THE ANALYSIS OF THE CONDE DE TOLOSA AND THE NUESTRA SEÑORA DE GUADALUPE OLIVE JAR ASSEMBLAGE

A Thesis

by

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ABSTRACT

The Analysis of the CONDE DE TOLOSA

and the NUESTRA SEÑORA DE GUADALUPE

Olive Jar Assemblage (May 1985)

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Bound for New Spain in 1724 the Conde de Tolosa and the Nuestra Señora de Guadalupe sank on the northeast coast of the Dominican Republic during a hurricane. Recent salvage of the two wrecks was undertaken by Caribe Salvage S.A. Among the items recovered were over 600 complete olive jars. Employed as a main type of shipping container by the Spanish during their exploration and colonization of the Americas the olive jar, with its various forms, has been shown by recent studies to be a temporal indicator.

Housed at the Museo de las Casa Reales in Santo Domingo the jars of the Tolosa and Guadalupe represent the largest intact olive jar assemblage recovered in the New World. Analysis of these containers imparts a wealth of information critical to the understanding of this widely used and diffused ceramic type. Besides revealing a previously unreported form the study suggests needed changes in both the chronological and typological framework of the olive jar and answers previous hypothesis pertaining to intended sizes and capacities, contents, and rim attributes and glazing frequencies employed as temporal indicators.

ACKNOWLEDGEMENTS

The following compilation was realized only through the efforts of many people, to all of whom I am deeply indebted. To my wife, Valerie, who deserves a world of credit, especially for her hard work in Santo Domingo; to Pedro Borrell for his permission to analyze the ceramics and his tremendous help during the sojourn in the Dominican Republic; to Darjelo, Marcelino, Francisco and Francis for their help in the laboratory; again to Francis for the Presidentes after work; to Tracy Bowden, president of Caribe Salvage S.A., for his time and trouble with maps, provenience and general information; to all the people of the Domincan Republic for their buenas aventuras and smiles given during our stay on the island; to all my friends, colleagues and professors, who made life at the Institute of Nautical Archaeology both memorable and enjoyable; to David Beiler and Jeff Hertzing for their S.E.M. and petrographis analysis; to Peggy for her typewriters; to my committee members for their time and instructive and constructive criticisms; to Gian Marco Brenni for his extensive translations and information concerning functional aspects of Mediterranean anphorae and dolia; to Paul White for his French tanslations; to Eugene Lyon and Hamo Sassson for their olive jar data; and to all the rest, too numerous to mention, I give my sincerest thanks.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

I INTRODUCTION

Two Spanish galleons, the Conde de Tolosa and the Nuestra Señora de Guadalupe sailed from the port of Cádiz on July 13, 1724. Laden with passengers and provisions and mercury for the mines of New Spain the ships set a course for Veracruz. Thirty nine days after leaving Cadiz the ships sighted Puerto Rico and anchored off the town of Aguada. Fresh provisions were brought aboard and the crew and passengers received a much needed rest. The morning of August 23 dawned with sultry foreboding. Premonitions of an impending storm, though noticed by a few experienced mariners, went unheeded by those in command. Orders were given to make sail. Two days after leaving Aguada the winds changed direction and intensified. On August 25 the luckless ships, driven by hurricane winds and seas, met their violent fates on the reefs of Samana Bay on the northeast coast of the Dominican Republic (Borrell 1980).

Two hundred and fifty three years later, salvage of the two wrecks was undertaken by Caribe Salvage S.A. During the course of salvage operations, which were directed by Tracy Bowden, numerous ceramic vessels were recovered. The majority of these vessels were relegated to anonimity on the shelves of various storage areas of the Museo de las Casas Reales in Santo Domingo. The bulk of the ceramic assemblage consisted of hundreds of narrow mouthed storage containers known to archaeologists as the Spanish Olive Jar. Though also recovered from archaeological sites of other nationalities such as French, English and Portuguese, the jars were used and produced primarily by the Spanish during the exploration and colonization of the Americas. The amphora-like shape of the jars indicates that they are lineal descendents of a pottery tradition that originated in early Eastern Mediterranean civilizations. The forms were brought to Spain by colonists and conquerors and were adopted and modified through time (Goggin 1960:5). Employed as a main type of shipping container the jars held assorted foodstuffs and supplies. Documents

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Historical Archaeology is employed as a guide for format and style.

from the General Archives of the Indies at Seville list various types of beans and olives as well as wine, olive oil, and tar that were shipped in botijas, botijas peruleras, botijas medias, and botijuellas (Arcila Farías 1946:188; García Fuentes 1980: 243; Goggin 1960:3-6; Ruidiaz y Caravia 1893:559-566; Torre Revello 1943:731). These ceramic containers are presumed to be what we know as olive jars. Archaeological evidence indicated that the jars were indeed used to ship such goods. A sealed olive jar recovered on the coast of North Carolina contained olives (Lawrence, personal communication 1982) and a jar excavated at Panama Vieja contained traces of tar (Long 1967:24).

The only intensive investigation of olive jars was undertaken by John Goggin (1960). Intended to be an introductory study, it remains to date to be the only true comprehensive examination of this extensively used and widely diffused ceramic type. Studying specimens from archaeological sites in Latin America, the Caribbean, and Florida, Goggin concluded that there were three olive jar types based on temporal differences: Early, Middle and Late. The Early Style, dated circa 1500-1580, is comprised of one form. The Middle Style is comprised of three distinct forms or shapes dated circa 1580-1780. The Late Style is comprised of four forms which date circa 1780-1850 or later (Figure 1).

Goggin, when defining the olive jar types, employed as a data base limited numbers of complete vessels and relied predominantly on fragments. Developed as a by-product of his majolica study the chronology was defined by archaeological stratigraphic sequences, a seriation of collections, and associational data suggesting beginning or terminal dates for certain types. In the case of the Middle and Late Style the temporal ranges were ascertained primarily by the paste differences recognized during excavations at the Convento de San Francisco in Santa Domingo. An orderly succession from Middle to Late Style paste in association with known ceramic types suggested a Middle Style date of circa 1580-1800 and a Late Style date of post 1800. Evidence from a series of site collections further refined these dates to circa 1580-1780 and 1780-1850 respectively (1960:20-

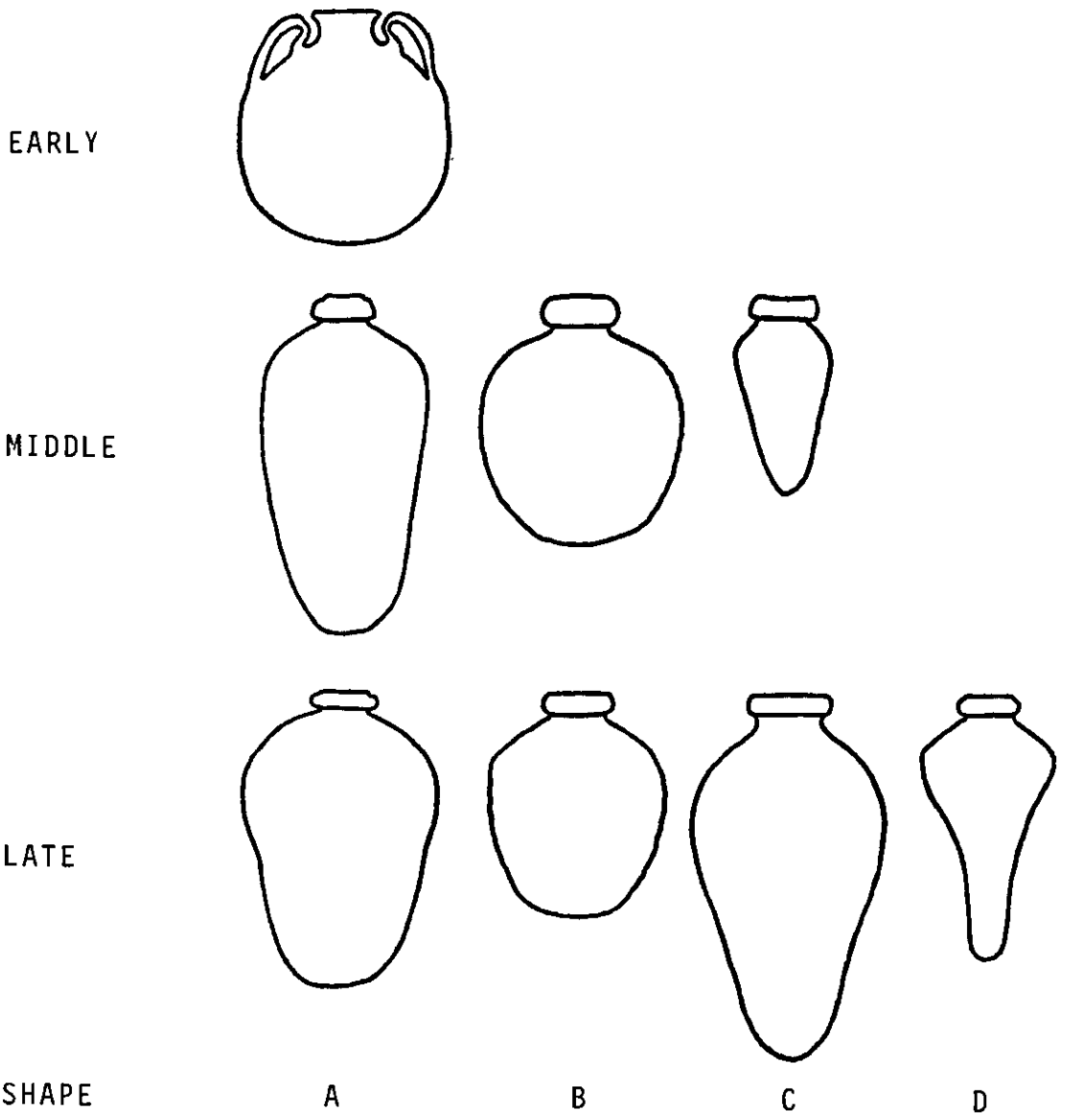

Figure 1. Jar Types Classified by John Goggin (After Goggin 1960).

24; 1968:101-114). When reviewing Goggin's studies, it becomes apparent that paste type and not jar form was used to define the temporal ranges, especially the range of the Middle Style. The jar forms, because of their paste types, were then placed within the time frames. In the case of the Middle Style forms, it is clear if one examines Goggin's evidence and other related reports and publications, that with the exception of Shape B, the forms do not span the 200 year period for this style. Goggin, stating that Shape C is rare, documents this form only from Santo Domingo. He does not give dates for the proveniences from which they were recovered. The only secure date for Shape C, to my knowledge, is from the 1621 wreck of the San Antonio (Peterson 1969). The earliest evidence of Shape A is also from the San Antonio while the latest is from the 1733 wreck of the San José (Saltus 1973).

The data base used to assign the three jar forms of the Middle Style to 200 years of Spanish maritime activity appears to be limited in certain respects. However, archaeological analyses, which deal in part with olive jars, use Goggin's typological study as the main or sole reference or as the basis for dating their finds. Although several authors have introduced olive jar forms which differ from known types or cannot be classified using his typology, the majority of this new material substantiates or mirrors Goggin's types. With the exception of works by Deagan (1978), Fairbanks (1975), Langouet (1973), Martin (1979) and McIntyre (1983), the olive jar material is for the most part hastily discussed and seldom analyzed to any extent. This may be a reflection of the limited data base that all previous studies have had as a common denominator. Their material is comprised of fragments or at best a very small number of complete vessels. In contrast the Tolosa and Guadalupe assemblage consists of hundreds of jars.

The containers from these two ships came to my attention while conducting research on the ceramics from the San Esteban wreck of 1554 (Arnold and Weddle 1978). It was immediately recognized that the assemblage possibly represented the largest collection of intact olive jars ever recovered. Their excellent state of preservation in

terms of completeness, coupled with the fact that they came from wrecks dateable almost to the minute of mishap, made the assemblage an extremely important and perhaps crucial link in furthering the understanding of this ceramic type. The salvaged jars, contemporaneous with Goggin's Middle Style, presented a unique opportunity to test expand our knowledge of the chronological and typological framework as defined by Goggin. With this in mind, permission to analyze the jars was sought and granted by the government of the Dominican Republic.

The analysis of the assemblage was instituted with the intention of addressing several specific research questions. The first and most basic question concerning the olive jar assemblage was, "Do the jars of Tolosa and Guadalupe conform to Goggin's typological framework?" If the forms are similar to Goggin's they will serve to strengthen his typology. If they differ how will they fit into or alter the chronology? Associated with the possibility of the presence of different forms is the suggestion by Colin Martin that there is an "official" jar. (i.e. those associated with military supply or trans-Atlantic trade), distinct from a "civilian" jar that is unassociated with military supply or trans-Atlantic trade. Noticing that Middle Style shape B jars from "official" contexts generally fell into one of two sizes, thereby suggesting stereotyping of forms, and that the jar shapes from "civilian" contexts varied considerably, Martin postulated that there may be two distinct categories, "official" and "civilian" (1979:282-284). The numerous jars in the Tolosa and Guadalupe assemblage, in contrast to the limited number of "official" jars available for study at the time to Martin, may answer this tentative hypothesis.

Because of the excellent condition and overwhelming quantity of the jars the presence of glazes and possibility of contents raised several questions to be addressed towards the assemblage. Is glazing directly related to shape? Is jar shape directly related to contents? The relationship of glazing, shape and contents is an area in which there is little or no previous information. Goggin's introductory study is to date the only source that discusses glazing

of the jars to any extent. He briefly addresses the glazing of whole jars and fragments but he was unable to conduct a detailed correlation of the use of glaze and vessel shape (1960). We know from archival data that certain items were transported in olive jars. Because both glazed and unglazed jars are present in olive jar assemblages scholars have speculated possible uses of the various jars. Glazed jars might have been used for light liquids such as wine, which would permeate unglazed vessel walls. Unglazed jars would be used for heavy liquids such as olive oil (Goggin 1960:6). The correlation of glazing, shape and possible contents in concert with information from archival sources could shed light on the particular uses of these containers.

Though the analysis was conducted with the intention of answering specific questions, other attributes, including jar closures and paste types, were examined. Provenience of the jars on the wrecks was also noted along with stowage techniques.

