied to wrought-iron, as well as cast

bronze, muzzleloaders with recoil stops. These had either a wooden tiller inserted into a specialized socket in the breech end of the gun, in the case of the bronze pieces, or an iron tiller welded into the breech end of the wrought-iron pieces.

One of the Spanish names for this type of gun was the *culebrina de mano* (Vigon, 1947: 38-40). Vigon's description (1947: 40) is quite clear: "*En su parte anterior llevaba una espiga de hierro en forma de un gancho que se clavaba en un poste tomando como punto de apoyo.*" ("On its forward part it has a tang of iron in the form of a hook which is grounded on a post for support."). Another name for the haquebut was *cañon para culebrina*. An example, supposedly used by Hernán Cortés in Mexico during 1519, is found in an arms collection in Spain (Catalogo General, 1911: 178-179).

According to Vigon (1947: 39) the earliest reference to this kind of weapon dates to 1374 in a reference to the Crown of Aragon and weapons called *ballestas de trueno*. It is not mentioned by Castillian chroniclers until the end of the fourteenth-century in an account of the battle of Egea, where the weapons were used by the Moors. They were called *truenos* and described as "hand cannon" (Vigon, 1947: 39).

Such guns were sometimes fired from horseback by hanging the end of the weapon from the horseman's neck and supporting the muzzle on a forked rest attached to the front of the saddle (Fig. 42; Vigon, 1947: 38; Kempers, 1983: 68).

The *espingarda*, a weapon very similar in construction and design, is first mentioned at the siege of Toledo in 1449. Its main advantage over the *culebrina de mano* was the incorporation of a wooden butt for firing from the shoulder (Catalogo General, 1911: 185). After its introduction, this gun seems to have coexisted with the *culebrina de mano* until the beginning of the sixteenth century, when the *espingarda* largely replaced the *culebrina de mano*, but apparently did not outlive it by much; both weapons were soon replaced by *escopetas* (Vigon, 1947: 40). This generic term for smooth-bore weapons is almost certainly a reference to the *arquebuz*, a wrought-iron muzzleloading shoulder arm fired with a matchlock firing mechanism (Keith, 1987: 212; Smith, 1993: 154).

In my research on arms used in the New World, I have come across references to the dispatch of considerable numbers of *espingardas* to the West Indies but none regarding the shipment of *culebrinas de mano* (Vigon, 1947: 446, 447; Tanodi, 1971: 4). I

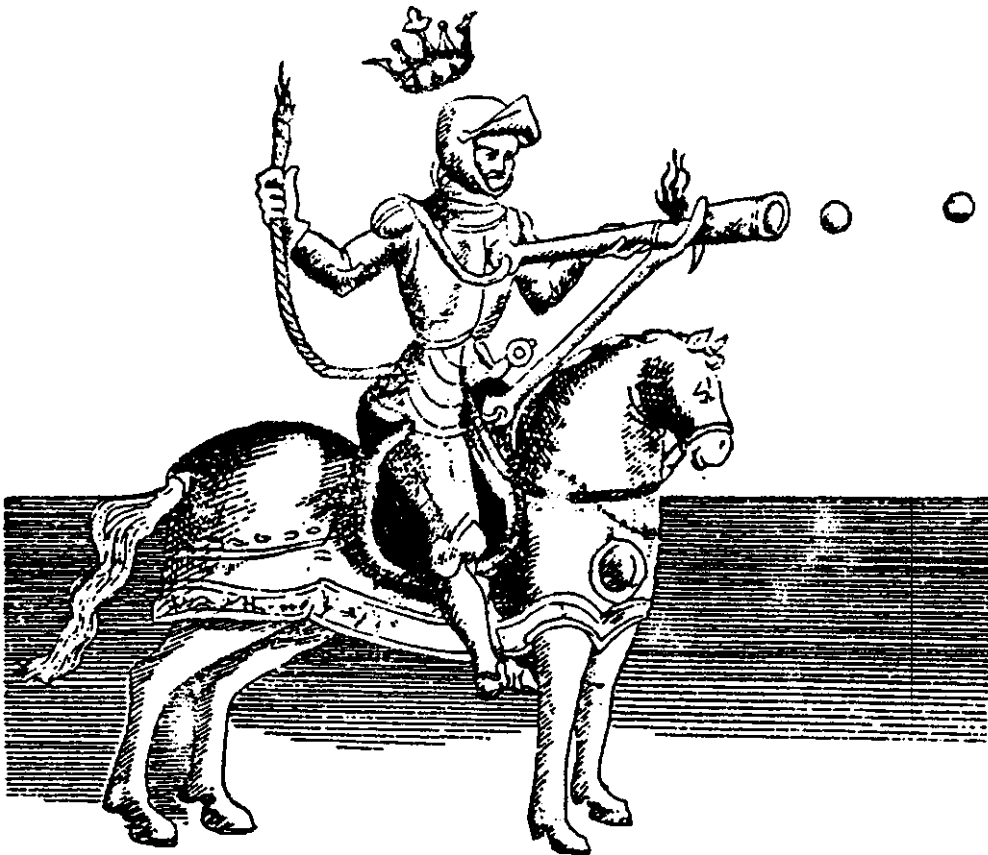


Figure 42. A horseman firing a hand cannon. Illustration dates from the second half of the fifteenth century. (After Kempers, 1983: Plate VIII).

have also found references to arms called *sacabuches* (Vigon, 1947: 446, 448). These too were shipped to the New World in some quantity and were frequently, if not always, made of cast bronze. In the records they are described as being made of *metal* or *buen metal* (Vigon, 1947: 446, 448). These terms refer, respectively, to regular copper alloys and alloys with a very high copper content (Vigon 1947: 58, 446), whereas *hierro* refers to iron (Tanodi, 1971: 4; Vigon, 1947: 448).

Smith (1993: 159) says the *haquebuts* from Molasses Reef may have been classified as *sacabuche*, but this is unlikely, since they were made of wrought-iron. The *sacabuche*, like the *culebrina de mano*, was a muzzleloader. It was a very similar weapon. Examples in a Spanish arms collection, described as having a high copper content, have cast trunnions and slots for attaching wooden tillers (Catalogo General, 1909: 67-68). In all probability these lacked the hook of the *culebrina de mano*, since they are not mentioned in the catalogue description, whereas they are in the case of the *cañon para culebrina*. It is likely that the name as well as the weapon evolved from the *Hackenbusch*, a number of which were adapted with swivels for either fortress or marine use (Kempers, 1983: 69). The early

haquebut design apparently gave rise to new weapons, the *espingarda* and the *sacabuche*. The *espingarda* with its shoulder butt was more mobile and eventually led to the portable musket (Kempers, 1983: 58). The *sacabuche* was a less mobile weapon mounted in a specific position on a swiveled yoke. Gun technology in the late fifteenth and sixteenth centuries was advancing at such a breakneck speed that all of these weapons could be found in use at the same time!

Haquebut #0035

This piece, recovered from Pre-site Two, was a short-barreled muzzleloader with the remains of an iron bar tiller at the breech end. It was approximately 106.1 cm long and had a bore diameter of 2.95 cm,, giving a caliber of 35.96. The remains of a metal tang on the forward end of the barrel proved conclusively that this was a haquebut (Fig. 43).

Kempers (1983: 58, 86), on the basis of his research and examination of 30 haquebuts in Dutch collections, claims that around 1470 the location of the touch hole moved from the top of the barrel, to the side of the barrel and provided with a horizontal powder pan. The Saona haquebut or *culebrina de mano* appeared to have a visible touch hole on the right

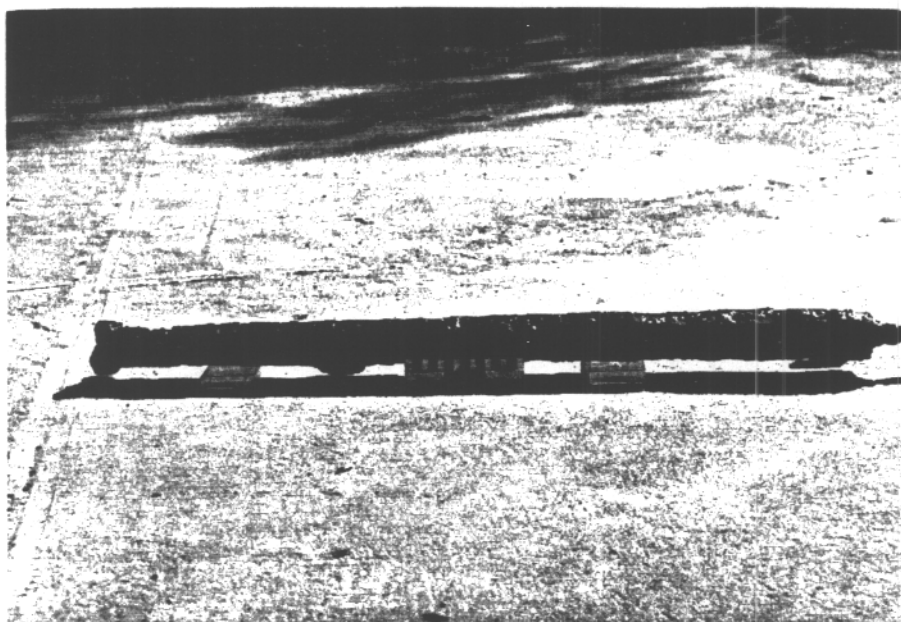


Figure 43. Haquebut #0035. Note the remains of the tiller and iron tang on the bottom of the barrel approximately 30 cm from the muzzle. (Photo by author).

hand side of its breech though no trace of a pan survives. This would tend to be indicative of a late fifteenth or early sixteenth-century date for the weapon (Fig. 44).

The gun was in very poor condition compared to the two examples from Molasses Reef (Fig. 45). Due to the condition of the barrel it was impossible to determine whether it was originally octagonal in shape (as were the two examples from Molasses Reef) or partly round as a number of examples studied by Kempers (1983: 60-65). The Saona haquebut appeared to be slightly tapered toward the muzzle and like the two examples from Molasses Reef was modified for marine use with a trunnion hoop and a yoke. These became separated from the weapon during conservation treatment at METLAB (Figs. 46, 47).

This piece of ordnance suggests a fairly early date of about 1498-1525 for Pre-site Two. We must keep in mind, however, that a well maintained piece could be used far beyond the period of its popularity. This appears to have occurred with two haquebuts found on the *Nuestra Señora Del Rosario*, which was wrecked off Cuba in 1590 (López Pérez, 1993: P.C.), for by the late sixteenth century, the haquebut was well past its heyday (Keith, 1987: 211; Vigon, 1947: 40).

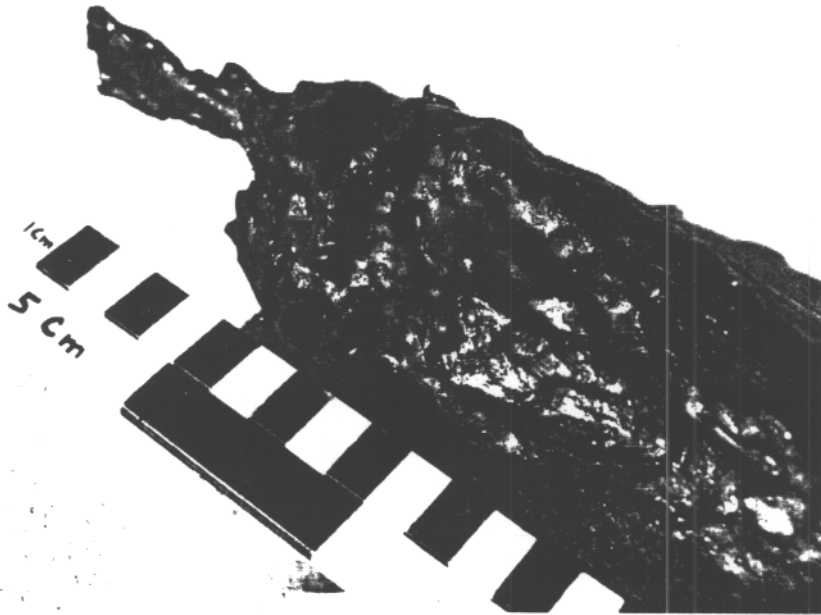


Figure 44. Illustration of #0035's breech showing what may be the touch hole on the right side of the barrel. (Photo by author).

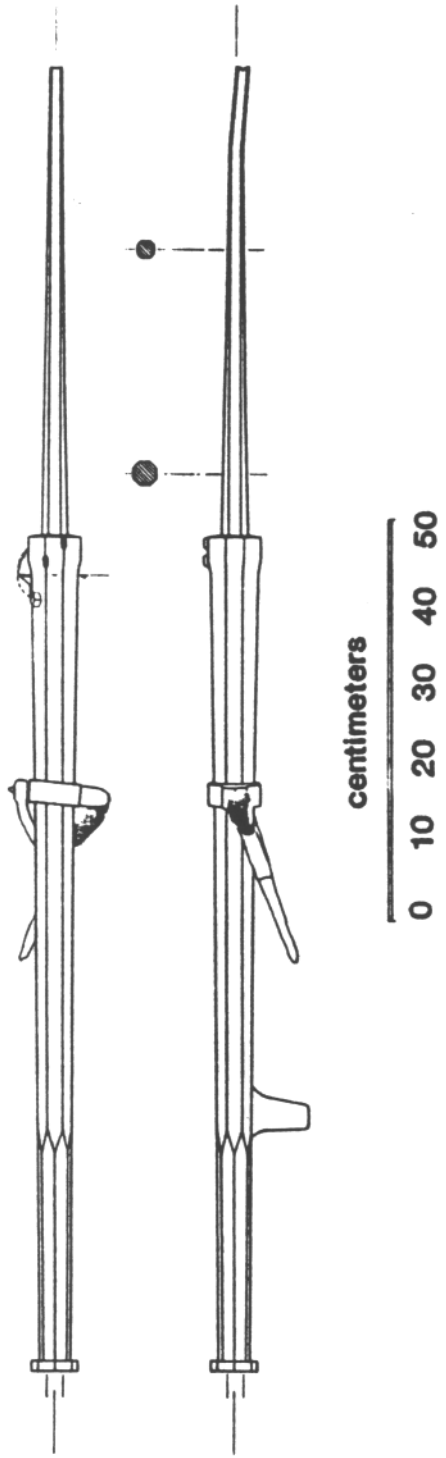


Figure 45. One of the haquebuts from the Molasses Reef Wreck. (After Keith, 1987: Figure 144).