II SOURCE REVIEW

Sources of information include archaeological reports, archaeological examples, isolated occurrences, archival references, and personal communication with the salvagers of the wrecks. Archaeological reports are divided into excavation reports, the majority of which deal briefly with the recovered olive jar material, reports that analyze only ceramics from excavations, and studies that deal solely with olive jars. Included in the excavation reports are those sources dealing with "treasure" or salvage operations. Archaeological examples can be defined as jars and fragments analyzed by the author. Isolated occurrences consist mainly of single whole vessels recovered from proveniences that lack associated material and are consequently nondateable. Archival references include copies of original documents and literary sources in which archival documents or information is presented either whole or in part but translated from the original Spanish.

Although sporadically mentioned by North American archaeologists in the first half of the twentieth century, the olive jar was not studied seriously until John Goggin, in the 1950s, undertook an intensive investigation of this widely occurring ceramic type. Based on field and museum research centered on the Caribbean, Florida, and parts of Central and South America, Goggin's investigation was oriented toward a broad analysis of Spanish material culture, the main focus being majolica pottery. Olive jar material, a major secondary area of attention, was presented in "The Spanish Olive Jar: An Introductory Study" (1960). Detailing the chronological and typological framework of the olive jar as found in the Americas, this extremely informative reference is limited in certain respects. However, no attempt has been made to update or clarify the data.

The only additional source which deals specifically with the olive jar is an article entitled "Les Jarres De La Rance" (Langouet: 1973). It is essentially an analysis of numerous nondateable jars recovered during dredging operations in the River Rance near St. Malo, France. The three jar forms, which are present in the

assemblage, are analogous to Middle Style shapes but Langouet imparts important information not found in Goggin's study. Measurements he gives of numerous Shape C jars illustrate size variation, and correlations are made between different rim styles and the various body shapes. Both the Shape C size variation and rim and body correlations are areas that have received little or no emphasis.

"Analysis Of Olive Jar Rims From The Nuestra Señora de Atocha and the Santa Margarita: A Step Towards Detecting Change Through Time In Olive Jar Rim Forms" is an unpublished manuscript written by Keith McIntyre (1983). It is an attempt to identify rim variation and then to apply those variations to other rim assemblages to detect change through time. Although no discernable variation existed in the Atocha and Margarita examples, the analysis contains useful compara-tive data especially applicable to Goggin's statement that rim thickness is a differentiating characteristic when distinguishing between Middle and Late Style rims.

Among the archaeological excavation reports Kathleen Deagan's "Material Assemblage of 16th century Spanish Florida" (1978) stands out because it brings attention to several interesting and important considerations. First, the predominance of Middle Style fragments recovered at St. Augustine, in concert with the settlement date of 1572, suggest that Middle Style jars may have been introduced at an earlier date than 1580. Secondly, the glazing frequencies of known assemblages appear to be less frequent through time, suggesting a temporal index for the glazing of olive jars.

The olive jar assemblage, described in the thesis "The Archeology of 16 Century Nueva Cádiz" (Willis 1976), was the largest ceramic category recovered from this early Spanish pearl fishery. The direct trade between Spain and this outpost, together with the high percentage of recovered Early Style jar fragments, supports a Spanish origin for this ceramic type. The glaze frequencies of the olive jar fragments from Nueva Cádiz have been employed by Deagan in her suggestion of glazing as a temporal indicator.

Numerous excavation reports make brief note of or illustrate recovered olive jar material. With the exception of a few, the sources impart little if any useful analytic data, partially due to paucity of material, and either mirror or further substantiate known types (Clausen 1965; Harris 1971; Harris and Nielson 1972; Kirkman 1974; Mayes 1972; Ortega and Fondeur 1978; Olds 1975; Platt and Coleman-Smith 1975; Smith 1979). A rim described and illustrated in "Search for the Cittie of Raleigh, Archeological Excavations at Fort Raleigh National Historic Site, North Carolina: (Harrington 1962) is the earliest evidence for the use of Middle Style jars. It was recovered from a 1585 context. In Archeological Investigations at Panama Vieja, tar is noted on the interior of a reconstructable Middle Style jar (Long 1967). Mendel Peterson's History Under the Sea (1969) illustrates three jar forms, analogous to Middle Style shapes, recovered from the 1621 wreck of the San Antonio. To my knowledge this is the only secure date for Shape C and the earliest published date for Shape A.

Of the ceramic analyses which deal in part with olive jar material, "Spanish Armada Pottery" (Martin 1979) is by far the most informative and thought provoking. Besides substantiating the disuse of the Early Style and the introduction of Middle Style shapes in the 1580's, Martin presents several tentative hypotheses. He suggests that there may exist both "official" jars made with specific capacities and "civilian" jars that were not standardized.

Like the excavation reports, many ceramic analyses, while adding to the general knowledge of olive jars, impart few revelations (Baart et al. 1977; Beidleman 1976; James 1982; Pearson 1981; Sassoon 1981; Woodward 1981). However, several do present new and useful information. "Spanish Artifacts at the Fortress of Louisbourg, Cape Breton Island: by Charles Fairbanks (1975) discusses vessels similar in shape to Late Style D jars but from a Middle Style period context. They are illustrated in "Coarse Earthenwares from the Fortress Of Louisbourg" (Barton 1981). These jars are identical to ones recovered from the Tolosa and Guadalupe. A Middle Style A jar, illustrated in an unpublished manuscript "Spanish Ceramics from the

Shipwreck San Jose" (Saltus 1973, is the latest known occurring vessel of this shape. The San Jose sank in 1733.

Archaeological examples are those olive jar specimens analyzed by the author. They include not only the Tolosa and Guadalupe assemblage but jars from the Nuestra Señora De La Concepcion, numerous vessels housed at the Museo de las Casas Real;es which are from various excavations, and a jar, located at the Old Naval Hospital in Port royal, Jamaica, which was recovered from the English brig Mary Margaret.

Isolated occurrences consist of two Late Style D jars recovered off the coast of Maine, a Late Style D jar recovered on the coast of North Carolina and a Late Style D jar housed at the Old Naval Hospital, Port Royal, Jamaica. The North Carolina specimen still retained its original seal and contents of olives and olive oil. The rim measurements, taken from the Jamaican specimen, question Goggin's contention that rim thickness is a differentiating characteristic of Late and Middle Style rims. Although the isolated occurrences are from nondateable contexts all three are distinctly Late Style D in shape.

Archival references were employed not only in the brief analysis of supplies carried in olive jars but more importantly in the correlation of the various terms used to describe the containers. These descriptive terms were also terms of measure. The archival information, either original or reproduced in part in literary sources, is of two types. The first type essentially lists the various commodities and provisions shipped to the Americas. Several items listed in Economia Colonial de Venezuela (Arcila Farias 1946), "Subsistence On Spanish Treasure Ships: (Hamilton 1929), Reglamento y aranceles reales para el comercio libre de Espana a Indias de 12 de Octubre de 1778 (Torres Ramirez ande Ortiz de la Tabla 1978), and "Merchandise Shipped By The Spaniards to America (1534-1586)" (Torre Revfello 1943) are known to have been carried on the Tolosa and Guadalupe. La Florida: su conquista y colonizacion por Pedro Menendez de Aviles (Ruidiaz y Caravia 1893) lists supplies carried by the Menendez fleet. The list mentions botijas and botijas peruleras.

An archival document, AGI CT 2932 (1566), obtained from the St Augustine Restoration Foundation, lists botijas peruleras and botijas de media arrobas as being carried aboard the Los Tres Reyes, a vessel in the Menendez conquest. In all, three jar types are listed aboard vessels in the fleet bound for Florida. The 1565 date of the voyage (Lyon 1976) in combination with the fact three different jars are present suggests an earlier date than 1580 for Middle Style jars.

The second type of information deals with or mentions archival references pertaining to measurement and the use of the terms denoting those meaurements (e.g., botija, botija perulera, botija media perulers, and botijuela). "Spaniens Koloniale Warenausfuhr nach einer Preisliste des 16 Jahrhunderts: (Schafer 1938) indicates that the containers were the measure on which prices were calculated. El Comercia Espanol con America, 1650-1700 (Garcia Fuentes 1980) and "The Evolution of Weights And Measure In New Spain" (Carrera Stampa 1949), though contradicting one another, list capacities of various jar types.

Personal communications consisted primarily of discussions with Tracy Bowden, President of Caribe Salvage S.A., concerning provenience and stowage techniques encountered during salvage operations. Though these topics do not directly relate to the intended research questions, to omit the information would leave the analysis incomplete. The findings are presented in Appendix I.

III OLIVE JAR ANALYSIS

Methodology

The jars of the Tolosa and Guadalupe were housed in two different buildings of the Museo de las Casas Reales. Approximately one third of the complete vessels were stored in the ceramics laboratory under the close scrutiny of its director, María Nieves Sicart. The remaining two thirds were housed in the conservation laboratory and main shipwreck artifact repository. Though excavation records indicate that approximately twice as many jars were recovered from the Tolosa as from the Guadalupe (Bowden, personal communication 1982), it was not possible to differentiate which jars had come from which wreck. An occasional jar was tagged "Tolosa" or "Guadalupe" but the provenience of most jars was in question. Because of this problem and the fact that both azogues (mercury carriers) were provisioned and left Cádiz together and subsequently wrecked together, it was decided to treat all jars as one assemblage.

Only complete olive jars and those complete enough to ascertain shape in the collection of the Museo de las Casas Reales were counted and analyzed. The terms of agreement between the government of the Dominican Republic and Caribe Salvage S.A. stated that all finds would be divided equally. If there existed a unique item the government had the option to claim it. Due to these terms, the governments olive jar assemblage, housed at the Museo, represented the types of jars recovered from the two wrecks.

No attempt was made to ascertain shape, glazing or numerical quantities of the numerous olive jar sherds. Though there was the possibility of a different type or shape of jar existing among the sherds, if one took the time to reconstruct the remains, the minute amount of sherds, when compared to the enormous amount of whole jars precluded the probability of an overlooked jar shape. A total count of all the olive jars from the wrecks was not undertaken for various reasons. Primarily the government's assemblage, with representative jar types, would be sufficient to answer the proposed research questions. Secondly, an accurate total count could not be effected

due to Caribe Salvage's jars being in Pennsylvania. Furthermore, olive jars reportedly from the 1724 wrecks were being sold, very cheaply I might add, at the local Sunday flea market in Santo Domingo. In addition, there are reports of jars from the Tolosa being sold in the Florida Keys (Smith 1978:88). The origin of these jars is unsubstantiated but the flea market examples were identical to those in the government assemblage. Other ceramics being peddled with these jars, including stoneware bellarmines, course earthenwares and mojolica, were also analogous to ceramics recovered from the two wrecks.

All jars were sorted into forms or shapes, counted, and analyzed for glaze. If a jar or several jars had a shape distinct from others it would be given a separate classification. Four jar forms were present in the assemblage; Forms, I, II, III and IV (Figure 2). Glaze analysis consisted of determining to what extent the vessels had been glazed. Glazing categories present consisted of internal glaze only, internal and external glaze, no glaze, and not ascertainable due to concretions. Glaze colors were also noted. Jars were then measured for height, maximum diameter, empty weight, and volume. Rims were measured for external and internal diameter, height, and thickness. Volume studies were accomplished by filling jars with water. The jars, filled to the base of the rim, thus allowing room for a cork closure, were then emptied into a container. The liquid in the container was then measured. All jars measured for volume, except Form IV, were internally glazed. Internal glazing prohibited the absorption of water into the vessel walls thereby giving an accurate volume measurement. Form IV jars, previously weighed, were again weighed following the volume measurement to determine if water absorption had ocurred and consequently giving an inaccurate reading. The vessels showed only a minute weight increase indicating that volume measurements were accurate. As most vessels were whole it was difficult to obtain a good view of the paste. However, enough cracked and partially whole jars existed to permit a proper analysis. The paste of all forms were alike, indicating a common clay source. Paste samples from each jar form were further

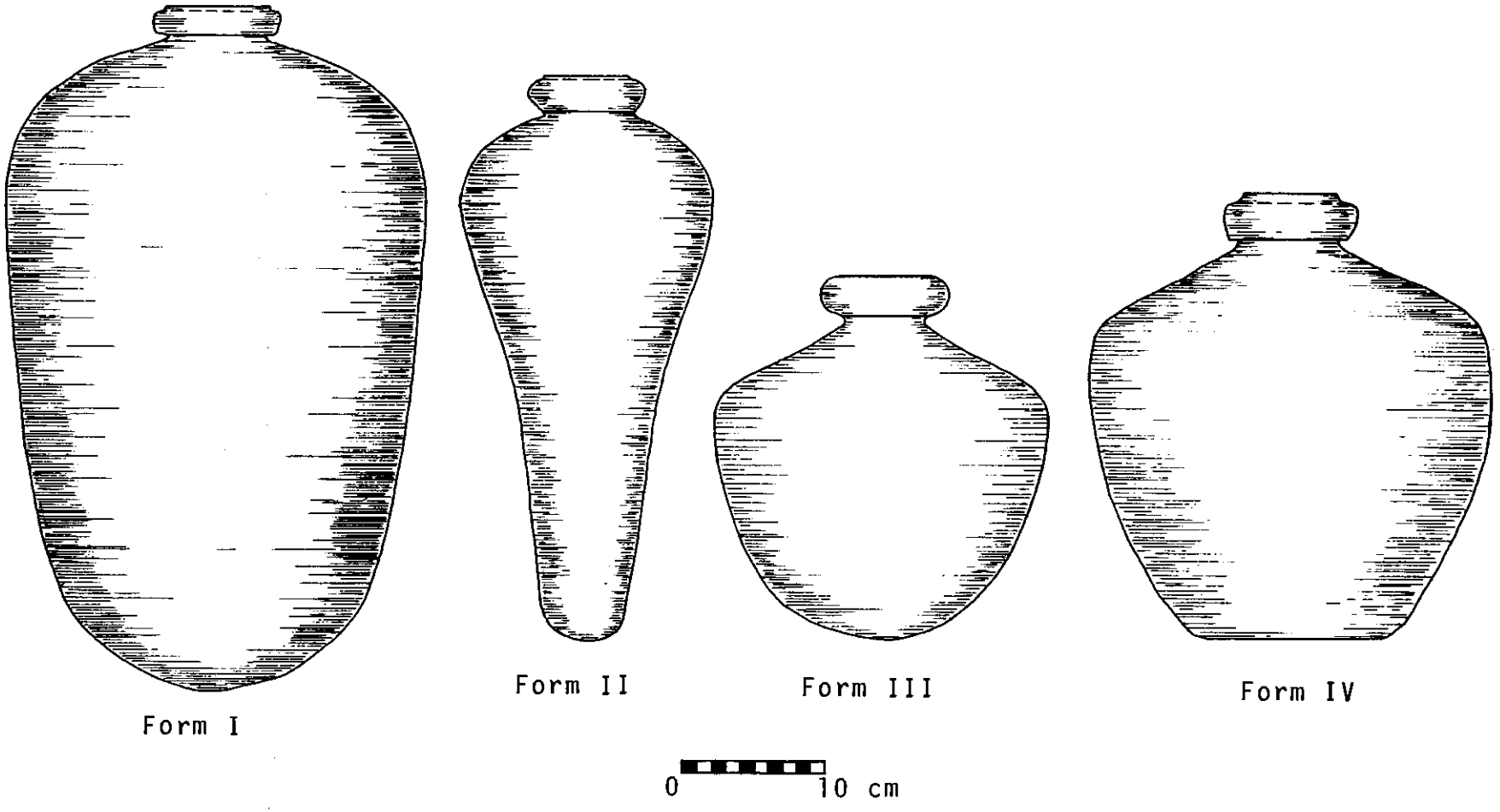

Figure 2. Jar Forms Present in the Tolosa and Guadalupe Assemblage.

analyzed to ascertain minerological composition using a Scanning Electron microscope and Thin Section examination. The findings from the analytic methods are presented in Appendix II.

Form I

From a total of 602 complete jars, 129 jars (21.4%) are of Form I. Analogous to Goggin's Middle Style Shape A jars, these elongated egg-shaped containers are the largest olive jar found on the two wrecks (Figure 3). A sample of eighteen jars (14%) were measured (Table 1). Heights ranged from 47 cm to 52 cm, with 51 cm being the most common height. Maximum diameters ranged from 29.3 cm to 32.8 cm. Volumes ranged from 15 to 20.1 liters. The weight of the empty jars ranged from 6.58 kg to 10.1 kg, with most of the weights falling between 8.5 kg and 9.5 kg. A jar with a larger height than another would not necessarily have a larger diameter or weight than the shorter jar. This indicates that no template was employed during jar construction and that the amount of clay used was an approximation.

Rims of all Form I jars are of the same shape. Fairly uniform in size, the ring-shaped rims have rounded sides with somewhat flattened tops and a distinctive raised lip. External diameters ranged from 9.7 cm to 10.6 cm, the majority falling between 10 cm and 10.2 cm. Three of the eighteen examples have rims with external diameters in the 15 cm range and internal diameters of 9.5 cm and 8.9 cm (Table 1). Although only three jars exhibit this extremely wide mouth, the large diameters, because of their uniformness, appear intentional. This apparent deviation from the norm might possibly be attributed to a specific contents need for a large-mouthed container. It should be noted that "makers" and/or "shipping" marks occasionally encountered on olive jar rims (Goggin 1960: 40-45; McIntyre 1983:8-11) are not present in the Tolosa and Guadalupe assemblage.

Eighty five of the jars (66%) are glazed either on the interior alone or on both the interior and exterior (Table 2). Exterior glaze colors include emerald to light green and brownish yellow. Interior glazes consist primarily of a dull greyish green with an occasional mottled brown. Differences in exterior and interior glaze colors on

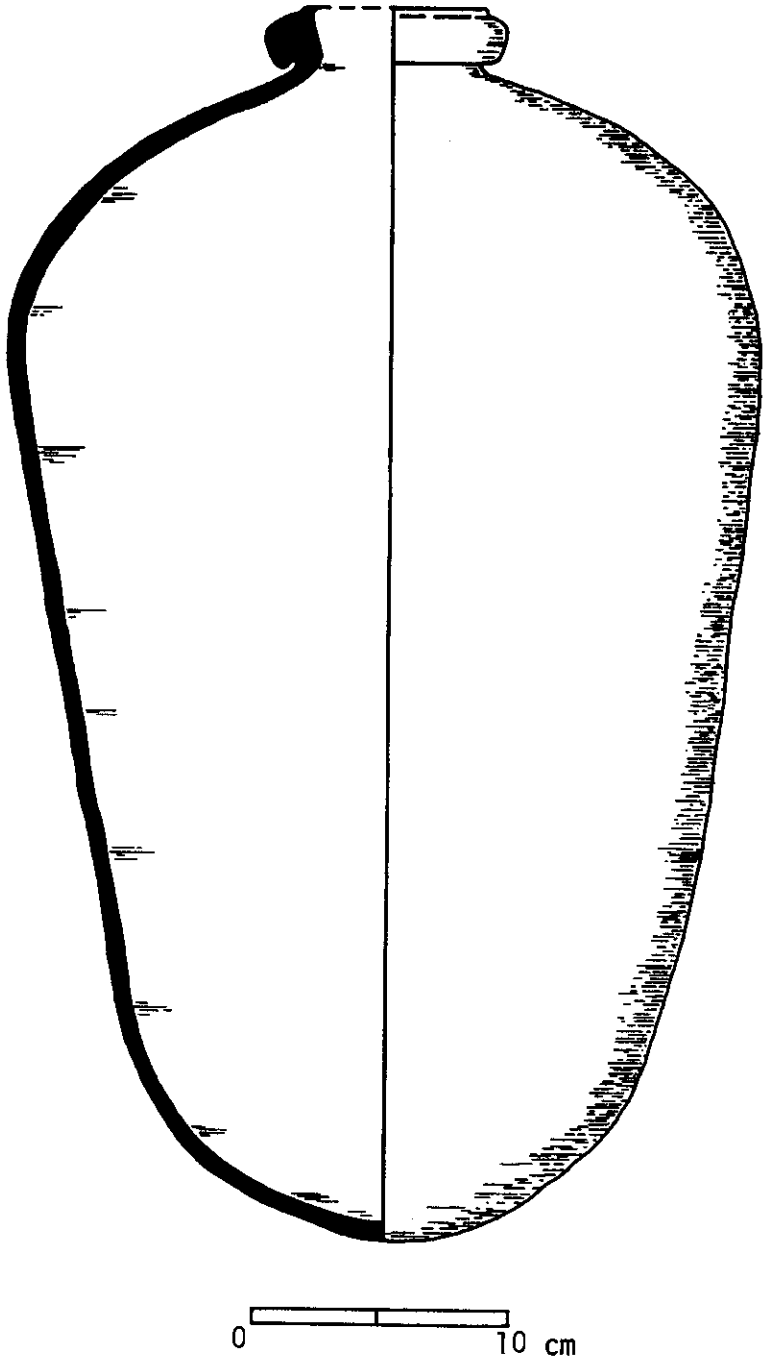

Figure 3. Form I.

Sample Number	Height (cm)	Maximum Diameter (cm)	Volume (l)	Empty Weight (kg)	External Rim Diameter (cm)	Internal Rim Diameter (cm)	Rim Width (cm)	Rim Height (cm)
1	50	30.9	18.3	10.09	10.2	5.0	2.6	3.0
2	50.5	32	20.1	8.72	10.2	5.2	2.5	3.3
3	47	29.3	15.0	7.37	10.2	5.2	2.5	3.1
4	50	30.9	18.2	9.53	10.0	4.8	2.6	2.9
5	48	31.4	16.0	6.57	10.0	5.2	2.4	3.0
6	52	31.8	*	8.72	10.0	4.7	2.6	3.3
7	51	31.2	19.1	9.19	10.0	4.8	2.6	3.1
8	49	30.6	18.7	9.41	9.7	5.0	2.3	3.0
9	51.5	31.2	19.0	9.64	10.2	4.2	3.0	3.4
10	51	31.2	18.8	9.22	10.6	5.6	2.5	4.3
11	51	32.5	18.4	9.19	10.0	4.9	2.5	3.0
12	51	31.8	*	*	10.6	4.6	3.0	3.5
13	51	30.6	*	*	10.2	4.7	2.7	2.9
14	51	32.8	*	*	10.5	5.4	2.5	3.4
15	52	30.6	*	*	10.4	*	*	3.1
16	47	31.8	18.0	*	15.5	9.5	3.0	3.2
17	51.5	31.8	20.0	*	15.5	8.9	3.0	3.0
18	51	*	*	*	15.0	*	*	3.1

* = concreted

Table 1. Form I Measurements.

Form	Nonglazed	External Glazing	Internal Glazing	External Internal Glazing	In Question *	Total
I	37 (28.5%)	0 (0%)	69 (53.5%)	16 (12.4%)	7 (5.4%)	129
II	28 (6.3%)	0 (0%)	302 (68.3%)	72 (16.3%)	40 (9%)	442
III	0 (0%)	0 (0%)	3 (27.3%)	6 (54.5%)	2 (18.2%)	11
IV	20 (100%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	20

* glazing not ascertainable due to concretions.

Table 2. Glazing Frequency.

a single specimen, a common characteristic of many jars, is likely due to the firing atmosphere and temperature differences between the interior and exterior surfaces of the vessels.

Several references dealing with olive jars state that a white or light slip is usually found on vessel exteriors (Goggin 1960:14; Martin 1979:281; Olds 1976:138). It appeared that many Tolosa and Guadalupe examples also had exteriors coated with a chalky whitish to greyish slip. However, after analyzing numerous vessels it became apparent that the whitish "slip" was not applied to the exterior walls but was more than likely a characteristic exterior color of the clay brought about by the firing process. Exterior walls of some vessels were completely whitish in color, including areas once covered by glazes. Other vessels were half white and half tan or beige with portions of the white running or blending into the other colors. Kenneth Barton, in this analysis of the course earthenwares from the Fortress of Louisbourg, Nova Scotia, makes a similar conclusion. Though no analytic studies were undertaken, he states that the whitish exterior surface of excavated "carrot-shaped" Spanish olive jars is the result of oxidation or overfiring and is not a slip. Barton assumes that the clay whitens at a critical point of temperature and that it is a natural process of manufacture (1981:40). The sulfur content of the pre-fired clay is a more plausible explanation for the whitish exterior "slip".

> Sulfur can occur in clay as iron sulfide (pyrite and marcasite), in organic matter, or in a sulfate (gypsum). Sulfur is objectionable because it unites with other substances to form salts that produce a scum on the surface of ware. Ferrous sulfate appears as a brown scum, and the sulfates of calcium, magnesium, potassium, and sodium form a white efflorescence (Shepard 1980:21).

The exterior of the vessels, though compact and fairly well smoothed, are slightly coarse to the touch because of clear quartz and dark grey particles protruding on the surface. The interior matrix composition is the same as the exterior but with an occasional large piece of grog or ceramic fragment present. Small lacunae or

voids in the clay matrix were numerous on some vessels, but almost nonexistent on others. For further paste analysis, consult Appendix II.

The remains of two types of contents, pitch and olive pits, were encountered during analysis. Resinas (pitch) and aceitunas (olives) can both be found in lists of goods shipped to the Americas (Arcila Farías 1946:188; Schafer 1938:317; Torres Ramírez and Ortiz de la Tabla 1978:33-62; Torre Revello 1943:781). Though the recovered contents are from an early eighteenth century context, it is interesting to note that in sixteenth century ships olives were not a daily ration of the crew but were reserved for ecclesiastics (Hamilton 1929:436). Twenty-three jars were filled or partially filled with a dark amber pitch presumable used for caulking purposes and various on-board repairs and upkeep. One jar, which contained the viscous pitch, had its original cork seal in place. It is likely that more vessels retained their original seals when recovered. A fifty-five gallon drum located in the conservation laboratory was full of pitch. It had been used as a receptacle for the contents of numerous jars. Seven jars held evidence of being used for the shipment of olives. Numerous olive pits were encountered concreted to interior walls and also lying loose. The large amount of pits in the jars seemingly preclude the possibility of post-wreck deposition. The jars that held olives and pitch had no exterior or interior glaze.

Several Form I jars had shrunken corks that had fallen through the mouths in the vessel interiors. The corks, similar in size and shape to those encountered in the other jar forms, were one-piece natural cork, tapering from top to bottom. An indentation, presumable from the narrowest part of the rim interior, is pronounced on most of the cork sides. The type of closure for the three jars with the 10 cm rim interior can only be speculated. Perhaps they too would have been sealed with cork. The sealed vessel, which contained pitch, had a piece of thin leather placed into the rim mouth. The cork was then pushed into place with the leather forming a gasket between the rim and cork. The reason for this is unclear. It is

possible that the leather was intended to protect the cork from possible negative reactions with chemicals present in the resin or simply served as a gasket for a cork too small to seal the container.

Form I jars are analogous in both shape and date to Goggin's Middle Style Shape A. Though the jars are similar in shape to Goggin's examples, the 1724 specimens are proportionately larger in diameter, capacity, and weight.

Form II

Represented by 442 whole jars, Form II comprises 73.4% of the total olive jar assemblage. Approximately half as tall as Form I jars, Form II can be described as a small globular vessel with rounded bottom and sides that intersect sloping shoulders at a fairly pronounced angle. The circular rims have rounded sides and lack the prominent lip found on Form I, II and IV (Figure 4).

Forty-four jars (10% of Form II), chosen randomly, were measured. Measurements show the variation possible in a single cultural unit. Heights range from 23.5 cm to 29.5 cm. Maximum diameters range from 22 cm to 27 cm. Volumes of the jars have what appears to be an extreme range of between 3.3 l and 7.2 l. Half the jars have volumes between 5 l and 6 l. A quarter of the jars have volumes between 4 l and 5 l (Table 3). Weights of the jars, while evenly distributed throughout the range, differ substantially. There is a difference of almost 2 kg between the lightest and heaviest jar. As a rule Form II vessels with a large diameter and height have a greater volume and weight that a Form II jar of lesser height and diameter. Exceptions to this rule exist. A jar with a weight greater than another may have a lower volume, height and diameter. Because of these and many other variations throughout the Form II sample it appears, as it does for the other forms, that the vessels were not thrown with the aid of a shaping device but were thrown freehand.