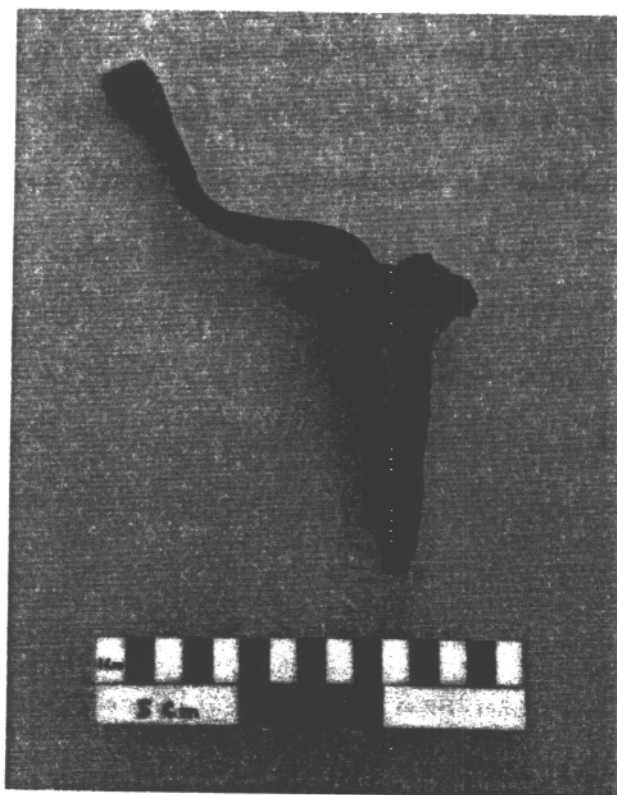


Figure 46. Haquebut #0036's yoke, which fell off during the hydrogen reduction treatment. (Photo by author).

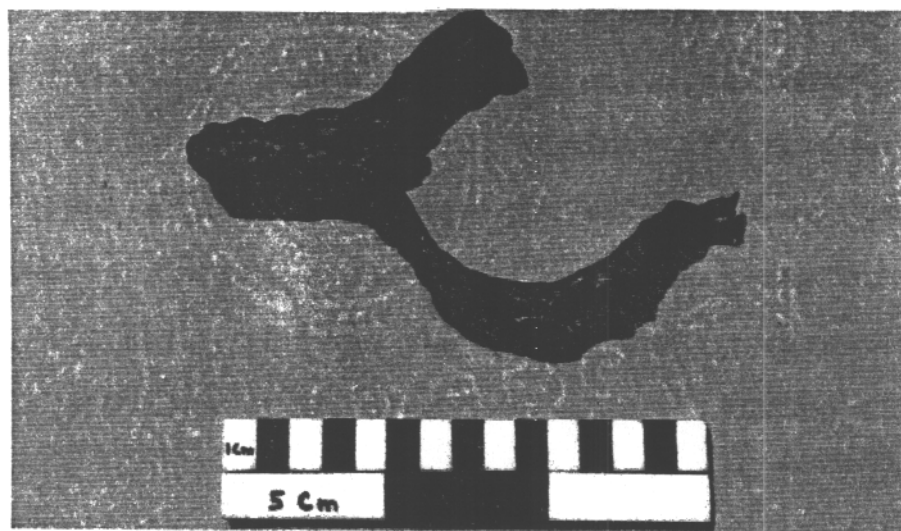


Figure 47. Trunnion hoop of haquebut #0035. (Photo by author).

TUBE GUNS AND THEIR POWDER CHAMBERS

Tube guns may have originally derived their form from wooden barrel construction or, if the technology was Asian, possibly from the structure of bamboo (Simmons, 1992: 130). These guns had an inner tube made up of relatively long iron "staves" which were tightly bound around a parallel-sided mandrel so that their seams fit snugly together (Arnold & Weddle, 1978: 245). It is likely that a good deal of work went into shaping the individual staves beforehand to guarantee good joins along the seams.

It would appear that these staves were not welded along their seams. This is demonstrated by tube gun #0036 from Pre-site One. It suffered considerably during treatment, and large portions of its hoops and bands were lost. As a result, the inner tube's individual staves are exposed. The seams between the staves are clearly visible as straight lines along a considerable length of the tube. One can clearly see where one stave begins and the other ends (Fig. 48). Perhaps the intent was to save the expense and time of welding each seam. Leaving the staves un-welded may also have allowed them to flex a bit with the force of the explosion. This would make

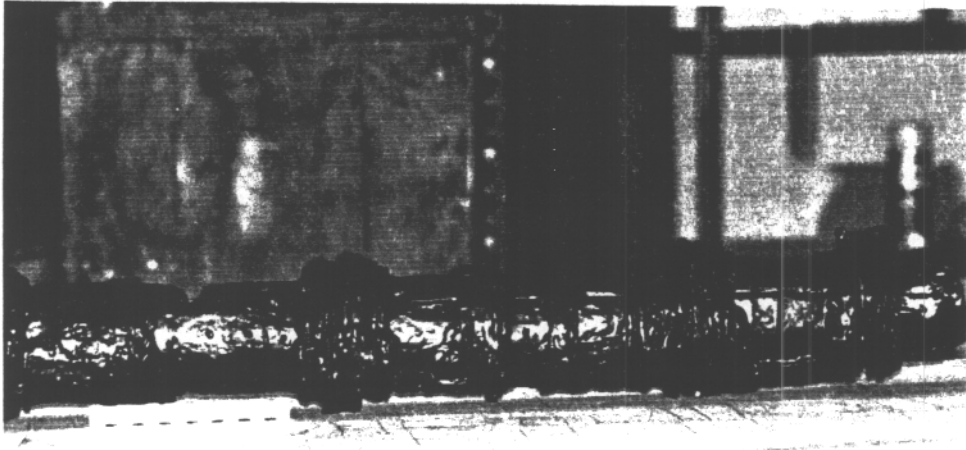


Figure 48. Close up of tube gun #0036 showing the seam between two staves.
(Photo by author).

it less likely that the interior tube would break with time and use.

Identifying welds in wrought iron is difficult. One has to scrutinize the surface before the telltale line demarcating two distinct pieces of metal can be identified. Though the weld lines are sometimes straight, there is a tendency for them to wander where the smith has spread the metal out to achieve a smooth surface. The piece also needs to be clean, and preferably with out an anti-oxidant protective coating. This was not the case with any of the Saona guns which were given thick protective coatings. Under the circumstances I was not able to positively identify any welds in the hoops or bands as I had hoped.

After the staves were bound on the mandrel, a series of "hoops" and "bands" were slid down the length of the tube to abut one another (Keith, 1987: 176-177; Simmons, 1988b: 124). These provided most of the strength necessary to resist the sudden and violent pressures exerted by hot expanding gases occurring during the operation of the gun. Hoops as a general rule were always considerably thicker and narrower than bands. Alternating hoops and bands allowed for evenly spaced strengthening throughout the length of the gun tube. This would have saved on

the weight, expense of iron, and fuel that would have been necessitated by a barrel made completely of hoops.

At certain intervals along the length of the tube, hoops fashioned to accommodate lifting rings were positioned to facilitate handling. The hoops at the muzzle of the gun were frequently fashioned into sights for aiming (Simmons, 1988b: 123). The breech was fitted with a collar to provide as secure a fit as possible between the tube and the powder chamber.

The tube gun category in Smith's typology (Smith, 1988) uses a simple system based on the repetition of groupings of hoops and bands throughout the length of the gun. The first type in the typology is the 1-2 type (Fig. 49). The 1 refers to the band and the 2 refers to the hoop, the arrangement being repeated through out the length of the gun. The 1 always refers to the band and the other numbers to hoops, the higher the number, the greater the diameter of the hoop. Hoops of the same diameter always have the same number (Smith, 1988: 11). Since a series of numbers can be confusing it was decided to give each type a name as well. The 1-2 type is the first in the series and known as TU1 (Smith, 1988: 12).

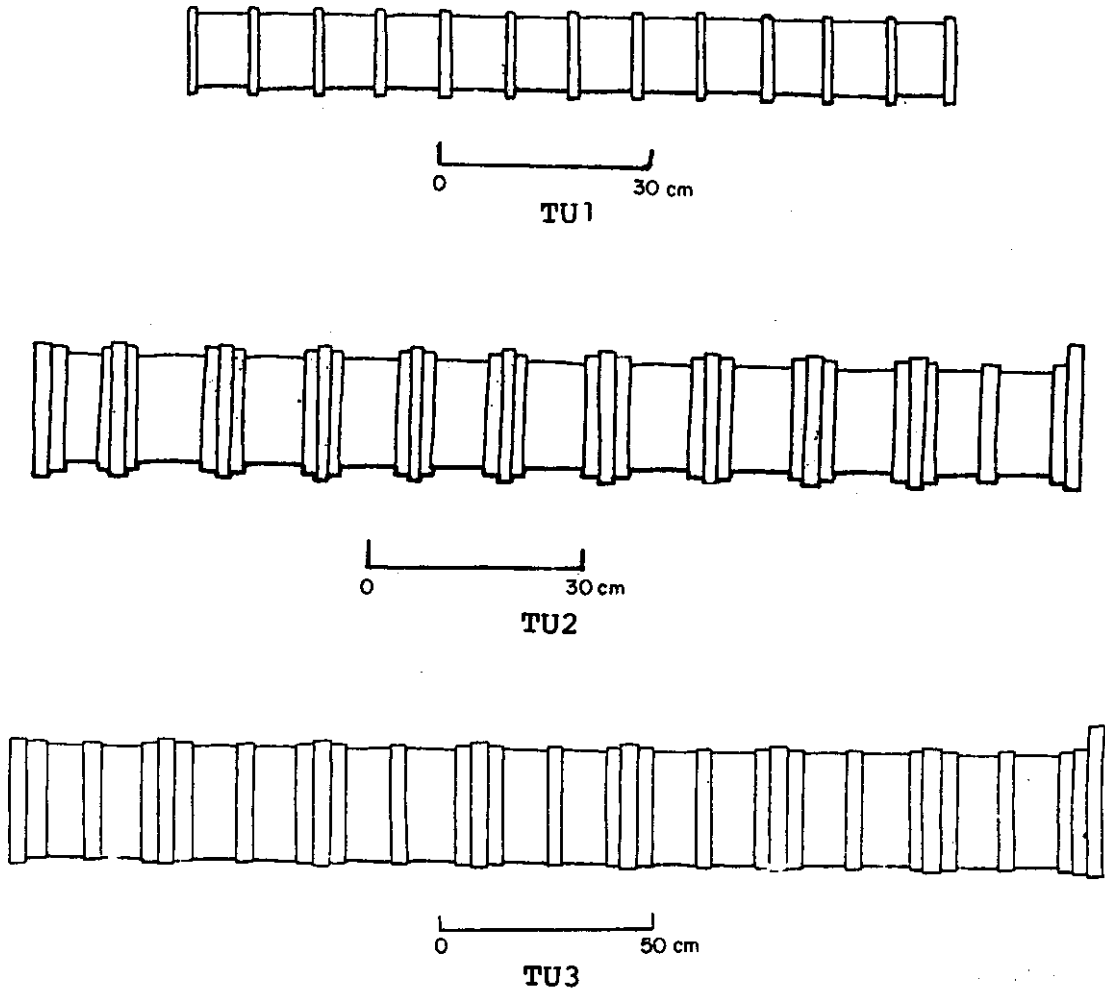


Figure 49. The three types of tube guns in Smith's current typology. (After Smith, 1988: Figures 8, 9, 10).

The second type is the 1-2-3-2 form. A band is followed by three hoops, the middle being of greater diameter. This is called a TU2 gun (Fig. 49). When classifying these weapons the muzzle and breech hoops are ignored since they are so variable. It also seems wise to ignore out of sequence lifting-ring complexes as they, like the muzzle and breech, have special functions.

The third type is the 1-2-1-2-3-2 type, that is to say, throughout much of its length it has a band followed by a hoop, then another band followed by a group of three hoops, the second hoop of greater diameter than either of the other two. This is the TU3 type gun (Fig. 49; Smith, 1988: 12). This is as far as the classification system goes. There are many guns that don't fall into either the three TU types and appear to be random groupings of bands and hoops. It is hoped that the TU category may be expanded with more research in the future.

Tube gun #0036

This gun, recovered from Pre-site One, is in the possession of Mr. R. Abplanalp of Precision Valve Inc. Its original pre-treatment length was approximately 206 cm. The best preserved bore diameter, taken at the breech end of the gun is 7.7

cm., giving a caliber of approximately 26.75. It appears from photographs taken prior to treatment that the tube arrived at METLAB almost complete. The photographs suggest that only the breech collar was missing at that time (Figs. 14, 15)

During the treatment process both ends of the gun suffered considerable damage resulting in a decrease in the gun's overall length of roughly 53.5 cm, as well as the loss of both muzzle and breech details (Fig. 50). Combining photographic and X-ray evidence with measurements from the 1:1 scale drawing, I was able to calculate roughly how much of the ends had been lost. The breech suffered the most deterioration, losing approximately 40.5 cm; the muzzle lost approximately 13 cm. On the basis of the above evidence and analysis, I was able to reconstruct the gun (Fig. 51).

I consider this gun to be a variation of the TU3 tube gun in Smith's classification (Smith, 1988: 12), since there was a series of seven alternating bands and single hoops at the breech end before the normal TU3 pattern of 1-2-1-2-3-2 began. This tube was either a heavy *cerbatana* or a light *bombardeta*.

This is the first recorded occurrence of this type of tube gun from the New World. All others are of the TU1 type, with the possible exception of a

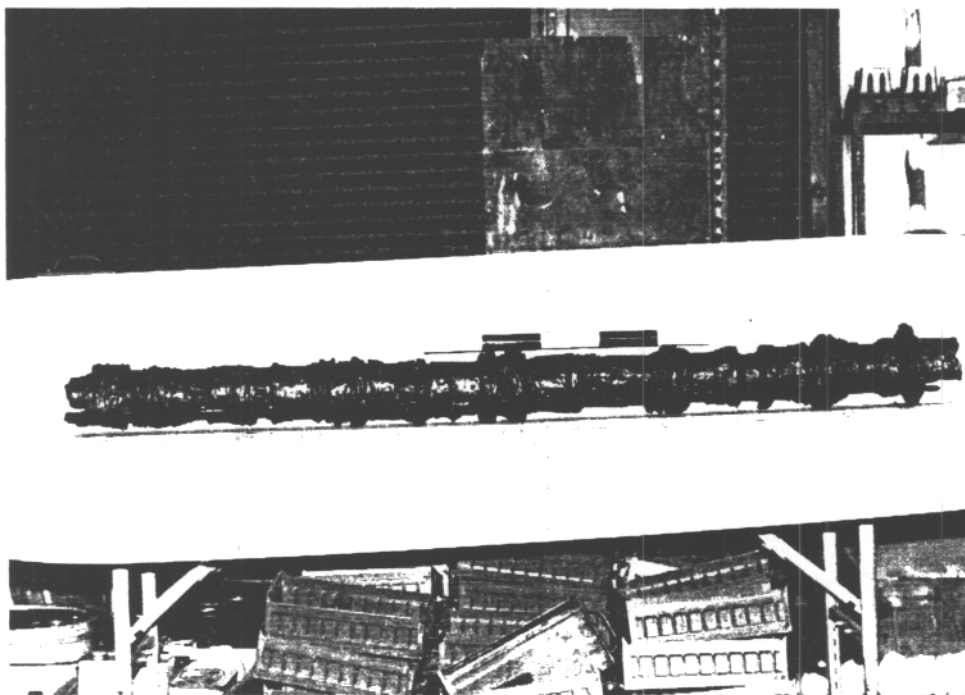


Figure 50. Tube gun #0036 at Precision Valve Inc. in Yonkers, New York. The muzzle is to the right. (Photo by author).

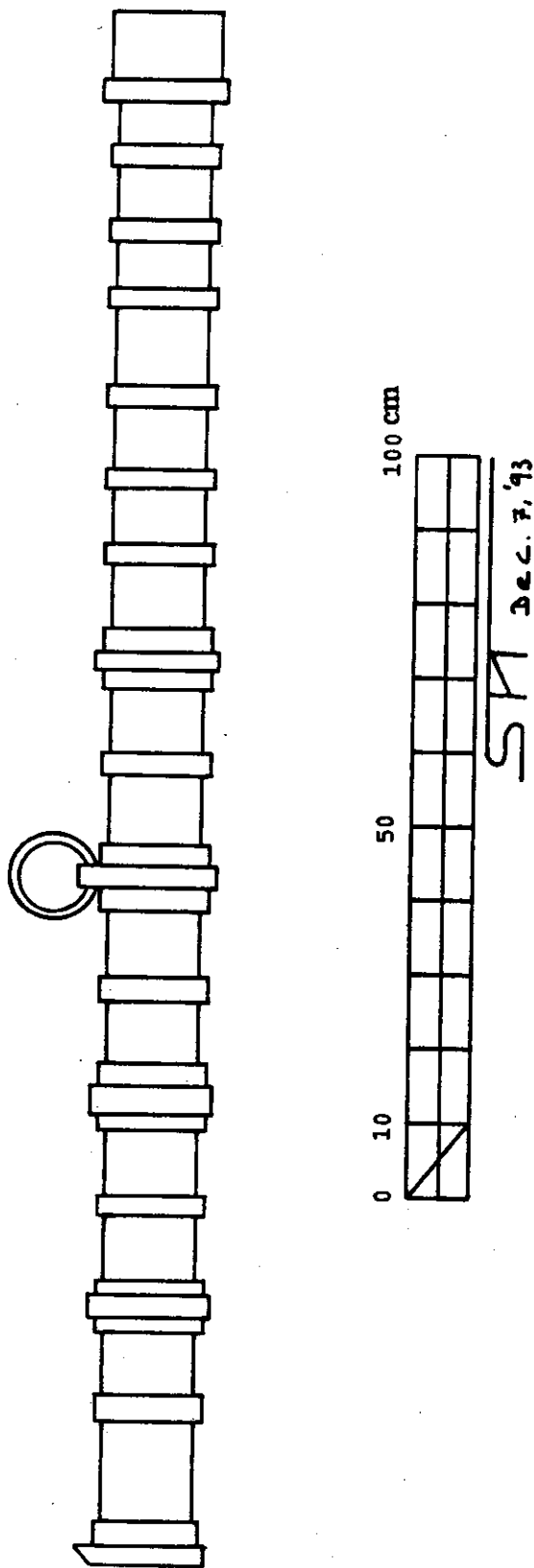


Figure 51. Reconstruction of #0036 based on pre-treatment photographs and x-rays.

tube gun salvaged from the Highborn Cay wreck (Peterson, 1974: 237). This gun has two triple hoop groupings but otherwise an alternation of bands and single hoops. It therefore does not fall into any TU classification type, unless the triple hoop groupings are lifting-ring complexes whose rings and lugs are gone or not recorded. In that case it would be a TU1 type as well (Fig. 52).

The inner tube of gun #0036 appeared to be made of three staves. The gun sight with accompanying muzzle hoops, one band, and a portion of the inner tube were missing from the muzzle. Four hoops, including the breech collar hoop, three bands, the breech collar, and a section of the inner tube were missing from the breech of the gun. In photographs the breech appears to be an exposed section of inner tube indicating that the breech collar was lost before arrival at METLAB. No evidence for lifting rings was present, but it seems likely that they would have existed in the past.

Tube gun #0031

This tube gun, from Pre-site Two, is 249.1 cm long and has a bore diameter of approximately 6.4 cm, giving a caliber of 38.92 (Figs. 14, 15, 53). This gun falls into the *cerbatana* category described by

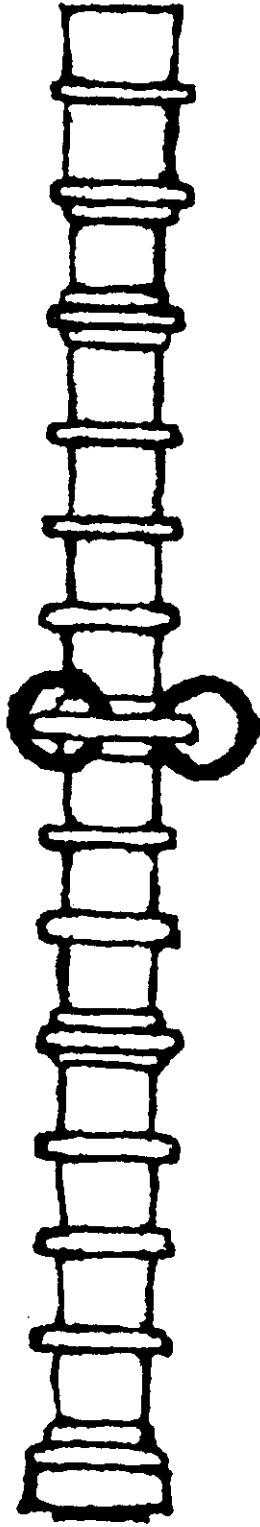


Figure 52. One of the two Highborn Cay tube guns salvaged in 1967. It and #0036 may be the only non-TU1-type tube guns found in the New World to date. (After Peterson, 1974: Figure 7).

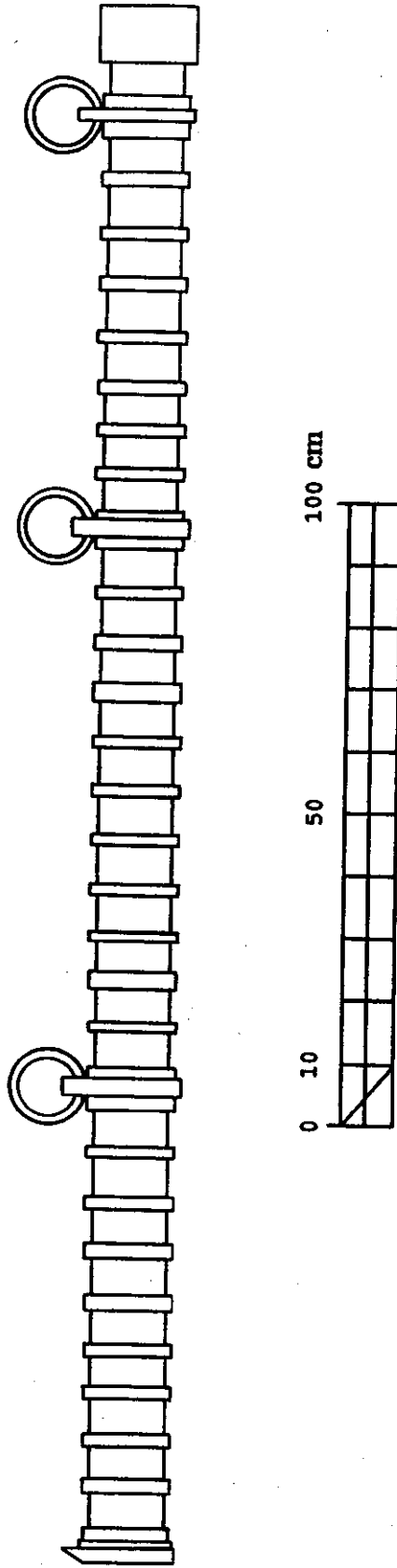


Figure 53. Reconstruction of tube gun #0031.

Vigon. *Cerbatanas* generally had bore diameters ranging from 2 to 7 centimeters and calibers from 25 to 40, as compared to *bombardetas*, whose caliber range was between 15 to 30 and were generally shorter than *cerbatanas* (Vigon, 1947: 36). These weapons first appeared in the possession of troops under Alfonso V a little before the middle of the fifteenth-century (Vigon, 1947: 37).

Tube gun #0031 broke during treatment in Philadelphia. The two pieces were displayed in the Altarazana Museum side by side, but with the powder chamber erroneously connected to the muzzle section (Fig. 1). Since the gun broke during treatment, the two parts were somewhat dissimilar due to small differences in their environments during the final stages of conservation. The muzzle section was slightly wider having retained more of its exterior (Fig. 54). Its hoops did not suffer as much as those on the rest of the gun (Fig. 55). Due to the manner in which the muzzle piece was displayed with the powder chamber, it did not become clear until the end of the study season that it was part of the larger tube gun laying next to it. This supposition was later confirmed by a photograph obtained from METLAB which clearly showed the fresh break (Fig. 56).

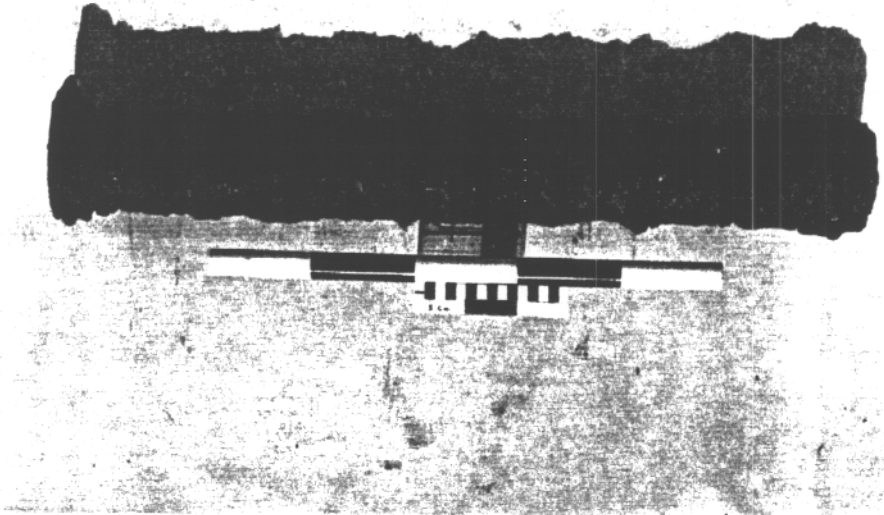


Figure 54. The muzzle section of tube gun #0031.
(Photo by author).

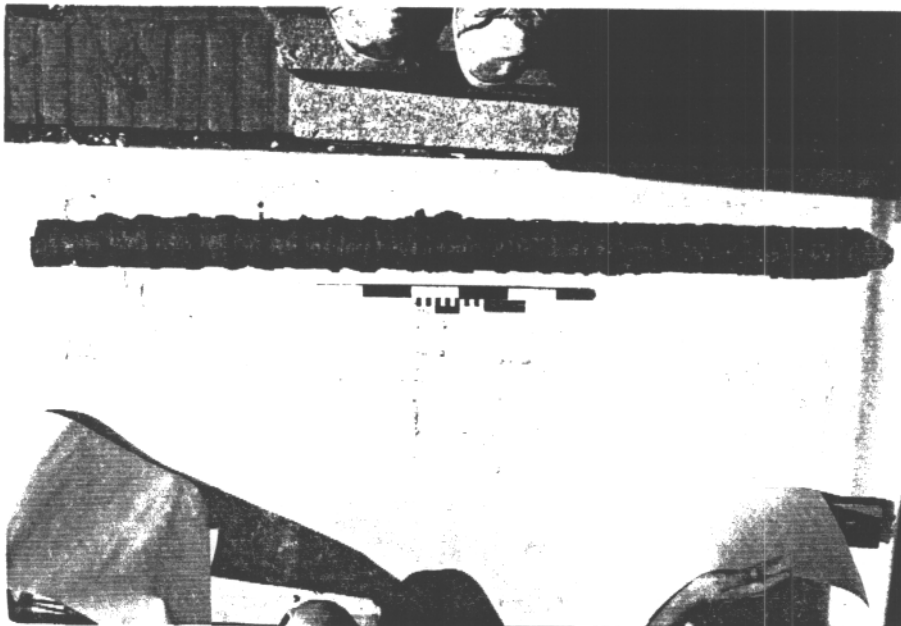


Figure 55. The main section of tube gun #0031.
(Photo by author).



Figure 56. The two sections of #0031 shortly after the gun broke at METLAB. (Photo courtesy of METLAB).