The rims, all of the same basic shape, are as varied in size as are the bodies. Maximum external diameters range between 8 cm and 9.7 cm, minimum internal diameters between 3.6 cm and 5 cm, rim

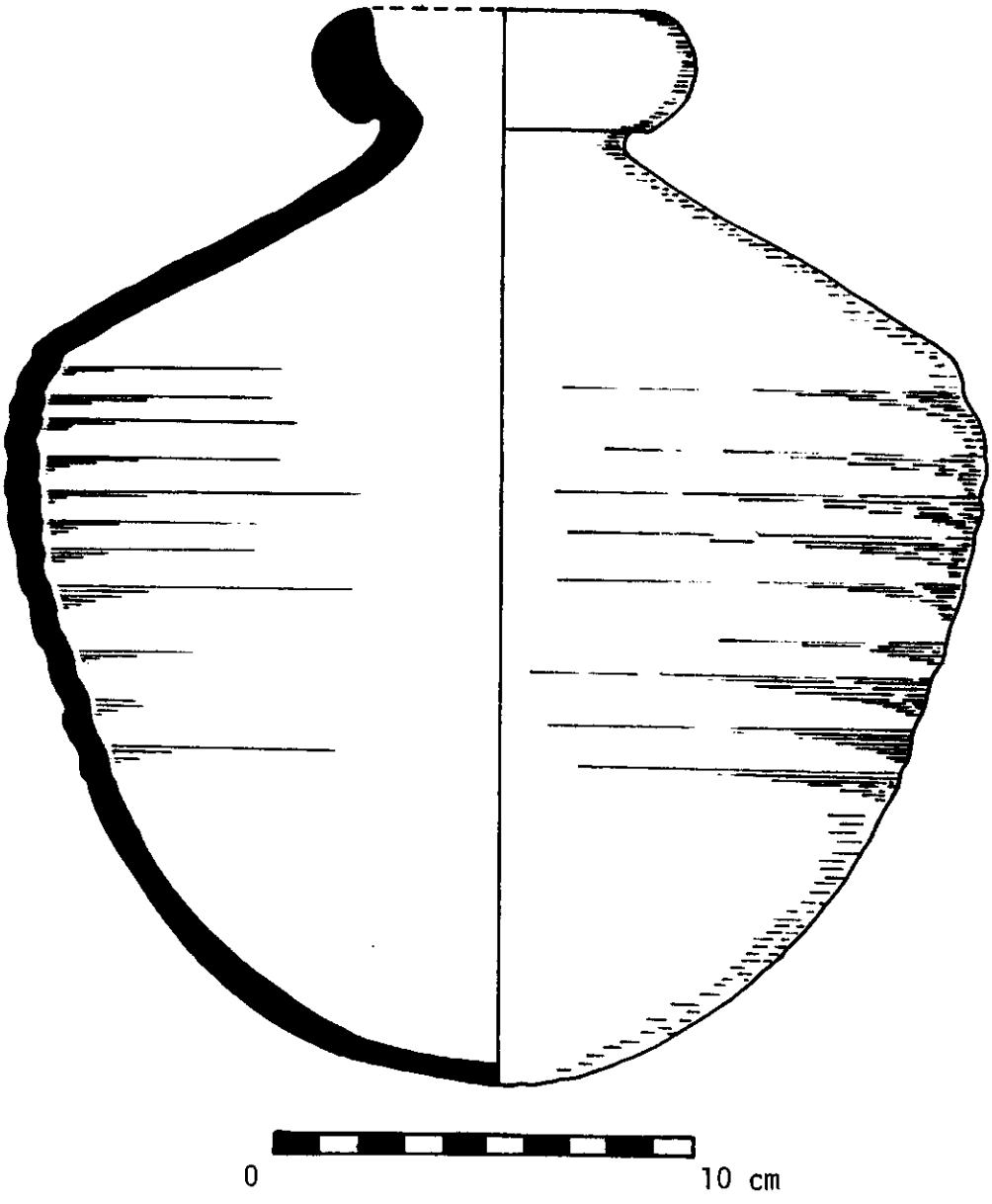

Figure 4. Form II.

Sample Number	Height (cm)	Maximum Diameter (cm)	Volume (l)	Empty Weight (kg)	External Rim Diameter (cm)	Internal Rim Diameter (cm)	Rim Width (cm)	Rim Height (cm)
1	23.5	21.8	3.3	2.83	8.9	4.2	2.3	2.7
2	25	22.8	4.6	2.83	8.9	4.4	2.2	2.7
3	28.5	24.5	5.6	3.06	8.9	4.7	2.1	2.9
4	27.5	24.2	5.5	3.3	8.3	4.4	1.9	2.8
5	27.25	24.5	5.5	3.41	9.0	4.4	2.3	3.1
6	29	26.4	6.5	3.96	9.5	4.7	2.4	3.0
7	28	24.2	5.5	3.74	9.2	4.3	2.4	2.9
8	28.75	26.8	7.2	3.63	9.2	4.8	2.2	3.0
9	28.25	23.9	5.5	3.85	8.2	4.3	1.9	2.4
10	29	25.5	6.2	3.63	9.0	4.8	2.1	2.8
11	26	24	4.6	*	8.5	4.1	2.2	2.4
12	24	22	3.3	2.77	9.0	4.5	2.2	2.7
13	27	24.5	4.2	*	9.5	5.0	2.7	2.7
14	23.75	22.1	3.9	2.72	8.8	4.4	2.2	2.7
15	28	24.5	5.3	3.57	9.5	4.7	2.4	3.0
16	25	23.6	4.3	2.94	9.0	4.5	2.2	3.0
17	25	22.6	4.2	*	8.5	4.3	2.1	3.0
18	28	24.5	5.5	3.41	8.3	4.2	2.0	2.5
19	24.25	23.6	4.5	3.06	9.4	4.9	2.2	2.8
20	28.25	24.8	5.7	3.4	8.5	3.9	2.3	2.7
21	27	24.2	5.2	3.41	8.2	4.3	2.5	2.8
22	27.5	24.5	5.6	3.11	8.5	4.6	1.9	2.4
23	26.25	25.5	5.7	3.91	9.6	4.8	2.4	2.7

* = concreted

Table 3. Form II Measurements.

Sample Number	Height (cm)	Maximum Diameter (cm)	Volume (l)	Empty Weight (kg)	External Rim Diameter (cm)	Internal Rim Diameter (cm)	Rim Width (cm)	Rim Height (cm)
24	28.25	26.4	6.7	3.85	7.4	4.9	1.7	2.7
25	29.0	24.5	5.5	3.74	8.5	4.2	2.1	2.5
26	24.0	23.2	3.8	2.72	9.0	4.4	2.3	2.5
27	25.5	22.9	4.6	2.38	8.8	4.5	2.1	2.5
28	27.5	24.5	*	2.8	8.8	4.3	2.2	2.8
29	29.5	24.5	5.9	3.08	8.8	4.9	1.9	2.8
30	27.5	24.8	5.4	3.41	9.5	4.5	2.5	2.8
31	28.8	24.2	4.1	3.42	8.5	4.1	2.2	2.6
32	27.5	24.5	5.1	4.13	9.0	4.7	2.7	3.1
33	27.75	25.3	5.7	3.63	9.4	4.4	2.5	3.0
34	27.0	24.4	5.1	3.4	9.0	4.4	2.3	3.0
35	27.5	24.0	5.2	3.45	8.0	4.2	1.9	2.6
36	26.0	23.6	4.9	3.88	8.7	4.8	1.9	2.9
37	29.25	25.3	5.9	3.41	9.7	4.8	2.4	2.6
38	26.0	24.5	5.0	3.34	9.2	4.7	2.2	2.6
39	24.5	22.6	4.0	2.72	8.7	4.5	2.1	2.6
40	27.25	24.4	5.6	2.94	8.4	3.6	2.4	2.8
41	27.5	25.2	5.5	3.77	8.3	4.1	2.1	2.6
42	26.0	23.9	4.8	3.08	9.4	4.7	2.3	2.9
43	26.5	23.5	4.8	*	9.0	4.5	2.2	2.7
44	25.0	22.0	4.5	*	8.5	4.3	2.1	3.0

* = concreted

Table 3. Continued.

heights between 2.4 cm and 3.1 cm, and rim width between 1.7 cm and 2.7 cm (Table 3).

Three hundred and seventy-four of the small globular jars (84.6%) are glazed either on the interior or on the interior and exterior (Table 2). The majority of the exterior glaze colors are emerald to light green. An occasional mottled brown occurs. Interior glaze colors consist of a dull greyish green, emerald, and light green. A white efflorescence, similar to that seen on Form I (above), is present on many of the vessels. During the glaze analysis the jars were inspected for contents. Out of 442 jars examined none contained any perceivable original contents. Numerous vessels had corks inside their bodies.

The paste is analogous to the paste of Form I (Appendix II). Like Form I vessels, the exteriors are compact and well smoothed. Exterior colors are the same as those present on Form I jars. Interior paste colors are generally terra-cotta to pinkish beige if well fired. Underfired specimens exhibit grey to dark grey cores.

The jars are similar in shape to Goggin's Middle Style Shape B jars but with a slightly more pronounced shoulder angle remeniscent of his Late Style B jars.

Form III

Comprised of only 11 examples, Form III makes up 1.8% of the total olive jar assemblage. The Form III jar is a small globular-shaped vessel with angled shoulders and slightly rounded sides. Though similar in shape and size to Form II jars, the rim style and base are entirely different. The base is concave, enabling the jars to stand erect. The jars have a lipped rim identical to those found on Form I and IV (Figure 5).

Form III can be divided into two different sizes, the larger examples having twice the capacity and weighing approximately twice as much as the smaller jars. The larger examples, of which there are eight, have heights ranging from 29 cm to 33 cm, weights ranging from 3.96 kg to 4.99 kg, maximum diameters ranging from 27 cm to 29 cm, and volumes ranging from 8 l to 10.2 l. The three smaller examples

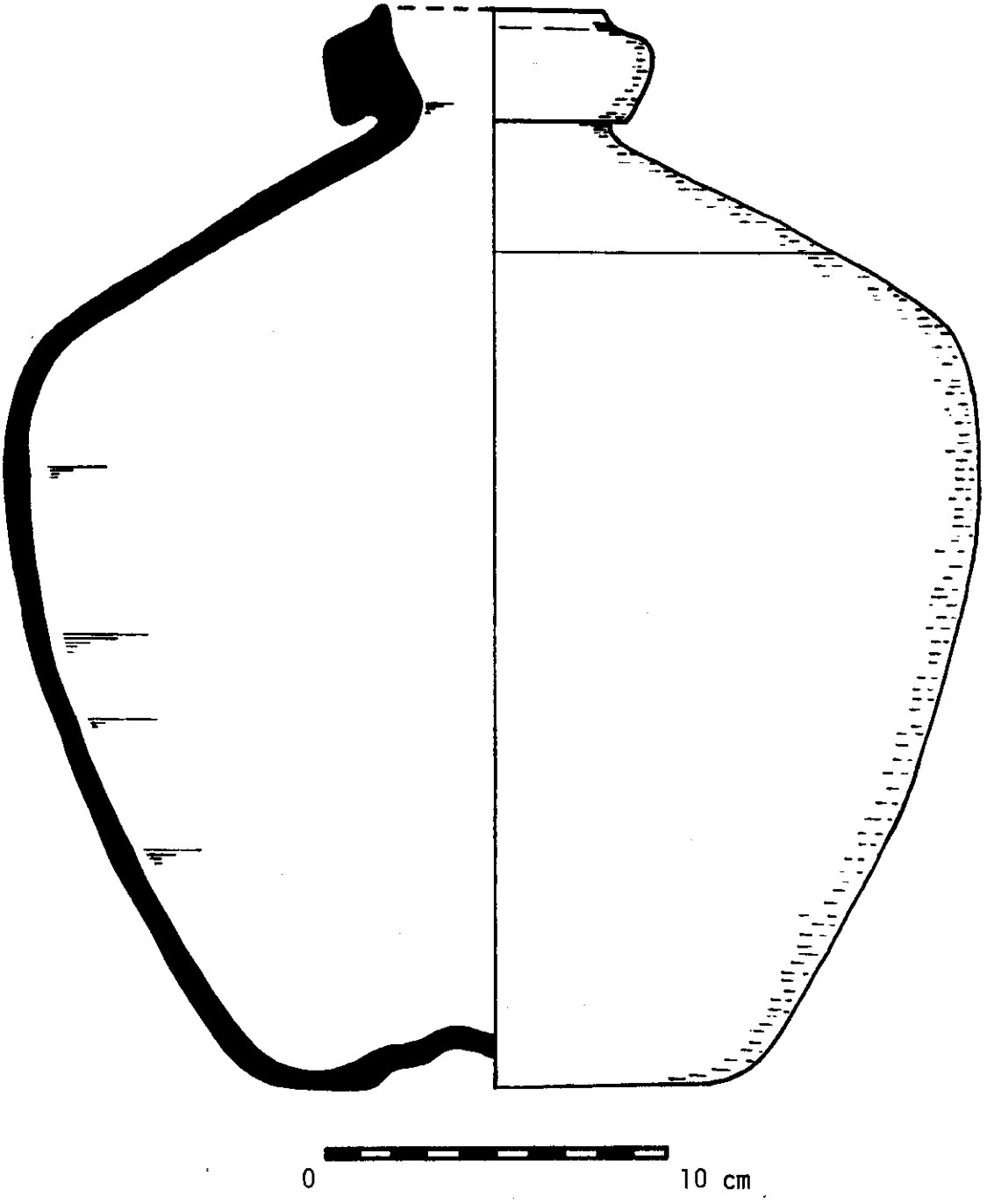

Figure 5. Form III.

have heights ranging between 24.5 cm and 26.5 cm and volumes which range between 4.1 l and 4.95 l. Because of external concretions on two of these examples only one could be measured for weight, 2.94 kg, and maximum diameter, 23.6 cm (Table 4).

All eleven jars, although of two different sizes, are identical in shape and manufacturing techniques. Form III, like I, II, and IV, appear to have been thrown in one piece with the rim thrown separately and added to the finished body. Throw marks or finger ribbing is well pronounced on the entire interior and on the exterior of the base and sides. However, the shoulders are smooth. On all Form III jars there is an incised line which circumvents the shoulder approximately midway between the rim and the point where the shoulders join the sides.

Rims for both sizes of the Form III jars are the same lipped rim as seen of Form I and IV. Rims of all three types are analogous in diameter, height, and thickness.

Of the eleven jars, six have glazes on both the interior and exterior, three have glazes on the interior, and two vessels are too concreted to ascertain glazing. Exterior glaze colors include dark emerald green, green, and light green. Internal glaze colors include green, greenish yellow, and clear. A whitish efflorescence (discussed earlier) was noted on the exteriors of several jars. Paste composition and color range is analogous to Form I (Appendix II).