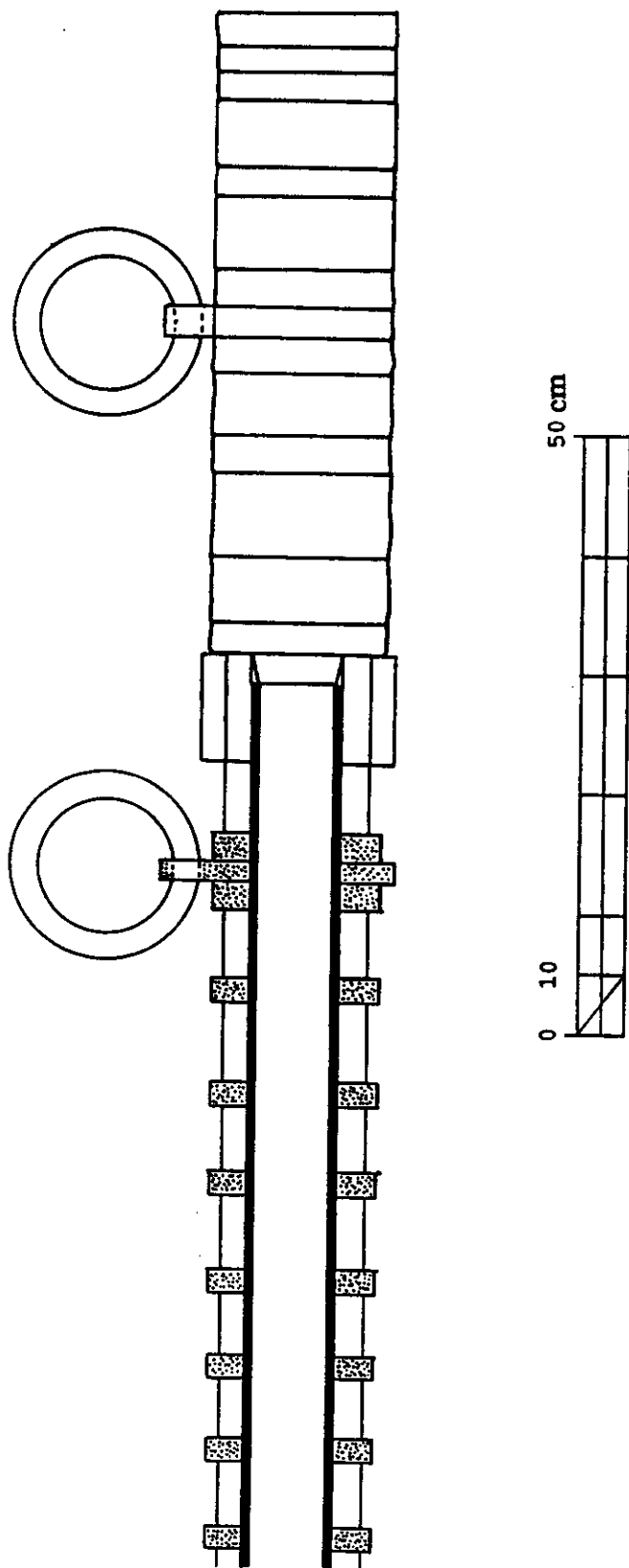


Figure 57. Reconstruction of powder chamber #0033 and the breech of tube gun #0031 showing how the two were joined for operation of the weapon.

is displayed in the Altarazana Museum together with tube gun #0031's muzzle section (Fig. 1). This breech chamber appeared to be unique in that the end plug stuck out of the chamber (Figs. 58, 59). In all other published instances (Olds, 1976; Arnold & Weddle, 1978; Keith, 1987; Simmons, 1988a; Martin & Parker, 1988), they always appear flush with the back of the chamber. Closer examination revealed that what projects out is not only the plug but the end of the inner tube as well. The last hoop of this powder chamber has disappeared. Originally it would have covered the inner tube and plug, making the back of the chamber flush. Measurements also indicate that the inner tube was tapered like the sectioned example (No. 1022) from Molasses Reef (Simmons, 1988a: 31-34). The urethane coating and general deterioration make it impossible to actually identify individual staves or the plug.

This powder chamber was in all probability built in the same manner as the sectioned example from Molasses Reef (Simmons, 1988a: 31-34). The inner tube was made from a number of iron staves like the inner core of the tube guns. A tapering gusset was welded to the end of the inner tube to be inserted into the breech. The gusset's function was to guarantee as tight a fit as possible between the

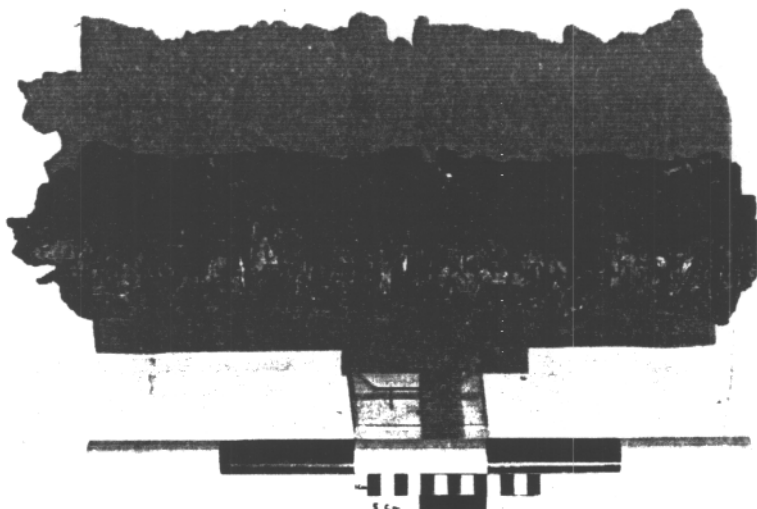


Figure 58. Powder chamber #0033. (Photo by author).

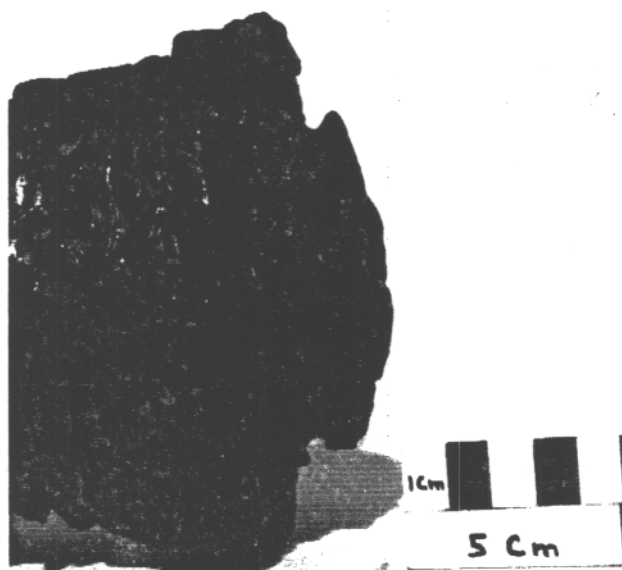


Figure 59. End of powder chamber #0033 showing exposed inner tube and plug. (Photo by author).

powder chamber and the tube gun's breech. The inner tube was then built up with a series of wrought iron hoops and bands. These were slipped over the core, the first hoop abutting the gusset, and then each hoop or band in turn abutting the one which preceded it. The smith took care to center his blows on the rear edge of the hoop to achieve a strong weld between it and the staves underneath (Keith, 1987: 189-192). In the case of Saona powder chamber #0033, the hoops and bands are the same thickness and do not follow one another in a regular order. One might even be tempted to say they were all hoops, but some are too wide to really fall into this category.

Powder chamber #0038

This piece from Pre-site One was intended for use with tube gun #0036 and remains untreated and uncleaned (Fig. 60) It is 83.5 cm long and thus larger than powder chamber #0033. This is not surprising, since it is paired with a weapon with a larger bore and therefore is more heavily built. The chamber appears to have a pair of lifting rings near one end. The positioning of rings suggests a four ring chamber which has lost the other set of rings (Fig. 61).

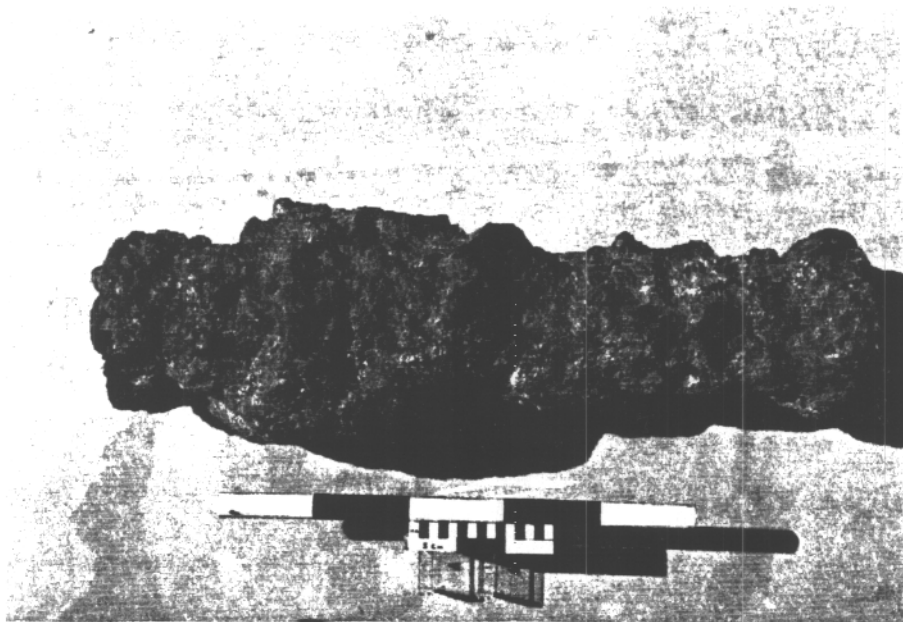


Figure 60. Untreated tube gun powder chamber #0038.
Note rings on the left end of the chamber.
(Photo by author).

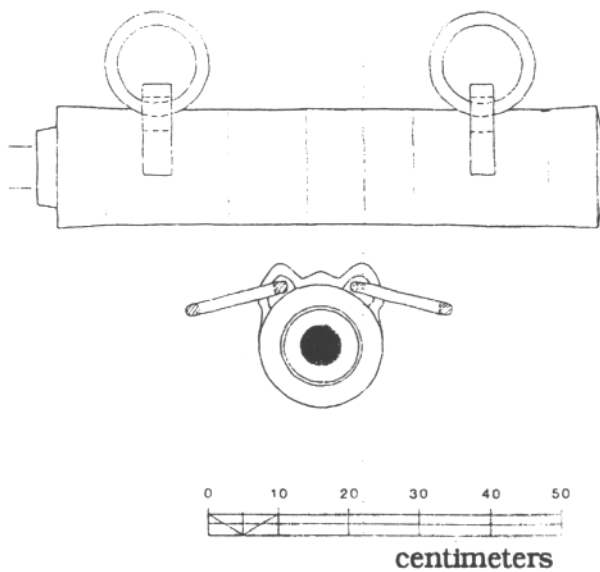


Figure 61. A typical four ring chamber.

Summary

The use of *versos* in the New World can be established for a forty-one-year period between 1513, the *terminus ante quem* for the Molasses Reef shipwreck (Keith, 1987: 287-289), and 1554, the year the three Spanish ships were wrecked at Padre Island. Though it is not certain that this weapon was referred to as a *verso* as early as 1513, a document dated 1523 employs the term (AGI, Casa de Contratacion, legajo 1079, #1-ramo5).

There are apparently two Spanish names for the haquebut: *culebrina de mano* (Vigon, 1947: 38-40) and *cañon para culebrina* (Catalogo General, 1911: 178). Though *sacabuche* sounds very much like *hackenbusch*, it apparently refers to a similar weapon made of cast copper alloy metal (Vigon, 1947: 446, 448). It is therefore unlikely that the Molasses Reef wreck or Saona Pre-site Two haquebuts would have been classed as *sacabuches* by the Spaniards.

Smith's swivel gun typology is a very useful tool but needs expanding to include muzzleloading swivel weapons as well as a refining of the SW4 and SW5 types. His tube gun and chamber typology is equally useful but also needs updating. Simmons' detailed nomenclature for *verso* swivel guns and tube guns (Simmons, 1988b: 123-124) is excellent, and in

most instances these are in agreement with the nomenclature developed by Smith (1988) and described along with his typology. A synthesis of the two nomenclatures is needed in order to reduce confusion in wrought-iron gun terminology.

Now that we have taken a detailed look at the Saona artillery and discussed what the Spaniards probably called these pieces and the way they were manufactured, it is time to take a look at the manner in which they were employed and how they may have been manned.

MOUNTING, MAINTENANCE, AND GUNNERY TACTICS

During the sixteenth century, naval gunners of all nationalities typically kept their guns deployed on deck, loaded at all times in preparation for action at a moment's notice (Konstam, 1988: 17). Exceptions to this practice were made during periods of rough weather or when sailing in a safe, secure region. When a ship was prepared for action, swivel guns were mounted along gunwales (Fig. 2) and through small ports (Fig. 62). They could be moved around depending upon the direction from which an enemy appeared. The only necessary accessory for mounting a swivel gun was a hole and saddle for holding the spike of the swivel yoke (Fig. 63; Keith, 1987: Figure 143). Swivel guns had tillers for training the piece; the loop or finial at the end of the tiller may have also served for lashing a gun down when it was not manned. Securing the gun was necessary to prevent it from swinging with the motion of the sea.

To protect the interior of a gun from humidity induced by rain or a heavy sea, gunners sealed the muzzle with a wooden tampion, the powder chamber with a wooden plug, and the priming pan or touch hole with a piece of lead sheeting (Konstam, 1988: 17). Palacio noted: "Mouths are to be plugged with a hide and the muzzles well-swathed, so that rain and sea water does not enter



Figure 62. An engraving by Frans Huys after Bruegel showing a sixteenth-century vessel armed with heavy guns and swivel guns protruding from small ports in the stern and fore castles. (Bruegel, N.D.: Figure 50).

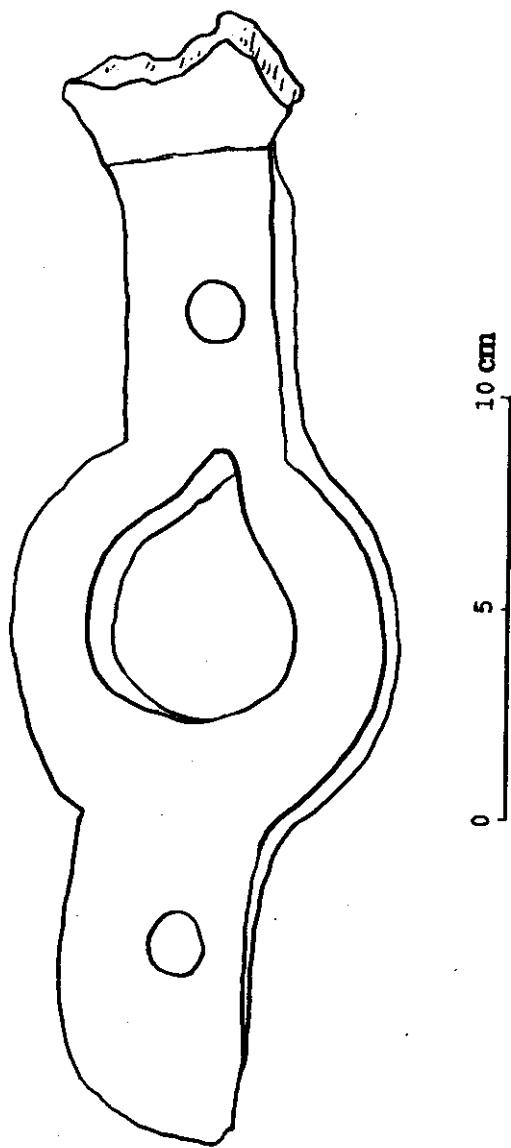


Figure 63. A swivel saddle for mounting versos. (After Keith, 1987: Figure 143).

them when the ship is on its side" (Palacio, 1587: 148). Loaded guns were only good if their powder was dry.

Sixteenth-century engravings after Pieter Bruegel show large merchant vessels with numerous swivel guns projecting from ports in the stern and forecastles. These barrels point down, probably because their tillers are lashed to anchor points in the beams above them to keep the tillers out of the way (Fig. 62; Martin & Parker, 1988: 39, 44).

Any iron in a marine environment is subject to rapid oxidation. In order to slow this down, guns were coated with a kind of paste to seal their surface from the damaging effects of salt water (Vigon, 1947: 36ff.). Wrought-iron guns had a relatively short working life once they arrived in the Indies in spite of their protective coating. This is supported by documentary evidence. A number of guns for the governor of Española, Nicolás de Ovando, were made in Málaga: "*todo de buen metal, porque de hierro, todo se daña alli a causa de la humedad de la tierra*" ("all of good bronze because all iron there deteriorates due to the humidity of the land") (Vigon, 1947: 448). In 1549 the authorities in Santo Domingo suggested that a small squadron of caravels be constructed for the defence of the West Indies. They specified that they should be supplied with oars, sheathed with lead, and armed with bronze guns "*pues la*

de hierro con los soles y la humedad se pierde pronto en Indias" ("because those of iron are quickly lost in the Indies due to the sun and humidity"; Haring, 1918: 233). Careful and regular maintenance of wrought-iron guns in the West Indies might have greatly prolonged their working life, but this may not have been generally practiced by sixteenth-century Spanish gunners.

The firing sequence for *versos* began by loading the shot, wrapped with a hemp wadding or wax-impregnated cloth to assure a tight fit, into the breech (Olds, 1976: 69, 78). Then a loaded powder chamber would be rammed into place in the chamber holder and rotated so that the handle was down and the lip on the plugged end of the chamber would catch the wedge, which was usually inserted from the right hand side (left-handed people were a minority back then too) and hammered into place. The gun was then trained using the tiller and fired, probably by using a linstock (Guilmartin, 1988: 44-45). Hammers were a crucial part of any breech-loading gun's accoutrements, as they were used for securing the breech wedge before firing and knocking the wedge out for reloading. They were also used to knock wooden plugs into the bores of powder chambers. This is illustrated in a number of stone reliefs in Spanish cathedrals depicting men hammering plugs into tube gun powder chambers (Vigon, 1947: 44-45).

Gunners were advised not to stand on the side of the verso where the breech wedge had been inserted as they were sometimes driven outward during firing. This probably occurred with tube guns as well when their wooden wedges or chocks were not properly wedged into position.

Operation of the tube gun was similar to that of the verso. After loading the shot into the breech of the tube, the gun's heavy powder chamber was placed in the breech and wedged into position. The gun, which lay in its stock (a large timber worked to accommodate the tube with its hoops, Figs. 64, 65), was then trained, probably by heaving on breeching lines running from iron hardware anchored in the gunstock and bulwarks of the vessel. A linstock or hot iron was placed to the touch hole to fire the gun. The wedge was then knocked out with a hammer, and the spent chamber was removed and reloaded or replaced with a fresh one.

The operation of haquebuts was different than that of versos and tube guns, as they were muzzle-loaders. They may have been more easily loaded if dismounted and stood on their tillers to pour in the powder and ram in the wadding and shot. After the gun was remounted on its swivel, powder would have been poured into the pan and the weapon trained by means of the iron tiller and fired.

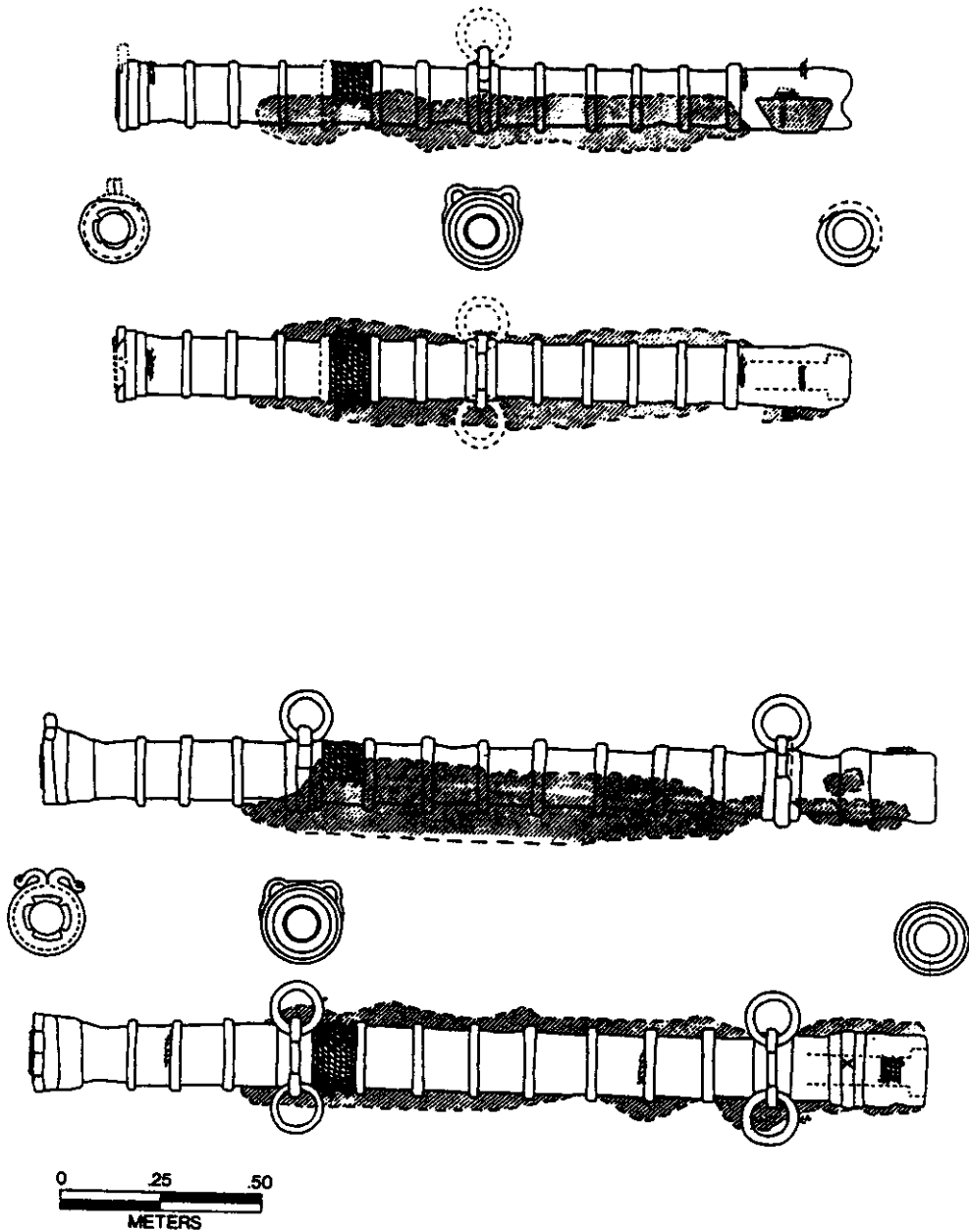


Figure 64. Drawings of Padre Island tube guns No. 156-3 (top) and No. 172-1, showing the remains of gun stocks and the lines used to secure the guns to the stocks. Note how far forward the lines are located, an indication of how far the stock extended. (Courtesy of the Texas Historical Commission and the Texas Antiquities Committee).

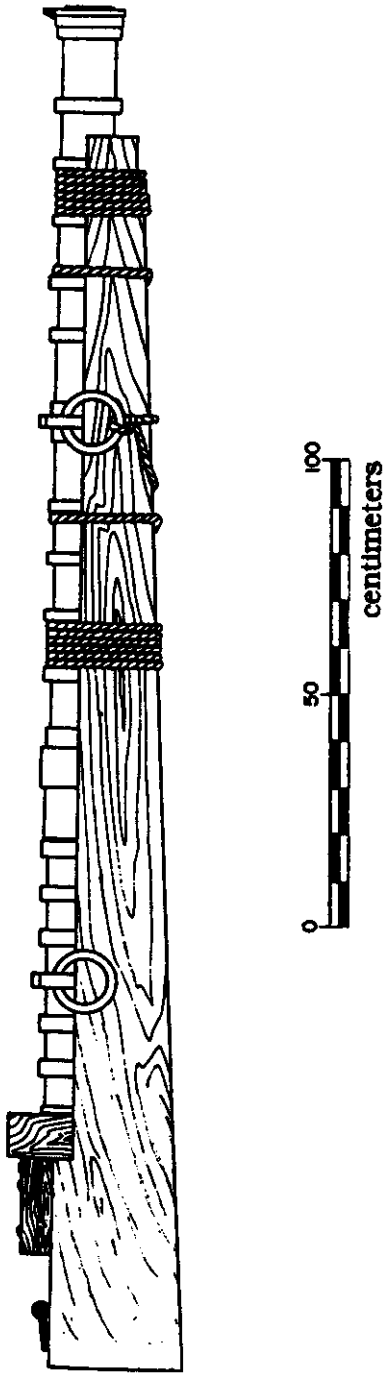


Figure 65. Reconstruction drawing of a tube gun and powder chamber in place in their stock. It seems unlikely that the lifting rings would have been used to lash the tube to the stock, as they would then be unavailable for lifting the gun and stock. The position of lashing remains on the Padre Island tube guns (Fig. 64) tends to support this. (After Olds, 1976: figure 33).

Overall, the gun was in a poor condition. The entire surface of the larger section had spalled away and in some cases entire hoops had disappeared leaving vacant spaces between bands. This tube gun falls into Smith's TU1 type (Smith, 1988: 12). Interspersed within the series of alternating bands and single hoops are three lifting-ring complexes. Two iron rings for lifting would have been fitted to the middle hoop in each three-hoop, lifting-ring complex (Fig. 53).

The muzzle is equipped with a sight and is reinforced by three or four muzzle hoops. Determination of the number of muzzle hoops was difficult owing to the state of preservation and the urethane coatings. I settled on three for the reconstruction drawing. The breech collar has suffered extensively and no longer protrudes beyond the end of the tube. The breech of the gun appears to have had two consecutive bands over the inner tube. The breech collar was placed over the last breech band (Fig. 57).

Powder chamber #0033

This powder chamber, from Pre-site Two, is 56 cm long and has a bore diameter of 5.6 cm. It was intended for use with tube gun #0031 (Fig. 57). It

During the late fifteenth and the sixteenth centuries, there were two predominant approaches to naval warfare: the artillery duel and the boarding action. The more wide-spread practice was to storm an enemy ship with soldiers or sailors equipped with small arms. This approach to sea fighting grew out of land warfare and employed similar tactics and defensive structures, including "castles". This eventually gave rise to a very large and specialized warship called the carrack, which was built with a towering forward castle and a longer, lower, strongly fortified after castle.

The tactics of storming an enemy's decks and castles are typified by the fight between Henry VIII's 1,000-ton carrack *Regent* and the 700-ton French carrack *Marie la Cordelière* in the English Channel during the Battle of Brest in 1512. After clashing with the *Mary James* of 400 tons and a close encounter with the *Sovereign* of about 800 tons, the *Cordelière* encountered the *Regent*. Grapnels and hooks were tossed into the French carrack, and the two ships were locked side by side. Realizing escape was impossible, the crew of the *Cordelière* released an anchor, and the two great ships turned slowly with the run of the tide (McKee, 1974: 33-38). After many longbow and swivel-gun volleys, the English stormed aboard to engage the French fighting men. This typical carrack fight had an unusual ending, however, for just as

the *Cordelière* was about to yield, a fire broke out onboard and quickly spread to the *Regent*, burning both ships in three hours time. More than two thousand men perished.

Boarding tactics were not limited to large European warships. They were also employed by pirates and privateers whose vessels were considerably smaller. In order to get the loot out of the hold or make money on a prize, capture of the vessel was of primary importance. Nothing was gained by engaging a vessel and sending it to the bottom.

A less frequent practice at this time, but well-tried and proven, was that of standing off and fighting an artillery duel with the intention of disabling and/or sinking the enemy with no attempt made at boarding (Padfield, 1979: 43). This approach was used by the Portuguese against a considerably larger fleet from Calcut in 1503. Vasco da Gama, the Portuguese commander, gave strict orders that if they were to fall in with the fleet of Calcut, they were not to board, but to fight with their artillery (Correa, 1869: 366). Using superior firepower, da Gama's fleet inflicted a stunning defeat upon a considerably larger and more heavily manned fleet. Generally, this approach was used when boarding was impractical due to a greater number of enemy ships or a greater number of fighting men on board these ships.

During the sixteenth century both breechloading and muzzleloading artillery were used. There were two ways in which muzzleloading artillery was worked on board ship during this time. The guns could either be hauled inboard and loaded within the ship, or they could be left in the run-out position and loaded outboard. The more effective process of allowing a gun's own recoil to drive it inboard under the restraint of a breeching rope was not developed until well into the seventeenth-century. Instead it was customary, after firing, to unhitch the piece and haul it back manually. During this operation the crew would be covered from the view, and to a certain extent the fire, of the enemy (Martin & Parker, 1988: 202).

The Saona tube guns, which made up the heavy batteries on the vessels which carried them, were breechloaders and so the routine to operate them would have been considerably different. The guns would have been lashed down. As a result, the hull took all the shock of recoil, as was the case with muzzleloaders until the mid-seventeenth century. With breechloaders, however, there would have been no need to run the gun in or to crawl outboard in order to reload. This meant that the servicing of the piece was considerably quicker and safer.

The number of men necessary to man these guns is a question which remains unresolved. The above-mentioned naval battle between the fleet of da Gama and the fleet of Calecut offers us some specific numbers of men and weapons on board the five Portuguese caravels which took part in the battle. According to Correa (1869: 367):

"Each of the caravels carried
thirty men, and four heavy guns
below, and above six falconnets,
and ten swivel-guns placed on the
quarter deck and in the bows, and
two of the falconnets fired astern;"

This gives a ratio of 20/30 for guns to crewmen. The four heavy guns below, mentioned by Correa, were wrought-iron bombards (Padfield, 1979: 46), obviously on the main deck in the waist of the ship. The number of men needed to man a *bombardeta* tube gun has been examined by J.F. Guilmartin Jr. (1988: 35-53). On the basis of the *bombardetas* found on the Molasses Reef Wreck, he evolved a theory involving two scenarios. The "overmanned" gun crew of twenty-two men per *bombardeta*, and the "minimum" gun crew of fifteen. These seem to be "best of all possible circumstances" scenarios. Such numbers might make for a highly efficient crew operating

at optimal speed, but such was only likely to occur back in European waters on the heavily manned carracks.

In all probability, these guns were operated with considerably smaller crews. An episode from da Gama's naval battle described by Correa (1869: 370) makes that clear.