No evidence of original contents was found. None were reported by the salvagers for this particular jar type. Closures were not found in association with these jars. In all probability, because Form III has the same rim style as Form I and IV, the jars would have employed the same cork closures associated with these forms.

Form IV

Conical or carrot-shaped jars make up the fourth and final form of olive jar recovered from the two wrecks. Form IV is comprised of 20 jars or 3.3% of the total assemblage. The jars, ranging in height from 36 cm to 45 cm, have lipped rims. The shoulders are rounded and

Sample Number	Height (cm)	Maximum Diameter (cm)	Volume (l)	Empty Weight (kg)	External Rim Diameter (cm)	Internal Rim Diameter (cm)	Rim Width (cm)	Rim Height (cm)
1	31	29	10.2	4.99	9.8	4.5	2.6	2.8
2	33	29	10.2	4.99	10.0	4.5	2.7	3.0
3	31	29	10.0	4.99	9.4	4.5	2.5	3.0
4	29	27.5	8.5	4.19	9.8	4.5	2.6	3.0
5	29.5	27.7	9.1	4.24	9.5	4.5	2.5	3.0
6	29.5	27	8.0	3.96	9.6	5.5	2.0	3.0
7	*	*	*	*	*	*	*	*
8	*	*	*	*	*	*	*	*
9	24.5	23.6	4.5	2.94	9.0	4.4	2.3	2.9
10	25	*	4.1	*	9.5	4.5	2.5	2.6
11	26.7	*	4.95	*	9.4	*	*	3.0

* = concreted

Table 4. Form III Measurements.

the main portion of the body has either straight or incurvate sides angling down to a pointed base (Figure 6). Maximum diameters range from 18.2 cm to 19.3 cm, volumes from 3 l to 3.8 l, and weights from 2.83 kg to 3.65 kg (Table 5).

None of the vessels have exterior or interior glazing. The white efflorescence, discussed above, is apparent on the exterior of several of the jars. Paste composition (Appendix II) and color, both interior and exterior, are analogous to the other three forms with two exceptions. The paste color on those two vessels is black in color. The reason for this deviation is unclear.

The vessels appear to have been thrown in one piece with the rim added. The lipped rims are the same shape and have the same size range as the rims on Forms I and III. Pronounced finger rib marks are evident on the interior from the pointed base to just below the rim. Exterior surfaces are smooth.

The conical jars, although similar in shape to Goggin's Middle Style Shape C jar, are much larger than his examples. The jars with the straight sides are closer in shape to his Middle Style C than the jars with incurvate sides. The incurvate-sided jars have slightly bulbuous shoulders and appear to be a mixture of Middle Style C and Late Style D shapes. Three jars excavated at Fort Louisbourg, Nova Scotia, are identical in size and shape to Form IV vessles. They date between 1713 and 1768 (Barton 1981:40-45).

Numerous olive pits were contained in two of the jars. Cork closures were not encountered in the analysis of this form, but a review of the salvagers excavation records state that corks were associated with "cone amphora". Though no other type of closure was noted for the four forms, various methods of sealing olive jars are known. Olive jar rims recovered from the Santa Margarita and Nuestra Señora de Atocha, Spanish galleons wrecked in 1622, had corks still in place. Two of the corks were cemented to the rim by a pez or pitch, presumably to seal the mouth of the jar (McIntyre 1983:10). Ceramic closures, associated with olive jars, have been reported in two assemblages. Two discs of unglazed flattened clay were recovered with the Fort Louisbourg examples which are identical to Form IV.

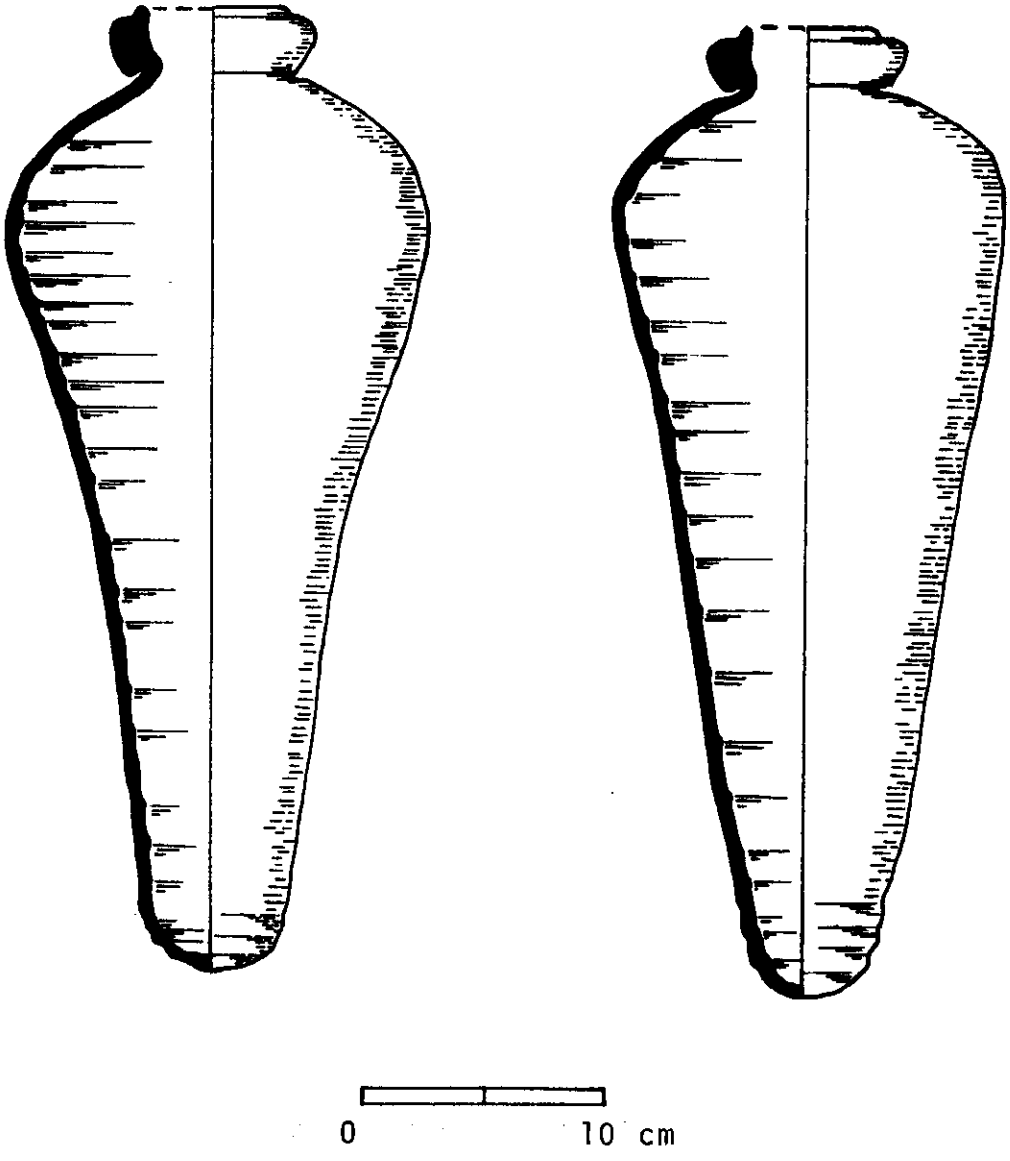

Figure 6. Form IV.

Sample Number	Height (cm)	Maximum Diameter (cm)	Volume (l)	Empty Weight (kg)	External Rim Diameter (cm)	Internal Rim Diameter (cm)	Rim Width (cm)	Rim Height (cm)
1	43	19.3	3.35	3.56	10.0	4.5	2.7	3.0
2	41.5	18.8	3.5	2.94	10.0	5.5	2.2	3.1
3	36	18.8	*	*	9.5	5.0	2.2	*
4	44	18.5	3.8	3.14	8.7	5.3	1.6	2.5
5	44	18.2	3.7	2.83	8.7	5.2	1.7	2.8
6	43	19.1	3.65	*	9.4	4.3	2.5	3.3
7	41	18.6	3.1	*	8.7	4.8	2.0	*
8	42	18.8	3.3	3.5	9.4	4.4	2.5	*
9	45	18.5	3.8	3.28	9.3	5.0	2.1	3.0
10	43	*	*	*	9.6	*	*	*
11	41.5	19.1	3.25	*	9.6	4.4	2.6	3.1
12	40	*	3.7	*	*	*	*	*
13	39	18.9	3.8	3.17	9.5	4.9	2.3	2.7
14	41	*	3.25	*	9.2	*	*	*
15	*	*	*	*	*	*	*	*
16	*	*	*	*	*	*	*	*
17	43	18.5	3.2	3.39	9.0	4.9	2.0	2.6
18	40	18.8	3.0	3.5	9.0	4.5	2.2	3.2
19	*	*	*	*	*	*	*	*
20	*	*	*	*	*	*	*	*

* = concreted

Table 5. Form IV Measurements.

The two discs are presumably "used as the base for lids or seals of either wax or resin poured over them to prevent the contents of the jars from leaking" (Barton 1981:40-43). However the paste type does not conform to Middle Style characteristics (Fairbanks 1975:35). The undated olive jar assemblage recovered from the River Rance in France contained two ceramic closures. Different than the Fort Louisbourg specimens, the Rance examples taper from top to bottom and one specimen has a handle (Langouet 1973:101).

IV TYPOLOGICAL REVIEW

Four distinct olive jar forms are present in the ceramic assemblage recovered from the two wrecks. Forms I and II represent Middle Style A and B shapes previously classified by Goggin (Figures 1, 2, and 3). Form III, to my knowledge, has not been reported from New or Old World sites. Form IV, similar to several shapes classified by Goggin, can best be described as a mixture of characteristics from his Middle Style Shape C and Late Style Shape D jar. Forms I and II indicate the size variation possible in jar shapes. Form I is proportionately larger in diameter, capacity, and weight than previously reported Middle Style A vessels. Form II jars, when compared to Middle Style Shape B, have slightly larger diameters and volumes.

Goggin's Middle Style B is described as a medium-sized, compressed egg-shaped vessel. His Late Style Shape B jar is also a "compressed egg-shaped vessel, fairly close to Middle Style Shape B jars. ...however the sharpness of the angle of the shoulder tends to be more pronounced" (Goggin 1960:12-18). Form II vessels have a pronounced angle at the shoulder. If the Form II jars are compared to the Middle and Late Style B jars, using sharpness of the shoulder angle as a main differentiating characteristic, the From II jars could be classified as Late Style B. But besides shoulder angle, rim shape, rim thickness, and paste are also used as distinguishing characteristics for the two Style B jars. Of the five rim shapes found on Late Style jars only rim A (Figure 7), which is sometimes found on Late Style B, can be easily distinguished from Middle Style rims due to its characteristic shape. The remaining four shapes are similar to Middle Style rims. Goggin proposed that thickness of the rim, though variable, is a significant diagnostic when comparing Middle Style with Late Style forms having these similar rims; the Late Style has a smaller rim thickness. It is not completely clear what Goggin means by "rim thickness". Thickness could refer to height or width (Figure 8). In a comparative study conducted on rims recovered from the Margarita and Atocha, rim thickness is the term

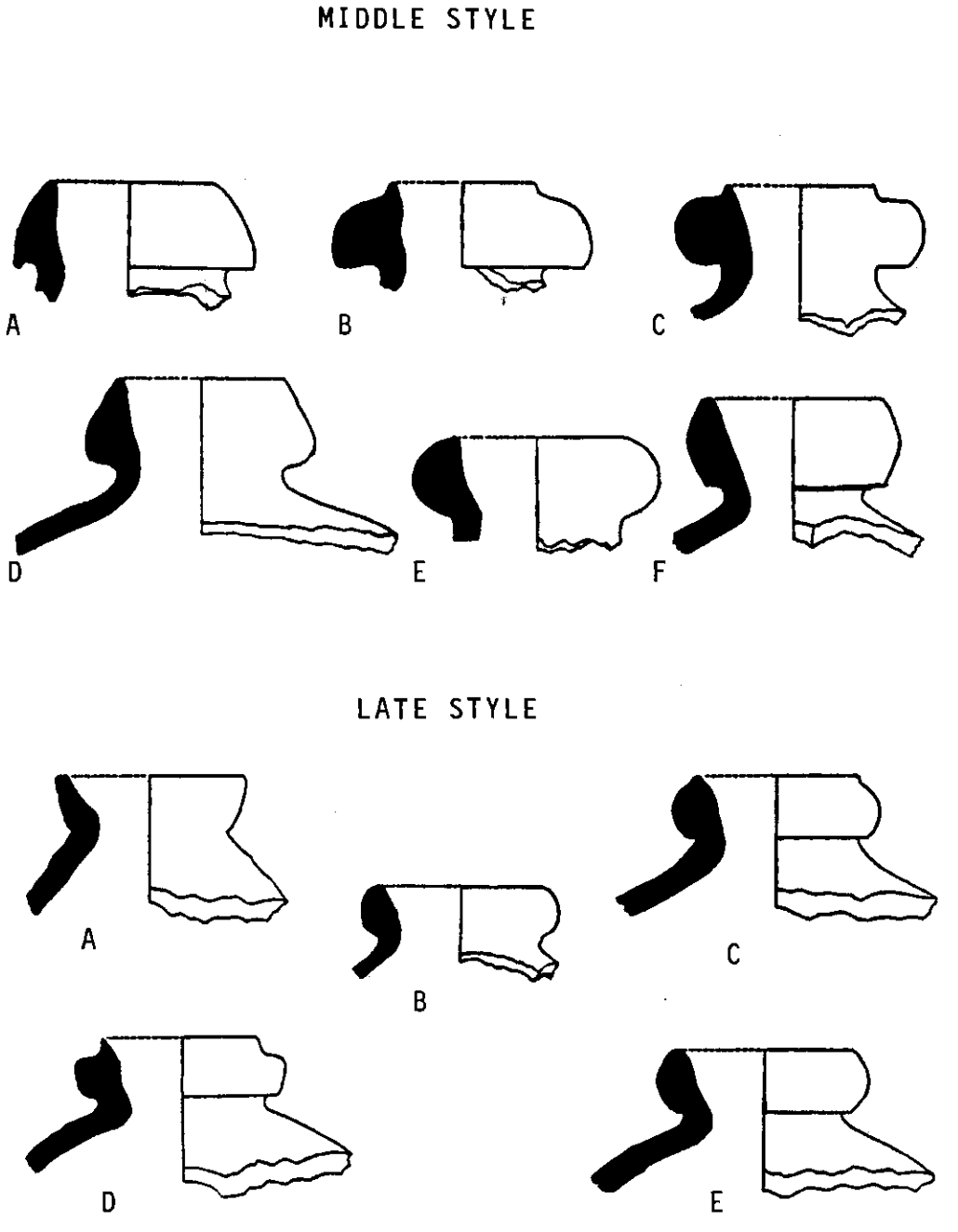

Figure 7. Middle and Late Style Rim Shapes (After Goggin 1960).