"The caravels, which ran along, also entered amongst the Moors without fear, seeing that they did not carry heavy guns, and they also discharged their guns on both sides, firing with the heavy guns between wind and water, and with the falconnets and swivel-guns at the Moors on deck, so that they killed many people and broke masts and yards which fell upon the Moors and killed them;"

Clearly, to man four heavy tube guns and sixteen swivel guns with a crew of thirty, considerably less than fifteen men may be assigned to each tube gun. Nor does this seem to have reduced their efficiency if we believe the graphic passage by Correa.

The task which seems to have required the most manpower in servicing the tube guns was transporting the

heavy powder chambers, some weighing up to three hundred pounds, and placing them into firing position (Guilmartin, 1988: 46). In both his models Guilmartin uses four men slipping a pair of iron bars through the lifting-rings. This may be accurate for the heaviest of powder chambers, but a Portuguese mariner accustomed to the hardships of life at sea in the early sixteenth century and experiencing an adrenalin rush brought on by the frenzy of battle might have been able to lift more weight than twentieth-century historians and nautical archaeologists are willing to credit him with.

Guilmartin raises an excellent point, however, when he contends that there may have been only one crew carrying powder chambers to all the tube guns. In this case, four men would likely move more swiftly and efficiently and cause less confusion than numerous gangs of two or even four men. If we remove four men from Guilmartin's minimum crew of fifteen to carry powder chambers to all the heavy guns, the gun crews are reduced to eleven men. Two men may have been assigned the task of reloading the powder chambers, and, like the chamber handlers, they may have serviced all the guns. These two men, also removed from the individual crews, drops the minimum gun crew model to nine men. The stripped-down operational model would require forty-two men to service

and operate four tube guns which is twelve more than da Gama's caravel crews of thirty.

Three men manning each tube gun, with two to traverse the gun and one to fire it, might have been sufficient to allow the gun to be efficiently employed. These three would share all other responsibilities such as swabbing (if tube guns were actually swabbed), loading, wedging, and removing the spent powder chamber to be recharged by the loading crew. Such a scenario would take up eighteen of da Gama's thirty men, leaving his swivel weapons somewhat under manned. It seems probable that the Portuguese guns were not all used simultaneously and that gun crews switched around depending on the immediate demands of battle. It would also have been necessary to allocate at least one man to the ship's tiller and a second man to guide him, in addition to a sail tender or two. Given the ratio of crew to weapons, the Portuguese guns were lightly manned, but in light of da Gama's success, they were clearly efficiently manned.

Another, later, example of a gun-to-crew ratio exists for a large trans-Atlantic treasure ship (McDonald & Arnold, 1979: 128-129). Of the three ships wrecked on Padre Island in 1554, only two, the *San Esteban* and the *Espíritu Santo*, have been archaeologically studied. Ironically, the only Spain-bound registry found so far

has been that of the *Santa María de Yciar*, the third ship wrecked on Padre Island. This vessel was armed as a bullion-carrying trans-Atlantic merchantman. Its artillery and munitions consisted of 10 heavy pieces of artillery (*artillería gruesa*), some of which may have been bronze, and 32 swivel guns (*versos*), some of which may also have been bronze. There were also 9 barrels of powder, 500 cannon balls, 100 harquebuses, 21 shields, 16 crossbows, and 250 spears and lances (McDonald & Arnold, 1979: 128).

All the above was for the service of the ship. The ship had a crew of twenty-six men including officers and thirty-nine passengers, many of them women (McDonald & Arnold, 1979: 129). In this example, there is a greater disparity between the number of crewmen to guns than in da Gama's caravels.

Bombardetas clearly required a relatively low number of men to operate them. This is demonstrated once again by the ratio of crew to heavy artillery. If, for the sake of speculation, we allocate four heavy bronze guns to the *Santa María de Yciar*, the remaining six would be wrought-iron tube guns, probably three per side of the ship. If we use a model gun crew of nine men, beneath Guilmartin's minimum of fifteen men, and allow two men for loading powder chambers and four in the chamber-handling gang servicing all the tube guns, *Santa María de*

Yciar would need thirty-three men in order to operate just three *bombardetas* on one side of the ship. This is more than the entire crew and excludes crews for the bronze guns and the *versos*. It would seem that Guilmartin's model is impractical.

If we assign three men to each tube gun rather than nine, fifteen men are required to man the three tube guns on one side. This leaves eleven crewman to man the other two bronze guns, the *versos*, and to tend the ship, again assuming that the vessel was engaged on only one side.

Although both tube guns and swivel guns might be employed at the same time under certain circumstances, it seems likely that the two batteries were used separately. The main battery of heavy guns would be manned by the majority of the crew and utilized in a long-distance artillery duel in an attempt to sink or disable an enemy vessel before it could approach and its crew board. Once the enemy came within swivel-gun range, the secondary battery of swivels could be manned. The main battery would probably have been loaded a final time before the switch to swivels to deliver a point-blank broadside just as the enemy closed to board. A well-aimed broadside could cause maximum damage and confusion.

After the broadside, the Spaniards, to repel a boarding attempt, would probably use light artillery, crossbows, and harquebuses. If they were unsuccessful,

it became a pitched battle utilizing harquebuses, crossbows, and lances from the fighting tops, and swords, spears, and shields in hand-to-hand combat on deck. Mariners were sometimes obliged to provide their own swords (Haring, 1918: 272). This appears to have occurred in the case of the *Santa María de Yciar*, for swords were not stocked in her armory.

In times of extreme emergency, as in the scenario above, the Spaniards almost certainly increased the size of the fighting crew by pressing all male passengers into service. It seems obvious that Spanish gunnery practices were such that all of the guns could not be manned at one time. How else can one account for the documented ratio of artillery to crewmen?

These practices were considered unsafe by the Spanish government. In February of 1552, ordinances were promulgated specifying minimal crew and armament required by trans-Atlantic ships based on their tonnage. The *Santa María de Yciar*, of approximately 220 tons (Chaunu, 1955: 484-485), was by the terms of the ordinances (sent to the printers the day she sailed for the New World) undermanned and over gunned.

According to the new regulations *Santa María de Yciar* should have had a crew of 48 men, instead of the 26 carried on the return voyage (Haring, 1918: 274). She would have been required to carry eight pieces of heavy

artillery (lombards), rather than ten, and 18 light artillery rather than the 32 that she carried. She would also have been required to carry one demiculverin, one *sacre*, and one *falcon* (possibly a breechloader), the last three all being of bronze (AGI, Casa de Contratacion, legajo 1079, #7-remo3; Haring, 1918: 274). The *Santa María de Yciar* was grossly undermanned and is an excellent example of the unwise practices of the sixteenth-century Spanish sailing community.

The number of harquebuses on board may be a clue to how an undermanned Spanish crew operated so many weapons. The harquebus, a muzzle-loading shoulder arm, took time to load but very little to fire. When fighting off a boarding attempt or killing mariners on a nearby ship's deck, a single man could fire any number of these weapons in quick succession, either discarding the spent weapon or handing them off for reloading by another crewman or passenger. Likewise, a single gunner could fire a bank of any number of *versos* while another man came behind and changed the powder chambers and another reloaded the chambers with powder. Alternatively, all the *versos* may have been discharged in the initial volley of fire and then a reduced number manned for continued combat.

If we use the ordinances of 1552, we can again get a crew-to-gun ratio. As we have seen, a ship of 220 tons was required to carry eight heavy lombards, three heavy

bronze guns, eighteen swivel guns, and a crew of forty-eight men. It seems possible that three men could traverse and man a muzzleloading bronze gun as efficiently as a tube gun. Therefore, for the sake of argument, we shall assign three men to all the heavy guns whether or not they are tube guns. We shall also have two chamber handling gangs of four men and four men assigned to loading the chambers with powder. It seems reasonable to increase the handling and loading crews, since in this case we are dealing with a government ordinance and there are considerably more than four heavy guns as in the da Gama example. In this scenario forty-five men are required to service and operate all eleven heavy guns simultaneously, leaving only three men to steer and operate the ship. However, this was only likely to occur if the ship was closely engaged on both sides. Under these ordinances a vessel of 220 tons would just be able to engage in artillery duels with enemies on either side and switch to swivel gun fire when appropriate. If engaged on only one side they would have just enough crew to use both heavy tube guns and swivel guns simultaneously.

Archaeological and documentary evidence

Unfortunately, to date, no documentary sources are available to help us identify a number of the sixteenth-century New World wreck sites studied so far.

One of these sites was found at Highborn Cay in the Bahama Islands north of the island of Española. The site, that of a sixteenth-century armed ship which appeared to have sunk at anchor, was discovered in 1965 and salvaged in 1966-7. The quantity of artillery found puts this ship in the heavily armed category. Artillery raised at that time included two *bombardeta* tube guns, two tube gun powder chambers, at least thirteen *verso* swivel guns (including two SW5 type *verso doubles*), and at least eighteen *verso* powder chambers (Keith, 1987: 50-51).

It should be pointed out that all armaments lists from ship registers this investigator has seen, and most early sixteenth-century archaeological sites in the New World, always have an even number of swivel guns. This makes sense as they can be deployed to afford equal protection to both sides of the ship. The Highborn Cay wreck is an exception to this rule. Since this site was salvaged and detailed archaeological recording of information was not emphasized, it seems reasonable to assume that at least one, and possibly three *versos* disappeared from the site without making it into the

written record for a total of fourteen to sixteen *versos*. It also seems likely that there were more *verso* powder chambers, which likewise did not make it into the record. During the exploration of the site in 1967 no personal belongings of the crew were found (Peterson, 1974: 241) possibly indicating that the ship sank slowly, allowing an organized and orderly abandonment of the ship. It is possible that some of the *versos* were taken at this time.

The most extensively studied and published site in the New World to date is the Molasses Reef Wreck in the Turk and Caicos Islands (Keith, 1987). This vessel was heavily armed. The artillery consisted of a matching set of two *bombardeta* tube guns, a *cerbatana* tube gun, sixteen *verso* swivel guns, and a matching set of two *haquebuts* adapted for sea use by the addition of swiveling yokes. With the exception of the *haquebuts*, all of the above were breechloaders, and each weapon was equipped with multiple powder chambers. A total of fifteen powder chambers were found for the tube guns and about forty powder chambers for the *versos* (Keith, 1987: 172).

The Molasses Reef Wreck's armament is strikingly similar to the armament on Vasco da Gama's five caravels mentioned above. Each of his vessels had four heavy guns, six *falconnets* (large swivel guns), and ten smaller

swivel guns (Correa, 1869: 367). The two haquebuts from Molasses Reef would appear to be a small difference.

Da Gama's caravels had thirty men each. A customs document made in Salvaleón de Higüey in January 1513 mentions a total of thirty-four people as composing the crew and soldiery for Juan Ponce de León's heavily armed caravel *Santa María de Consolación* (Tanodi, 1971: 175-176). This caravel sailed on an expedition to Florida close to the same time and possibly through the very waters that the Molasses Reef ship did. The Molasses Reef Wreck therefore, possibly a caravel and gunned very similarly to da Gama's caravels, may have carried roughly thirty to thirty-five people. If we use the tentative model of three men per tube gun, four chamber handlers and two chamber loaders, the Molasses Reef vessel would have required fifteen men to service and operate the three tube guns. This would leave fifteen to twenty men to man the swivel guns and look after the ship.

The Molasses Reef vessel was well supplied with shot of varying calibers and carried its own molds and tools for casting ammunition on board or ashore. The apparent lack of a supply of spare lead on board suggests that time was taken before hand to provide the ship with adequate amounts of ammunition for the voyage.

Another sixteenth-century site at Bahía de Mujeres in Mexico was quite differently armed (Keith & Smith,

N.D.). This site, discovered in 1958, was subsequently salvaged over a period of four years. The armament of the vessel, quantitatively, appears to be closer to those of Pre-site One and Caballo Blanco.

The salvage of the Bahia de Mujeres artillery occurred in the following order: in 1958, at least one small breechloading cannon, apparently a tube gun, and possibly two other guns were recovered from the site; in 1959 Edwin Link removed at least one cannon; in 1960 two or three cannons were raised; and in 1961, one cannon. This amounts to a gun count of five to seven (or even more) pieces for the site. There is some possibility that wreckage from this vessel may still lie undiscovered in the bay (Keith & Carrell, 1990: 5).

Some of the salvaged guns were available for examination and recording by members of the *Institute of Nautical Archaeology* in 1983. They included a *falconete grande* swivel gun, a *verso liso*, a *bombardeta*, what may be another tube gun missing both ends, and a third possible tube gun. The Bahia de Mujeres Wreck appears to have carried at least two and possibly three tube guns and at least two swivel guns. It is unfortunate that the various salvagers of this site did not keep their gun count straight. This has obscured what might otherwise have been a clear picture of a lightly or relatively

lightly-armed vessel operating in Mexican waters in the early sixteenth century.

A sixteenth-century site on Little Bahama Bank is currently being excavated and promises to be a very important site, since a considerable amount of the hull appears to have been preserved (Malcom, 1993: P.C.). There also appears to be more artifactual material than at the other early wreck sites. After two seasons of excavation three tube guns and seven *versos* have been found (Malcom, 1993: P.C.). It is possible that more guns remain undiscovered on the site.

In the realm of documentary evidence, Denise C. Lakey, a renowned expert in sixteenth-century Spanish paleography, has transcribed numerous registries of Indies-bound ships and has generously shared some of her findings. In a number of instances to be discussed below, vessels crossing the Atlantic, like the Molasses Reef vessel, carried three tube guns. This may indicate that they could all be run out on the same side with out unduly disturbing the vessels balance. This was apparently not possible for da Gama's caravels, perhaps due to the size of their large guns (Correa, 1869: 368). The Molasses Reef vessel had two heavy tube guns (*bombardetas*), and one moderately heavy tube gun (a *cerbatana*). This archaeological evidence may hint that in the inventories mentioned below the numerous reference

to three *lombardas gruesas* need not necessarily mean that they are all the same size.

In 1511, the nao *Santa Carolina* sailed from Seville for Santo Domingo under Maestre Rodrigo Bermejo. She carried three *lombardas gruesas* with their powder chambers and twelve *lombardas pequeñas* (AGI, Casa de Contratacion, legajo 1451, #1). In 1523, the nao *Santa María de Guadalupe*, under the Maestre Gonzalo Rodríguez, sailed for the Indies with three *lombardas gruesas* with two powder chambers each, and twelve *pasavolantes* (AGI, Casa de Contratacion, legajo 1079, #1-ramo1). The same year another vessel sailed under Francisco de Vara with three *lombardas gruesas*, each with two chambers, and twelve *pasavolantes*, each also with two chambers (AGI, Casa de Contratacion, legajo 1079, #1-remo2).