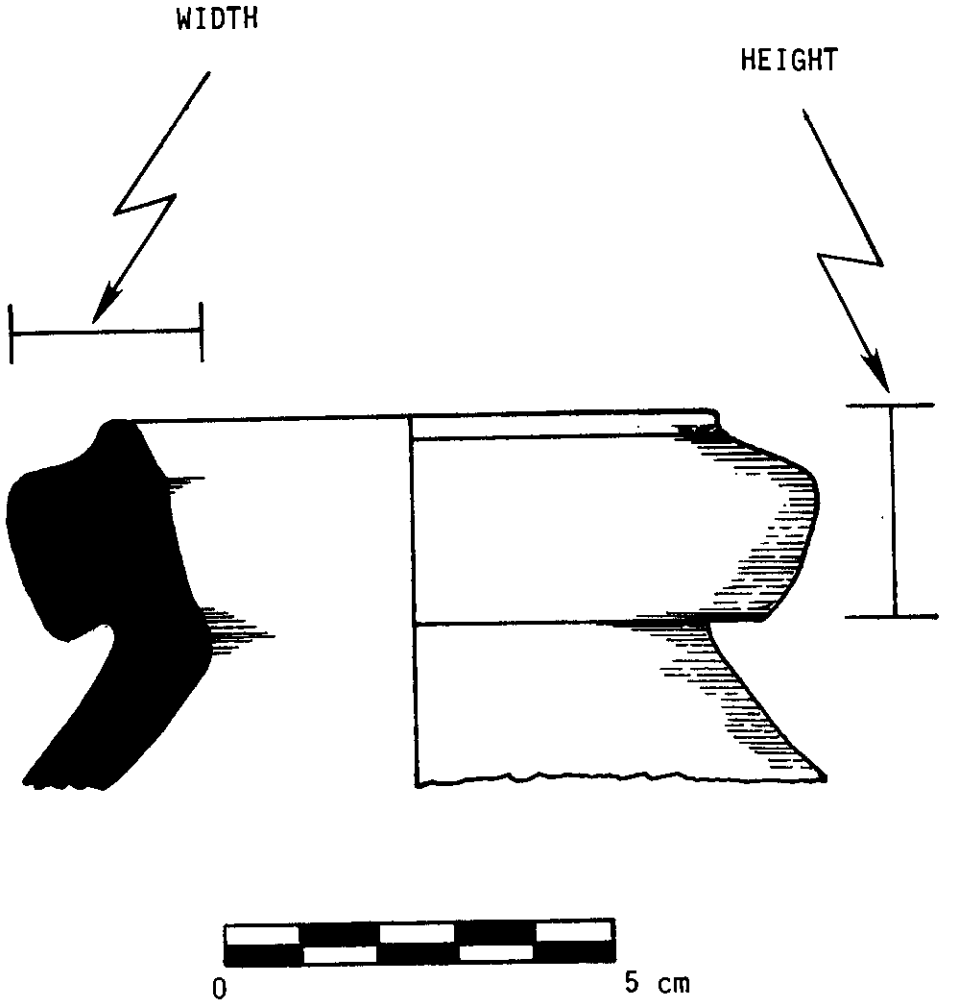

Figure 8. Rim Attributes: Height and Width.

used to describe the rim width (McIntyre 1983). The ambiguity of the term thickness dictates that both rim attributes, height, and width, be analyzed to determine if they can be employed to distinguish between Middle and Late Style rims. In a series of rim measurements taken by Goggin, thicknesses ranged from 10.5 mm to 29 mm on 63 Middle Style rim fragments and 13 mm to 20 mm for 6 Late Style rim fragments. Rim widths on 44 Form II rims range between 17 mm and 25 mm. Nearly 40% range between 17 mm and 21 mm. Forty percent of the rim widths from the Atocha and Margarita range between 16 mm and 21 mm. This high percentage of the measurements can be placed in the ranges of both the Middle and Late Style, indicating that rim width cannot be used to distinguish between the two Styles. On the other hand the Styles do differ in rim height ranges. Rim heights of 44 Form II rims range between 24 mm and 31 mm. Heights for the remaining Forms range between 25 mm and 43 mm. The Atocha and Margarita have rim heights from 24 mm to 43 mm. All fall within the Middle Style range and are larger, some appreciably, than those of the Late Style. However the small sample of Late Style rims used by Goggin in contrast to the large sample of Middle Style may conceivably be the cause for the low range of the Late Style rim thicknesses (height). A classic Late Style D vessel; rediscovered in storage at Cardiff Hall, St. Ann's Parish, Jamaica and currently on display at the Old Naval Hospital museum in Port Royal, indicates that perhaps more data may increase the Late Style range. It had a rim height of 25 mm, well within the Middle Style range. Because of the small sample and the fact that the ranges do overlap, the integrity of utilyzing rim height to distinguish between the two styles is questionable. Since rim thickness, height or width, rim shape and shoulder angle are not necessarily differentiating characteristic, distinguishing between the two Style B jars may rest soley on paste recognition. The paste of Late Style B jars is distinct from Middle Style B in its chalky consistency and low temper content (Goggin 1960:26).

Form III, with its lipped rim and concave base, is a unique form previously unreported from terrestrial or shipwreck sites. Similar

in body shape to Form II, it has the added feature of a concave base that allows the jar to stand erect. The lipped rim, also present on Forms I and IV, is not found on Form II. Form III can be divided by size into two groups, large and small. The small jars are similar in size, weight, and volume to Form II while the larger jars further distinguish themselves from Form II by having greater weights and much larger volumes. Like the posulate of two sizes of Middle Style B (below), the Form III assemblage may be so small that it lacks representative samples which would close the gap between the two size groups. The absence of this form from other sites questions the validity of categorizing this jar style. However Late Style A jars, similar to Form I, have been reported only from the city of Mérida in Yucután, Mexico. Middle Style C jars, encountered only in Santo Domingo, were considered rare at the time Goggin's typology was published (1960:13-21). Since his study, Middle Style C jars have been reported from France (Langouet 1973) and Bermuda (Peterson 1969).

Form IV is a mixture of Middle Style C and Late Style D characteristics. The jars are conical wtih sides that vary between incurvate and straight. The straight-sided jars are similar in shape to Middle Style C but maximum diameters on all Form IV vessels are larger. They average over 15 cm taller with some specimens 20 cm higher. Volumes and weights are three times larger (Table 4). Goggin documented measurements for only one Shape C (1960:13-14), but jars recovered from France and Bermuda are comparable in size to his specimen. Distinguishable by paste types, incurvate sided jars are similar in shape to Late Style D though not as bulbous. With one exception, vessels analyzed by Goggin are smaller than Form IV specimens. The Shape D example that differs is appreciably larger than Form IV jars. Two vessels, one analyzed in Port Royal, Jamaica (Cardiff Hall specimen), and one recovered in North Carolina (Lawrence, personal communication 1982) complete the Late Style D size range. Both are similar to size to Form IV. The three jars excavated at Fort Louisbourg are contemporaneous and identical in size and shape to Form IV (Barton 1981). Their existence suggest

that Form IV jars are not coincidental variations of other forms. Form IV jars are much larger and differ slightly in shape to Middle Style C. Besides having a different temporal context than Late Style D, they differ in shape and paste type and have a much more uniform size range. It is interesting to note that in Fairbanks' analysis of the Fort Louisbourg ceramics he states that Late Style D jars were seen in the assemblage. (1975:32). Because of recognizable similarities and a paucity of archaeological evidence for these jars, one must hesitate in stating that they are a distinct form. Evidence of their relationship to Shape C and D might be found in the chronological record. As we have seen Middle Style C has only been dated to the first quarter of the seventeenth century. Goggin does not date his examples (1960:13-17) and the jars from France were from a nondateable context (Langouet 1973). The only securely dated examples come from the 1621 wreck of the San Antonio (Peterson 1969:182-183). The early seventeenth century date of Middle Style C, in concert with the early to mid-eighteenth date of Form IV, invites the suggestion that the different jar forms might conceivably be designated as Middle Style C, late sixteenth to Late seventeenth century; Form IV, eighteenth century; and Late Style D, late eighteenth to mid-nineteenth century.

V. GLAZE, SHAPE, AND CONTENT CORRELATIONS

The analysis of glaze, shape, and content relationships reveals several interesting aspects of the olive jar assemblage. Four hundred and sixty-eight of the jars (77%) are glazed either internally or internally and externally. None are glazed externally exclusively. Eighty-five jars (14%) are unglazed and 49 (8%) are too concreted to ascertain (Table 2). This high percentage of glazed jars contrasts markedly from analyzed assemblages of sixteenth, seventeenth, and eighteenth century Spanish terrestrial sites. Glazing of olive jar fragments from these contexts appears to be less frequent through time. The frequency of glazing in the olive jar assemblage from Nueva Cádiz, 1498-1545, is 44% (Willis 1976:123). Frequencies are just less than 15% from late sixteenth century sites, 1570-1600, and even lower from eighteenth century contexts at St. Augustine, Florida (Deagan 1978:34). In the analysis of sherds from six seventeenth and eighteenth century sites, Goggin found that five of the six sites had extremely low frequencies of glazed fragments, some less than 1%. The collection controls from the one site that differed were in question (1960:14-15). This apparent decrease in the frequency of glazing through time has been suggested as a temporal indicator (Deagan 1978:35). However the preponderance of glaze on the Tolosa and Guadalupe specimens, contemporaneous to the later sites, questions the validity of using glazing as a temporal index.

It should be mentioned that little, if anything, is known about the detrimental effects on glazes during deposition. The majority of course earthenware fragments recovered from the Molasses Reef Wreck, an early sixteenth-century wreck currently undergoing excavation and analysis (Keith et.al 1984), were unglazed. The sherds that had evidence of glazing retained only a few minute flakes of glaze to indicate they had infact been glazed. Because many unglazed fragments were obviously from the same vessels as the glazed sherds, one can only wonder if they too had been glazed. Since the wreck was located in a dynamic area of constant wave action, it should be

viewed as an extreme example of adverse conditions. It does however serve to illustrate that glazes can be affected by the environment to which they are subjected; the frequency of glazing on recovered ceramics not necessarily reflecting the original frequency of glazing present at the time of deposition. Due to the excellent condition of glazes on the olive jars recovered from the Tolosa and Guadalupe, the glazing frequencies are considered to be accurate representations of the original state of the jars.

The frequency of glazed jars is higher than nonglazed jars in Forms I, II and III. All Form IV jars are unglazed. Because both glazed and nonglazed jars are represented in Forms I and II, correlations between glazing and shape are not apparent. Eighty five (66%) of Form I are glazed and 37 (28.7%) are unglazed. Only the unglazed vessels held remains of their original contents. Twenty-three jars were filled or partially filled with pitch and 7 contained olives. Nine of the 11 Form III jars are glazed. The remaining 2 jars are too concreted to ascertain glazing. Because of these two jars, one cannot assume that this form is always glazed. These jars, like Form II, are void of original contents, making correlations between shape and contents impossible. Though of similar shape and size to Form II, Form III differs markedly in rim and base styles. Form III vessels might possibly have held different contents than Form II jars with the eccentric rim and base combination intented to facilitate identification of that contents. Form II jars have an extremely high rate of glazing with only 28 (6.3%) of the 442 jars being nonglazed. Goggin has speculated that glazing may be more common in this vessel shape (1960:15). Findings from this assemblage, together with data from other sites, support his early suggestion (Barton 1981:102; Harris 1972:102; Platt et al 1975:179; Sassoon 1981:119). All Form IV vessels are unglazed. The only known examples similar in size and shape were recovered from Fort Louisbvourg. These three examples are also unglazed.

Both glazed and unglazed jars are present in the Tolosa and Guadalupe assemblage, the latter being considerably less frequent. "The presence of both glazed and unglazed forms of this vessel has

led some scholars to speculate that glazed types were used for liquids such as wine, while heavy liquids such as oil could be shipped in the unglazed forms without danger of seeping through the porous vesseld walls" (Goggin 1960:6). The only contents recovered from any of the jars, pitch and olive pits, were in unglazed forms. Over a third of all the unglazed jars contained remains. This high incidence of content remains in unglazed jars, which comprise only a small percentage of the total assemblage, may be an indication that glazed jars did not contain the same provisions and supplies as unglazed jars. Upon viewing the pitch one realizes that there is no need to place this viscous substance into a glazed container. It is not so readily apparent why the jars containing olive pits were unglazed. While the olives could have been dried, thus eliminating the need for glazing, a jar recovered on the coast of North Carolina shows that olive oil was employed in the shipments of olives. The Late Style D jar retained its original seal and contents of olives and olive oil (Lawrence, personal communication 1982). The glazing and contents of the North Carolin speciamen suggests that, while not necessarily incorrect, previous speculation on the correlation of contents and glazing may not always be the case.