Also in 1523, the caravel *Santa María la Blanca*, under the command of Maestre Diego Quintero de la Rosa, sailed with two *lombardas gruesas* each with two chambers, and six *pasavolantes* with their chambers (AGI, Casa de Contratacion, legajo 1079, #1-remo3). Again in 1523, the caravel *San Vicente*, Maestre Cristobal Alvarez, sailed with a crew of approximately twenty-five. She carried two *lombardas gruesas* with two chambers each, two *versos* with two chambers each, and four *pasavolantes*, again with two chambers each (AGI, Casa de Contratacion, legajo 1079, #1-remo5) .

Another group of vessel registries for a later period are very similar. In 1542, the nao *Santa Agueda*, under Sebastián Ruiz and carrying a crew of twenty-two, sailed with two *lombardas gruesas*, each with two chambers, and six *versos*, each with two chambers (AGI, Casa de Contratacion, legajo 1079, #6). In the year 1545 the caravel *San Antonio*, under Maestre Juan Rodríguez Zarco and with a crew of fourteen, sailed from Seville to Nombre de Dios. On board were one *lombarda gruesa* with two chambers, and six *versos* each with two chambers (AGI, Casa de Contratacion, legajo 1079, #7-remo5).

The same year, the caravel *La Concepción* of sixty tons, under Hernando de la Madrid and with a crew of thirteen sailed for Nombre de Dios. The vessel was armed with one *lombarda gruesa* with two chambers and six *versos* with two chambers each (AGI, Casa de Contratacion, legajo 1079, #7-remo4). Also in 1545, the nao *San Bartolomé* under the command of Maestre Francisco Sánchez sailed for Nombre de Dios with fifteen men. On board was one *falcon grande*, possibly made of bronze (Haring, 1918: 274), with two powder chambers and eight *versos*, each also with two powder chambers (AGI, Casa de Contratacion, legajo 1079, #7-remo3). These vessels, usually sailing singly, were armed in a manner deemed suitable for a trans-Atlantic passage.

A number of observations can be made from the above information. Obviously, further study of the nomenclature of different types of sixteenth-century Spanish wrought-iron artillery is needed. However, all the above registries agreed in giving the name *lombarda gruesa* to heavy tube guns. The *falcon grande with its two powder chambers* is obviously a breechloader, but almost certainly not a tube gun as these were always made of wrought-iron.

We can also state with authority based on archaeological evidence (Highborn Cay, Molasses Reef, Bahia de Mujeres, St. John's Bahamas, Padre Island, Pre-site One, Pre-site Two, and Caballo Blanco) that sixteenth-century Spanish vessels sailing in the New World were frequently armed with a combination of tube guns and swivel guns.

On these sites, swivel guns almost always outnumbered tube guns and, with few exceptions, are found in even numbers. We may therefore say of the above registries that they too probably follow this pattern and that the *pasavolantes* and *lombardas pequeñas* refer to swivel guns. This is especially important considering that *pasavolantes* are identified in both Vigon (1947: 37) and the *Catalogo General* (1909: 14-15) as heavy tube guns. Haring (1918: 272), on the other hand, identifies them as swivel guns, possibly on the basis of their

numbers on board ships and the greater quantity of shot with which they were provided. Could two distinctly different types of weapons have the same name? Were the inspectors conducting the registry ignorant of the names for the different pieces? It is interesting to note that all references to *pasavolantes* come from ships sailing in 1523. In one case, the *San Vicente*, there would appear to be two types of swivel guns, for both *pasavolantes* and *versos* are listed.

Royal ordinances passed in July 1522 stated that ships of 100 tons were required to carry crews of at least twenty-six, four large iron guns and twenty-four swivel guns (Haring, 1918: 271-2). All of the ships in the vessel registries cited above, with the exception of the *Santa Carolina* which sailed in 1511, if of 100 tons, would have been obliged to abide by these regulations, which they do not. Since their armament is considerably less, we can surmise that they are vessels of under 100 tons. One vessel, *La Concepción* of 1545 with a crew of thirteen, was listed as being of 60 tons. In new ordinances, passed in February 1552, one hundred tons was established as the minimum for trans-Atlantic voyages, thus ending six decades of trans-Atlantic navigation by these small vessels.

According to Lakey, who has studied and transcribed many registries besides those discussed above, small

trans-Atlantic traders of the first half of the sixteenth century were usually armed with one to three tube guns, often with two powder chambers each, and six to twelve swivel guns, also generally with two chambers per gun (Lakey, 1993: P.C.).

From what we have seen, armed New World Spanish shipwrecks from the first six decades of the sixteenth century, can be placed into four distinct categories. Category One, consisting of large ships over one hundred tons, were heavily armed trading naos capable of carrying large cargos and bullion. The Padre Island 1554 Wrecks *Santa María de Yciar*, *San Esteban*, and *Espíritu Santo* fall into this category. Ships in this category can be subdivided into three groups by using the classification system of the 1552 ordinances as a guide (Haring, 1918: 271). The ships in Group One would be from 100 to 170 tons; Group Two, from 170 to 220 tons; Group Three, from 220 to 320 tons.

Category Two consisted of smaller ships under 100 tons, heavily armed for exploration and discovery and equipped with two to three tube guns and 14 to 16 swivel guns. Highborn Cay and Molasses Reef fall into this category.

Category Three consisted of small vessels under 100 tons, often engaged in trans-Atlantic trade. They are variably armed with one to three tube guns and six to

twelve swivel guns. Analysis of archaeological evidence and the nine registries transcribed and provided by Denise Lakey has demonstrated that this third category can be subdivided into two groups based on the quantity of artillery carried.

Relatively lightly-armed ships were equipped with one to three heavy guns, usually of the tube variety, and six to eight swivel guns. This group includes the vessel at Pre-site Two, possibly the vessel at Bahía de Mujeres, and from the registries, the *Santa María la Blanca* and *San Vicente* in 1523, the *Santa Agueda* in 1542, and the *San Antonio*, *La Concepción*, and *San Bartolomé* in 1545. Relatively heavily-armed ships would be equipped with two to three tube guns and ten to twelve swivel guns. This group includes the *Santa Carolina* in 1511, as well as the *Santa María de Guadalupe* and an unnamed vessel under Maestre Francisco de Vara in 1523. It is interesting to note that all of the above had three tube guns and twelve swivel guns.

Category Four consisted of small craft, under 100 tons, lightly armed and probably engaged in inter-island trade, armed with one to two tube guns and four swivel guns. Pre-site One, Caballo Blanco, and possibly Bahía Mujeres fall into this fourth category.

It is hoped that this proposed classification system will aid researchers understand the differences between

Spanish New World shipwrecks dating to the first six decades of the sixteenth century.

New World contingencies

There is still a great deal to be learned regarding sixteenth-century naval tactics and how those tactics differed between various nations. How indeed were the tactics particular to the mariners of one nation, Spain, affected by the circumstances of the New World?

Spanish captains arming their ships for a New World voyage, either in Spain, Santo Domingo, Salvaleón de Higüey, or San Germán had to consider carefully the possible gunnery requirements that any given course of action might demand, as well as regulations with which they had to comply.

Spanish documents transcribed by Aurilio Tanodi (1971) contain records of numerous cross-channel trading ventures between Española and San Juan Bautista. Besides providing an exact record of the material transported and its value, the records frequently contain information regarding the size and composition of the crews serving on these vessels.

Among the vessels listed is the already mentioned *Santa María de la Consolación*. This vessel was owned by Juan Ponce de León and, among other things, was engaged in trade between Salvaleón de Higüey and San Germán. She

made a voyage from Puerto de Yuma, the port which serviced the town of Salvaleón, to San Germán in December 1512 (Tanodi, 1971: 164). She carried approximately twenty-five passengers and food to bolster the colony of San Germán. The vessel, described as a "Carabela", had a crew of nine: a Master, Juan Bono de Quejo; a pilot, Pedro Bello; a mate-Rodrigo Gallego; and six sailors.

Though this is not the most typical of cross-passage trading trips because it is one of the earliest, it is typical of the lightest-manned vessels and likely reflects the minimal number of crew needed to operate the vessel safely. A crew of this size would be capable of operating alternately either the light tube gun or the four *versos* and still control the ship in both instances.

We are fortunate that Juan Ponce received a license from the King of Spain to explore to the north and discover the Island of Bimini. As a result, documentation for a considerably different voyage exists for comparative study (Tanodi, 1971: 175). A little more than a month after the above voyage, the *Santa María de la Consolación* was crewed and outfitted in Puerto de Yuma for Juan Ponce de León's historic voyage which led to the official discovery of Florida and the Gulf Stream. For this trip, *Santa María de la Consolación* had a crew of 18, double that of the above-mentioned trading voyage. She still had three primary officers. Juan Bono de Quejo

was made Captain, a military title denoting his importance in the expedition hierarchy. Pedro Bello was promoted from pilot to Master. Bartolomé Rodriguez, who served on the previous voyage, was made mate. There were ten sailors, one, and possibly three, who served on the previous voyage, and five apprentice mariners, all new.

In addition to the crew, referred to as *gente de mar*, there is another group of sixteen people called *gente de tierra* (Tanodi, 1971: 175). This group, for the most part, is the soldiery needed by any expedition seeking to trade with Indians for pearls or gold.

While on the west coast of Florida in June 1513, Ponce and his three ships were set upon by hordes of Indians in canoes on an inlet where they had put in to water, collect wood, and careen one of the ships. The first attack of twenty canoes was dispersed by sending out an armed ship's boat. They disabled a number of canoes and captured five of them, killing a number of Indians. One Spaniard was killed by an arrow. The second attack the following day was made up of eighty canoes that fell upon a single vessel. No boat was dispatched. The Spanish held off their attackers with crossbows and ship guns, while the Indians loosed their arrow barrages from a safe distance. Clearly, this ship was sufficiently armed to discourage eighty canoe loads of Indians from getting within range and pressing their

attack. A ship without considerable armaments and sufficient crew to man them would not have fared so well.

Indian canoes presented a considerably smaller and therefore more difficult target than a ship of any sort. It seems likely that swiveled guns rather than the tube guns would have been the more efficient weapon against them. Interestingly, no grape or cannister shot has been reported so far in the New World dating to this early period, but only iron-filled lead bодоques, a kind of composite shot, or solid cast iron shot (Keith, 1987: 197). This kind of shot, fired from a verso would almost certainly have holed a canoe and thus might have constituted a sort of boat-smashing shot.

Palacio (1587: 149) describes an anti-personnel shot made up of flints, nail heads and sheathing-nails. In the eighteenth century, if not earlier, this is called "langrage" (Falconer's, 1780: 171). Since such iron items were probably present on all ships, they may be overlooked by archaeologists as anti-personnel ordnance and placed in the "fasteners" category with which they would overlap (Keith, 1987: 111-115). It would have been practical for a metal-scarce island society in the New World to import or manufacture commodities such as nails rather than specialized anti-personnel shot which had only one function. This anti-personnel shot would have been used at very close range in attempting to hold off

boarders. Thus the doubt expressed by Keith (1087: 197) that the *verso* should be classified as an anti-personnel weapon due to its inaccuracy and large diameter shot can probably be put to rest.

Tube guns were not, however, without use. During this early period, the great strength of the tube gun was not in the size of the shot and the damage it could inflict, but rather in the psychological effect it had on the Indians due to the great noise and quantity of smoke it produced. This tactic was employed by Columbus on his first voyage when he fired a few shots at the remains of the dismantled *Santa Maria* in order to impress upon the Indians the power of the Spanish (Morison, 1974: 81).

After the hostile encounter in Florida, Juan Ponce continued exploring before eventually turning back towards home. Off Grand Bahama Island in early August, they met another ship from Española under the Pilot Diego Miruelo, who was there on "his adventures" (Herrera, 1945: 211). It is unlikely that Miruelo was the first adventurer to voyage so far north without a license, and in all probability Juan Ponce de León was not the first to discover Florida, though he was the first licensed authority able to claim that distinction. The earliest unlicensed Spaniards would have had encounters with the Floridian Indians, who were not nearly as docile as the Lucayan Tainos. Rumors of these hostile northern peoples

may well have influenced the manner in which Ponce armed his ships.

In view of these findings, one can speculate about the armament and mission of the Molasses Reef vessel. Its heavy complement of artillery seems to preclude it from being a Category three trans-Atlantic trader. This supposition is based on the registries transcribed by Lakey. In none of the examples which I have seen, ranging in date from 1511 to 1545, did any of the vessels, all apparently under 100 tons, carry so many swivel guns or powder chambers. The only documented vessels similarly armed that I have come across are da Gama's caravels armed for war. Though slaving in the comparatively tranquil Lucayan Islands may have been planned by the crew of the Molasses Reef vessel, the substantial battery of defensive armament suggests they may also have planned on exploring to the north where hostile canoe attacks were a real possibility.

Miruelo accompanied Ponce's ships on the voyage south to San Juan Bautista (Puerto Rico), but somewhere in the Lucayan Islands, they were beset by foul weather. They sheltered at an island where Miruelo's ship was lost. Fortunately, Herrera tells us, all the crew were saved (1945: 211). It would appear that the Molasses Reef (Keith, 1987: 287) and Highborn Cay vessels (Peterson, 1974: 241) were lost under similar

circumstances, the crews getting off with their personal possessions.

Small and relatively light-armed ships like those of Juan Ponce mentioned earlier were plying the inter-island trade making relatively short voyages with small crews. The only hostile encounters they were likely to have would be with Carib war canoes, and though they could be quite deadly, Caribs did not usually travel in the numbers encountered by Juan Ponce in Florida. A lightly-crewed merchantman with four swivel guns and a tube gun or two would have had a chance of surviving such an attack.

When the French first arrived in the waters of the Mona Passage in the 1520's, they found a fairly active cross-passage trade being carried out by lightly armed Spanish merchant vessels. These vessels, so lightly armed and crewed, no doubt attempted flight not being in a position to win either an artillery duel or a hand-to-hand fight. If flight failed, they would have been boarded and sacked. This probably led to the upgrading of armaments carried on board cross-passage traders by those who could afford it. This no doubt increased the costs of trading, since guns and powder had to be purchased and additional mariners or gunners employed to man the guns. This almost certainly had a negative impact on trade.

Spanish captains arming their ships for a New World voyage, in either Spain or a New World port, had to consider carefully gunnery requirements and regulations. Any consideration along these lines almost certainly included how much they were willing to risk by saving on armaments and facing a higher chance of capture or fining, versus the profits of success achieved at a lower expense. These considerations were no doubt influenced by the economic means of those involved as well as the availability of shipboard artillery.

CONCLUSIONS

The initial expansion of Spanish European society into the New World occurred on the north coast of the Island of Española, bounded by the Atlantic Ocean to the North, the Caribbean to the South, the Windward Passage to the West, and the Mona Passage to the East.