First century A.D. dolia (very large Mediterranean ceramic jars), employed as olive oil containers, were internally waxed to prevent the oil from penetrating into vessel walls. Oil that was allowed to permeate the clay became rancid and foul smelling. The fetidness evidently made reuse of the jars impossible or illadvisable, resulting in their disposal or destruction (Ash et. al. 1968: 316-319). Second century A.D. oil amphorae, Dressel Types 19 and 20, produced in the Betica region of Spain, comprise the top layers of a large hill in Italy of broken ceramic containers. Deposited layer upon layer the amphorae fragments were systematically covered with subsequent layers of quick lime to counteract the umpleasantries of decaying olive oil. The internally uncoated jars could not be cleaned on the interiors due to small neck diameters, thus necessitating in their disposal after a single use (Rodríguez Almeida 1972: 115-116). This practice may reflect on the use by the Spanish

of glazed jars to contain olive oil. It is possible that glazing was utilized not only on containers for certain items but as insurance that jars could be reused for whatever they wished to place in them. We know that ships returning to Spain carried numerous jars. The 75 vessels recovered from the Atocha and Margarita, bound from Havana to Spain, are considered to be only a fraction of what will be recovered once the primary cultural deposits are located (McIntyre 1983:6). The San Antonio, bound from Havana to Spain, carried numerous commerical products from the New World. Among the goods destined for Spanish markets was cochineal dye. Because many recovered olive jar fragments were stained red on their interiors it is believed that the jars were used to carry this dye (Peterson 1972:258). The Nuestra Señora de las Maravillas, also bound from Havana to Spain, carried at least 4000 jars (Smith 1979:34). It can be safely assumed that the majority of the 4000 jars contained commodities and provisions obtained in the New World. One of the most important provisions probably held in these jars (glazed?), and one which is not mentioned or dealt with in any study, is water. A document listing supplies carried by the nine ships of Pedro Menéndez' fleet bound for Florida lists 2500 botijas peruleras of water (Ruidiaz Caravia 1893:561). Because there is no evidence of olive jar production in the New World the origin of jars found on homeward bound ships is in question. Certainly among the foodstuffs contained in olive jars were items from Spain such as wine, olives and oil, brought to Havana by newly arrived ships, and purchased for the journey home. Other provisions and commodities such as water and cochineal dye would have been placed into empty jars, the jars either coming from the ships themselves or from the location of the commodity or provision. Whatever the case, it is highly probable that numerous jars were reused as shipping containers, especially in the homeward bound journey.

The replacement of the Early Style jar with Middle Style forms, and they in turn by Late Style vessels, is fairly well documented. The presence of the latter two styles on archaeological sites can be attributed to the demands of a changing economy brought about by the

colonization of a new empire. But reasons for utilizing these certain jar shapes can only be speculated. We know through literary and archaeological records that numerous types of provision and supplies were shipped in the jars; there were too many for each item to receive its own specifically shaped jar. The presence of olive pits in Forms I and IV illustrates this point. One hypothesis dealing in part with the presence of certain jar shapes is the tentative suggestion by Colin Martin that there may exist

> two distinct categories of olive jars; a stereotyped official form made to contractual specifications for the Case de la Contratacion and associated with military supply and trans-Atlantic trade, and a 'civilian' version produced by the same potteries but for a wider general market, the diversity which is reflected in its considerable variety of 'non-official' forms (1979:283).

It should be noted that the only "civilian" jars referred to were specimens recovered from the River Rance. It is my opinion that the Rance assemblage (Langouet 1973) does not differ markedly in size or shape from Middle Style forms classified by Goggin. In the analysis of olive jar material from the Spanish Armada wrecks of 1588, Martin observed that the internal volume of the Middle Style B jar from the La Trinidad Valencera was 6.25 l. Because the volume was almost exactly half the old Castillian oil arroba of 12.56 l and jar remains from the other wrecks were of similar size, it was postulated that the half arroba measure was the volume intended. He sites documentary evidence and jar sizes from other "official" contexts as support for the existence of a "standard" half arroba jar. Use of term such as media arroba botija (half arroba jar) in literary sources cannot be ignored, but the archaeological record does not readily support a Middle Style B jar and a half arroba volume relationship. Martin, noticing that jars from "official" contexts generally fell into two sizes, one of which relates to the half arroba jar and other slightly smaller, lists sizes from six jars including Goggin's examples recovered from several sites. The larger jars, half arroba size, have height ranges between 29.6 cm and 30 cm and maximum diameters between 21.6 cm and 23.5 cm. The smaller group

has a height range between 23.4 cm and 24.1 cm and a maximum diameter range of 20.3 cm to 20.9 cm. Form II jars, also from an "official" context, do not fall into two size groups. Quite the contrary, the jars reflect the enormous variation possible for a certain shape (Table 3). The volume of Form II vessels range between 3.3 l and 7.2 l. Most volumes are in the 4 l to 6 l range with few approaching the 6.25 l measure of the half arroba (Table 2). Though no Form I, Middle Style A jars were recovered from the Armada wrecks, Martin, in order to further substantiate his hypothesis that jars were manufactured to certain specifications, notes that Goggin's examples have an average capacity of 16 l to 17 l, similar to the Castillian wine arroba of 16.133 l. The volume variations of Form I vessels, like Form II, are extreme, ranging from 15 l to 20 l, with the majority falling between 18 l and 19 l.

The enormous variation in the volumes of the Tolosa and Guadalupe vessels imply that the jars were not manufactured with a specific capacity in mind. But a list of goods shipped to the New World from Spain in 1579 suggests the opposite. It indicates that the containers were the measure on which prices for the various commodities were calculated: botijas for wine, botijas medias peruleras and botijas peruleras for olive oil and botijuelas for honey (Schafer 1938:317-323). Additional information supports the contention that the different jar sizes and the terms identifying them were based on a system of measures. Carrera Stampa, in an analysis of the evolution of weights and measures in New Spain, found that the term botijuela, used as a measure for honey, was approximately 10 kg. Botija, a measure for wine, alcohol, and other liquids, varied from 5 l to 8 l (1949:12-13). García Fuentes, studying archival records of commerce between Spain and the Americas from 1650-1700, states that containers were not only of a certain measure but their bolumes were in accordance to various laws. The capacities of pipas and barriles, casks used to carry wine, presented certain discrepencies in their measures but the botija, also used to contain wine, "generally showed up with a capacity of 1.25 arrobas in accordance to Ley I, Titulo XXI, Libro IX de la Recopilacion. There

is a second botija of 1.5 arrobas, better known as the botija perulera, rarely used in the exportation of peninsular liquids" (1980:243-244). While revealing that specific capacities were intended, the information appears to be contradictory when cross referenced. García Fuentes' source states that the botija perulera was rarely used in the exportation of peninsular liquids. Admittedly 85 years earlier than García Fuentes' period of study, 720 botijas peruleras or wine are listed as supplies aboard the Menendez fleet of 1565 (Ruidiaz y Caravia 1893:561). At the same time Schafer notes that the botija perulera, which as we have seen was a container for wine in the Menéndez fleet, was a measure for oil and that the boitja was the measure for wine.

Besides being contradictory, it becomes confusing if one attempts to apply the measures to known jar volumes. Though it is unclear what type of arroba is intended by García Fuentes' statements, if we inject the volumes used by Martin for both the Castillian oil and wine arroba into the 1.25 and 1.5 arroba capacities we are left withs: for wine, 1.25 arrobas X 16.133 = 20 l and 1.5 arrobas X 16.133 = 24 l; for oil, 1.25 arrobas X 12.56 = 15.7 l and 1.5 arrobas X 12.56 = 18.8 l. All the botija volumes (1.25 arrobas) are appreciably larger than the botija capacity (5 l to 8 l) for New Spain. With the exception of the 24 l volume, which is larger than the volume of any olive jar recovered thus far, the capacities can be contained only in Form I, Shape A jars. If the contention is correct, which it appears to be, that the jars and the terms that identified them were based on a system of measures, the volume variations may indicate that different forms represented certain capacities but their actual volumes were only approximations of the intended measure. However, the contradictions and discrepencies inherent in the information gleaned from archival sources leave the problems of identifying the quantities intended and the correlations of terms with those quantities unsolved. Determining their solution may ultimately depend on the identification and analysis of much more archival material in concert with future archaeological evidence.

VI RIM AND BODY SHAPE CORRELATIONS

Correlations between rim and body shape in the assemblage are apparent. There are four jar forms but only two rim forms. The lipped rim is associated with Form I, III, and IV. The rounded rim is found only on Form II. Several authors have noted the existence of rim and body shape relationships. Goggin associates several rim shapes with specific Late Style jar shapes. He does not make any association for the Middle Style. Though he recorded numerous rim shapes for each style (Figues 7), it is interesting to note that all his illustrations of Shape A and B vessels, Middle and Late Style, depict jars with only two rim shapes (1960:Plates 1-7). Shape A jars have a lipped rim similar to those on Form I, III, and IV. Shape B jars have rounded rims similar to those on Form II. A related study was conducted on numerous olive jars recovered from the mouth of the River Rance near St. Malo, France. Presumably from a wreck or wrecks, the jars were from a non-dateable context. Langouet in his analysis of the material notes a distinct relationship between rim and jar shape. Three jar forms, analogous to Middle Style shapes, are represented in the assemblage. The rim and body shape combinations for the Rance jars, similar to Middle Style A and B, are present on Forms I and II and Goggin's illustrated Shapes A and B. Langouet associates a quasi-triangular rim similar to Middle Style A and D (Figure 7) with the small conical Rance jars. He differentiates between the rims on the conical and Rance shape A jars, but several rims on the conical jars are almost identical to those on Shape A jars (1973).

When comparing the Tolosa and Guadalupe material, the Rance assemblage, and Goggin's specimens, together with other known Middle Style jars, certain correlations emerge. Middle Style A and Form I have lipped rims of various shapes (Barton 1981:42; Goggin 1960; Langouet 1973: Peterson 1969:183: Platt et. al. 1975:178; Smith 1979:44). The rounded rim is found only on Shape B, Form II (Baart et al. 1977:264; Barton 1981:44, Borrell 1983:103; Goggin 1960; Harris 1971:65; Langouet 1973; Mayes 1972:108; Peterson 1969:183;

Platt et al. 1975:178). Though not the only rim shape present on this jar form it is predominant. Middle Style B jars recovered from a 1697 Portuguese wreck in the old harbour of Mombasa, Kenya, have rims similar to Goggin's MIddle Style D (Figure 7) but with a discernable lip (Sassoon 1981:119-120). Jars from the Armada wrecks have rims also similar to Middle Style D (Martin 1979). Middle Style C jars have lipped rims of various shapes similar to Figure 7 a,b, and d (Goggin 1960; Langouet 1973; Peterson 1969:183). Form IV jars have lipped rims as illustrated in Figure 6. Rim shapes of Middle Style jars, with the exception of the rounded rim (Figure 4), are not diagnostic of a specific jar shape. The rounded rim is indicative of Shape B or Form II jars.

Scholars have speculated on rim attributes as being temporal indicators. As we have seen, rim height and width are not reliable characteristics when distinguishing between Late and Middle Styles. The enormous variability of rim shapes prohibits quantifiable classification. Other scholars do not consider rim variations particularly diagnostic. Instead they view them not as products of an industrialized society but as products of Spanish artisians "who placed little importance on the kind of exactitude that we Anglo-Saxons seem to think is critical" (Lister, personal communication 1984). With the exception of Early Style and Late Style A rims, both of which are temporally diagnostic, archaeological evidence supports this position. However it does not explain why in the Tolosa and Guadalupe assemblage we encounter two distinct rim types on over 600 jars, and why in the total olive jar record the rounded rim is represented only on Form II, Shape B jars. Answers to these questions remain elusive.

VII CONCLUSION

Although several olive jar studies have been undertaken data ascertained form the analysis of the Tolosa and Guadalupe assemblage reveals information that is crucial to our understanding of the chronological and typological framework of this ceramic complex. A brief synopsis of information relevant to the assemblage alone and to the olive jar present in the archaeological record of Spanish material culture includes:

1. Form I and II are analogous to types classified by Goggin.
2. Form III represents a previously unclassified type.
3. Form IV, similar to both Middle Style C and Late Style D, appears to be a unique type. It may be a chronologic and stylistic link between the Middle and Late Style jars. Tentative dates are: Middle Style C, late-sixteenth to late-seventeenth century; Form IV, eighteenth century; and Late Style D, late-eighteenth to mid-nineteenth century.
4. Middle and Late Style jar forms do not necessarily occur throughout their respective time periods. The only secure date for Middle Style C is 1621. Middle Style A is present between 1621 and 1733.
5. Predominance of Middle Style fragments, as opposed to only three identifiable Early Style sherds in St. Augustine olive jar material dated between 1570 and 1600, suggests that Middle Style jars may have been introduced at a somewhat earlier date than 1580 (Deagan 1978:34). Three jar types are listed aboard ships in the 1565 fleet bound for Florida (AGI CT 2932; Ruidiaz Caravia 1893:559-561). Because only one type of Early Style jar is known, the use of three different jar types implies that two or more are Middle Style jars. The early appearance of this style (1565) appears to be reflected in the archaeological record of St. Augustine.
6. Glazing frequently should not be used as a temporal indicator.
7. Glazing, possibly used for certain liquid contents, may also be a relection on the need for the reuse of the jars.
8. Correclations between glazing, contents and shape are not apparent. However, Form IV specimens from both the 1724 wrecks and Fort Louisbourg are unglazed.

9. Archival sources indicate that olive jars and the terms used to identify them were based on a system of measure. Archaeological evidence does not readily support this statement.

10. Rim attributes are not reliable differentiating characteristics of Middle and Late Style jars with similar rims.

11. Rounded rims are indicative of Shape B or Form II jars.

While revealing many important aspects applicable to both terrestrial and nautical sites, the analysis indicates that much is still to be learned of this widely used and diffused ceramic type.

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APPENDIX I

The following information in the form of direct quotes by Tracy Bowden, President of Caribe Salvage S.A., concerns the provenience and stowage techniques encountered during salvage operations. Admittedly incomplete, the data is both informative and useful to scholars of Spanish maritime history.

Nuestra Señora de Guadalupe:

Olive jars were concentrated in area A (Figure 9). They were side by side, with wood chocks between them, and tiered. The lowest two levels were large jars and the upper level was small jars. None of these were handled or flat-bottomed. There were approximately 42 large and 100 small jars in this area. Area B contained jars at random, more so on the starboard side due to the starboard list upon grounding. These jars were not handled nor flat-bottomed. Most of the large jars contained black pitch (in this area only). The jars that were on the port and starboard sides of this area were for the most part chocked with fire wood and on beds of hempline. There were approximately 60 large and 45 small jars in this area. In the stern area, 5 or 6 small, handled, flat-bottomed jars were found (table use). Approximately 20 large and 25 small jars were found midship to the bow outside the starboard hull, ranging up to 50 feet from the hull. There were many shards found in this area.

Conde de Tolosa:

There were approximately 50 large and 475 small jars found over the entire site (Figure 10). Most were found in the port stern to midship area. In the stern area, many were chocked with wood pieces. Forward of this area, approximately 15 small jars were on beds of straw or plant matter with hempline between them.

General Notes:

Fire bricks were found on the Guadalupe and Tolosa at the bow. More cermaics were found forward on the Guadalupe than aft.