The founding of Santo Domingo on the south coast in 1496 by Miguel Diaz de Aux and Francisco de Garay led to a dramatic increase of maritime activity in the Mona Passage, particularly around Saona Island. All ships bound for Santo Domingo from Europe would have passed Saona Island whether they followed the north or the south shore of San Juan Bautista (Puerto Rico). Likewise, all Spanish ships bound for Spain would have sailed north through the Mona Passage to catch the prevailing westerlies, which would take them back across the Atlantic.

The three sixteenth-century sites near Saona Island were tragic shipwrecks, the violence of their demise leaving only heavy ordnance, anchors, and scattered ballast. There were probably no survivors. Since heavy material was apparently not salvaged, the sites may be regarded as containing complete ordnance collections, reflecting, to an extent, the different vessels' missions at the time of their loss.

An active trade developed between Española, San Juan Bautista, and the islands of Mona and Saona during the first half of the sixteenth century. Vessels carried animals, dried meat, salt, and manufactured products. They frequently had small crews and therefore would have been lightly armed. One or two tube guns and four *verso* swivel guns seems appropriate armament for a small vessel engaged in inter-island trade. The vessels at Pre-site One and Caballo Blanco possibly engaged in this trade.

Swivel guns recovered from the *San Esteban* and the *Espíritu Santo* are *versos* and were known as such by the Spaniards of the time. The use of *versos* in the New World has been established for a forty-one year period between 1513, the *terminus ante quem* for the Molasses Reef shipwreck, and 1554, the year the three Spanish ships were wrecked at Padre Island. It is likely that this period will be extended as the armaments of other sites are studied and published.

Haquebuts have now been reported at three sites: Molasses Reef, *Nuestra Señora del Rosario* in Cuba, and Saona Pre-site Two. The Spaniards called these weapons *culebrina de mano* and *cañon para culebrina*. The *sacabuche* was a similar weapon made of cast bronze, referred to as *metal* or *buen metal* depending on the copper content of the alloy.

Tube gun #0036 from Pre-site One is the first documented example of a tube gun from the New World of the TU3 type. Its extremely deteriorated condition has caused the inner tube to become exposed showing the seams between the staves, clearly indicating that the staves were not welded to one another.

One can speculate about the armament and mission of the Molasses Reef vessel, whose heavy complement of artillery, three tube guns and sixteen verso swivel guns, seems to preclude it from being merely a trans-Atlantic trader. The closest comparison seems to be da Gama's caravels armed and crewed for war. The Molasses Reef Wreck was possibly a caravel, and like Juan Ponce de León's caravel used in the 1513 expedition to Florida, may have carried roughly thirty to thirty-five people.

It would seem that Guilmartin's "overmanned" and "minimum" gun crew models are impractical when examined in the light of documented cases of gun-to-crew ratios on board Spanish and Portuguese vessels during the first six decades of the sixteenth century. A lot of work remains to be done on the nomenclature of different types of sixteenth-century Spanish wrought-iron artillery carried on board vessels sailing in the New World. These ships were almost always armed with a combination of tube guns and swivel guns. Swivel guns usually outnumbered tube guns and, with few exceptions, are found in even numbers.

The registries transcribed by Lakey seem to follow this pattern. The *pasavolantes* and *lombardas pequeñas*, and generally any weapon mentioned that outnumbered the heavy weapons, refer to swivel guns.

Based on the heavy armament requirements for Indies-bound vessels of 100 tons in 1522 and on the registries of numerous small vessels of less than 100 tons sailing to the Indies up until 1552, we can say that in all probability, the three vessels wrecked in the waters around Saona Island were small vessels of less than 100 tons. Those at Pre-site One and Caballo Blanco were lightly armed vessels, in all probability engaged in inter-island trade. They were armed with one to two tube guns and four swivel guns. Such vessels have not been adequately documented in the New World until now. The ship at Pre-site Two was a relatively lightly-armed vessel equipped with one tube gun, eight swivel guns, and approximately eight smaller-caliber muzzle-loading haquebuts or other portable weapons. This vessel, by reason of its location and portable weaponry, may have been engaged in the wars to reduce Higüey. It may also have been one of the more heavily crewed and armed inter-island traders or a trans-Atlantic trader.

Information from these three sites lost due to the unfortunate mixing of ceramics and other sixteenth-century archaeological material could be offset by a

reinvestigation of all three sites. The incomplete nature of the site map for Pre-site Two and the unique information on portable arms locked in its anchor concretion argues strongly for a close reexamination of this site in particular.

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NAUTICAL ARCHAEOLOGY

APPENDIX A



1000 E. Mermoid La., Phila., Pa. 19118 | Phone 215 | 233-2600

January 11, 1988

Mr. Robert Abplanalp
Precision Valve Corp.
700 Nepperhan Ave.
Yonkers, NY 10703

Dear Mr. Abplanalp:

At the request of Bert Webber, I am writing this letter to review and summarize the status of this job and our present recommendations. (This is an update of previous letters sent to Mr. Borrell 1/16/86)

Enclosed is a copy of our original quotation to Mr. Duncan Mathewson.

Background:

Metlab's previous experience with the hydrogen reduction process had been with cast iron barrels approximately 200 years of age. The original set, for the City of St. Mary's, were cleaned of encrustations by the archaeologist and our responsibility was for the hydrogen treatment only. That project proceeded without incident and we have been told that they have been on display, out of doors, since 1971, without further deterioration.

About the time we received your barrels, we also received from other sources, several more cast barrels of about the same vintage as those from the City of St. Mary's.

These, as yours, had not been cleaned prior to our receiving them, and we were asked to assist by doing the cleaning.

This we discovered, was a task somewhat out of our line of expertise. The main problem was the subjective difficulty of knowing what to remove. That is, when to stop chipping.

We discovered that having removed everything we thought should be removed and proceeding with the reduction process, there then remained a dark gray spongy material in some areas. We surmised this to have been scale (iron oxide) that we had failed to remove prior to the reduction treatment. This product, having been effected by the reduction process, was now fairly easily scraped and blasted off.



Heat Treating and Metallurgical Consulting

Page 2

We then discovered that under these patches, the base iron had not been freed of its chlorides, and it began to collect water hygroscopically, and to rust. We then retreated the barrels, reblasted them, and found that they no longer showed signs of being hygroscopic. We painted them with two (2) coats of epoxy paint and shipped them.

Record of work done on your artifacts:

Your artifacts, being much older and more heavily encrusted, while also very much more fragile, present us with problems that we are finding to be very much more difficult.

As recommended by Bert Webber, we cleaned the parts by chipping, wire brushing and sandblasting, then ran them through the hydrogen reduction cycle. We subsequently found localized spots and areas that rusted and exhibited the weeping characteristics of a hygroscopic condition.

On Robert Coffee's authorization, we again chipped, wire brushed and sandblasted the parts to remove all visible rust, and ran them for a second time through the hydrogen reduction cycle. After this, they still showed localized rusting and weeping. This indicates that contaminated areas remain, in spite of the above efforts.

Mr. Webber then came to Metlab and rechipped, wire brushed and cleaned the parts on October 8, 1985, preparatory to a final hydrogen reduction cycle.

With the calcarious excrustations removed to this extent, it has become evident that many of the pieces are so fragile and deteriorated as to be partially disintegrated.

The experts agree that it is usually best to remove all encrustations, particularly from the bore in an effort to insure that there be no further deterioration due to corrosion.

In this case, it was feared that nothing would remain of several of the pieces if complete cleaning was attempted.

Accordingly, we proposed the following:

1. The artifacts be resandblasted and given a third and final hydrogen treatment and reblasted.
2. The artifacts be soaked in a solution of tannic acid.

Page 3

3. The parts be drained and allowed to air dry.
4. The parts be dipped twice in clear urethane to saturate the encrustations and consolidate and seal the mass.
5. The parts be wrapped in plastic, boxed and delivered to Precision Valve.

We were authorized to proceed as above by Mr. Coffee and by Mr. Borrell, and we did so.

When we got to step 4, we selected only 3 barrels, and painted them with 3 coats of urethane.

We have allowed them to sit in our plant for several months, and they again show the rusting spots characteristic of being hygroscopic.

After all of the above experience we believe it is not possible to totally eliminate this condition by the hydrogen reduction process on artifacts with residual encrustations.

We therefore propose that we now complete the treatment as follows:

1. Paint with 1 coat of Chesterton Nr.763 Rust Transformer.
2. Paint with 1 coat of Chesterton 745 Universal Primer.
3. Paint with 2 coats of Chesterton 411 Urethane Black Enamel.
4. Dip in Chesterton 740 Heavy Duty Rust Guard to saturate the encrustations in the bore.
5. Wrap in plastic, box and deliver to Precision Valve.

Page 4

Based upon our conversations with a half dozen conservationists and the various articles they have sent us, we conclude that short of thoroughly removing all encrustations, the above proposal represents a reasonable and practical solution, and should provide excellent protection for storage and/or display of the artifacts in a museum environment.

Expenses incurred to date are as follows:

- | | |
|---|----------------|
| 1. X-ray - as requested by Duncan Mathewson and authorized by Robert Coffee | \$ 475.00 LOT |
| 2. Cleaning, hydrogen reduction treatment, sandblasting and coating, as quoted | \$3,100.00 LOT |
| 3. Recleaning and blasting, retreating in hydrogen and reblasting as quoted orally to Robert Coffee | \$1,800.00 LOT |
| 4. Recleaning by Bert Webber October 8, 1985, reblasting, re-treating in hydrogen and reblasting | -NO CHARGE |
| 5. Final treatment outlined above - | -NO CHARGE |

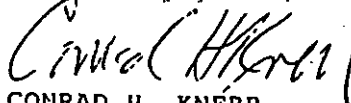
ADVANCE - REC'D 10/86

TOTAL	\$5,375.00
	\$1,187.50
BALANCE	\$4,187.50

Because of the unusual age and the extreme delicacy of these parts, we have had to proceed very cautiously. The whole process has taken very much longer than anticipated.

With your approval of the proposed procedure, we feel that we can complete the processing by February 15th., and are proceeding accordingly.

Very truly yours,


 CONRAD H. KNERR
 President

ENC. Copy of original quotation of April 9, 1987
 Chesterton Literature

cc: Mr. Pedro Borrell
 Mr. Bert Webber

APPENDIX B



GOBIERNO DOMINICANO
PRESIDENCIA DE LA REPUBLICA

Comision de Rescate Arqueologico Submarino

November 24, 1992


Mr. Conrad Knerr
Met Lab
1000 E Mermaid Lane
Philadelphia
FAX (215) 233-5653

Dear Mr. Knerr,

With reference to a request for information by Mr. Samuel P. Turner, you and your company are hereby authorized to share all documentation and conservation information which may be of use to him so that he may expedite a study of 16th century artillery treated in your laboratory. Said study will lead to his Masters thesis and possibly a section in a book currently under preparation.

Your cooperation in this matter is sincerely appreciated.

Sincerely,


ARQ. Pedro J. Borrell Bentz
Secretario Ejecutivo



19 September 1993

Samuel P. Turner
Nautical Archaeology Program
Department of Anthropology
Texas A&M University
College Station, TX 77843-4352

To Whom It May Concern:

Mr. Samuel P. Turner has requested the limited reproduction in his Master's Thesis of the following figures of my creation:

- 1) Sectional view of swivel gun MRW-66 recovered in 1982 from the Molasses Reef Wreck, Turks and Caicos Islands, British West Indies. Published in "Early Modern Wrought-Iron Artillery: Macroanalyses of Instruments of Enforcement," by Joe J. Simmons, Materials Characterization 29(2), September 1992, p. 133, fig. 2.
- 2) Planar and sectional views of MRW-66 and associated powder chamber. Published in "Early Modern Wrought-Iron Artillery: Macroanalyses of Instruments of Enforcement," by Joe J. Simmons, Materials Characterization 29(2), September 1992, p. 133, fig. 3.
- 3) Exploded view of the barrel assembly of swivel gun MRW-66. Published in "Early Modern Wrought-Iron Artillery: Macroanalyses of Instruments of Enforcement," by Joe J. Simmons, Materials Characterization 29(2), September 1992, p. 134, fig. 4.
- 4) Exploded view of the breech assembly of swivel gun MRW-66. Published in "Early Modern Wrought-Iron Artillery: Macroanalyses of Instruments of Enforcement," by Joe J. Simmons, Materials Characterization 29(2), September 1992, p. 135, fig. 5.

- 5) Suggested nomenclature for generic tube gun. Published in The Molasses Reef Wreck, by Donald H. Keith, Ph.D. Dissertation, University Microfilms, Ann Arbor, Michigan, p. 180.
- 6) Suggested nomenclature for generic swivel gun. Published in The Molasses Reef Wreck, by Donald H. Keith, Ph.D. Dissertation, University Microfilms, Ann Arbor, Michigan, p. 198.

I hereby grant permission for limited reproduction of these figures in Mr. Turner's Master's Thesis.

Respectfully,

A handwritten signature in cursive script, appearing to read "Joe J. Simmons". The signature is written in dark ink and is positioned above the printed name.

Joe J. Simmons



CURTIS TUNNELL
EXECUTIVE DIRECTOR

TEXAS HISTORICAL COMMISSION
 P.O. BOX 12276 AUSTIN, TEXAS 78711-2276 (TELEPHONE) 512-463-6096 (FAX) 512-463-6095 (RELAY TX) 1-800-735-2989 (TDD)
 DEPARTMENT OF ANTIQUITIES PROTECTION

November 1, 1993

Samuel P. Turner
 Nautical Archaeology
 Dept. of Anthropology
 Texas A&M University
 College Station, TX 77843-4352

Dear Mr. Turner:

Thank you for your letter of 9/28. You are welcome to duplicate or redraft the figures you need from *The Nautical Archaeology of Padre Island*. Please credit the Texas Historical Commission and the Texas Antiquities Committee.

We appreciate your interest in the agency's publications.

Yours truly,

J. Barto Arnold III
 State Marine Archeologist

VITA

Samuel Peter Turner
130 Wing Rd.
Ramey, PR
00604

Education:

1988 Antioch College: B.A. History as a Social Science
1994 Texas A&M University: M.A. Anthropology

Experience:September 22, 1992 to Present

Saona Island Artillery Study, Dominican Republic. Late
15th to mid 16th Century.

October 30 - November 9, 1992

Cruz Bay Pier Project, St. John, U.S. Virgin Islands.
18th Century.

November 1990-February 1993

Assistant Field Director, Monte Cristi Shipwreck Project,
Dominican Republic.

April-August, 1990

Intern in Maritime History at the Smithsonian
Institution- National Museum of American History.
Washington D.C.

May 10-15, 1990

Yorktown Shipwreck Project, Yorktown, Virginia.

September-December, 1989

Ma'agan Michael Shipwreck Project, Israel.

August, 1989

Museum of Underwater Archaeology, Bodrum, Turkey.

June-July, 1989

Tel Nami Land and Sea Regional Project, Israel.