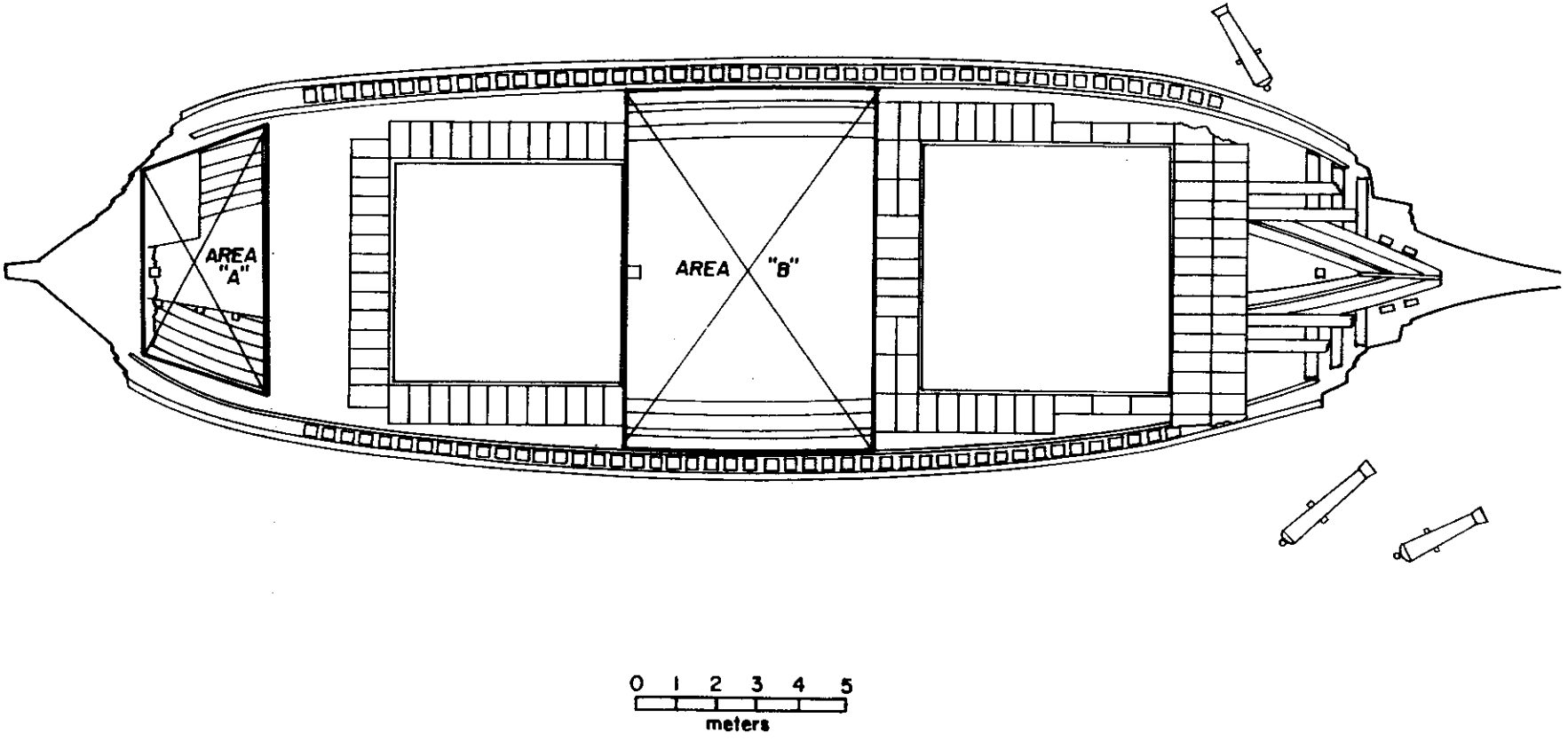

Figure 9. Olive Jar Provenience on the Nuestra Señora de Guadalupe (After Borrell 1960).

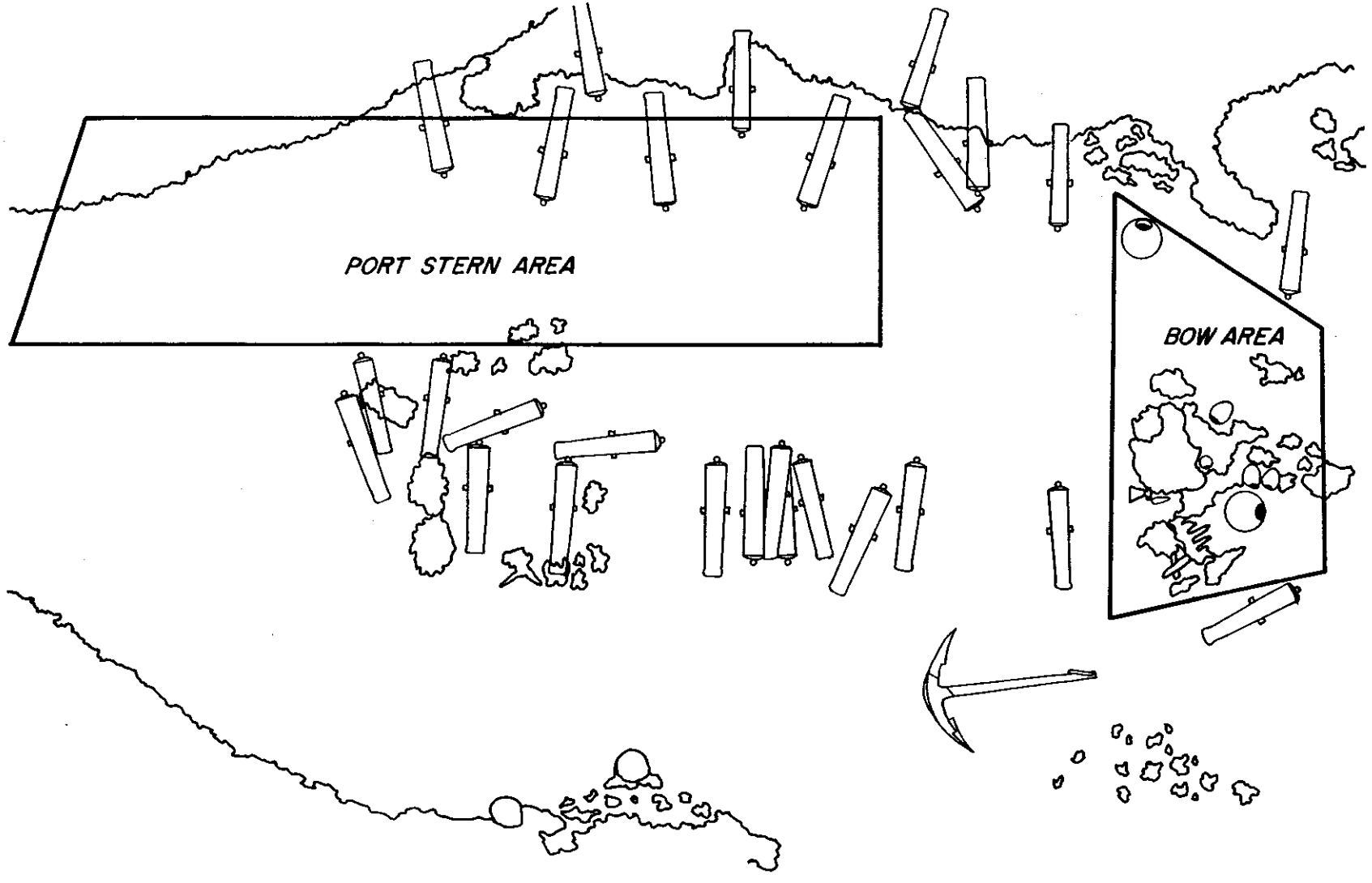

Figure 10. Olive Jar Provenience on the Conde de Tolosa, no scale (After Borrell 1980).

More ceramics were found admidships on the Tolosa. Numerous jars did in fact contain olive pits. The wood chocks between the jars were generally tree branches approximately 3 inches in diameter by 18 inches long, many still with bark. The two types of jars were found mixed together and the same types were found on both ships. Two very large jars were found in the bow area of the Tolosa. They were approximately 3 ft. high by 3 ft. in diameter.

APPENDIX II

Eleven olive jar sherds were analyzed at the Memphis State University Geology Department by Dr. David Beiler and Jeff Hertzing. The analysis, involving the use of thin sections and Scanning-Electron Microscope (SEM), was conducted in order to identify clay types and major mineral components. Four sherds were from Form I vessels, four were from Form II vessels and one was from a Form III and IV jar respectively. A single sherd from a Shape A vessel recovered from the Concepcion (1641) was also included. Morphological aspects that were investigated included surface textures, crystal sizes and shapes and the crystallinity of the clays. This, combined with the compositional variations of the olive jar pastes, may possibly shed light on the relationships and origins of the different jar forms.

The exact determination of the different clay types found in the samples was very difficult due to the general amorphous surface texture of most of the sherds. However, from the well-crystallized samples, it was determined that kaolinite and to a lesser degree chlorite are the predominant clay types that are present. Kaolinite was easily recognized by its distinct morphological shape. Several well-formed "Kaolinite worms" were encountered in many of the specimens. These consist of several hexagonal plates of kaolinite stacked one upon another. In other samples, several poorly formed kaolinite worms were present throughout the otherwise amorphous matrix material. Chlorite was also present in some of the well-crystallized samples, although much less predominant than kaolinite. Chlorite was recognized by its characteristic "rosette" structure.

In all the samples, quartz is the most abundant mineral present. It occurs as sub-rounded to angular shaped grains approximately .25 mm to .5 mm in size. Most of the grains have been slightly strained, indicated by the undulose extinction. Predominantly the grains are monocrystalline, though some, 3% in most samples, are polycrystalline. In one sample the grains are distinctly different from the preceding description and are much more abundant. They comprise 95% of the mineral components found within the clay matrix whereas the

preceding samples averaged between 80 to 85%. They are extremely angular and of much smaller size, approximately .05 mm to .1 mm. Almost all are monocrystalline.

Chert is the next mot abundant mineral present in the samples. It averages about 10% except in the sample with the high percentage of quartz, where the chert then is less than 1%. Most of the grains are sub-rounded and average .25 mm to .5 mm in size.

Feldspar is generally not very abundant, and average about 5% in most of the samples. Predominantly plagioclase they are angular shaped, generally between .1 mm to .5 mm in size.

Rock fragments comprise 5% of the total composition of the samples. They are generally sub-rounded and are elliptically shaped grains averaging .25 mm in size. Most rock fragments consist of micaceous material indicated by the high birefringence and parallel alignment of the micas. However occasional pumice fragments and clay fragments from ceramic jars are present.

Void spaces occur in all samples studied. The amount of void spaces vary greatly between samples and range from less than 1% to almost 40%. The size of the voids are relatively constant and average between .2 mm and .7 mm.

Besides the mineralogic components found within the samples, there are also secondary components present that were probably formed due to alterations caused by sea water. These include the formation of lepisphere and calcite. It is suggested that the lepisphere crystals precipitated from silica rich solutions and formed authigenically on the ocean floor. The calcite crystals probably grew due to the direct precipitation of $CaCO_3$ out of sea water. Both of these features are restricted to void spaces.

The homogeneity of the mineralogic components argues for a single source of origin for the samples. The one sample that differs in grain size may or may not be distinct from the others. The Concepcion specimen due to its similarity with the Tolosa and Guadalupe samples also suggests a common source for the paste constituents.

APPENDIX III

GOBIERNO DOMINICANO
PRESIDENCIA DE LA REPUBLICA

Comision de Rescate Arqueologico Submarino

April 18, 1984

TO WHOM IT MAY CONCERN

By means of this letter I confirm my authorization to Mr. Stephen R. James Jr., to use, with the correspondent credit line, the illustrations of the book ARQUEOLOGIA SUBMARINA EN LA REPUBLICA DOMINICANA for his thesis on ceramics.

Very truly yours,

Arq. Pedro J. Borrell

PJB:lkv

PRESIDENCIA DE REPUBLICA

APPENDIX IV

Publishing Department
Department of Anthropology
Yale University
New Haven, Conn. 06520

Stephen R. James Jr.
4909 West Park Dr.
Austin, Texas 78731

March 23, 1984

Dear Sir,

I am currently writing my Masters Thesis on 600 olive jars from two Spanish Azogues (mercury carriers) which wrecked in 1724 off the coast of the Dominican Republic. In order to better illustrate various olive jar types I am seeking written permission to reproduce in my thesis illustrations of olive jars found in Figure 3 pg. 10, Figure 5 pg. 13, Figure 8 pg. 19, and Figure 9 pg. 28. These figures are found in John M. Goggins The Spanish Olive Jar: An Introductory Study, Yale University Publications in Anthropology Number 62. Proper source citation will be given in the thesis.

Your attention to this matter will be greatly appreciated.

Sincerely

Stephen R. James Jr.

April 4, 1984

PERMISSION GRANTED

Robert O. Lagace, President
Human Relations Area Files, Inc.

VITA

Stephen Robert James, Jr. received a B.A. in Anthropology from Memphis State University in 1979. Participating in numerous area archaeological projects Mr. James' major area of study during his undergraduate years was Indians of the Southeast. Mr. James applied and was granted admission to the Nautical Archaeology Program at Texas A&M Univeristy in the Fall of 1980 where he has concentrated on the Spanish in the New World. During this study period, he became well-versed in Spanish ceramics. He conducted an analysis of the ceramics recovered from the San Esteban, a Spanish vessel wrecked on the coast of Texas in 1554. He participated in the first excavation phase of the Molasses Reef wreck, and contributed the description of the recovered ceramics in the preliminary report (Keith et. al. 1984.

For the past two years Mr. James has been employed with Espey Huston and Associates (EH & A), an engineering and environmental consulting firm based in Austin, Texas. During this period Mr. James participated in numerous nautical archaeology surveys and excavations. He has been the assistant nautical archaeologist for two seasons during the survey and subsequent test excavations of assorted sailing and steam vessels scuttled by the Confederate Army during the Civil War. Mr. James also directed an underwater survey in the Sacramento River, Sacramento, California. The survey identified and delineated two historically significant vessels. Mr. James' permanent address is 6236 Ivanhoe Road, Memphis, Tennessee, 38134.

Publications/Technical Reports

Spatial Limits of Two Historic Shipwrecks: J Street Area, Sacramento, California, EH & A Doc. No 84671, September 1984.

The Molasses Reef Wreck, Turks and Caicos Islands, B.W.I.: A Preliminary Report, The International Journal of Nautical Archaeology and Underwater Exploration, 13(1):45-63 (with Keith et al.).